

Social representation and gender in the teaching of mathematics with multimedia devices

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Abstract Every new technological development provokes controversy among educational actors and society because it is often considered the origin and solution of learning problems. It causes expectations challenging teachers, school and the educational system for its efficient incorporation into the classroom (Rojano, 2006). This is the case of Enciclomedia, a multimedia device developed in Mexico to support different primary school topics, including mathematics. Following the theory of social representations (Moscovici, 1971) we analyse 30 primary teachers' (8 male and 22 female) representation of mathematics teaching using Enciclomedia. All of them had at least three years teaching experience. Data were collected using three different instruments: Abric Associative chart; a semi-structured personal interview; video records of teachers' daily classroom practice. The interviews and video record transcripts were analyzed with ALCESTE (Reinert, 1986 en De Alba 2005). Moreover, teachers' representations were analysed from a gender perspective, where gender is conceived as a social regulation system, culturally constructed, that directs the development of specific cognitive structures determining the notions of male and female (Flores, 2001). Exploring the gender differences in male and female teachers' social representations of mathematics' teaching with Enciclomedia, provided the possibility to identify the factors underlying their classroom practice when using this multimedia device. The way teachers are structuring their relations with the technological tool and the other educational actors, in the school context, was analysed and linked to specific teaching practice in the classroom.

Results: Three social representations of the teaching of mathematics with Enciclomedia were identified and important gender differences were found. Female teachers assign to Enciclomedia attributes related to emotions and their performance when teaching mathematics with this multimedia device is supported by female teachers' solidarity. Male teachers, a bit more familiar with the use of technology, are more self-confident in their capability to make an efficient use of Enciclomedia and they seldom share information or ask for support. In contrast, female teachers recognize their need for more support concerning both, the technical use of the device and the mathematical notions embedded in the activities offered by Enciclomedia. In general teachers' perception of the use of a multimedia devices for mathematics' teaching is linked to high social acceptance and desirability. However, teaching practice is far from matching teachers' discourse.

Keywords: Mathematics taught with Enciclopedia, gender, social representations, primary school teachers.

Introduction:

Since 1985 Mexican educational authorities have created programmes to incorporate technology into primary education, placing special interest in the teaching of mathematics. Few of these projects have achieved a significant impact in learning, either due to their implementation or their coverage. As Enciclomedia is the most recent and ambitious of these projects it is important to analyse the way in which teachers appropriate this tool. The educational result depends on this appropriation.

In this research the theory of Social Representations allows us to explore the meanings which circulate within the social thinking of primary education teachers teaching mathematics with Enciclomedia. A gender perspective is integrated into the analysis of representations as this construction is a system of social regulation which orientates a specific cognitive structuring, which in turn regulates the notions of masculine and feminine, being the cultural norm which defines the modalities in which the difference of sexual roles are symbolically formed (Flores 2001). Gender differences existing within Social Representations permit a coming together of factors which consolidate their practices in the classroom, starting with how the relationship between teachers and technological resource are structured as well as with other educational actors within the working environment.

These are some of the questions which this essay will attempt to answer:

What social representation do primary teachers have with regard to teaching mathematics with Enciclomedia?

What gender differences present themselves within the Social Representations and their repercussions in the teaching practices whilst teaching mathematics with Enciclomedia?

Theoretical framework

We will use the Theory of Social Representations as a basis for our questioning, where social representation is defined as the elaboration of a social object by a given community (Moscovici, 1979).

The concept of social representation denotes a form of specific knowledge, the knowledge of common sense, whose contents demonstrate the operation of generative and functional processes marked socially. In its widest sense it denotes a form of social thought. Social representations are forms of practical thought, orientated towards communication, understanding and the control of social, material and ideal surroundings. As such they present specific forms on the level of organization of content, as well as mental operations and logic. The social dimension of contents and processes of representation has to refer to the conditions and contexts in which the representations appear, through the communication network in which they circulate and to the functions which serve in the interaction with the world and with others (Jodelet, 1986). In this manner Moscovici (1979) defines them as a system of values, notions and practices relating to objects, aspects or dimensions of social surroundings which permit, not only the stabilisation of a framework of life for individuals and groups but also constitute an instrument to orientate the perception of situations and the elaboration of responses.

Jodelet (1986) suggests that social representations fulfil certain social functions, for example:

- The maintenance of social identity;
- The socio-cognitive balance;
- An orientation for conduct and communication;
- An anticipated or retrospective justification of social interactions.

