ATTITUDES TOWARDS MATHEMATICS OF TEACHERS IN SERVICE OF TELESECUNDARIA: AN EXPLORATORY STUDY

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The results of a research carried out with in-service teachers of federal "telesecundarias" in the area of the city of Xalapa Veracruz, Mexico, will be shown in this article. The research explored the teacher's attitudes towards mathematics as a first approach on the research of affective factors in the teaching-learning process within this educative subsystem. The overall results showed no negative attitudes coming from the teachers but rather neutral with positive charge and slightly positive. However, in the subscales analysis the presence of a negative disposition in items related to anxiety and a low self confidence in some teacher's mathematical skills can be seen.

INTRODUCTION

The recognition of the importance of affective factors (emotions, beliefs, attitudes and values) in the quality of learning (Goldin, 2002; Gómez-Chacón, 2000; Hannula, Evans, Philippou, & Zan, 2004) and assessment processes of learning of mathematics has led to include these aspects in educational reforms in many countries in recent years (Martínez Padrón, 2008). Such is the case of Mexico with the secondary education reform in 2006 which has mainly focused on the competence-based learning, giving attitudes a leading role as well as conceptual and procedural contents. In recent years there has been an increasing emphasis on the development of better researching methods in attitudes (Leder & Forgasz, 2006). A particular point of interest was the measurement of some dimensions of self-concept (Bandura, 1997; Malmivuori, 2001), conceptual clarification (Di Martino & Zan, 2003; Ruffell, Mason, & Allen, 1998) and development in college stages (Galbraith & Haines, 2000; Gómez-Chacón & Haines, 2008; Liston & Odonoghue, 2008). As it comes on training future primary and secondary teachers some descriptive studies on attitudes were found. These focused on different aspects: mathematics as an object of study, its role in the society and science, its application in real contexts and the teaching-learning process of mathematics and the proposal of some measuring instruments on conceptions, beliefs and attitudes towards mathematics (Beswick & Callingham, 2011; Camacho, Hernández, & Socas, 1995; Hernández, Palarea, & Socas, 2001; Rico & Gil, 2003).

There is not a consensus in the definition of attitude among researchers in mathematics education (Di Martino & Zan, 2003, 2011; McLeod & Adams, 1989). For this job, we adopt Gómez-Chacón (2000) definition, who accurates it as:

> Evaluative predisposition (negative or positive) that determines the personal intentions and influences on the behavior. Therefore, it consists of three components: one cognitive that manifests on the mentioned attitude underlying beliefs, another one affective, that manifests on the work or matter acceptance or rejection feelings and one intentional or trending to a certain behavior. (p. 23).

And thus a multidimensional perspective was adopted for this paper.

This paper is focused on the teacher's attitudes towards mathematics. There are many factors that make this research important in order to clearly understand what is happening in this educational subsystem; first of all, the lack of enough research in this matter in the Mexican context (Juárez, 2010). Second, the contrasting results of previous researches. For instance, some authors have pointed out that teachers' beliefs and emotions towards mathematics influence the achievement of their students, as well as their beliefs and attitudes towards this discipline (Caballero, Blanco, & Guerrero, 2008; Ernest, 1989; Pezzia & Di Martino, 2011). It is indicated that the development of positive attitudes towards mathematics depends on the teaching style. Thus, negative attitudes may be appear when the teacher teaches instrumentally and the student attempts to learn relationally (Amato, 2004). On the other hand, other researches stated that affective variables such as conceptions, beliefs and attitudes towards mathematics play a determining role in the development of teaching practice (Frade & Gómez-Chacón, 2009; Hodgen & Askew, 2006; Philippou & Christou, 1998, 2003).

