

Influence of the female teachers' gender vision on the type of interactions they establish with boys and girls in the mathematics classroom.

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Abstract

We report the results of a research studying the "gender vision" three primary school Mexican female teachers have about mathematics and how this influences the interactions they establish with boys and girls when they teach mathematics. By "gender vision" we mean how women perceive different topics according to their social and cultural concept of the world. Data were gathered using two instruments: teachers' interviews and class observation. The results show that female teachers consider mathematics as a male domain, thus the type of interaction they have with girls and boys is different, favoring the latest; actually, they think that girls only learn mathematics thanks to the effort and continuous practice, whilst boys learn mathematics "naturally".

Background

The extended idea that the mixed school came to provide boys and girls the same participation opportunities in and experience numbering literated , has made less evident the gender differences that are reproduced in the classrooms (Moreno, 1996; Subirats, 1997; Fainholc, 1997) Especially in the math class, as has been reported investigations Brophy and Good , 1971; Good et al., 1973, 1981; Reyes, 1984; Brophy and Evertson, 1981; Becker, 1981; Leder, 1987; Sadker and Sadker, 1991; Boekaerts, 1995; Wimer, Rinedour and Place, 2001; Tyrrel, Brown and Ellis, 1994; Taole, Zonneveld et Letsie-Taole, 1995; where it is informed about the existence of inequities in the interactions that take place in the classroom and that are originated in the social and cultural processes to which are submitted boys and girls affecting their behavior, attainment and participation in mathematics.

The Study

The present research starts by considering that in the secondary school and superior education levels difference are found in the attainment, participation and mathematic performance (Fennema, 1974; Maccoby, 1974; Sherman –Fennema 1978; Becker, 1981; Wolleat, Pedro, Becker y Fennema, 1980; Leder, 1980, 1992; Benbow, 1980; Jungwirth, 1991; Muños, 1994; Atewh, 1995; Taole, 1995; Gray, 1996; Postigo et al., 1999; Rivera, 2003). This led us to have an hypothesis that "something" originates in the elementary school these differences, if it considers that this is the first instance of officially legalizes knowledge "non-formal" socio-cultural environment of the students and where teaching plays a role determinant in the implementation and reproduction of generic concepts (Leder, 1996).

There the need to investigate the perception that have the mathematics teachers with the intention to shape the vision towards this subject; if this vision strikes the verbal interactions that are

established with the students' body in the classroom and if these interactions are different when the teachers address to the girls or the boys, for that purpose one of the three types of communication and interaction are considered that are present inside the classroom; the message carriers of the investigation. Fainholc (1997) y González (2003).

The research considers as a starting point, two facts: first, the 63.7% of the plant teaching elementary education consists of women and the second, that the teachers are sexually beings, whose biological characteristics are the foundation of a complex Network construction historical, social and cultural fields that shape the female gender, guide and justify their behavior in a "natural and evident manner."

The study is part of the gender studies understood as socio-cultural constructs, which organize and classify the social relationships among male and female. They are the result of socio-cultural-historical composed practices, symbols, representations, norms and values, whose foundation is sexual difference. Gomariz (1992) Lamas (1986) Scott (1996) Bustos (1994).

As subsequent when referred to the concept gender refers to a socio-cultural construction, while the concept sex refers to the anatomical and physiological characteristics derived from the biology.

Method Frame

For more than three decades, researchers and educators have tried to discover the nature, causes and consequences that gender differences have on the achievement in mathematics and science in general achievements. The initial explanations given on the subject were of sexist type based in biological factors (Kimura, 1999). In the end of the 70's it is considered that these differences were originated by social and cultural processes to which were submitted girls and boys, affecting their behavior, achievement and participation in mathematics. Gender, now appears in the mathematical field, as a category of analysis with a qualitative focus, that takes into account all the socio-cultural elements in which individuals are involved, considering not only as individuals with different characteristics, but with the essential characteristic of human beings.