Three wide fields can be distinguished in social representation research. The first characterises the original perspective of representations as vulgar knowledge of popularised scientific ideas; the second refers to culturally constructed objects with a long history and their modern equivalents. The third indicates a field of conditions and social and political events, where the representations which prevail have a short term meaning for social life (Wagner, W y Eljebarrrieta, F, 1994).

As the incorporation of Enciclomedia is a factor which alters the daily activities of teachers it is important to approach this study from a gender perspective and to know their representations. The way in which each society symbolises sexual difference takes shape in a collection of practices, ideas, discourses and social representations which regulate people's objective and subjective behaviour, attributing distinct characteristics to each sex. In this way gender is constructed, taking as a reference the different anatomies of men and women, with their evidently distinct reproductive functions. In other words through the process of gender constitution society creates ideas around what men and women should be and what is suitable for each sex. Gender appears not only as a sort of cultural "filter" with which we interpret the world, as much as a type of framework which restricts our lives. Gender not only marks the sexes but also the perception of everything else: the social, the political, the religious and the everyday. We live in a society that uses a discourse of what is correct according to our sex (gender), forcing us to occupy a certain place (Lamas, 1996). The way in which being a man or a woman is interpreted and conceived depends on the historical and socio-cultural moment in which one lives. We can see that "The notion of gender has spread within popular and scientific discourse and some of the consequences of the particularities, objectivities and anchorages introduced by this category in the social panorama are the diversification of meanings, which in social research need to be treated cautiously..." (Flores, 2001). From a psychosocial vision " gender is defined as an ideological system whose distinct processes orientate the modelling of a social representation differentiated by sex and determining specific forms of behaviour assigned by biological sex function" (Flores, 2001).

Methodology

Participants were 30 primary school teachers from Mexico City.

The criteria for selection of subjects were: to be a fifth or sixth grade primary school teacher with an Enciclomedia kit; to be assigned to the school zone in which the research was carried out; Three years minimum service.

This is a descriptive – exploratory study. Exploratory because there are no studies covering the subject of mathematics teaching with Enciclomedia where social representations are frame-worked in a gender perspective. It is descriptive because we seek to look at the most important aspects of the phenomenon, with relation to the conditions, characteristics and profiles of the people who participate in the study. Moreover it belongs to the tradition of fieldwork, characterised by the discovery of relations and interactions between sociological, psychological and educational variables in real social structures” (Kerlinger, 1994). Their objective is to “study a particular group of people to know their structure with its social relations. Their principal characteristic being that they are carried out in the natural surroundings in which individuals perform (Ito y Vargas, 2005). As regards the evolution of the phenomenon the study can be classified as transversal because it collects information in only one given moment (Hernández, 2003).

Instruments

The collection of information was carried out with three research instruments:

Associative Card: The method of free associations permits a reduction in the difficulties or the limits of discursive expression (Abric, 1994). Given the spontaneous character and the projective dimension of this production one can access rapidly the elements which constitute the semantic universe of the term or object under study. This helped us identify the three basic dimensions of the social representation: information, the field of representation and attitude.

Semi-structured interview: The semi-structured interview was chosen as it is useful in situations where there may not be further opportunities to interview people, as well as for its high grade of freedom and depth (Bardin, 1982).

Video recordings: Of mathematics class with Enciclomedia with the objective of showing the congruence between discourse and practice.

Procedure

First phase:

- a) Application of the associative card in its two levels of association.
- b) Execution of the semi-structured interviews.

Second phase:

- a) Preliminary analysis of the information collected from the associative card and the interviews in order to select teachers whose answers aroused greater interest and who would then be filmed teaching mathematics with the multimedia resource.
- b) Filming of the selected teachers.

Third phase:

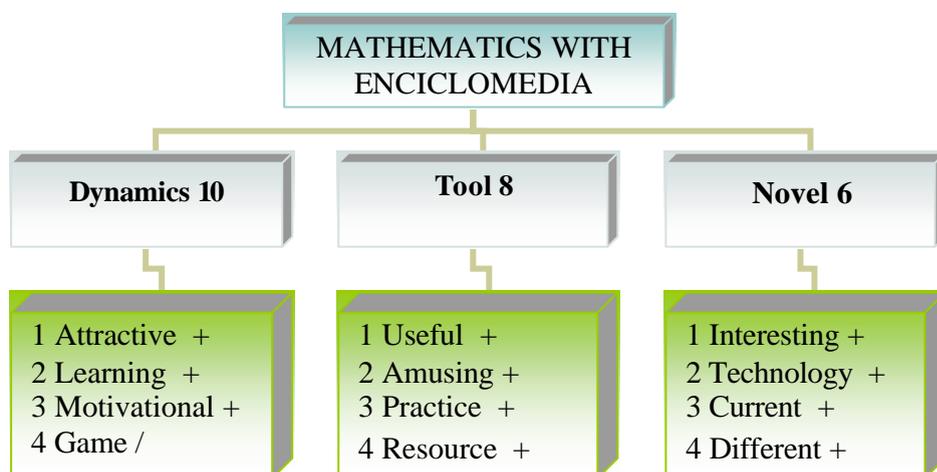
Analysis of the information obtained from each of the instruments of enquiry, using distinct tools and techniques.

