DOCUMENT RESUME

ED 476 633 SE 067 904

AUTHOR	Ursini, Sonia; Orendain, Monica; Sanchez, Gabriel; Butto, Cristianne
TITLE	Using Technology in the Mathematics Classroom and Its Impact on Girls and Boys: Teacher's View.
PUB DATE	2001-00-00
NOTE	12p.; In: Proceedings of the Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (23rd, Snowbird, Utah, October 18-21, 2001). p657-67. For full proceedings, see SE 065 231.
AVAILABLE FROM	ERIC/CSMEE Publications, 1929 Kenny Road, Columbus, OH 43210-1080. Tel: 800-276-0462 (Toll Free); Tel: 614-292-5680.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS	Computer Uses in Education; Educational Technology; Foreign Countries; *Graphing Calculators; Learning Strategies; Mathematics Instruction; Mathematics Teachers; *Problem Solving; Secondary Education; *Sex Differences
IDENTIFIERS	*Mexico

ABSTRACT

Since 1997 the Ministry of Education in Mexico has been sponsoring a national project in which technology (computers and TI-92 calculators) is used to support the teaching of mathematics at secondary school level (children aged 12 to 15 years old). One of our concerns during this project was to investigate if its implementation affects some of the aspects of girls' and boys' behavior in the classroom. A first approach consisted in investigating teachers' views concerning nine behavioral aspects (participation, capability to analyze a problem, capability to interpret the creativity, and preference for working in teams or individually). The results show that teachers consider that to use technology in mathematics classroom impacts the majority of these aspects and this impact is different for girls and boys. We found as well that male and female teachers have different perceptions of the observed behavioral changes. (Author)

USING TECHNOLOGY IN THE MATHEMATICS CLASSROOM AND ITS IMPACT ON GIRLS AND BOYS: TEACHER'S VIEW

Sonia Ursini
CINVESTAV, México

Gabriel Sanchez
UNAM, México

Mónica Orendain
ILCE, México

Cristianne Butto
CINVESTAV, México

Abstract: Since 1997 the Ministry of Education in Mexico has been sponsoring a national project in which technology (computers and TI-92 calculators) is used to support the teaching of mathematics at secondary school level (children aged 12 to 15 years old). One of our concerns during this project was to investigate if its implementation affects some of the aspects of girl's and boy's behavior in the classroom. A first approach consisted in investigating teachers' views concerning nine behavioral aspects (participation; capability to analyze a problem; capability to interpret the worksheets; initiative; requirement for help; dedication; defense of their own ideas; creativity; preference for working in teams or individually). The results show that teachers consider that to use technology in the mathematics classroom impacts the majority of these aspects and this impact is different for girls and boys. We found as well that male and female teachers have different perceptions of the observed behavioral changes.

Introduction

In the last decade there has been a strong tendency to introduce technology in the mathematics classroom. The intention in using it is to support students' mathematics learning. However, does the presence of technology in the mathematics classroom have some impact on gender differences? Does it affect, for example, boys' and girls' behavior in the mathematics classroom? There has not been much research yet investigating these issues. In the late 80's Noss (1987), using Logo for developing children geometrical concepts, found that the Logo experience consistently favored girls. Apple (1989), on the other hand, considered that mathematics and science curricula were strongly contributing to the reproduction of gender differences (in spite of the efforts of the experts to change this). He stressed that this could get worst with the introduction of technology to support the learning of these subjects. A finding of the IEA Computers in Education Study is that no gender gap appears among U.S. students in either grade 8 or 11 in computer performance. In a Mexican study (Morales et al., 1998) it was found that to work with computers promotes the development of creativity both in boys and in girls. In another study Dinkheller (1994) (cited in Penglase and Arnold, 1996) found that to work with calculators produced anxiety in both male and female starting college students but that after getting used to it, anxiety disappeared in both of them. These short comments and findings put forward the necessity for more investigation in order to find out the ways in which using technology in the mathematics classroom impacts girls and boys contributing or not to reinforce gender differences.

