STUDENTS' ATTITUDE TOWARDS MATHEMATICS IN MALAWI: CAN THEY BE IMPROVED?

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ABSTRACT

The paper reports on an ongoing Malawian case study that is part of the Forum for African Women Educationalists (FAWE) initiatives to improve the learning of girls in Science Mathematics and Technology (SMT) which is being implemented in a number of FAWE chapters in Africa. The study has so far run for one school calendar year. The data for this study was collected from three co-educational pilot schools in Malawi. The current report will focus on the students' attitude towards mathematics. Data collection for the study was carried out through an administration of an attitude questionnaire to all Form one (year 9 of formal schooling) students in the three pilot schools. The questionnaire was administered at the beginning and at the end of the 2007 academic year. The initial data was used as baseline line data. Several intervention activities were implemented in the schools during the year. Such interventions included training of teachers on Gender Responsive Pedagogies, visits to industry to see mathematics at work, remedial classes, team teaching amongst teachers, reflective meetings amongst teachers to discuss issues concerning girls' learning of mathematics and holding of Science, Mathematics and Technology (SMT) camps during school term holidays.

Analysis of data from the questionnaire responses revealed that girls had started with a relatively low attitude towards mathematics compared to boys at the start of the study. However, the girls' attitude had improved more that the boys' by the end of the first year. This indicates that the intervention of the project did not impede the boys' attitude but had more positive impact on the girls than the boys. Implications for the findings are discussed in the paper.

INTRODUCTION AND BACKGROUND

Malawi is one of the countries where the problem of gender disparities in access to education has persisted over many years. Since 1994 when free primary schooling was introduced in Malawi, the enrolment of girls is slightly more than that of boys in standard one (year one of primary) but girls' enrolment is significantly reduced at secondary and tertiary levels of education. For instance, in 2007 academic year, there were 415,041 boys and 431,893 (51%) girls in standard one but only 92,677 boys and 73,493 (44%) girls in standard eight (last year of primary). The proportion of girls at secondary school level and University level in 2007 academic year were 43% and 30% respectively. Relatively more girls than boys drop out of school due to several factors such as (i) family responsibilities, (ii) employment, (iii) early pregnancy and marriage, (iv) employment and (v) sickness (Government of Malawi, 2007).

The gender disparities in favour of boys is worse in Mathematics and Science. Chamdimba (2003) showed that the proportion of female enrolment at the University of Malawi in the Mathematics and Science related faculties was less than 30 %. This proportion of low female enrolment in mathematics and science has remained the same to date as indicated by the annual statistics by the University of Malawi.

ATTITUDE, GENDER AND MATHEMATICS LEARNING

One of the most common explanations for gender disparities in mathematics achievement has focused on attitude that students have towards mathematics. Several studies have reported that there are gender differences in attitude towards mathematics with girls showing more negative attitudes than boys. In general, most of the studies reported that, compared with boys, girls lacked confidence, had debilitating causal attribution patterns, perceived mathematics as a male domain, and were anxious about mathematics (Casey et al, 2001; Hyde et al, 1990; Ma, & Kishor, 1997; Sayers, 1994; Vermeer et al, 2000). The causes of the gender differences in mathematics attitude were found to be multifaceted. Researchers have identified parental and societal attitudes (Papanastatsiou, 2000; Wong, 1992), and students' classroom experiences (Fisher & Rickards, 1998; Forgasz & Leder, 1996), as being influential in making girls internalize the feeling that they are inferior to boys in mathematics. Studies that have considered