With respect to the interactions that take place in the mathematics class, two observation systems are distinguished: the quantitative associated to the search of causes (taking of time between the question made the teacher and the time it taken by the students to answer, number of questions made by the teacher, etc), and the one related in a directly social processes, some of the studies circumscribed to the last are the following:

- Becker (1981), Who in the area of geometry, reports that boys interact with the teachers more than girls.
- Leder (1987), who look at the number of interactions and time employed by boys and girls, in response to a question made by the teachers in Spanish classes, mathematics and science. The results show differences in the patterns of interaction among teachers and boys and girls with high and low achievement, and these differences coincide with the teachers perceptions on ability and achievement. Significant differences in the number of interactions were not found in each area, but if the quality and quantity of these, all of them in favor for boys. In reference to the time employed to answer to the question made by the teacher differences are not observed. It is interesting to note that girls show more attention and enthusiasm for solving a question, while boys establish more than girls, a larger number of public interactions and more interactions with the teachers.

- Sadker and Sadker (1991) Found in a consistent manner that boys receive more attention by teachers, more time to talk in the classroom, more praise, critic and feedback correction than girls.

-Boekaerts (1995), studies the interaction between the affective and the cognitive in solving mathematic problems. Report slight differences but important in the attributions of boys and girls. Differences are not found in the time of work needed to solve a mathematic problem.

-Wimer, Ridenour y Place (2001), studying patterns of interaction between boys and girls, considering the level of the questions made by the teacher. They conclude that the patterns of response that have the students to high-level questions have clear relation with gender differences. They point out that the teachers observed and employed low-level questions in their classes.

Method

The instruments considered for the studies of the case were: an interview semi-structured addressed to teachers of elementary school and no participant observations in the mathematics class (Goetz, 1988; Cohen, 1990).

The interview application has the purpose to know the genre's vision that have mathematics teachers and at the same time establish representative subjects with whom the observations were performed. It is validates with a triangulation between items (Goetz,1988)

The observation guide used for the registration of interactions of content considered: the type of scenario, the verbal conduct observed and those that answer the questions or to those that are directed. In it the number of verbal interactions that the teachers establish in two scenarios: the one of opened invitation (interactions that the teachers establish in a general way with the entire group) and the scenario of closed invitation (interactions that the teachers establish in a direct way with a boy student or a girl student in particular). In each of the scenarios the knowledge level is registered (high and low level) of the questions made by the teachers according to the proposal of Wimer, Ridenour, Thomas y Place (2001). High-level questions privilege memorization processes or evocation of the information, mean while the low-level processes and critical abilities of thoughts.

The interviews were applied to teachers from five elementary schools in Mexico City. The information allows establishing representative teachers observed in the classroom.

RESULTS

The results obtained according to the outline of the investigation are in two categories:

A) Gender vision that have mathematics teachers.

The answers of the interview allow to view how the teachers consider themselves in reference to the ability's and domain that they have on mathematics and how they perceive boys and girls as mathematics students.

The result shows that 93% of the interview teachers manifest to have from medium to low self confidence both in the dominion of the mathematics contents as I the ability to make use of he same. The female teachers attribute their low an or medium self confidence to mathematics as a signature of difficult access, with a high grade of difficulty, whose teaching along the schooling of teachers was deficient.

In relation to how they consider girls and boys as mathematics students 86% of the female teachers mention that boys and girls have different "genetic" characteristics that facilitate or not

the mathematics knowledge development. They characterize boys as "talented" and the girls as "skillful" on this subject.

They define talent as: The genetic and natural ability to accomplish a task; and ability as: The capacity that developed throughout an entire work, practice and / or exercising.

This fine but powerful distinction implies that whether or not talented in mathematics, or not due to its utility and practical character, the determination of the work future of girls and boys. Due to the fact that female teachers relate mathematics with an access to educational superior levels, a higher family and social status, with its resulting familiar and social empowerment and occupation of better positions. Hence, these female teachers see mathematics as a masculine domain where men have advantages genetically predetermined.

14 % of the female teachers do not establish the difference between talent and ability

Among the female teachers interviewed three of them were selected in order to realize observations in the classroom with them, the selection was based in the stereotype that female teachers have on mathematics, the perception that have on boys and girls as students of the same and if these two aspects influence its teaching practice. Starting with these indicators three groups were obtained of each one. The most representative female teacher was selected:

Group No. 1: formed by 79% of the female teachers, they consider mathematics as a masculine domain, they establish that boys are talented and girls are capable in mathematics and they believe they don't make difference between them in teaching this subject.

