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Volume No 1 Issue No.2 June 2012

www.iresearcher.org

ISSN 227-7471

THE INTERNATIONAL RESEARCH JOURNAL "INTERNATIONAL RESEACHERS"

www.iresearcher.org

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SECONDARY SCHOOL STUDENTS' ATTITUDES TOWARDS MATHEMATICS IN QUETTA, PAKISTAN

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ABSTRACT

This paper reports the results of a small scale research study that aimed to investigate male and female students' attitudes towards Mathematics at the secondary level in Quetta, Pakistan. The sample in this study comprised students (n = 387) of ninth grade from two schooling systems: public and private. Data were collected through an adapted tool 'Attitudes Toward[s] Mathematics Inventory' (ATMI) (Tapia, 1996). Students were asked to reflect their degree of agreement with each statement in the ATMI, from 'strongly disagree' to 'strongly agree'. The results indicated significant differences between male and female students, where male students showed highly positive attitudes towards the discipline as compared to female students. In light of the study, some recommendations have been put forward for policy and practice.

Keywords: Attitude, Gender, Mathematics, Secondary School

1. INTRODUCTION

There is a general consensus among teachers and scholars that attitudes towards Mathematics are vital in the achievement and participation of students in the discipline. However, students' low achievement in Mathematics is the major concern of the developing world in general and Pakistan in particular (Hoodbhoy, 2007; SPDC, 2003). It is also a fact that many students opt out from Mathematics at the tertiary level - particularly female students – soon after their matriculation in Pakistan. The key reason for opting out from studying Mathematics at the tertiary level or not taking mathematics-related professions as their possible future career is that students usually view Mathematics as a difficult, boring and dry subject (Horn, 2004). As a result, they consider themselves unfit for Mathematics because they think that the subject requires natural talent. Despite this Mathematics is used widely in many fields of everyday life such as engineering, business education, psychology, computer science, and sociology. Developing countries like Pakistan cannot ignore the importance of Mathematics and Science in today's fast changing world. With the passage of time it is becoming increasingly clear that Mathematics is truly a gateway to the scientific inventions and it brings prosperity to the nation. That is why low achievement of students in Mathematics is a concern for the Pakistani nation. This concern is also raised by scholars and highlighted in different reports that the country is lagging behind regional as well as other countries around the world regarding school-related variables such as 'mathematics achievement' (Hoodbhoy, 2007; SPDC, 2003).

A key factor that greatly influences students' achievement in Mathematics is students' attitude towards the discipline. Moreover, attitude towards Mathematics is also influenced by many factors such as gender, parents, peers, teachers, teaching methods, ethnicity, the home and the school environment. However, the focus of this study is to investigate the influence of gender on students' attitudes towards Mathematics.

Generally, people believe that females cannot perform better in Mathematics as compared to males because they think that females do not possess the natural talent that males have to perform better (Halai, 2007). This belief takes us to the explanation of gender differences in mathematics achievement that has focused on attitude that students have towards Mathematics. Several research studies have reported gender differences in attitude towards Mathematics with female students showing more negative attitudes than male students (e.g. Chauhan & Bhutta, 2010; Leder, 1995; Swetz, Langgulung, & Johar, 1983). Most of these research studies indicated that female students lacked self-confidence in learning Mathematics as compared to male students (see Leder, 1995; Norton & Rennie, 1998). The reasons of the gender differences in mathematics attitude were found to be multi-faceted such as parental and societal attitudes (Halai, 2011; Wong, 1992) and students' classroom experiences (Forgasz & Leder, 1996). Despite better performance in Mathematics, female students are viewed as successful in the discipline due to their hard work (Jussim & Eccles, 1992; Siegle & Reis, 1998; Tiedemann, 2000), while male students' success in Mathematics is attributed to their natural talent (Jussim & Eccles, 1992). Consequently, females internalise the feelings that they are inferior to males in Mathematics. Moreover, gender differences in attitude towards Mathematics have often been referred to as one factor that has contributed to lower enrolments of females as compared to males in Mathematics courses and low performance in those courses (Forgasz & Leder, 1996; Fullarton, 1993; McLeod, 1992). These researchers believe that interest in Mathematics is a significant predictor of students' success. On the other hand, research studies conducted in Pakistan show a mixed picture of gender differences. A research study conducted in the rural context of Pakistan by Chauhan and Bhutta (2010) found a significant difference among male and female students' attitudes towards Mathematics with male students showing more positive attitudes towards the discipline than their female counterparts. In contrast, some studies conducted in the urban contexts (Lahore and Karachi) of Pakistan (e.g. Amirali, 2010; Farooq & Shah, 2008) found no gender difference at the secondary level.

