GENDER BASED PATTERNS OF CLASSROOM INTERACTIONS AND PUPILS ATTITUDE TOWARDS MATHEMATICS AMONG SECONDARY SCHOOLS PUPILS IN MOZAMBIQUE

Bhangy Cassy

University Eduardo Mondlane, Maputo, Mozambique

The present study intended to explore possible gender-based patterns of teacher-pupil interactions in mathematics classrooms and its effect on pupils' attitude towards mathematics. Data were gathered using an attitude scale and a classroom observation schedule and the study was carried out in a natural school environment following a quantitative research design methodology and it involved junior secondary school pupils and their mathematics teachers. The general result showed gender-based differences in attitudes towards mathematics and in the patterns of teacher-pupils interactions, with boys demonstrating more positive attitude and interacting more with their mathematics teacher than girls.

BACKGROUND

The females' under-representation in formal education can be seen as an ancient problem which was born with the common belief that females are not considered equally talented as males for working in mathematics (Fennema, 1980). Although Fennema's finding was relative to a certain population, it could be extrapolated to a broader population since there is a worldwide convention that girls are not interested in participating in mathematics and its related fields. Though, this aspect is of extreme importance and hence it is recognized that a strong mathematical background is a pre-requisite to many career and job opportunities. Therefore, the aim of this study was to explore possible gender based differences in pupils' attitude towards mathematics and patterns of teacher-pupils interaction in mathematics classrooms.

Although, Forgasz and Leder (1996) noted that the related literature reveals inconsistent findings, other researchers such as Kimball (1989) and Peterson and Fennema (1985) found that gender differences in mathematics are related to teacher behavior and classroom climate. And, in addition Fennema et al. (1990), stated that one component of the external influences, which may affect the development of gender related differences in mathematics would be the teacher influence on both students' internal motivational beliefs and on students' participation in classroom learning activities. On one hand, Leder (1990a) stated that the overall impression conveyed by the data from her study carried out in Australia, suggested that boys and girls were treated differently in Mathematics lessons. In fact, there have been other studies (e.g., Cassy, 2002; Forgasz and Leder, 1996; Leder, 1993; Koehler, 1990 and Leder, 1990b), indicating that males and females are not treated equally in the Mathematics classroom, with females being disadvantaged, as Mathematics teachers interact more with boys than with girls. Thus, compared with females, males have been found to receive more assistance and have their work monitored more often. The same authors underlined the evidence that teachers have interacted more frequently with boys than with girls. However, Fennema and Hart (1994) argued that in USA the gender-differences in mathematics may be decreasing and that an intervention is a need for achieving equity in mathematics education.

Meanwhile, other authors, (Forgasz, 1995; Fennema & Hart, 1994; Fennema et. al., 1990 and Peterson and Fennema, 1985), claim that the effect of the way teacher interacts with their pupils, and therefore its influence on pupils' participation in classroom should be one of the components of the external influences, which may contribute to the development of gender differences in the learning of mathematics and in attitude towards mathematics. Therefore, in a review of relevant research reports regarding the affective variables, several authors such as Midgley, Feldlaufer and Eccles (1989), Leder (1990a), Relich (1996), Middleton and Spanias (1999) noted that the pupils' decline in positive attitudes toward mathematics could be explained in part as a function of teacher supportiveness and the classroom environment. This role of the mathematics teachers was widely examined in others studies (Fennema and Hart, 1994; Fennema, 1996; and Middleton and Spanias, 1999), and most of the results lead to the conclusion that students tend to attribute their feelings about mathematics to their identification with influential teachers or to their reactions to bad experiences for which they blame teachers. In fact, in a study by Forgasz (1995) examining the link between students' attitudes to mathematics and their perceptions of classroom environmental factors in co-educational schools found that teacher variables were stronger indicators of mathematics attitude for males than for females.