During the last three decades there has been a considerable amount of research studies investigating gender differences in mathematics learning. Studies on achievement, performance, attitudes, attributions were developed (Fennema, Leder, 1996; Hanna, 1989; Figueiras et al., 1998). Consistently, some differences in performance favoring males have been found, in particular when high cognitive level skills were required (Leder, 1992). There is evidence stressing that cultural and social pressure on male and female lead to different behavior that is internalized by individuals and this leads to different beliefs and attitudes that strongly affect the learning of mathematics. These different behaviors can be observed for example in relation to active participation, call for attention, requirement for help, involvement and dedication, creativity, discipline. Several research reports developed in different countries show that boys tend to be more active in the classroom and they participate more than girls; they ask for attention and for help more than girls and they receive more attention and help (Koehler, 1990; Subirat & Bruller, 1999). Some of them stress that not to help girls to develop a more active attitude can be detrimental for their learning because an active attitude is fundamental for the learning process and the acquisition of new knowledge (Subirat & Bruller, 1999; Cooper, Marquis & Ayers-Lopez, 1982). Girls, on the other hand, are usually considered to be more dedicated and constant (Figueiras et al., 1998). Although it is not easy to find a creative behavior in students, there are some characteristics (for example, paying more attention to the process than to the result, discipline and hard work, self-criticism) that can favor its development and these characteristics are found more often in women than in men (Maslow,1983).

EMAT: A Mexican Project

Since 1997 the Ministry of Education in Mexico has been sponsoring a national project, EMAT (Teaching Mathematics with Technology), in which technology (computers and TI-92 calculators) is used to support the teaching of mathematics at secondary school level. The software used in this project are: Spreadsheets (for arithmetic, pre-algebra and algebra); Cabri Géomètre (for geometry); SimCalc MathWorlds (to approach the idea of variation and its different representations); Stella (for modeling simple situations). A series of activities having these software as support and linked to Mexican curriculum were designed by local and external experts and presented through worksheets. Activities in worksheets were provided to the teachers involved in the project (16 teachers for the first year of the project and 73 teachers more for the second and third year; in total they attended about 10,000 children) after they attended the workshops in which they learned to use the TI-92 and one of the software mentioned above. During the workshops the didactical approach, from practice and particular examples to general theoretical principles, characterizing EMAT was stressed. The dynamic of the classroom organization was stressed as well: students work in pairs or triads; after a short introduction they are given the worksheets corresponding to the programmed activities; the role of the teacher is to observe pairs' or triads' work and to support them by answering their questions, providing hints and, when necessary, suggesting approaches; periodically the teacher organizes group discussions in order to arrive to a common understanding of the mathematical concepts involved in the activities. The proposed approach and the class dynamics are opposed to the one usually followed in Mexican schools in which general theoretical statements precede exercises and students tend to conform a passive audience: after listening to the teacher, they solve the proposed exercises individually.

One of our concerns during this project was to investigate teachers' point of view about behavioral changes in girls and boys when technology is used in the mathematics classroom. Some of the aspects we decided to investigate have been already analyzed by other researchers observing mathematics classrooms without technology. Other aspects concerned directly the EMAT project (for example, aspects 2 and 3). The aspects observed were:

1. **participation** (he/she comments about the proposed tasks with the teacher and/or mates; he/she intervenes in group discussions);
2. **capability to analyze a problem** (he/she understands the posed problem; is able to analyze the outcomes obtained on the screen in order to answer the questions of the worksheet);
3. **capability to correctly interpret the worksheets** (he/she is able to follow the indications of the worksheet and understands the purpose of the questions posed);
4. **initiative** (he/she proposes possible solutions and activities without consulting with the teacher; is able to take decisions autonomously);
5. **requirement for help** (he/she asks the teacher or a mate for help in order to develop the proposed task);
6. **dedication** (he/she gets involved in the task and persists in it);
7. **defense of their own ideas** (he/she is able to sustain his/her points of view with the teacher and mates);
8. **creativity** (he/she approaches the solution of the task in an original way and, on occasions, develops activities not indicated explicitly in the worksheet);
9. **preference for working in teams or individually** (he/she prefers working in pairs/triads and co-operates in the solution of the task or he/she prefers working on him/her own, independently of others).