Based on a review of literature, therefore, this is the first study that has gauged gender differences in attitudes towards Mathematics at the secondary level in the context of Quetta, the provincial capital of Balochistan, Pakistan.

In this study attitude towards Mathematics has been operationalised as one's feelings and emotions towards Mathematics that includes self-confidence, value, enjoyment, and motivation (Tapia, 1996; Tapia & Marsh II, 2004).

2. STATEMENT OF THE PROBLEM

The purpose of this study was to investigate the differences between male and female students' attitudes towards Mathematics at the secondary level in Quetta, Pakistan.

3. METHODOLOGY

A cross-sectional survey design was employed to investigate the differences between male and female students' attitudes towards Mathematics at the secondary level in both public and private secondary schools in Quetta using a tool. Surveys are "… extremely efficient at providing large amounts of data, at relatively low cost, in a short period of time" (Robson, 2002, p.234). More specifically, a cross-sectional survey design served the purpose of this study which was to collect data in order to find out the differences in attitude across gender (Fraenkel & Wallen, 2006; Robson, 2002).

4. SAMPLE AND SAMPLING PROCEDURE

The target population in this study was all students of grade nine studying in public and private secondary schools functioning in Quetta, Pakistan. The sample in this study comprised 387 students of ninth grade of which 193 were males and 194 were females. The sample was selected randomly from two strata (gender) from six boys' and six girls' secondary schools.

5. DATA COLLECTION TOOL

A standardized tool – 'Attitudes Toward[s] Mathematics Inventory' (ATMI) which was constructed by Tapia (1996) and later on validated by Tapia and Marsh II (2004) – was adapted for this small scale research study. ATMI

consists of 40-items under four subscales (*self-confidence*, *value*, *enjoyment*, and *motivation*). In the tool, all participants were required to choose the answer that reflected their feelings in accordance with the Likert-format scale of five points from '1 = strongly disagree' to '5 = strongly agree'. Since the ATMI had to be administered in the context of Pakistan for the first time, it was essential to establish the content validity of the tool. For this purpose, the tool was sent to eight experienced Mathematics practitioners for content validation. They suggested minor modifications in some items. Moreover, the tool was also translated into Urdu (the National Language of Pakistan) to make it more user-friendly particularly for public school students where the medium of instruction is Urdu.

Furthermore, the ATMI tool was also piloted on a group of students (n = 20) of grade nine of both public and private secondary schools. The sample included both male and female students. During the pilot study, both English and Urdu translated versions of the tool were used as per the medium of instruction followed in the schooling system.

Prior to piloting, I obtained informed assent from the children and informed them that they were participating in a pilot study where their critical feedback about any confusing statements would help the researcher to make necessary modifications in the tool (Oppenheim, 1992). Tool was directly administered to students. After completion, students were asked about their experiences of filling in the tool specifically in terms of the difficulty levels of wording, statements or the inclusion of any redundant items. The following points were noted during the pilot study:

- The time taken to fill the tool ranged from 20 – 30 minutes.
- Majority of the students felt that the language of the tool was simple.
- Generally, students felt that the statements in the tool were very clear.

Furthermore, the internal consistency of the tool was also established using Cronbach-Alpha. For this purpose, all negatively worded items were reverse coded in order to calculate the alpha coefficient by employing the reliability scale method as described by Field (2005). The reliability coefficient of the adapted tool was found to be (α =0.94).

6. PROCEDURE

The ATMI was administered directly to research participants in their classrooms in an examination set-up. This technique entails that the researcher is present at the site when the tool is being filled by the group of research participants (Gorard, 2003). Direct administration helped to get a higher response rate as compared to other methods (Frankel & Wallen, 2006). Directions for filling in the tools were provided uniformly to all students to minimise bias. Students were informed about their right to withdraw from the research study.