It is important to highlight the teaching context in this subsystem. In Mexico secondary schooling is provided in four modes; general, technical, for workers and "telesecundaria". This last one was founded in 1968 to provide coverage to rural areas where technical or general high schools are not built due to its high operation costs. Unlike the other secondary schools, "telesecundaria" teachers are in charge of all the subjects, likewise primary teachers. People with mayors in the "Normal Superior" with specialties such as English, Natural Sciences, Social Sciences, Math, Arts, etc.; and university courses in Physics, Biology, English and Mathematics are hired. Also professionals with other university mayors may be accepted, as long as they take complementary studies of Normal Superior or any Masters Degree in Education. To back up the teachers work a 15-minutes-long class is satellitaly broadcasted. This class is repeated daily during a learning sequence, giving the teacher the freedom to use it whenever it is more convenient. The methodology of this subsystem also includes the use of a book for each subject, one for the student and another one for the teachers. These books are distributed Nationwide, just as it happens in primary schools as well.

As the teaching context in primary schools and "telesecundarias" is quite similar, as stated before, some findings that researchers have reported in other countries on training primary school teachers will be used. It was found that many people at university stages

have weak knowledge and negative attitudes, being some of them even afraid about mathematics (Beswick & Callingham, 2011; Frade & Gómez-Chacón, 2009; Philippou & Christou, 1998). While others have revealed moderated to positive attitudes among teachers in training and currently working (Caballero et al., 2008; Eudave, 1994). Additionally, a low performance in mathematics can be clearly seen in this subsystem as it has been shown by the international results in PISA 2006 and nationally in the results of ENLACE for its initials in Spanish (National Assessment of Academic Achievement in School centers). Therefore the need of researching on the telesecundaria teachers' attitudes towards mathematics in order to set the ground for future researches that may be carried out. The research question we have raised is then the following: What are the attitudes towards mathematics of Telesecundaria teachers who do not have a training profile in math?

Teachers who have a mayor in mathematics were not taken into account in this research since it was assumed their attitude towards mathematic should be positive.

METHODS

Subjects

35 teachers attached to the Federal Telesecundarias of Xalapa, Veracruz, Mexico. 70 teachers with many different specialties compose the complete staff. As indicated before teachers with specialty in math according to the aim of the study, and also those teachers who due to their administrative functions (directors, supervisor, etc.) are not teaching classes were not included.

Instrument

The Likert scale, ATMAT by its initials in English of Ludlow y Bell (1996) was carried out. It was designed to measure attitudes and experiences related to mathematics and its teaching. This scale consists on 29 items, with options for three levels of agreement and three of disagreement. It was piloted with 240 undergraduate and graduate students in a mathematics teacher training institution in New England. Cronbach's alpha coefficient as well as a factorial analysis were carried out in order to validate this scale. Cronbach's alpha coefficient was 0.96

As the scale was applied in a Spanish-speaking context it was translated into Spanish and in order to avoid understanding problems from which it was piloted. This lead to separate item 1 in two, so that the final scale was composed of 30 items. Each one of them had five options ranged from "strongly disagree" to "strongly agree", including the neutral or of indecision option, since we consider that in this way we would obtain more descriptive results. Cronbach´s alpha coefficient was verified for this version of the scale, obtaining a 0.754 value, which continues being a good reliability index, even if diminished with division of item 1.

The scale was divided into three subscales according to the three components of the multidimensional model of attitudes: Cognitive Subscale (C), Affective Subscale (A), Behavioral Subscale (B). The Affective Subscale is formed by items that refer on one side to the liking/disliking towards mathematics and on the other side to the anxiety caused by mathematics itself and the resolution of mathematical problems and also by the possibility of their teaching in different educational levels. The Cognitive Subscale is formed by items that refer to the beliefs about mathematics, mathematical problems, and self-efficiency and competitiveness beliefs. Finally the Behavioral Subscale is formed by items that show the tendency to act in concordance with their perspective of mathematics in learning and problem solving. This classification was validated by the criterion of two experts in research on attitudes in Mathematics Education. The drafting of the items in the subscales were of two types: positive (because they reflect a positive attitude) and negative (because they reflect a negative attitude). In the following table we present an item from each subscale according to the type of drafting as an example.