In the case of the Associative card Excel was used with the aim of identifying the most frequent associations in each associative level. This information was then presented in different diagrams. The semi-structured interview: each one of the participants was submitted to to an analysis of classical content (Bardin, 1982) and ALCESTE (Lexical analysis of concurrence in simple text statements) in its 4.8 version (De Alba, 2005).

Two types of diagrams were elaborated in order to explain the free associations; the first type corresponds to the diagram referring to inter-group results (diagram 1)¹. The second corresponds with the intra-group results (diagrams 2 and 3).

Diagram 1 shows the words which were associated with our object of study without making a distinction of associative levels. These associated words are accompanied by a number which indicates their hierarchy according to the frequency with which they were associated with the inductor term. The word associated the most times and which was therefore awarded the highest frequency, was assigned a hierarchy of 1 and so on; in this way the higher the number the lower the frequency. The symbols + (positive), - (negative) and / (neutral) indicate the emotional association of each term in association with mathematics with Enciclomedia.

Diagram 1 **Inter-group results**



In this part we intend to analyse the results found from the theoretical framework of social representations and specifically with reference to the three basic dimensions of the social representation: information, the field of representation and attitude.

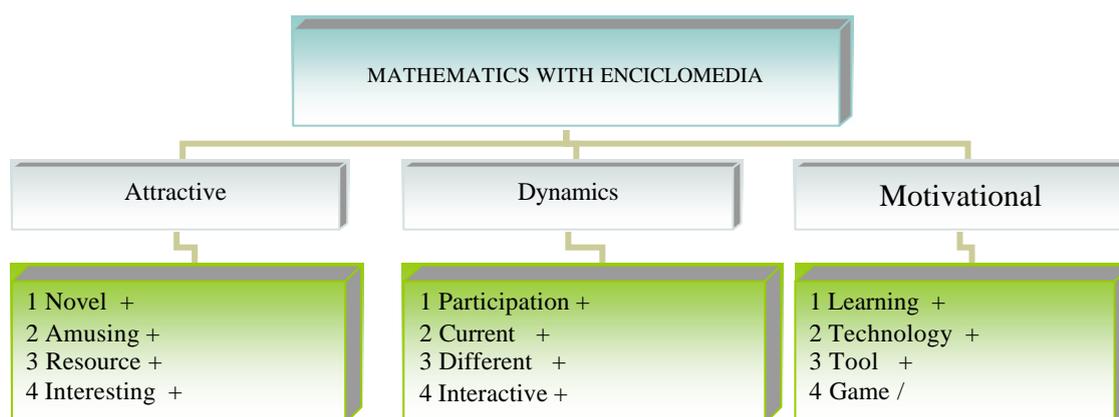
The information dimension is determined in the associative card by the terms associated with “Mathematics with Enciclomedia” considering as relevant those which presented the highest frequencies. For the 30 participants in this study the words associated with the inductor term which obtained the highest frequency are: dynamics (10), tool (8) and novel (6).

¹ For the two types of diagram we recommend in first place to locate the centre of the diagram in the upper part, where the inductor term is found (Mathematics with Enciclomedia). Starting from this inductor term the rest of the data are analysed.

The field of representation is made up in this first phase of the structure which presents the information dimension and which expresses itself in terms of the hierarchies given and the value assigned by each of the subjects, expressing the proximity or distance of the terms associated freely with the inductor term. For Mathematics with Enciclomedia and dynamics we found that the words in hierarchical order were attractive, learning, motivating and game. For Mathematics and Enciclomedia and tool the associations were useful, amusing, practice and resource. Finally in the case of Mathematics with Enciclomedia and novel the words were interesting, technology, current and different.