classroom environments consider teachers' classroom behaviours to be a factor associated with students' attitudes. Fisher and Rickards (1998) found that students' attitudes towards mathematics tended to be more positive in classrooms where students perceived greater leadership and helping/friendly behaviours in their teachers, and more negative in classrooms where students perceived their teachers as admonishing and enforcing strict behaviours. Other researchers have compared the effect of single-sex and co-educational classrooms upon students' attitudes (Forgasz & Leder, 1996; Norton & Rennie, 1998). Students in single sex schools were found to have more positive attitudes than students in the co-educational schools. For example, Norton and Rennie's (1998) study of grades 8 to 12 in four secondary schools (one private single-sex girls' school, one private single-sex boys' school, one coeducational state high school, and one coeducational private school) in Queensland, Australia, found that boys in the single-sex schools had the most positive attitudes. The attitudes of boys in coeducational schools were similar to the girls in the single-sex school, and the girls in the coeducational schools reported less positive attitude on most scales. All these results suggest that strategies that target teachers' instructional practices may have an effect on students' attitudes towards mathematics.

The reported gender differences in attitude towards mathematics influenced some researchers to study some affective variables as mediators of gender differences in mathematics achievement (Casey et al, 2001). However, little consensus existed among researchers regarding the influence of affective variables on gender and mathematics achievement. For example, some studies reported statistically significant effects of affective variables on the learning of mathematics (Casey et al, 2001); Ho, et al, 2000, Ma & Kishor, 1997), while others indicated no relationship between attitude variables and mathematics achievement (Papanastasiou, 2000). Even among those studies that found a significant relationship, there was still controversy regarding the educational implications of the results. For example, some researchers concluded that although statistically significant, the mean effect size for the relationship between attitudes towards mathematics and achievement in mathematics was not strong enough to have useful implications for educational practice (Ma & Kishor, 1997). On the other hand, some researchers (Hyde et al, 1990; Norton and Rennie, 1998) have cautioned against dismissing the effects of affective variables on longer term learning outcomes, despite the finding that most of the gender

differences in mathematics were small. One of the explanations for the inconsistent findings regarding the relationship between attitude and mathematics achievement, was that such a relationship existed only with respect to particular mathematics content areas (Casey et al, 1997; Ma, 1999) and for specific affective variables (Ho et al, 2000).

However, Confidence in learning mathematics, or the degree to which a person feels certain of his/her ability to do well in mathematics, has consistently emerged as an important component of gender-related differences (Casey et al, 2001, Vermeer et al, 2000). Generally confidence in mathematics has been associated with mathematics achievement (Ryan & Pintrich, 1997), with correlation coefficients ranging from 0.3 to 0.4 (Hart, 1989; Newman, 1990; Ryan & Pintrich, 1997). For example, Ryan and Pintrich (1997) showed that students who perceived themselves as cognitively competent were less likely to avoid seeking help, whereas, students who were unsure of themselves were more likely to feel threatened when asking their peers for help and more likely to avoid seeking help. Hart (1989) found that the mean for public teacher-student interaction was higher for high confidence students than the mean for low confidence students. Ryan and Pintrich explained that students with high confidence in mathematics do not attribute their need for help to lack of ability and thus are more likely to seek help when they need it (Ryan & Pintrich, 1997). Hart further found that high confidence students were engaged in mathematics a greater percentage of the time than were low confidence students.

Studies that have compared gender differences in mathematics self confidence have mostly reported that girls had lower self-confidence in mathematics than boys (Case et al, 1997); Norton & Rennie, 1998). In some case, boys were more confident than girls even when their mathematics achievement was similar to that of girls (Casey et al, 1997). Vermeer et al (2000) have further shown that the gender differences in self confidence were more marked for application problems than computation problems, with girls showing significantly lower confidence for application problems.

Despite such consistent findings of girls' low confidence in mathematics, studies of classroom environment have shown that the girls' confidence in mathematics improved greatly in classes which actively involved girls in the learning of mathematics (Boaler, 2000; 1997; Rennie & Parker, 1997).