NO. ÍTEM	SUB SCALE	DRAFTING TYPE	STATEMENT
1	C	Positive	Mathematics is very interesting to me.
16	C	Negative	I have forgotten many of the mathematical concepts wich I have learned.
2	A	Positive	I enjoy math courses.
4	A	Negative	I feel a sense of insecurity when doing math.
17	B	Positive	I learn mathematics by understanding the underlying logical principles, not by memorizing rules.
12	B	Negative	I do not attempt to work a problem without referring to the textbook or class notes.

Table 1: Example of items in each subscale

After evaluating each teacher intervals were established to classify their attitudes as it is shown in the table 2. So if a teacher, for instance, obtained a score of 68, he/she would be in the interval of 60-74 and his/her attitude would be considered neutral with negative charge, symbolized as "I—"

Intervals	CLASSIFICATION OF ATTITUDES	SYMBOLOGY
30-44	Strongly negative	NN
45-59	Moderately negative	N

60-74	Neutral with negative charge	I--
75-89	Neutral with slight negative charge.	I-
90-104	Neutral with slight positive charge.	I+
105-120	Neutral with positive charge	I++
121-135	Moderately positiva	P
136-150	Strongly positive	PP

Table 2: Intervals, attitudes and symbols classification

Application

The schools of participating teachers were visited with their authorities' consentment. Teachers taking part in this research gathered in a classroom where they were given the necessary indications. They were invited to answer honestly as their names would be kept private. Afterwards it was proceeded to deliver the printed scale, giving them plenty of time to answer.

RESULTS

The results are presented in two sections, the first of them called global results. The total scores of the participants were addressed, which allowed us to characterize their attitudes. In the second section, results for subscales, a more detailed analysis according to the three components of attitude was done.

Global Results

According to the classification of attitudes raised, 23 teachers exhibit neutral attitudes, 4 of them are neutral with slight positive charge and 19 neutral with positive charge, the 12 remaining ones present positive attitudes, 11 moderately positive 1 strongly positive. It can finally be seen that they do not present negative attitudes.

To sum up it can be said that most teachers have neutral with positive charge and moderately positive attitudes towards mathematics (30 teachers). This is somehow consistent with the results obtained by Caballero et al., (2008), who found that Primary School teachers in training in the Extremadura University had not negative nor rejection attitudes. Eudave (1994), also found neutral with slight positive charge attitudes within high school in-service teachers. On the other hand, this is contrasting with results showing negative or even frightening attitudes among Primary School prospective teachers, especially at early training stages (Beswick & Callingham, 2011; Frade & Gómez-Chacón, 2009; Philippou & Christou, 1998). We have compared our results with the ones obtained on studies over primary professors, because of the context similarity as we anticipated on the introduction.

Subscales results

Valuable information on the affective, cognitive and behavioral areas has been gathered after this research.

Affective subscale. Unlike what was found by Philippou y Constantinos (1998), who stated that "an alarmingly high proportion of students brought very negative attitudes to Teacher Education" (p. 196), most of the teachers show from moderately positive to positive attitudes on the different items that form this scale, specially on those about liking of mathematics, where no negative attitudes are shown. However, despite this positive tendency, we find high anxiety levels on 20% of the participants on items referred to "it makes me nervous to even think about having to do a math problem". Also on items referring the possibility of teaching mathematics on the next educational level, we find negative attitudes on between the 16.7 and the 33.3% of the participants.

Cognitive subscale. Most teachers showed favorable conceptions about mathematics, math problems and classes as well as self-confidence regarding their capacity of facing mathematical problems and their background on the subject. However, a 16.7% of the teachers of this study show a very low self-efficiency referring problem solving, for example the "I can draw upon a wide variety of mathematical techniques to solve a particular problem" kind of items. Similar results are to be found on items related with professional training, where from a 13% to a 20% of the teachers show a very low sense of competence. This is coherent with the results obtained by Caballero et al., (2008).