7. DATA ANALYSIS

Data were analysed through Statistical Package for Social Sciences (SPSS) version 16 software. Based on the non-normality of the data, data were analysed using Mann-Whitney test – the non-parametric equivalent of the independent *t*-test.

8. RESULTS

Although there were slightly more females (n=194; 50.13%) as compared to males (n=193; 49.87%) there was no significant difference in the ratio of students' gender [χ^2 (1) = 0.003; $p > 0.05$].

The mean age of the students who participated in this small scale research study for the whole sample was 14.32 years (SD = 1.14). Female students were slightly younger (M = 14.07 years; SD = 0.94) than male students (M = 14.59 years; SD = 1.27). Moreover, this difference was also found to be statistically significant [Mann-Whitney U = 14074.50; $p < 0.001$].

8.1 COMPARISON BETWEEN GENDER

On average, male students showed a significantly more (M = 4.13; SD = 0.53) positive attitude towards Mathematics as compared to female students (M = 3.83; SD = 0.70). This difference was found to be statistically significant [U = 13827; p < 0.001] with a small effect size[1] (r = 0.23).

8.2 ANALYSIS AT SUBSCALE LEVEL

Table 1 compares male and female students' attitudes towards Mathematics at subscale level.

Table 1: Comparison across Gender at Subscale Level

Groups	N	Self-confidence		Value		Enjoyment		Motivation	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	193	4.00	0.70	4.38	0.47	4.13	0.65	4.00	0.70
Female	194	3.55	0.90	4.34	0.57	3.80	0.86	3.65	0.96
Sig. value		p<0.001		p>0.05		p<0.001		p<0.001	
Effect size		0.27		…[2]		0.19		0.17	

An examination of Table 1 reveals significant differences between male and female students' attitudes towards Mathematics at the subscale level. On average, male students scored significantly higher than female students on the subscale 'self-confidence' in Mathematics. This difference was found to be statistically significant [Mann-Whitney U = 12888.50; p < 0.001] with a small effect size (r = 0.27). Similarly, male students scored slightly higher than female students on the subscale 'value of mathematics'. However, this difference was not statistically significant [Mann-Whitney U = 18705.50; p > 0.05].

Furthermore, analysis on the subscale 'enjoyment of mathematics' indicated that, on average, male students scored significantly higher as compared to female students and the difference was statistically significant [U = 14509.50; p < 0.001] with a small effect size (r = 0.19). Moreover, male students scored significantly higher as compared to female students on the subscale 'motivation for learning mathematics'. The difference was found to be statistically significant [Mann-Whitney U = 14954.00; p < 0.001] with a small effect size (r = 0.17).

9. DISCUSSION

The aim of this small-scale research study was to investigate the differences between male and female students' attitudes towards Mathematics at the secondary level in both public and private secondary schools in Quetta, Pakistan. Results of the study revealed that male students claimed to have highly positive attitudes towards Mathematics as compared to their female counterparts with a statistically significant difference. This gender-based result is consistent with the study of Chauhan and Bhutta (2010) who also found a high disparity among male and female students in rural areas of Sindh and Balochistan in Pakistan with male students showing more positive attitudes towards Mathematics as compared to their female counterparts. Several other research studies have also reported gender differences in attitudes towards Mathematics with male students showing more positive attitudes than female students (e.g. Leder, 1995; Norton & Rennie, 1998; Khatoon & Mahmood, 2010). However, in contrast to

[1] The threshold for small, medium and large effect size is 0.10, 0.30, and 0.50, respectively (Field, 2005).
[2] Effect size was not calculated because difference across gender for this subscale was not statistically significant.

the findings of this study, a study conducted by Amirali (2010) in private secondary schools in Karachi, Pakistan found no significant differences between male and female students' attitudes towards Mathematics. Similarly, another study conducted by Farooq and Shah (2008) in Lahore, Pakistan also found no effect of gender on students' attitudes towards Mathematics.

This gender-related difference may be attributed to the known fact of the socio-cultural setting, where people in the society generally believe in the superiority of males over females. Female students are generally not encouraged to study mathematics in Pakistan in general and Quetta in particular. Despite better performance in Mathematics, females are viewed as successful in the subject due to their hard work, while males' success in Mathematics is attributed to their natural talent (Jussim & Eccles, 1992). Consequently, female students internalise the feelings that they are inferior to male students in Mathematics. Halai (2007) found that male teachers as well as female teachers viewed that males were better in Mathematics as compared to females. She concluded that such beliefs and perceptions of teachers were deeply and fundamentally rooted in contextual practices in the society. My experience as a Mathematics teacher also confirms that males are seen as innately better in learning and doing Mathematics as compared to females both by teachers as well as by the society as a whole. As a result, female students develop the attitude that Mathematics is for males while females do not have the potential to study Mathematics.