Group No. 2: Formed by 7% of the female teachers, they consider mathematics as a masculine domain, establish boys are talented and girls are capable in mathematics. They recognize they make difference between boys and girls when teaching mathematics, because they given preference attention to girls as a measure to counter the "natural talent" of boys.

Group No. 3: constituted by the 14% of the female teachers, they consider mathematics as a Neutral domain, they do not make distinction between talent and ability because they consider both sexes are equal "For everything" They consider they don't make differences between boys and girls when teaching mathematics.

B) Verbal interactions that occur between the female teachers observed and the students in mathematics class, their instruction with the genre vision of the female teachers observed.

SCENARIO I. Interaction to at Open Invitation

In this scenario the content interaction established by the female teacher with the student body are observed when she waits for spontaneous answers from the students body to a question made by her giving or not the Word to someone of the group.

In Figure 1 data related to spontaneous answers from the student body is shown, there is an emphasis in the analysis of the data by sex in order to establish in there is a pattern of answers related with the type of questions that the female teacher posed to boys and girls.

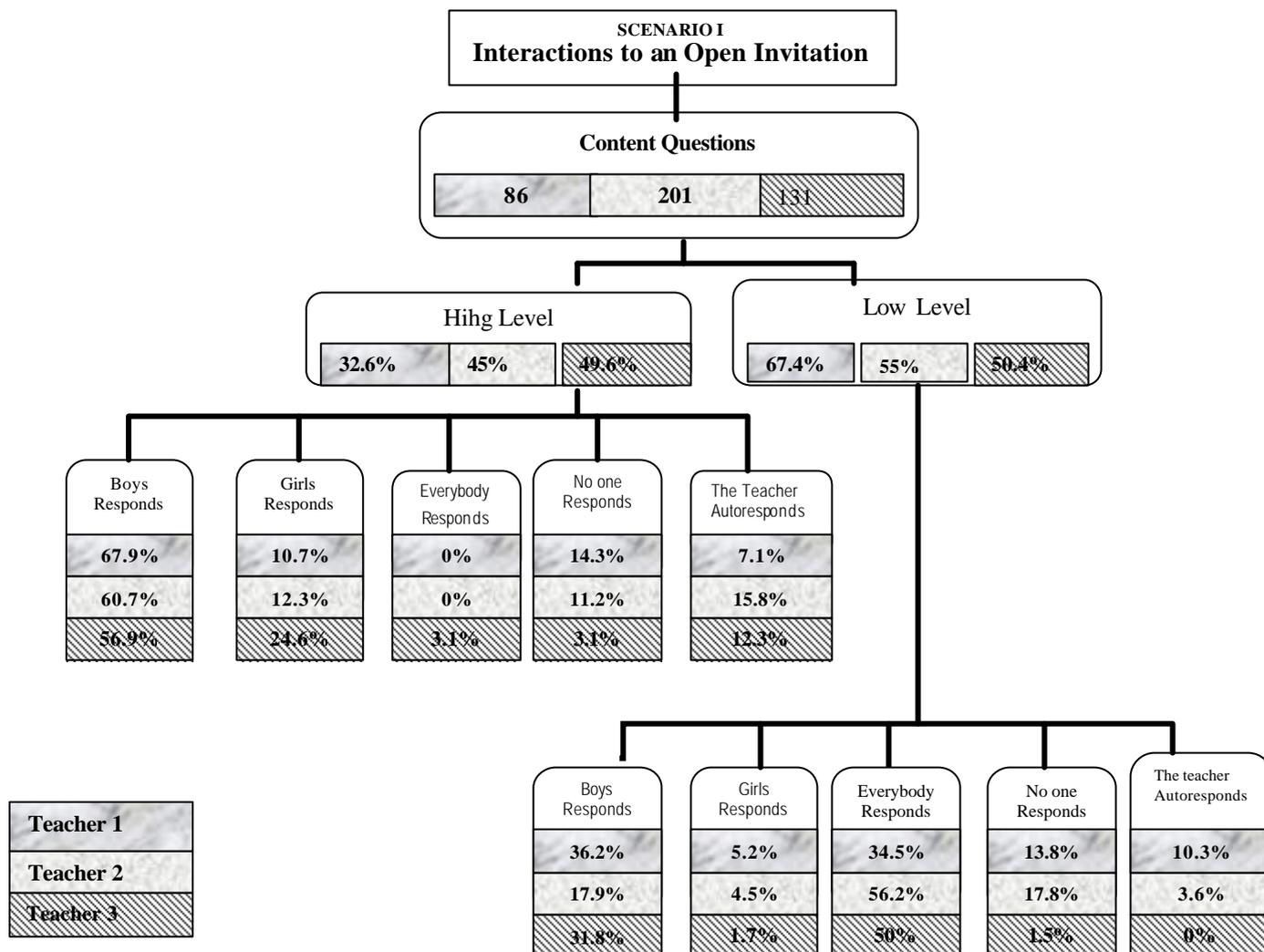


Figure1. Percentage of answers to questions posed by female teachers at an open invitation

As it can be observed in figure 1, the female teachers that consider mathematics as a masculine domain, pose a larger number of low level mathematics than of a high one.

In reference to answers given by boys and girls, we found that: the boys of the three groups are given spontaneous answers and significantly to more high level questions than low level questions, they show themselves more participation than the girls to give answers to questions posed by the female teacher.

On the other hand, girls from the three groups give answers on a spontaneous manner to a larger number of high level than a low level questions.

The results show that girls and boys participate on a spontaneous way giving answers to high level questions, beginning with this data. An analysis is made to know if there are or not