Methodology

In order to obtain the required information we worked with 24 teachers (15 men and 9 women) that were attending EMAT groups and that voluntary decided to participate with us. Their professional background was heterogeneous (professional teachers, engineers, agronomists and chemists). Their experience as mathematics teachers was 17.13 years in the mean with a range of 26 years (31-5). The great majority (18) had two years experience in working in EMAT and 6 of them have been working in EMAT for already three years. Their mean age was 41.5 years with a range of 33 years (58-25).

As said above 9 female teachers participated in the study. Two of them had three years experience in EMAT and 7 had two years experience in EMAT. Female teachers' mean age was 40 years with a range of 32 years (57-25). Their experience as mathematics teachers was 18.12 years in the mean with a range of 20 (28-8). Four out of the 15 male teachers had three years experience in EMAT and 11 had two years experience in EMAT. Male teachers' mean age was 42.4 with a range of 28 years (30-58). Their experience as mathematics teachers was 16.6 in the mean with a range of 26 (31-5).

When starting the project none of them had experience in using computers nor in using them to support the mathematics classroom. We discussed with them the 9 aspects in order to share a common meaning for each one of them. Each teacher was asked to choose one, two or three (this was his/ her decision) EMAT groups he/she was attending and to give a mark to each student for each aspect. To qualify children behavior concerning each one of the nine aspects they were asked to use marks: 1 –when the considered aspect was almost never observed; 2 – when it was observed on occasions; 3 – when it was almost always observed. Aspect 9 (preference for working in pairs/triads or individually) was marked 3 if the preference was for working in pairs/triads, 2 if the student did not show a specific preference and 1 if he/she preferred working alone.

The behavior of a total of 1113 students (568 boys and 545 girls) aged 12-15 years old was analyzed in this way. They were attending different school grades and their experience in working in EMAT was different: 576 has been working in EMAT only for one year, 459 for two years and 78 had a three years experience. The great majority belonged to medium and medium-low social class. Additionally to calculators, 597 were using spreadsheets and 516 were working with Cabri Géomètre. After analyzing the data, 4 teachers (2 with 2 years and 2 with 3 years experience in EMAT) were interviewed.

Results and Discussion

The scores obtained by students for each one of the aspects considered were initially grouped together and they were analyzed using the Kruskal-Wallis test (Table 1). The variables considered were: students' sex; and students' permanence in EMAT.

The purpose of this analysis was to find out if teachers' marks reflected significant differences when students' sex or when students' experience in working in EMAT were considered. The results presented in Table 1 show that when the variable sex is analyzed, significant differences between girls and boys are found for all the nine aspects considered. Significant difference at level .01 can be observed for the aspects numbered 1, 2, 3, 4, 6 and 9. That is, teachers consider that there are significant differences between girls and boys concerning: participation (1) in the classroom; capability to analyze a problem and the outcomes obtained (2); capability in interpreting a worksheet (3); initiative (4) and dedication (6) when solving a task; and preference for working in teams or individually (9). There are as well significant differences, but at level .05, concerning requirement for help (5); defense of their own ideas (7); and creativity (8). Significant differences for almost all the aspects (except aspect 9) are found as well when variable permanence in EMAT is analyzed. For aspect 5 (requirement for help) the difference is significant at level .05 while, for all the other aspects the difference is significant at level .01.