MATERIAL AND METHODS

The sample of this study consisted of 1221 junior secondary pupils (531 boys and 690 girls) of 9^{th} and 10^{th} grades and their mathematics teachers from 4 co-educational schools (2 private and 2 state schools) of Maputo City. To gather data an Attitude Scale and a Classroom Observation Schedule were developed and used by the researcher based respectively on the "Modified Fennema-Sherman Mathematics Attitude Scale" -MAS, (Doepken, Lawsky and Padwa, 1996) and the FIAC – Flanders Interaction Analysis Category, (Wrag, 1994) and the Brophy and Good Dyadic systems for classroom observations, (Good and Brophy, 1991). The decision to use an attitude scale and observational methods is supported by the research methodology of previous studies (Schumacher and McMillan, 1993; Cohen and Manion, 1985) where these types of instruments have been used to carry out effective data collection. Statistical data analysis was performed using the "SPSS-10.1" for Windows and, in general these analyses considered gender and age group as the independent variables.

RESULTS

Pupils' Attitude Towards Mathematics

The pupils' attitude, in this study, was measured by using the "Modified Fennema-Sherman Mathematics Attitude Scale" (MAS) covering four components of the affective domain that have been established in the literature as likely to be important aspects of pupils' attitudes toward mathematics. The items of the MAS were aggregated in 4 different sub-scales regarding pupils' perceptions about "pupils' Confidence in learning and performing well in mathematics tasks"; "mathematics Teacher Attitude towards the pupils"; "mathematics as a Male Domain" and the "Usefulness of mathematics". For each sub-scale half of the statements were positively worded while the remainder were negatively worded. The MAS had an internal consistency of α =0.83 for the total sample, α = 0.79 for boys and α = 0.85 for girls. These values are regarded as good (Anastasi and Urbina, 1998). Although, similar satisfactory results were found only for two of the sub-scales, "Confidence" and "Usefulness", since the other two sub-scales, the “Teacher Attitude” and “Male Momain” showed values below 0.70. The pilot study showed that the full Portuguese Fennema-Sherman MAS version was sufficiently reliable for use in Mozambique. The unhappiness in the wording of some of the “Male Domain” sub-scale statements may well have contributed to the lower values of internal consistency of this sub-scale.

		Boys		Girls		
		Mean	SD	Mean	SD	t
Confidence	Younger	3.43	0.74	3.21	0.59	3.120[a]
	Older	3.51	0.70	3.23	0.56	6.523[b]
	Total	3.49	0.71	3.22	0.57	7.185[b]
Male Domain	Younger	2.08	1.01	1.68	0.64	4.515[b]
	Older	2.01	0.94	1.85	0.81	2.641[a]
	Total	2.03	0.96	1.80	0.77	4.567[b]
Teacher	Younger	4.01	0.74	3.93	0.75	0.889
	Older	4.04	0.75	3.88	0.76	3.052[a]
	Total	4.03	0.74	3.90	0.76	3.063[a]
Usefulness	Younger	4.29	0.67	4.25	0.56	0.530
	Older	4.17	0.70	4.16	0.72	0.191
	Total	4.20	0.69	4.19	0.68	0.377
MAS	Younger	3.45	0.43	3.27	0.33	4.489[b]
	Older	3.43	0.42	3.28	0.39	5.471[b]
	Total	3.44	0.42	3.28	0.37	6.889[b]
a) p<0.01; b) p<0.001						

Table 1: Means and SD of the attitude sub-scales by gender and age group

The female pupils particularly suggested improvements to the language in the scale, as they considered the Male Domain sub-scale’s language as being of an offensive nature. As an example, the majority of the girls did not like the connotation of the items:

“When a woman has to solve a mathematics problem, she should ask a man for help”

“It is hard to believe a female could be a genius in mathematics”

“I would have more faith in the answer for a mathematics problem solved by a man than a woman”