The attitude dimension in the first phase is the emotional association expressed in negative, positive or neutral terms with which the subjects classified each of the free associations with Mathematics with Enciclomedia. All the associated words had a positive emotional association except the term game, defined by two participants as neutral as well as little relevant for the learning process.

Diagram 2 **Intra-group Results**
Women



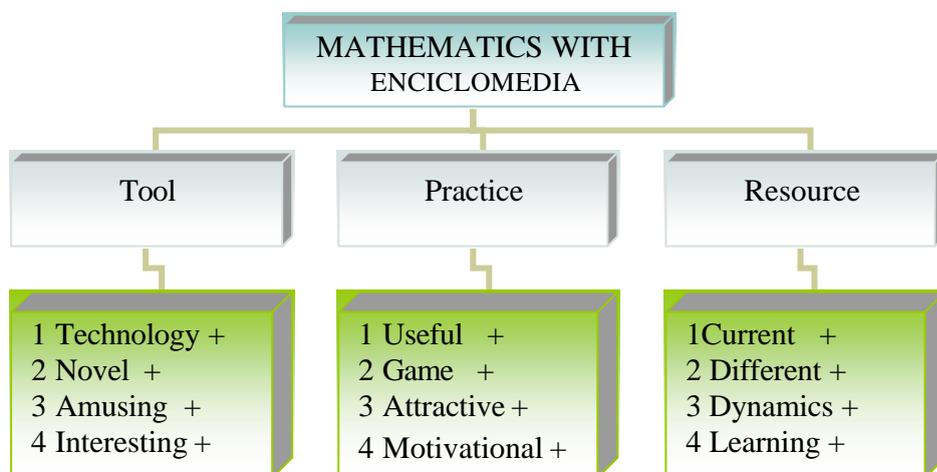
The information dimension amongst the female teachers is related on the first level of association with terms like attractive, dynamics and motivating, denoting a strong link between the teaching of mathematics with Enciclomedia with the emotion which this resource generates amongst students although not with female teachers.

The representation field for Mathematics with Enciclomedia and the word “attractive” made up hierarchically ordered associations with words such as: novel, amusing, resource and interesting. In the case of Mathematics with Enciclomedia and the word “dynamics” the associations are: participation, current, different and interactive. Finally in the case of Mathematics with Enciclomedia and the word “motivating” the associations are: learning, technology, tool and game. In this sphere it is notable that the prevailing terms are affective

attributes generated for the students. In the final block we can observe how the females teachers place what “should be” above pleasure.

As regards the attitude dimension all the associated words had a positive emotional association except game which for two of the participants was classified as neutral and not considered relevant for the learning process.

Diagram 3 Intra-group results
Men



The information dimension amongst the male teachers is related on a first level with terms like tool, practice and resource seen by them as elements which help them teach mathematics with Enciclomedia.

The representation field is made up of, for Mathematics with Enciclomedia and the word “tool”, made up hierarchically ordered associations with words such as: technology, novel, amusing and interesting. For Mathematics and “practice” the associations were useful, game, attractive and motivating. Finally in the case of Mathematics with Enciclomedia and “resource” the associations were current, different, dynamics and learning. The associated words and their hierarchies demonstrate the pragmatic aspect of a masculine vision towards this multimedia resource.

The attitude dimension of the associated words had a positive emotional association including the word game, considered relevant for the learning process although at the same time making evident that pleasure is never far from duty.

The 30 interviews carried out with teachers were analysed using the Alceste software programme. Alceste was an aid used to achieve a more complete content analysis. This procedure allowed us to observe the semantic universes making up the “Mathematics taught with Enciclomedia” representation as well as the way these relate to each other.

A descending hierarchical classification was obtained in the case of the 30 interviews which reordered the discourse (75.9% of u.c.e.) into 3 classes². These classes are then divided into three great branches (I, II and III), we found that classes 1 and 2 produced strongly linked semantic universes, in comparison with class 3 which was more distant than the other two (see dendogramme 1).

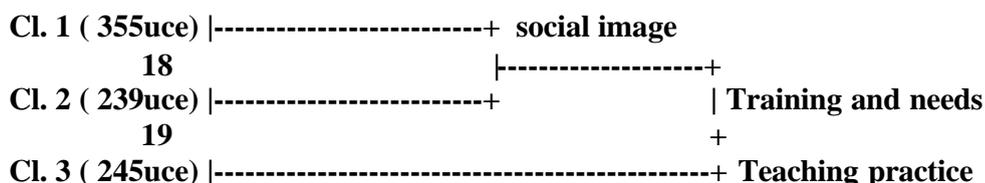


Figure 1 Dendogramme of stable classes

The “labels” established for different lexical worlds were assigned according to: 1) the specific vocabulary for each class and 2) the more representative units of contexts³ (u.c.e.).