These results suggest that the experience in using technology for learning mathematics does affect the great majority of the aspects considered and its impact is different for boys and girls. The only aspect that does not seem to change substantially when technology is used, at least in the way in which it was used in EMAT, is students' preference for working in teams or individually. In EMAT we were trying to promote work in pairs or triads, however it must be taken into account that the great majority of teachers were not used to this way of working. Although two or three students were usually sharing one computer, teachers were not encouraging them to work as a team and this decision depended mainly upon the students themselves. Teachers confirmed this when interviewed. For example, a teacher commented "On occasions, when there is a computer free, a boy moves to it in order to work on his own .... often girls ask for permission to move to another team .... in general, I observed that there are more boys than girls like to work on their own. Girls tend to prefer working in teams."

In order to have more information about the differences found using the Kruskal-Wallis test, data were re-grouped and for each aspect the mean scores given to boys

Table 1
Analysis of variance using the Kruskal-Wallis test :
χ^2 values calculated for each one of the 9 aspects observed

Variable	Aspects observed								
	1	2	3	4	5	6	7	8	9
Per sex	27.1*	15.2*	11.49*	9.42*	6.0**	15.84*	4.0**	5.41**	8.68*
Per EMAT	29.28*	18.93*	37.5*	25.17*	7.20**	51.55*	44.31*	14.03*	5.25

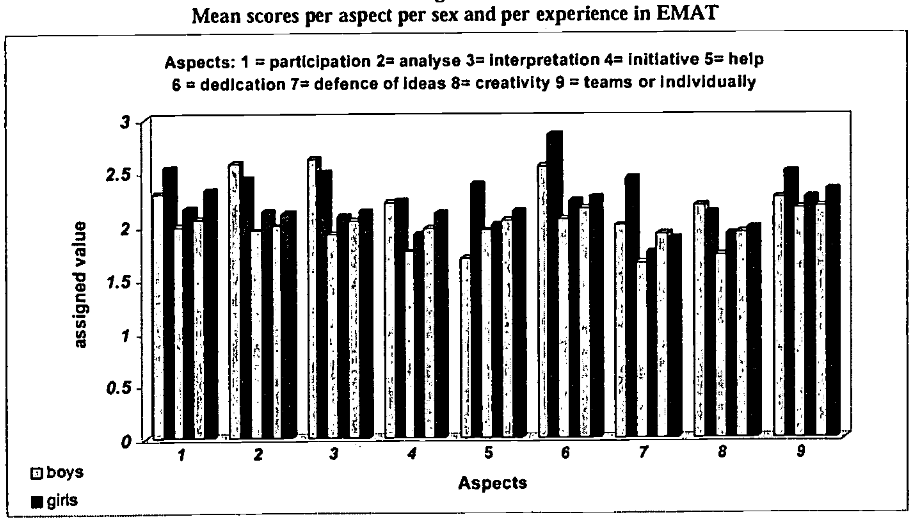
* $p < .01$ ** $p < .05$

and to girls with respectively one, two and three years experience in EMAT were analyzed. These scores are presented in Figure 1, where for each one of the 9 aspects considered there are three couple of bars. For each couple the first bar represents the mean of the scores given to boys and the second the mean of the scores given to girls. For each aspect, the first, second and third couple of bars refers, respectively, to students with three, two and one year experience in EMAT.

The mean scores presented in Figure 1 confirm the differences per sex for almost all the aspects examined. It can be observed that girls with one or two years experience in EMAT, obtain higher scores than boys in almost every aspect. The only exception is in the defense of their own ideas (7) for which the score boys with 1 year experience in EMAT have, is slightly higher than the one girls have. That is, when they start using technology boys are slightly better than girls in defending their point of view. For students with one-year experience in EMAT the highest difference between boys and girls corresponds to participation (1). From the point of view of teachers, girls starting to use technology tend to participate much more than boys. When interviewed, a teacher explained "Usually girls discuss the proposed task between themselves and with the teacher too, much more than boys. ... Girls tend to ask for help more than boys and they intervene more during group discussion."