Then, in establishing whether statistically significant gender differences existed in pupils' attitude towards mathematics the analysis (see Table 1) revealed that there were statistically significant differences between the patterns of attitudes toward mathematics expressed by boy and girl pupils in which boys were found to be rating their attitude more positively than girls ($t_{1:1220}=6.889$; $p<0.001$). This result is partially supportive of different findings (e.g. Fennema and Sherman, 1977; Leder, 1990a and Weinburgh, 1995), where females have been noted to have less positive attitudes toward mathematics and that these differences increase as pupils progress in school. Although, it contradicts the findings from Tressou-Milonas study (1990), who concluded that no serious differences were detected in the attitudes of boys and girls toward mathematics since both boys and girls exhibited the same enthusiasm or faced the same difficulties on different topics. Perhaps the apparent contradiction between these sets of findings and those from the present study could be clarified by the gender comparison in the different sub-scales and hence the general attitude may be masked by the depth of the differences in each sub-scale.

For instance, it is evident that Confidence in learning mathematics has consistently been found as an important component of gender-related differences (Fennema and Sherman, 1977, 1978; Armstrong, 1981; Shaughnessy, Haladyana, and Shaughnessy, 1983; Norton and Rennie, 1998). And, the results of this study are supportive in that boys were more confident about working in mathematics than girls. Although gender differences in perceptions of mathematics as a Male Domain may not be as significant as it may have been when the original scale was constructed, they are persistent and still evident in current work. In this study, girls did not strongly stereotype mathematics as a Male Domain they believe much more than boys that mathematics is more appropriate for males than for females and this was particularly evident in the younger pupils. In this sub-scale, low scores indicate that mathematics is not a Male Domain. So, the results on the Male Domain sub-scale are similar to those reported in other research carried out in different countries and involving different educational levels (e.g. Forgasz, Leder and Gardner (1996) and Norton and Rennie, 1998). And, regarding the mathematics Teacher's Attitude sub-scale, in general, boys rated their perception more positively than girls on how their mathematics teachers feel about them as learners of mathematics. This was particularly evident within the older pupils, in this study. This finding reinforces the argument by some authors who state that mathematics teacher's attitude is frequently invoked to explain gender differences in pupil participation and performance in post-compulsory mathematics courses (Fennema and Sherman, 1978; Becker, 1981; Fennema and Peterson, 1985; Mallan, 1993; Jungwirth, 1991 and Fennema, 1996).

Teacher-Pupils Interactions

In the attempt to explore possible gender based patterns of classroom interactions between mathematics teachers and their pupils an observation scheduled was constructed and used. A total of 3864 interactions were recorded in 344 lessons observed among Public and Private interactions. Within this total number of the interactions recorded, 18% (687) involved the Mathematics teacher interacting with the class as a whole and thus, only the remaining 82% (3177 interactions) were analyzed for possible gender-based patterns of teacher-pupils interactions. Frequencies and mean number of teacher-individual pupil interactions are summarized in Table-2 by pupils' gender and grade. The observed classes had more girls than boys.

Type of Interactions	Boy (158)	Girl (190)	Boy (158)	Girl (190)	X [illegible]
	b_i	b_i/b	g_i	g_i/g	
9th Grade					
Public	547	3.5	473	2.5	27.838b
Math Content	475	3.0	405	2.1	26.103b
Non Math Content	72	0.5	68	0.4	2.051
Private	73	0.5	90	0.5	0.025
Total	620	3.9	563	3.0	-
10th Grade					
Public	575	4.5	697	3.6	15.419b
Math Content	531	4.1	644	3.3	14.175b
Non Math Content	44	0.3	53	0.3	1.245
Private	206	1.6	516	2.7	38.357b
Total	781	6.1	1213	6.2	-
b_i=Number of boys' interactions; g_i = Number of girls' interactions; b=Number of boys; g=Number of girls: a) p<0.01; b) p<0.001					

Table-2: Frequencies and Mean Number of Interactions by Gender and Grade

From that Table, it can be seen that in general boys interact in public much more with their mathematics teacher than girls and, this boy domination can be seen as a consequence of the higher proportion of teacher-boy interactions on mathematics content. Similarly, Leder (1990a) and Taber (1992) found that boys were involved in significantly more public interactions with their teachers than girls, and in particular, in more interactions related to the subject content. It appears that, as Fennema (1996) argued, the climate in mathematics classrooms is often more favourable to boys' learning than to girls' learning. These findings reinforce the view that males and females are not treated equally in the mathematics classroom, (Becker, 1981; Koehler, 1990; Leder, 1990b; Leder, 1993; Atweh and Cooper, 1995; Forgasz and Leder, 1996 and Reliech, 1996).