CONCEPTUAL FRAMEWORK

The current research into students' attitudes towards mathematics is theoretically based on social constructivism. Constructivism is a philosophical perspective on knowledge and learning. It is widely recognized that different forms of constructivism exist (Dengate & Lerman, 1995; Nola, 1997). Geelan (1997), for instance, identified six forms of constructivism, namely (i) personal constructivism, (ii) radical constructivism, (iii) social constructinism, (iv), (v) critical constructivism and (vi) contextual constructivism, while at the same time acknowledged that this did not exhaust the possibilities of the field and that different authors may call a particular form by different names. The various forms of constructivism could be viewed as spreading on a continuum between 'those that emphasis on individual cognition' on one end, and those that emphasise on social processes' on the other end (Phillips, 1995). However, all variants share the belief that knowledge is actively constructed by the learner, rather than conveyed to the learner from an external source. Smith (1997: 106), for instance, noted that in its most popular form, constructivism may be viewed as

> "a commitment to the idea that we construct our knowledge. This means that knowledge is not and cannot be placed inside our heads; rather we make our own knowledge by selectively using our experiences to create mental structures that form the basis for our knowledge."

Evidence from research findings has so far shown that intervention programmes that have attempted to use methods that actively engaged students in learning mathematics had been successful in improving girls' confidence and achievement (Adedayo, 1999; Boaler, 2000). Boaler (2000,) found that girls in a school that used an open problem-solving teaching developed increased confidence and enjoyment of mathematics, and attained statistically significant higher grades on the GCSE examination than girls in a school with a similar population using a

textbook-based traditional approach. Other studies have reported similar equitable gains for boys and girls in their confidence, problem solving and conceptual understanding in mathematics as a result of open approaches to mathematics teaching (Carpenter et al, 1998; Fuson et al, 2000). Hence, this study aimed at exploring whether meaning-based or constructivist approaches to mathematics teaching would improve students' attitude towards mathematics. The study is an on going FAWE funded project and is being piloted in three co-educational secondary schools in Malawi.

DESCRIPTION OF THE PROJECT

The Science, Mathematics and Technology (SMT) project is part of the Forum for African Women Educationalists (FAWE) initiatives to improve the learning of girls in SMT which is being implemented in a number of FAWE chapters in Africa. The involvement of FAWE into SMT for girls began in 1996 when the Female Education in Mathematics and Science in Africa (FEMSA) Project was launched. FEMSA ran for six years and was evaluated internally in 2001 and externally in 2003. The FEMSA evaluation report showed that there were a few activities that promoted the learning of girls in science and mathematics. These included: study circles, SMT camps, and SMT clubs (Osaki, 2005). As a follow-up to FEMSA, FAWE has funded a number of SMT activities in Malawi. These included an SMT baseline survey in 2005. The aim of the survey was to establish the status of SMT in secondary schools in Malawi. The findings of the survey revealed among other things that both boys and girls preferred learning languages and disliked SMT subjects with mathematics being the most disliked subject (Chamdimba, Chikasanda and Mbano, 2005). Based on such findings, Chamdimba et al recommended that there was need for strategic intervention to motivate boys and girls to develop an interest in SMT subjects. These findings were used to design intervention strategies for the FAWE Phase Two STM Projects. This paper reports on the ongoing pilot study that is being implemented in three schools in Malawi.

The data for this study was collected from three co-educational pilot schools. The study was concerned with the students' attitude towards SMT subjects. Data collection for the study was carried out through an administration of an attitude questionnaire to all Form one students in the

three pilot schools. The questionnaire had 40 items measuring 6 variables. Each variable was measured by having the students react to a number of 5-point Likert-type items as indicated in Table 1 below. The response options ranged from 'strongly disagree' which was given a score of 1; 'disagree' which was scored 2; 'neutral' which was scored 3; 'agree' which was scored 4 and 'strongly agree' which was scored 5. Reverse scoring was done for negatively worded items.

The questionnaire was administered at the beginning of the study in April 2007 and at the end of the academic year in November 2007. The April data was used as baseline data. In between the April and November data, several intervention activities were implemented in the schools. Such interventions included: Training of teachers on Gender Responsive Pedagogies, visits to industry, remedial classes for SMT, team teaching amongst SMT teachers, fortnightly reflective meetings amongst SMT teachers to discuss issues concerning girls' learning of SMT subjects.