This gender disparity may also be attributed to textbooks because the textbook is the only resource available to teachers as well as to students in Pakistan. Halai (2007) found that in Mathematics textbooks, males are more visible and dominant in comparison to females in terms of their roles. It may be possible that the use of such textbooks may prevent female students from developing a positive image of their role as Mathematics students. My experience as a Mathematics teacher and teacher educator also confirms that pictures, word problems and examples and the use of language in word problems used in the textbooks favour males as compared to females. In such a situation, it might be possible that females view their roles as something other than mathematicians, engineers and managers where Mathematics is involved.

Furthermore, analysis at the subscale level revealed that male students reported to have a significantly higher degree of self-confidence in learning Mathematics as compared to their female counterparts. This result is also in line with the study of Chauhan and Bhutta (2010) who found that male students claimed to have a significantly higher degree of confidence in learning Mathematics as compared to female students. Similar results were also obtained by Norton and Rennie (1998) in that male students claimed to have the highest level of confidence in learning Mathematics as compared to female students in single-sex schools.

Moreover, analysis at the subscale 'enjoyment of mathematics' revealed that there was a significant difference between male and female students' attitudes towards 'enjoyment of mathematics' with male students scoring higher than their female counterparts. This result is in line with the study of Tapia and Marsh II (2002) who found that students who had a high level of confidence in learning mathematics scored significantly higher in 'enjoyment of mathematics' than students who had a lower level of confidence in learning the subject. This result shows that students who enjoy Mathematics in the classroom scored higher on this scale. In other words, students who were engaged in exciting and challenging activities in Mathematics classrooms scored significantly higher than those who did not enjoy Mathematics.

Analysis at the motivation subscale level indicated that male students reported to have a higher degree of motivation for learning Mathematics as compared to female students. It indicates that more male students are willing to study Advanced Mathematics courses as well as work on challenging tasks in comparison with female students. This result is in line with the study of Leder (1992) who found a similar degree of motivation among male and female students and concluded that more males than females were willing to work on difficult tasks. This result is also consistent with the study of Norton and Rennie (1998) who found significant gender differences with male students showing a slightly higher degree of motivation than female students towards learning Mathematics.

10. CONCLUSION

In conclusion, the results of the study provide evidence that male students claim to have a more positive attitude towards Mathematics as compared to female students particularly relating to confidence in learning Mathematics, enjoyment of Mathematics, and motivation for learning Mathematics.

11. RECOMMENDATIONS

This section presents some recommendations for policy and practice in light of the results of this small-scale research study.

- There is a need to create awareness among teachers of the existing gender gap between male and female students' attitudes towards mathematics. This would help teachers in general and Mathematics teachers in particular to plan their lessons in order to address these gender biases.
- The results of the study suggest that Mathematics teachers must re-examine their traditional teaching strategies e.g. chalk-and-talk method, that mostly do not match the learning styles of students. Teachers need to use a variety of innovative teaching strategies such as cooperative learning while delivering their lessons.
- The heart of teaching lies in interaction and discussion with students. Based on the results of the study, it is suggested that teachers must appreciate and encourage interactions and discussions in the classroom so that students can express and justify themselves. In this way, they can gain confidence which would definitely improve their attitude towards Mathematics. Teachers must create a platform for students to interact with the aim that useful learning will take place in the classroom.
- There is widespread consensus among educationists and researchers that a student's positive attitude is an important factor in his/her success and future participation in Mathematics. Hence, there is a need to understand more about how attitudes are shaped and altered in order to avoid unnecessary failure in Mathematics. If students' attitudes can be changed, significant improvements in performance may be expected. For this purpose, teachers need to measure students' attitudes towards Mathematics at the beginning of the year. In case it is revealed that some students have negative attitudes towards the discipline at least the teacher should know about their attitudes so that s/he can develop strategies which could alter students' attitudes towards Mathematics at the earliest.

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