Figure 1 shows as well that for almost all the aspects, the mean scores obtained by girls and boys with two years experience in EMAT is lower than the one obtained by students with less experience in using technology. That is, from the point of view of

Figure 1
Mean scores per aspect per sex and per experience in EMAT



teachers, both boys and girls who have worked in EMAT for two years participate less (1), they have less capability to correctly interpret the worksheets (3), they have less initiative (4), they show less dedication (6), they show less capability to defend their point of view (7) and they are less creative (8), than their mates who are just beginning to use technology. When interviewed all the teachers agreed that this outcome could not be attributed to EMAT but to different factors as: students' age and development, and students' own interests. It must be remarked that all the students with two years experience in EMAT were attending the second year of secondary school (children aged 13-14 years old). Teachers explained that the same happens for other subjects. A teacher said "I think that these results do not depend on the use of technology ... at that age students are not interested in what we are teaching them; they do not understand its usefulness. In general, when they start secondary school they are very enthusiastic, during the second year their interest slows down dramatically and in the third year they begin to understand the utility of what they are learning and their interest rises again. This does not depend on EMAT, it is due to their own development".

From Figure 1 it can be observed that the only exception concerns aspect 2 (capability to analyze a problem). Girls and boys with two years experience perform as well as their mates with one year experience. There is as well no change for boys in aspect 9 (preference for working in team or individually). Scores referring to aspect 5 (requirement for help) as well, slow down indicating that students with two years experience tend to ask less for help than their mates with one year in EMAT.

The panorama just depicted above changes substantially when the scores given to students with three years experience in EMAT are examined (first couple of bars for each category). For all the aspects studied the scores obtained by students with three years experience in EMAT are substantially different from those their mates with less experience have. Except for boys in aspect 5 (requirement for help), these scores are clearly higher. In particular, there are three aspects (2, 3 and 6) for which the difference with previous scores is remarkable. An improvement in students' capability to analyze a problem (2) and to interpret the worksheets (3) is not surprising after three years in EMAT where all the work with technology is supported by worksheets and students are asked to solve problems. More interesting is the result concerning dedication (6). Observe that for both, boys and girls with three years experience with technology, the score for this aspect increases substantially. However, it increases much more for girls than for boys. A possible explanation is that, in general, girls in Mexico have less opportunities than boys to be in contact with technology, therefore its presence in the mathematics classroom stimulates much more girls' curiosity and interest than boys'. This leads girls, more than boys, to increase their involvement in the proposed tasks and their determination to solve them. Teachers explained "Girls are more dedicated than boys, girls focus on the worksheet and they try to solve it. Boys do not pay too much attention to the worksheet and they focus their attention elsewhere, they explore more the other possibilities offered by the computer. Girls tend to follow instructions, boys feel more free to explore." Another teacher commented "Boys and girls are dedicated but boys less that girls, they are not so persistent, they feel they do not need to work too much, they feel 'culturally superior' (sic)".

It is as well interesting to notice that there are three aspects (2, 3 and 8) for which boys obtain scores higher than girls. That is, although both, boys and girls have improved in these aspects, teachers consider that boys with three years experience in EMAT are better than girls in analyzing problems and their outcomes (2), in interpreting the worksheets (3). Moreover, boys are considered to be more creative (8) than girls. Creativity is a characteristic difficult to find in students (Maslow, 1983), however, from the point of view of teachers EMAT has a positive impact on this aspect. When interviewed a teacher explained "I think that students develop their creativity when they look for a possible solution to the problem they are facing. Although they follow the worksheets, when they realize that something is wrong they look for another approach. This is evident to me in particular when they work with computers, using Cabri.". Another teacher commented "Students' creativity develops a lot. They develop different strategies, different ways to solve a problem and they find general solutions, they learn how to generalize".