significant differences between the frequency of answers given by girls and boys to high and low level questions posed by the female teachers. The obtained data is showed on table 1.

Table. 1 Statistical analysis to compare the frequency of answers between girls and boys.

SCENARIO	CATEGORY	Teacher 1	Teacher 2	Teacher 3
OPEN INVITATION	High Level	There are significant differences in favour of the boys. $\chi^2 (1) = 24.13 \quad p < .05$	There are significant differences in favour of the boys. $\chi^2 (1) = 44.78 \quad p < .05$	There are significant differences in favour of the boys. $\chi^2 (1) = 14.04 \quad p < .05$
	Low level	There are significant differences in favour of the boys. $\chi^2 (1) = 17.02 \quad p < .05$	There are significant differences in favour of the boys. $\chi^2 (1) = 10.12 \quad p < .05$	There are significant differences in favour of the boys. $\chi^2 (1) = 4.125 \quad p < .05$

It is estimated the χ^2 , the number of questions for high and low level that makes teaching is obtained when compared $\chi^2 (1) = 1 \quad p > .05$

The results indicate that in front of a question formulated by the female teacher on opened invitation, the boys are those that give significantly more high and low knowledge level in the mathematics class, in comparison with girls.

In this same scenario another type of interaction is observed that is established as an open invitation to all the numbers of the groups to give answer to a question, with a variation, that the students body raise the hand in order the female teacher decides through a direct election who will be the one to answer the question. The data is shown in table 3.

Table 3. Percentage of constitution of majority and granting of the word to someone of the members of the group on the part of the female teachers.

Teachers	Questions Conducted	Boys constitute as majority	Girls constitute as majority	Gives the word to a boy.	Gives the word to a girl.
1	20/86	65%	35%	70%	30%
2	3/201	100 %	0 %	66.6%	33.4 %
3	17/131	64.7%	35.3%	64.7%	35.3%

As it can be observed the female teachers use very little the protocol of raising the hand to decide which one of the members of the group has to answer the question formulated by her, nevertheless, when this occurs boys show more enthusiasm to give answers to the questions, because they set themselves up as a majority in a significant way, in more occasions than the girls. On the other hand, the female teachers select boys more than girls in a significant way to answer.