DATA ANALYSIS AND FINDINGS

For each of the variables measured, the means for boys and girls for each item were calculated. The summaries are presented in table 1 below. Findings have been presented alongside that for baseline data for easy comparison.

Table 1: Summaries by Gender and by the time of data collection

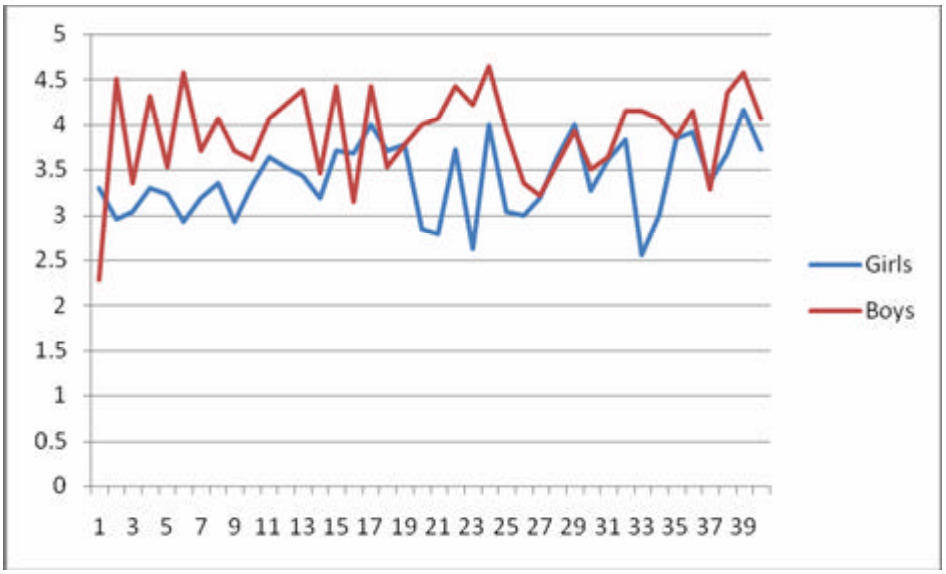
Summaries	**Baseline data**		**November data**		**Difference (November data – Baseline data)**	
	Girls	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**
Mean	3.40	3.91	3.98	4.04	0.58	0.13
Max	4.17	4.64	4.85	4.74	0.68	0.1
Min	2.5	2.29	2.68	2.43	0.18	0.14

The findings indicate that both boys and girls have improved their attitude towards SMT during the project period. However, the data in table 1 indicates that girls started with a relatively low

attitude towards SMT compared to boys at the start of the project but had improved more that the boys by the end of the first year. This indicates that the intervention of the project did not impede the boys' attitude but had more positive impact on the girls than the boys.

The means for boys and girls for each item are plotted in Figures 1 and 2 below.