For aspect 5 (requirement for help), girls' score is considerably higher than the one assigned to boys. That is, girls with three years experience in EMAT ask for help (5) much more than boys. Moreover, girls with three years in EMAT ask for help more than their mates with two or one year experience. This contrasts with boys who ask for help substantially less than their mates with less experience. A teacher explained "Girls ask more than boys for help, both about technical aspects and about mathematics. Boys ask less because when somebody ask others boys take mock of him."

Another interesting outcome concerns participation (1) and defense of their own ideas (7). Girls' scores for these two aspects are remarkably higher than those of the boys with the same experience in EMAT. A teacher's comment was the following "Boys are very passive, they accept others' point of view very easily. Girls are good in listening to others arguments but when they do not agree they argue back. They argue within the team too when they are convinced about an idea. ... Boys are obstinate, they think they are never wrong, they are stubborn; girls reflect and when they are convinced they defend their ideas."Finally, students' preference for working in teams or individually (9) does not change when their experience with technology increases. For both, boys and girls, there is a tendency to prefer working in a team and this is slightly stronger for girls.

In order to see if there were differences in the way in which male and female teachers were marking students in relation to the nine aspects, the mean scores were compared (Table 2). In Table 2 the first raw refers to the nine aspects. The index indicates the presence of a significant difference between male and female teachers' way of marking. The numbers in the second raw represent the mean of the scores given to students by male teachers for each aspect. Numbers in the third raw (in brackets) correspond to the mean of the scores given to students by female teachers. The forth and the fifth row indicate the corresponding standard deviation.

Table 2

The information presented in Table 2 indicates that there is a significant difference between male and female teachers in the way they mark students' behavior. Observe that the mean score given by female teachers is lower than the one given by men teachers for all the aspects except creativity (8). An explanation for these results might be that female teachers tend to be more demanding with their students than men teachers are. This can be deduced from the mean marks given to participation (1), capability to analyze a problem (2), interpretation of worksheets (3), initiative (4) and dedication (6). Moreover, concerning requirement for help (5) it is interesting to notice that female teachers consider that students in general do not ask too much for help. In contrast male teachers seem to consider that students require a lot of help. This might be explained considering the social role played in Mexico by women, for whom very often it is assumed that their "natural" role is to help, satisfy and take care of others. This is not assumed as a characteristic of male nature. These assumptions might originate the difference in the mean scores given to students for this aspect. Another interesting result refers to aspect 7 (defense of their own ideas). This aspect had the lower score by both male and female teachers. An explanation for this might be that given the traditional teaching approach usually employed in Mexican schools, students are not used to or encouraged to make a defense of their own ideas. However, when inter-

Table 2
Means scores and standard deviations per teachers' sex

Aspects

	1[1]	2[1]	3[2]	4[2]	5[3]	6[1]	7	8[3]	9[1]
μ	2.21 (2.08)	2.11 (2.02)	2.11 (2.05)	2.01 (1.90)	2.16 (1.84)	2.24 (2.17)	1.85 (1.84)	1.89 (1.96)	2.32 (2.12)
	.74 (.85)	.71 (.68)	.72 (.70)	.82 (.73)	.68 (.67)	.69 (.73)	.82 (.71)	.72 (.75)	.71 (.82)

[1] $p < .001$ [2] $p < .01$ [3] $p < .05$

viewed both male and female teachers commented that EMAT was strongly promoting the development of this aspect and that girls, in particular, were developing this capability more than boys.

A comparison between the mean scores assigned by male and female teachers to girls and boys separately, was suggesting a general tendency to assign higher marks to girls than boys. However, an analysis of variance (ANOVA), although not totally appropriate for this kind of data, allowed us to re-examine the data differentiating teachers' sex and students' sex. The results obtained showed that there was not significant difference between the marks male and female teachers assigned to boys and girls. In all the cases we obtained $F<1$ (the highest value was $F = .69$) with $p > .05$.