For instance, in grade 9, boys could expect to interact more frequently with their Mathematics teacher ($b_i/b=3.5$), in Public, than girls ($g_i/g=2.5$) and the differences were found statistically significant $(X_1^2 = 27.838;\ p < 0.001)$. Similarly in grade 10, boys reached a higher frequency of interactions of $b_i/b=4.5$ than girls who had on average $g_i/g=3.3$ and the chi-square value yielded a statistical significance at $p<0.001$ (X [illegible] = [illegible]). In the expectation of interacting with their Mathematics teacher on Mathematics contents in grade 9, it was also seen to the boys' advantage ($b_i/b=3.0$) compared to the girls ($g_i/g=2.1$), and this difference in frequency was statistically significant $(X_1^2 = 26.103;\ p < 0.001)$. Though, the Mathematics content interactions involved mostly the Mathematics teachers and their boys' pupils ($b_i/b=4.1$) than their girls' pupils ($g_i/g=3.3$). This difference was also found to be statistically significant (X [illegible] = [illegible]; $p <$ [illegible]). However, in grade 10, within the teacher-pupils private-interactions it was found that girls ($g_i/g=2.6$) accounted for more of this type of interaction than did boys ($b_i/b=1.6$), yielding a $X_1^2 = 38.357$, with a statistical significance of $p< 0.001$. Although, in exploring the Mathematics content interactions the study also distinguished 2 categories according to the modes of initiation of the interactions, whether the interchange was teacher-initiated or pupil-initiated. Here, the majority of the teacher-pupils exchange that were observed and recorded were mostly, initiated by the mathematics teacher, meaning that most of the mathematics lessons in Mozambique's secondary schools are of teacher-centered style. Indeed, taking into account the grade level, the teacher-initiated interactions were consistent over the grades, being more often addressed to the boys than to the girls. In grade 9 for instance, boys ($b_i/b=3.6$) were involved in most of the teacher-initiated interactions than girls were ($g_i/g=2.7$). The Chi-square test showed that the proportions between boys and girls in teacher initiating the interaction with their pupils were significantly different ($X^2 =$ [illegible]; $p <$ [illegible]). Similarly, in grade 10, where, on average, boys ($b_i/b=3.8$) were involved in teacher-initiated interactions much more than girls ($g_i/g=2.9$), the difference was also significant ($X^2 =$ [illegible]; $p <$ [illegible]).

In a more specific analysis for gender bias, the teacher-initiating interactions were further classified into four different ways, by nominating a specific pupil or selecting a volunteer and the pupil involved in the interaction could answer verbally from the desk or could solve a problem on the board in writing and verbally. There, the data indicated that boys received more of the teachers'-addressed questions than did girls regardless of the mode of questioning. In grade 9, for instance, Mathematics teachers have shown greater preference for nominating boys ($b_i/b=1.1$) more often than girls ($g_i/g=0.7$) to solve problems on the board $(X_1^2 = 14.403;\ p < 0.001)$. Other statistically significant differences favoring boys were found in teacher selecting a pupil from those who volunteered to solve a problem on the board ($X^2 =$ [illegible]; $p <$ [illegible]) or to answer from the desk ($X^2 =$ [illegible]; $p <$ [illegible]). The only exception was the category of teacher nominating a specific pupil to answer at the desk, where boys and girls had similar proportion. In grade 10, the difference in proportion in giving the answer from the desk by nomination or to solve a problem on the board by being selected from those who put up their hands was not statistically significant when comparing the mathematics teachers' attitude either towards boys or girls. Though, in this grade, Mathematics teachers on average nominated significantly more boys than girls to answer or to solve a Mathematics problem on the board, ($X^2 =$ [illegible]; $p <$ [illegible]), and also selected more volunteering boys to answer from the desk than girls ($X^2 =$ [illegible]; $p <$ [illegible]). Here, the only exception was the category of teacher nominating a specific pupil to set up an answer from the desk, where mathematics' teachers nominated boys and girls similarly.