Once analyzed to whom, if to boys or girls the females teachers request in a direct way an answer to a question, investigation is made on the level of the same one (high or low level of knowledge)

with the intention to know if there exists a pattern of questions and to whom it is directed. Data is concentrated in table 4.

Table 4. Level of knowledge of the questions posed by the female teachers to some member of the group that wishes to answer through the protocol of raising the hand.

Teachers	High level questions	Gives the word to a boy	Gives the word to a girl	Low level questions	Gives the word to a boy	Gives the word to a girl
1	45% (9/20)	77.8%	22.2%	55% (11/20)	63.7%	36.4%
2	66.6% (2/3)	33.3%	33.3%	33.3% (1/3)	33.3%	0%
3	70.6% (12/17)	66.7%	33.3%	29.4% (5/17)	60 %	40%

When reviewing the level of knowledge of the questions posed by the female teacher, in this type of interaction, it was discovered that two teachers gave the wand to boys more tome than to the girls, when posing high level questions. The female teachers that established a same percentage of questions to both sexes, is the one that says to favor girls given their “genetic incompetence” In the meantime, in low level questions the differences are significant in favor of males. This data shows a different pattern of instructions, in quantity and quality, that favor boys, these possibility influence in the type of knowledge abilities that develop girls and boys.

SCENARIO II. Interactions at close invitation.

In this scenario interactions that the female teacher establishes with the group are registered, when she formulates questions and selects one member of the group to give an answer. It is pertinent to clarify that it is in this scenario where the vision of genre on mathematics that have the female teachers, influences on a direct way in the interactions that they are the ones who decide when mentioning concrete names, if it is a girl or a boy that one that has to answer her question.

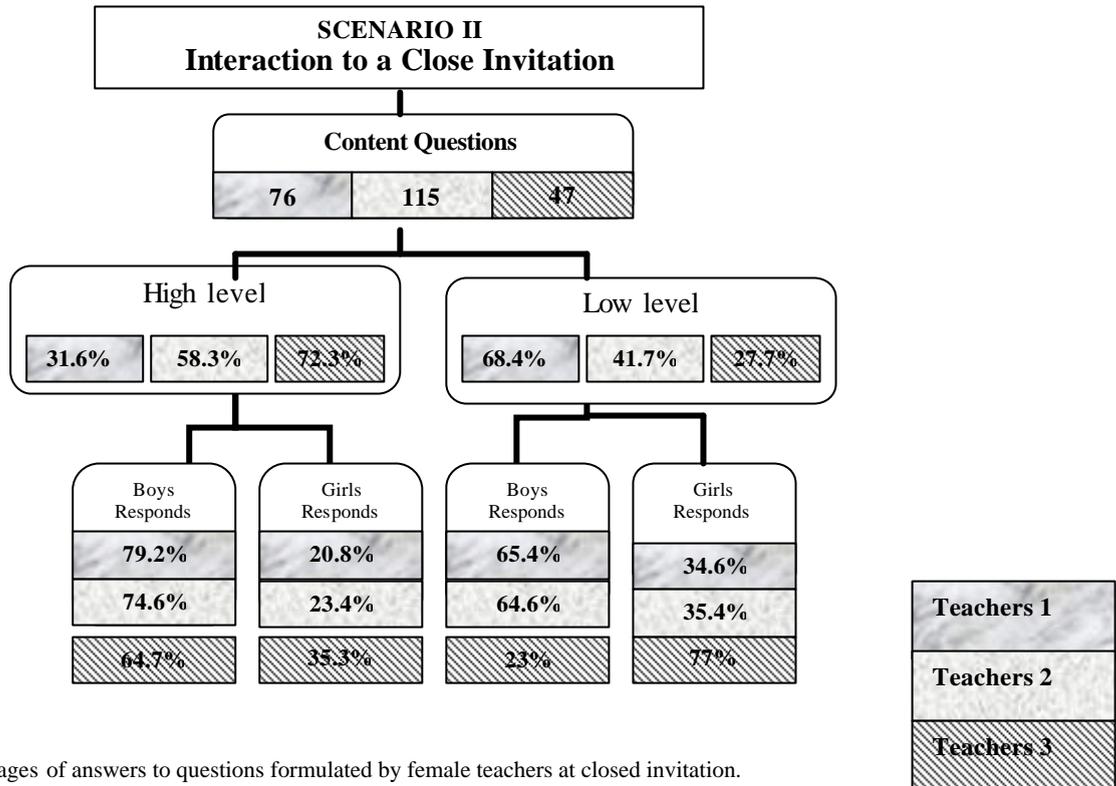


Figure 2. Percentages of answers to questions formulated by female teachers at closed invitation.