Conclusions

The results presented in this paper provide evidence showing that the presence of technology in the mathematics classroom can have significant impact on several aspects of students' behavior. The way in which technology was used in EMAT helped both girls and boys to increase their involvement in the task and to persist in it. Although girls were more dedicated than boys, this behavioral aspect increased substantially for boys after working with technology for three years. Teachers considered that to work with technology helped students, in particular boys, to be more creative. A very important outcome refers to girls' participation and defense of their points of view. From the teachers' perspective, girls were participating more than boys, and they were defending their ideas with greater enthusiasm than boys. These outcomes contrast with results from other research where it is stressed that boys tend to participate more than girls. Girls' active behavior might be reflected as well in the increase of their requirement for help. Other researchers report that in general boys are more active and they ask for help more than girls. Another interesting result concerns the difference found between male and female teachers concerning the way they assign marks to students. More research should be developed in this direction.

References

Apple, M. W. (1989). *Maestros y textos: Una economía política de las relaciones de clase y de sexo en educación.* Buenos Aires: Paidós.

Cooper, C. R., Marquis, A., & Ayers-López, S. (1982). Peer learning in the classroom: Training developmental problems and consequences of children's spontaneous interactions. In L. C. Wilkinson (Ed.), *Communicating in the classroom*, (pp. 69-84). New York: Academic Press.

Figueiras, L., Molero M., Salvador, A., & Zuasti, N. (1998). *Género y Matemáticas.* Madrid: Síntesis.

Hanna, G. (1989). Mathematics achievement of girls and boys in grade eight: Results from twenty countries. *Educational Studies in Mathematics, 20*, 225-232.

Kloosterman, P. (1990). Attributions, performance following failure, and motivation in mathematics. In E. Fennema, & G. C. Leder (Eds.), *Mathematics and gender* (pp. 96-127). New York: Teachers College Press.

Koehler, M. S. (1990). Classrooms, teachers, and gender differences in mathematics. In E. Fennema, & G. C. Leder (Eds.), *Mathematics and gender* (pp.128-148). New York: Teachers College Press.

Kuyper, H., & Van der Werf, M. P. C. (1990). Math teachers and gender differences in math achievement: Math participation and attitudes towards math. In G. Booker, P. Cobb, T. Mendicuti (Eds.), *Proceedings of the Fourteenth International Conference of the Psychology of Mathematics Education* (pp. 143-150). Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Leder, G. C. (1992). Mathematics and gender: Changing perspectives. In D. A. Grows (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 597-622). Reston, VA: National Council of Teachers of Mathematics.

Leder, G. C. (1996). Equity in the mathematics classroom: Beyond the rhetoric In L. H. Parker (Ed.), *Gender, science and mathematics* (pp. 95-104) Netherlands: Kluwer.

Leder, G. C., & Fennema, E. (1990). Gender differences in mathematics a synthesis. In E. Fennema & G. C. Leder (Eds.), *Mathematics and gender* (pp. 188-200). New York: Teachers College Press.

Maslow, A. (1985). *La personalidad creadora.* Barcelona: Kairos.

Middleton, J. A., & Spanias, P. A. (1999). Motivation for achievement in mathematics: Findings, generalizations and criticism of the research. *Journal for Research in Mathematics Education, 30,* 65-88.

Morales, C., Turcott, V., Campos, A., & Lignan, L. (1998). Actitudes de los escolares hacia la computadora y los medios para el aprendizaje. In *Tecnología y comunicaciones educativas*

Noss, R. (1987). Children's learning of geometrical concepts through Logo. *Journal for Research in Mathematics Education, 18,* 343-362.

Penglase, M., & Arnold, S. (1996). The graphics calculator in mathematics education: A critical review of recent research. *Mathematics Education Research Journal, 8,* 58-90.

Subirat, M., & Brullet, C. (1999). Rosa y Azul. In M. Belausteguigoitia & A. Mingo (Eds.), *Géneros prófugos: Feminismo y educación.* México: Paidos.

Note

This research was sponsored by the National Council for Science and Technology (CONACYT) Group Project G26338S.