The results on the quality of the teachers' feedback to pupils' indicated that in grade 9 the teacher was indifferent to the pupils' answer (did not give any feedback) more frequently to the boys ($b_i/b=0.5$) than to the girls ($g_i/g=0.3$). Similarly, the teacher finished the interchange by giving the answer proportionally more times to the boys ($b_i/b=1.0$) than to the girls ($g_i/g=0.6$). All of these differences were statistically significant at $p<0.01$. The other statistically significant gender difference in this grade, and also favouring boys, were found when comparing the teachers' feedback in simply saying "correct", ($X^2 =$ [illegible]; $p <$ [illegible]). Thus, from these results the teachers' reactions were in certain categories gender-related. In grade 10, the simplest reaction of the Mathematics teacher confirming the answer by saying "Correct" was found more frequent for boys who reached the higher proportion ($b_i/b=1.7$) compared to the girls ($g_i/g=1.2$). The Chi-square value confirmed this statistical significance ($X^2 =$ [illegible]; $p <$ [illegible]).

Mathematics Classroom Interactions and Pupils' Attitude

When the patterns of the mathematics teacher-individual pupil interactions were related with the three categories of the pupils' attitude (negative, neutral and positive attitude) it was found that girls with neutral attitude towards mathematics, in grade 9, were found to have proportionally more Private interactions than all the other groups. This group was not represented within the volunteers selected in grade 9 and, within the pupils with Private interactions in grade 10. On the other hand, boys who had negative attitudes toward mathematics did not have Private interactions with the mathematics teachers in both grades 9 and 10 and they were only nominated in grade 10 and selected within the volunteers in grade 9. Comparing boys and girls with positive attitudes toward mathematics it was found that the Private interaction percentage in grade 9 differed from the others hence only here, boys reached higher percentage than girls. Even the nomination by the mathematics teacher presented higher percentage of girls with a positive attitude than boys. Then, girls with neutral attitude towards mathematics, in grade 9, were found to have proportionally more Private interactions than all the other groups. This group was not represented within the volunteers selected in grade 9 and, within the pupils with Private interactions in grade 10. Perhaps from the proportionate difference in Private interactions it could be inferred that these pupils are more unsure about their mathematical abilities, and that the teacher then approaches them in a more co-operative way by means of Private interactions. In addition, mathematics teacher nominated and selected within the volunteers more girls than boys, regardless of the pupils' attitude towards mathematics in grade 10. However, in grade 9, the teacher selected more volunteer boys with a negative or neutral attitude than girls with similar attitudes, while within the pupils' group of positive attitude more girls than boys were selected. The teachers' nomination also differentiated boys and girls in grade 9 since girls more than boys, within all the attitude groups were nominated. This shows that the patterns of classroom interactions are a direct consequence of teacher's attitude and influenced by the pupils' attitude towards mathematics. Clearly, the attitude of teachers was of great importance and these results give support to the findings of Barnes and Coupland (1990) who stated the teaching methods used in mathematics contribute to create barriers to female participation. On the other hand, the same results confirmed the argument that teachers have interacted more frequently with pupils for whom they held positive expectations. To this conclusion also arrived Koehler (1990) and Forgasz and Leder (1996) amongst others.