On figure 2 it can be observed that the three female teachers request the boys to answer more than 50% of the high level questions. While, to low level questions, female teachers 1 and 2 request boys the same proportion. Female teacher number 3 request girls in a direct manner in a significant percentage, answer low level questions.

It is analyzed again if there are or there are not significant difference between the frequency of answers given by the boys and girls to high and low level questions poses by the female teacher. The obtained is shown in table 5.

Table. 5 Statistical analysis to compare the frequency response between girls and boys.

SCENARIO	CATEGORY	Teacher 1	Teacher 2	Teacher 3
CLOSED INVITATION	High Level	There are significant differences in favour of the boys. $\chi^2(1) = 16 \quad p < .05$	There are significant differences in favour of the boys. $\chi^2(1) = 32.4 \quad p < .05$	There are significant differences in favour of the boys. $\chi^2(1) = 5.6 \quad p < .05$
	Low Level	There are significant differences in favour of the boys. $\chi^2(1) = 9.6 \quad p < .05$	There are significant differences in favour of the boys. $\chi^2(1) = 8 \quad p < .05$	There are significant differences in favour of the girls. $\chi^2(1) = 7.5 \quad p < .05$

It is estimated the χ^2 , the number of questions for high and low level that makes teaching is obtained when compared $\chi^2(1) = 1$
 $p > .05$

In the election made by female teachers in order a member of the group answers a question formulated by them, it was found that when there are high level questions they favor boys significantly. When there are low level questions only female teachers 3 (who consider mathematics as a neutral domain) favor girls significantly while female teachers 1 and 2 favor boys. This data indicates again a differential pattern of interaction that favors boys; for high level questions (more then low level ones) because it appears thy ascribe them high abilities in mathematics, as for girls is the opposite.

CONCLUSIONS

Now then, it has been repeatedly said that boys and girls have the same opportunities to participate in the experiences inside the classroom, the result of the investigation shows, that the fact that the female teachers have a male gender vision on the mathematics subjects, strikes the interaction processes (contents) that are established within the class because differentiates patterns are observed for girls and for boys, where the last ones are favored. The female teachers, in the three cases, favor boys, both at open and at close invitation, the development of the Basic facts, the concepts and critical abilities of thought, given the quantity and quality of the interactions that establish with them. As for the girls are mainly favors the low level processes of knowledge (memory or evocation).

The results suggest that the differences on the quantity and type of interaction established by the female teachers with the female students contribute to develop a passive and personality that Hill impact probably in the election of subjects with less knowledge demands. While for the boys contribute to develop active personalities, secure and with more knowledge activities.

It is necessary to emphasize that both the female teachers that support feminine – masculine stereotypes towards mathematics, as well as those that do not support tem, through the interactions ascribe higher mathematics abilities to male students. These abilities go much related with the distinction that the female teachers establish between talent (natural and genetic capacity to accomplish a task) and the ability (capacity developed throughout a whole work, practice and / or practice) with the first one is born the second is made. The distinction, of being talented or not in mathematics defines, according with the female teachers the working future for boys and girls, given its useful and practical character.

In the same way, they relate mathematics with access to superior educational levels, a mayor family and social status, with its resulting familiar and social empowerment an the attainment of better working positions that have the greatest part of female teachers, of the talent and ability of boys and girls to develop mathematics are al least affected partially by their own stereotype of gender.

Although the results of this study indicate that the female teachers in interacting with the students body contribute for boys and girls students go incorporating in a gradual manner patterns of differentiated interaction in the classroom, we must recognize that this fact is the result of a series of social, cultural and historical variables that are experienced by boys, girls and female teachers.

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