Class 1 Social image

In this class 68% of the teachers considered that their social image would improve if they made an efficient use of Enciclomedia. It is worth mentioning that a greater proportion of women held this opinion.

“The parents are happy with my work with Enciclomedia and my family say that it was about time that I used computers.” Woman interview 14

“Well I say that the father above all when one has Enciclomedia and you use it well improves or reaffirms# the opinion that the teacher is good.” Woman interview 09

It seems that the men consider that they enjoy social approval with or without an efficient use of the multimedia resource.

Class 2 Training and needs

Only 20% of the teachers used computers before the introduction of Enciclomedia in the classrooms, proportionally the majority were men. For example, a teacher said:

² Each class groups together the vocabulary belonging to a specific semantic universe.

³ Segments of text made up of principal words whose size is defined by the user of the programme (from 8 to 20 words) or by clear punctuation.

“As I knew about computing well it was easy to make it work, I just had to identify the sequences, the paths.” Man interview 02

90% of the teachers said that the training in the use of Enciclomedia was limited to learning how to operate the equipment, how to create links and the exploration of the activities of a few lessons. Proportionally the majority were women. For example, a female teacher said:

“I went to an introductory course and since then I’ve been to two more. The content of the courses varied the first they just showed us how to use the computer, the basics and #it was the first version of Enciclomedia I liked a lot the one they gave us of 8 hours two consecutive days a few weeks ago but I don’t know who gave it, but the other one for the teaching degree I feel it was nothing more than using up time.” Woman interview 17

Only 10% claim that they have learned in the courses to use the resource to generate mathematical knowledge with Enciclomedia. Those who claim this were all men:

“Last year they gave me two good consultancies, but I came here to discover many things so basically you realise that you have to use it”. Man interview 06

Class 3 Teaching practice

With regard to the daily activities of the teachers we found that 3 teachers, two women and one man, never use Enciclomedia:

“But I can deal with Pythagoras’ theorem, second grade equations and I help the kids who have difficulties in preparatory school and on Sunday I do the housework”. Woman interview 04

60% use Enciclomedia only to reaffirm contents, this use is indistinct between sexes:

“Well I present the content which we’re going to cover we work with the student’s book, the student’s text book there we review what we’re going to work on we follow the activities, then I go into the activities in Enciclomedia.” Man interview 19

30% recognise that Enciclomedia is a resource for constructing mathematical knowledge and use it to work on and reaffirm contents:

“In the beginning we switch on the machine and get on with the mathematics in the lesson which we’re going to study and the students work with their book we read what comes on the screen and we resolve problems in their text books.” Man interview 20

“We switch to the blackboard well the children come up resolve the exercises with the interactive blackboard they make marks with the pens.” Woman interview 15

Video Tapes

The results analysed until now demonstrate that 9 of the teachers filmed do not work with the Mathematics based on problem solution approach. They begin work by explaining concepts and describing procedures for solving problems. It would seem that the traditional training and practices of mathematics teaching have not abandoned the classrooms of the majority of the participants in this study. This, despite the fact that the education reform of 1993 administered different ways to incorporate a didactic approach which permits the students to construct their own knowledge. It seems that the change of teachers' attitudes with regards to this didactic approach has remained on a cognitive or information level. It is present in the teachers' discourse but not in their practice. Nevertheless it is worth mentioning that one teacher generates reflections about results obtained, but if they are different the students present the procedures used.

Conclusions

In the group of teachers studied we can divide into three the representations of teaching mathematics with Enciclomedia. Seven male teachers and four female teachers who have more time to use the technology view Enciclomedia as a resource which supports teaching work.

Sixteen female teachers see the resource as a panacea which will permit the students to learn mathematics. One male teacher and two female teachers perceived it to have an inaccessible language. The difficulties experienced to appropriate the technology make them feel that they will be displaced by it.

Female teachers allocate to Enciclomedia attributes associated with affectivity. Their performance teaching mathematics with Enciclomedia is favoured by sorority.⁴

The male teachers use the technology more. Discursively they were more confident in their efficiency using Enciclomedia.

The teaching discourse revolves around social desirability.

Classroom practices do not coincide with discourse.

There is recognition of the necessity for teacher training in the efficient use of the resource.

⁴ A term used to define solidarity between women.

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