DISCUSSION AND CONCLUSIONS

The present study shows that mathematics teachers interacted with boys in public much more than with girls and, thus, this male domination of the teacher-pupil interaction can be seen as a consequence of the higher proportion of teacher-boys' interactions on Mathematics content. It appears that, as Fennema (1996) argued, these Mathematics classrooms were often more favourable to boys' learning than to girls' learning although in other studies, it was also found that males and females are not treated equally in the Mathematics classroom, (Cassy, 2002; Forgasz and Leder, 1996; Reliech, 1996; Atweh and Cooper, 1995; Leder, 1993; Koehler, 1990; Leder, 1990b; Becker, 1981). Similarly Cassy (2002), Taber (1992) and Leder (1990a) also reported that boys were involved in significantly more public interactions with their teachers than girls and in particular, in more interactions related to the subject content. And this male dominance in interactions with the teacher was in classrooms with more girls than boys. The recorded interactions showed the existence of patterns based on gender since mathematics teachers interacting more with their boy pupils, particularly on subject content, than with girls, and selected boys more times within the volunteers than did for girls. Thus, it can be concluded that mathematics teacher attitude may have contributed to the gender differences observed in the patterns of teacher-pupils classrooms interaction and attitude towards in secondary schools in Mozambique. However, these gender differences in mathematics by themselves are not large enough to justify the gender disparities that exist in the pupil's participation and career choice involving mathematics.

References

Anastasi, A. and Urbina S. (1998): *Psychological Testing*, 7th Edition, Prentice-Hall International. Upper Saddle River, New Jersey.

Armstrong, J. (1981): Achievement and Participation of Women in Mathematics: Results of Two National Surveys, *Journal for Research in Mathematics Education, 12* (5): 356-372.

Atweh, B. and Cooper T. (1995): The Construction of Gender, Social Class and Mathematics in the Classroom, *Educational Studies in Mathematics, 28*:293-310.

Barnes, M. and Coupland, M. (1990): Humanizing Calculus: A Case Study in Curriculum Development. In L. Burton (ed.), *Gender and Mathematics An International Perspective* (pp. 29-37), Cassel Educational Limited, Singapore.

Becker, J. (1981): Differential treatment of females and males in mathematics classes, *Journal for Research in Mathematics Education, 12*:40-53.

Cassy, B. (2002): *Effect of Classroom Interaction and Gender on Mathematics Performance and Attitudes Toward Mathematics of Secondary Pupils in Mozambique.* Unpublished PhD Thesis, University of The Witwatersrand, Johannesburg, RSA.

Cohen, L. and Manion, L. (1985): *Research Methods in Education*, 2nd Edition, Croom-Helm, London.

Doepken, D.; Lawsky, E. and Padwa, L. (1998) "Modified Fennema-Sherman Attitude Scales". *Lpt@www.woodrow.org*.

Eccles, J. and Blumenfeld, P. (1985) Classroom experiences and student's gender: Are there differences and do they matter? In L. Wilkinson and C. Marrett (Eds.). *Gender influences in classroom interaction*. New York : Academic Press

Fennema, E. (1980) Sex-Related Differences in Mathematics Achievement: Where and Why? In L. Fox, L. Brody, and D. Tobin (eds.), *Women and the Mathematical Mystique*, (pp.76-93). Baltimore: The Johns Hopkins University Press

Fennema, E. (1996) Mathematics, Gender, and Research. In G. Hanna (Ed.), *Towards Gender Equity in Mathematics Education*, (pp.9-26). The Netherlands: Kluwer Academic Publishers

Fennema, E. and Hart, L. (1994) Gender and the JRME, *Journal for Research in Mathematics Education, 25* (6): 648-659.

Fennema, E. and Peterson, P. (1985) Autonomous Learning Behaviour: A possible explanation of gender-related differences. In Mathematics. In L. Wilkinson and C. Marrett (Eds.), *Gender Related Differences in Classroom Interaction*, 17-35, Academic Press, New York.

Fennema, E.; Peterson, P. and Carpenter, T. 1990, 'Teachers' Attributions and beliefs about girls, boys, and Mathematics, *Educational Studies in Mathematics, 21*(1): 55-69.