Behavioral subscale. In this topic there are neutral with positive charge attitudes. It can be stated that most teachers prefer learning through the real understanding of the logical intrinsic principles rather than memorizing rules although 26.7% manifests indifference. Many of them would be willing to work with problems which go beyond the difficulty level prepared for class while some other were undecided or reluctant to do so.

DISCUSSION AND CONCLUSION

We can observe on the global results that on one side, no negative attitudes are shown and on the other side the teachers attitudes are to be found mostly between neutral with a slight tendency to positive, to moderately positive. Watching the graphic carefully, it is to be noticed that the highlight occurs on the neutral attitudes (23/30) instead of the positive (7/30) ones. So the obvious question that comes out is, why does the highlight occur on the neutral attitudes? We can find the explanation on the results by subscales analysis, where some dimensions like the value and liking of mathematics are highly scored, while others, despite of being positively scored, negative and even very negative attitudes appear on percentages that go from 16.7% to 33% of the participant teachers. These issues can be grouped in two topics: The first one refers to the mathematical problems along the three subscales and the anxiety caused by facing them and a low self-efficiency perception at solving them, that seems to be caused by the feeling of not

being secure of their previous knowledge and developed skills. Just as it was pointed out by Philippou & Constantinos (1998), who stated that the lack of confidence to solve problems is directly associated with negative attitudes. The second one refers to the possibility of teaching mathematics in different educational levels, particularly in the immediate superior level, where the 33% show a high insecurity level.

On the other hand and returning once again to the relationships among attitudes (cognitive, affective, behavioral) dimensions, we recognize some external factors that can influence each teacher's internal perspective. We consider that the attitude is part of this internal perspective. The external factors to consider are: teacher characteristics and teaching characteristics, in particular the method or problem solving (Wilkins & Brand, 2004; Wilkins & Ma, 2003). Let's consider each one of these factors (cognitive, affective and behavioral) more closely to obtain a better understanding of the teacher's perspective. Complementary to these scales, the information obtained from informal interviews, highlights the external factors that affect their perspective and their attitudes towards mathematics. The first external factor that emerged from the obtained information belonged to characteristics of the teachers when they were students. We see these characteristics as some of the most important, since teachers often have the power to affect other factors. These teachers described memories of nice teachers, funny teachers and devoted teachers. They also underlined personal attention that some students received from their teachers and the effect this had on such students' attitudes. So their "views" are related with the influence a teacher's behavior had on their attitude towards the class.

The second external factor of teaching characteristics is clearly related to the teachers' characteristics and their capacity to solve problems. The participants were encouraged to reflect on their mathematical experience and talk about their attempts to solve problems. Their knowledge of mathematics were insufficient to solve all the given problems, causing them anxiety when dealing with students and work at different levels. Significantly fewer teachers claim they have to memorize ideas. A medium-high percentage of teachers consider a dynamic and social perspective of mathematics. It is not a subject about concepts and procedures they have to memorize and they indicate the importance of working a problem-solving approach ("I learn mathematics by understanding the underlying logical principles rules, not by memorizing rules"). We note the apparent discrepancy in their responses when asked about their beliefs regarding themselves (self-efficiency). They indicate that their tendency is not to be able to solve problems. Whereas when they responded to beliefs about mathematics itself, their responses are more suited to social desirability.

All these findings and information supporting our statement that this group needs specific course in problem-solving, in order to improve the cognitive dimension of attitudes from mathematics as a body of procedures to be learned, to mathematics as a

process of thinking. These courses shall also reinforce their knowledge and mathematical skills, so that they manage to perceive themselves as more capable to solve problems and as consequence, their anxiety levels will diminish. This way, we may be able to reverse and prevent poor attitudes towards mathematics in "Telesecundaria" Teachers. Besides, since the secondary reform in Mexico on the mathematics subject is focused on problems solving, teachers have to be prepared, both, in knowledge and attitude, in order to the reform to be successful, as regards to improve the mathematics teaching and learning.

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