Figure 1: Mean per question by Genderfor baseline data

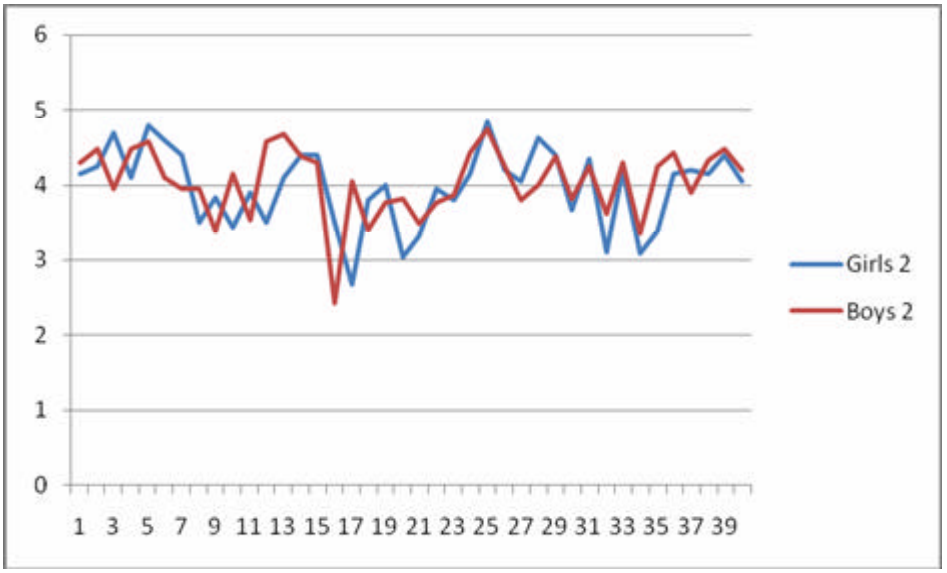


It is clear from the figure 1 above that the line for the boys' attitude is above that of the girls. The boys' means were slightly higher than the girls in almost all items at the beginning of the study when the baseline data was collected in April 2007. This implies that the boys displayed a relatively higher positive attitude about SMT subjects than the girls. The lowest mean for the girls in the baseline data was 2.5 on the item: "I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in SMT" implying that they were neutral about the statement. Their highest mean was 4.17 for the item: "I believe studying SMT helps me with problem solving in other areas" suggesting that the girls strongly agreed with the statement.

The boys on the other hand had their minimum mean of 2.29 on the item: "SMT are one of my most dreaded subjects", while their maximum mean was 4.64 on the item: "SMT subjects are important in everyday life. These results show that both boys and girls believe that SMT are

useful subjects but the boys were more anxious about SMT subjects than the girls while the girls were less confident about the SMT than boys.

Figure 2: Mean per question by Genderfor November 2007 data



It is clear from figure 2 above that there is no difference in attitude towards SMT between boys and girls for the November data. This is in contrast with the baseline findings for the attitude questionnaire administered at the beginning of the study where boys' attitude towards SMT were relatively higher than that of girls as shown in Figure 1.

The findings after the intervention revealed that the girls' lowest mean was on 2.68 on the item "I have a lot of self-confidence when it comes to SMT subjects" implying that the girls were neutral about the statement. Both boys and girls had their highest mean on the item "SMT subjects are dull and boring" indicating that they strongly disagreed with the statement. The boys' lowest mean was on item "SMT subjects do not scare me at all" indicating that the boys continue to be anxious about SMT subjects.

CONCLUSION

It can be concluded from the results that it is likely that the intervention has contributed to help both boys and girls to perceive SMT subjects as interesting subjects although the interventions have not helped to remove the fear of SMT in boys and to boost the confidence amongst girls. The reported improvement in attitude towards mathematics was possibly due to the fact that teachers' participation in the project made them more "sensitive" and responsive to issues that concerned girls learning as evidenced by a comment from one of the teachers:

> 'One of the effects of this project to us is that it has enabled us to be more sensitive to issues that affect girls generally, even those that are not directly related to the learning of science and mathematics. For example, there was an incidence of sexual harassment that happened with one of the girls by a school building contractor and when the school management was down playing it, we took it up, a thing we wouldn't have done (sensed) before the project'.

The teachers' enhanced sensitivity to girls' learning as a result of their participation in the study is similar to that reported by Wickett (1997). Wickett reported that her participation in the Equity in Mathematics Education Project sponsored by the California Mathematics Project gave her the opportunity to become aware of her gender bias practices and to deal with them meaningfully which resulted in increased girls' confidence in mathematics classrooms. The increased girls' confidence possibly resulted from the friendly behaviours displayed by the teachers (Fisher and Rickards, 1998). Such findings suggest that one way of improving the mathematics learning of girls is to give teachers opportunities to reflect on their instructional practices using a gender lens on issues affecting the learning of girls. The teachers also reported that they valued the reflection meetings in that they enabled them to be open with each other and that it increased mutual trust amongst each other. Consequently, they were able to seek help from one another in topics that they were not comfortable to teach.

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