Fennema, E. and Sherman, J. (1977) Sex-related differences in mathematics achievement, spatial visualisation and affective factors, *American Educational Research Journal, 14* (1): 51-71.

Fennema, E. and Sherman, J. (1978) Sex-related differences in mathematics achievement, and related factors: A further study, *Journal for Research in Mathematics Education, 9*, 189-203.

Forgasz. H. and Leder G. (1996): Mathematics classrooms, gender and affect, *Mathematics Education Research Journal, 8* (1): 153-173.

Forgasz, H. J. (1995) 'Gender and the relationship between affective beliefs and perceptions of grade 7 mathematics classroom learning environments', *Educational Studies in Mathematics, 20*, 219-239.

Forgasz, H.; Leder, G. and Gardner, P. (1996): The Fennema-Sherman Mathematics as a Male Domain Scale: A re-examination, in *Proceedings of the 20th Conference of the International Group for the Psychology of Mathematics Education*, (2):361-368, Valencia, Spain: University of Valencia.

Good, T.L. and Brophy, J.E. (1991): 'Looking in Classrooms', 5th Edition, Harper Collins Publishers

Jungwirth, H. (1991): Interaction and gender-findings of a microethnographical approach to classroom discourse, *Educational Studies in Mathematics, 22*, 263-284.

Kimbal, M. (1989): A new perspective on women's Math achievement. *Psychological Bulletin, 105*, 198-214.

Koehler, M. (1990): Classrooms, teachers, and gender differences.In Mathematics, in E. Fennema and G. Leder (Eds.), *Mathematics and Gender*. New York: Teachers' College Press,.

Leder, G. (1990a) Gender and classroom practice. In L. Burton (Ed.), *Gender and Mathematics. An International Perspective*, (pp. 9-19), Singapore: Cassel Educational Limited

Leder, G. (1990b) Gender differences in mathematics: an overview. In E. Fennema and G. Leder (Eds.), *Mathematics and Gender: Influences on Teachers and Students*, 10-26, New York: Teachers' College Press

Leder, G. (1993) Teacher/student interactions in the mathematics classroom: A different perspective. In E. Fennema and G.C. Leder (Eds.), Mathematics and gender, (pp.149-168). Queensland, Australia: Queensland University Press

Mallan, W. (1993) Impact of school-type and sex of the teacher on female students' attitudes toward Mathematics in Nigerian secondary schools, *Educational Studies in Mathematics, 24*:223-229.

Midgley, C.; Feldlaufer, H.; and Eccles, J. (1989) Change in teacher efficacy and student self and task-related beliefs in Mathematics during the transition to junior high school, *Journal of Educational Psychology, 81*:247-258.

Norton, S. and Rennie, L. (1998) Students' Attitudes Toward Mathematics in Single-Sex and Coeducational Schools, *Mathematics Education Research Journal, 10* (1),16-36.

Peterson, P. L., and Fennema, E. (1985) Effective teaching, student engagement in classroom activities, and sex-related differences in learning mathematics, *American Research Journal, 22*, 267-288.

Relich, J. (1996) Gender, self-concept and Teachers of Mathematics: Effects on attitudes to Teaching and Learning, *Educational Studies in Mathematics, 30*:179-195.

Ministério da Educação, Direcção Nacional de Planificação, 1999 '*Indicadores Educacionais e Efectivos Escolares*' ,Maputo, Moçambique.

Schumacher S. and McMillan, J. (1993) *Research in Education, A conceptual Introduction*, 3rd Edition, Harper Collins College Publishers, New York.

Shaughnessy, J.; Haladyna, T.; and Shaughnessy, J. (1983): Relations of student, teacher, and learning environment variables to attitude towards mathematics, *School Science and Mathematics, 83 (*1), 21-37

Taber, K. (1992) Girls' interactions with teachers in mixed physics classes: results of classroom observation, *International Journal of Science Education, 14*(2): 163-180.

Wragg, E.C. (1994) *An Introduction to Classroom Observation*. New York:Routledge