The Influence of Gender, Parents, and Background Variables on Perceived Usefulness of Mathematics among Grade 7 Students in Mozambique

Adelino Murimo
Monash University
<aemur1@student.monash.edu.au>

Data from a larger study were used to identify variables that best predict children's perceived usefulness of mathematics [PUM]. Gender differences in PUM scores were also explored using a sample of 300 grade 7 children and 225 parents from February to May 2011 in Mozambique. Surveys and interviews were used to collect data. Consistent with traditional beliefs it appeared that mathematics is viewed as more useful for boys than for girls. Education of parents, school geolocation, and number of siblings were statistically significant predictors of children's perceived usefulness of mathematics.

In developed countries, research on the factors contributing to gender disparities in mathematics learning outcomes (e.g., achievement, participation rates in high level elective mathematics courses and applied fields, affect, beliefs, and attitudes) has evolved, and measures to ameliorate the problem are well documented (Leder, Forgasz, & Solar, 1996).

In Mozambique, as in many other countries from Sub-Saharan Africa, research on gender and mathematics education has received scant attention (Asimeng-Boahene, 2006). Studies relating gender and mathematics learning conducted in Mozambique focused on secondary school students' performance (Cassy, 2002), and teachers' classroom discourse (Fagilde, 2001). The few studies focusing on primary education examined the portrayal of females and males in mathematics textbooks (Murimo & Forgasz, 2007), and performance in mathematics among grade 6 children (Saito, 2010). However, the studies by the Southern and Eastern Africa Consortium for Monitoring Education Quality [SACMEQ] have reported clear gender differences in mathematics achievement in favour of boys among grade 6 children in Mozambique, and recommendations to conduct research to understand the causes have been put forward (Saito, 2010). Hence, this paper is part of a larger and ongoing study designed to examine the impact of gender, parents, and background factors on primary school children's beliefs and attitudes towards the study of mathematics in Mozambique. In this paper three research questions will be answered:

1. What contribution do gender, education and occupation of parent, geolocation, home language, siblings, and books make to the prediction of children's perceived usefulness of mathematics [PUM]?
2. Which owned economic resource is the most salient predictor of PUM?
3. Are there statistically significant differences in perceived usefulness of mathematics between: (a) girls and boys, (b) mothers and fathers, and (c) parents of daughters and parents of sons?

The answers to these questions are important as they might contribute to the understanding of some of the factors influencing children's motivation and engagement in the study of mathematics in primary schools in Mozambique, and other places with similar contexts. To acknowledge previous studies that served as the basis to answer the research questions of this study, the following literature is reviewed.

In J. Dindyal, L. P. Cheng & S. F. Ng (Eds.), Mathematics education: Expanding horizons (Proceedings of the 35th annual conference of the Mathematics Education Research Group of Australasia). Singapore: MERGA.

Literature Review

Fennema and Sherman (1976) described the notion *perceived usefulness of mathematics* as the "students' beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation, or other activities" (p. 5). Aiken (1974) acknowledged that not only achievement, but also enjoyment and perceived usefulness of mathematics for the person and for society in general are some of the objectives of mathematics education.

Recently, Luttrell, Callen, Allen, Wood, Deeds, and Richard (2010) identified four dimensions comprising the perceived usefulness of mathematics, namely: *Interest*, *General utility*, *Need for high achievement*, and *Personal cost*. According to Luttrell and colleagues (2010), interest in mathematics learning is related to the importance a person gives to mathematics stemming from a real interest in the subject. General utility is the importance the individual places on understanding mathematics because the person wants to accomplish a variety of goals presently and in the future. Need for high achievement refers to the aspiration a student has on performing very well in mathematics. Personal cost is associated with the subjective estimation of loss suffered by the student as a consequence of learning mathematics at a high level. The perceived loss would include: effort; time spent studying mathematics; entertainments missed out; and negative reactions from peers.

Gender differences in favour of boys have been reported in regard to perceived usefulness of mathematics (e.g., Eccles, 1987; Fennema & Sherman, 1976; Luttrell et al., 2010). Research on perceived usefulness of mathematics is important to education because it has been associated with the type of courses the students elect when mathematics is not compulsory, engagement and achievement in high level mathematics, and career intentions (see Simpkins, Davis-Kean, & Eccles, 2006).

However, on their more recent studies on gendered views about mathematics, Leder and Forgasz (2010, 2011) found that the majority of respondents believed mathematics was important to get a job, and that mathematics was equally useful for females and males, challenging a traditional view that mathematics is more important for males than females.

Method

Study Site

The study was conducted in three districts of Sofala Province in the central region of Mozambique. The districts were selected by the researcher on the basis of geographic location: *Beira* (urban), *Dondo* (rural), and *Buzi* (remote). The districts also represented the three main languages spoken in Sofala Province, namely: *Portuguese, Sena,* and *Ndau*. Portuguese is a heritage from the Portuguese colonial master and has been adopted as the medium of instruction in Mozambique. However, the schools were not selected by the researcher as they were determined by the Education, Youth and Technology Services of the respective districts after permission to conduct research in Sofala Province was obtained; three primary schools were selected in *Beira*, one in *Dondo* and one in *Buzi*, and all were government institutions.

Recruitment and Characteristics of the Participants

A convenience sample constituted by 300 grade 7 children (134 boys and 166 girls), 225 parents and other guardians representing the children (118 males and 107 females) participated in the study. The ages of the children ranged from 10 to 16 years, the mean age was 12.9, and the standard deviation was 1.4. The ages of parents ranged from 18 to 67 years. The guardians other than parents were brothers, sisters, and husbands of some girls; despite the oldest girl being 16 years old, some were married.

In order to approach schools and invite children, parents, and school principals to participate in the study, authorizations from relevant institutions were obtained. To meet ethical principles, consent forms were signed by all participants interested in taking part in the study.

Instruments: Surveys and Interviews

Pen-and-paper surveys and interviews were used to collect quantitative and qualitative data respectively. As there is a lack of studies on the same topic in Mozambique, quantitative data were considered important to reveal trends and relationships among variables (Creswell, 2003). In addition, to delve deeper understanding of the data, quantitative data were complemented with more contextualized qualitative data. Qualitative data were collected through one-on-one face-to-face interviews with parents.

The children and parents completed similar surveys. However, items for parents were written to reflect their perspective. Twelve items from the Mathematics Valuing Inventory [MVI] (Luttrell at al., 2010) were selected and translated into Portuguese with the authors' permission. To maintain scale reliability, items were back translated into English with the assistance of a person fluent in both languages. An example of an item from the MVI for children was: 'There are almost no benefits for me to learn mathematics'. The equivalent item for parents was: 'There are almost no benefits for my son/daughter to learn mathematics'. Responses were given on 5-point Likert-type formats ranging from strongly disagree (1) to strongly agree (5); In order to ensure that high scores indicated high levels of perceived usefulness of mathematics [PUM] all negatively worded items were reverse scored.

Apart from items selected from MVI, the children were asked about their gender, education of guardian, occupation of guardian, home language, geolocation, number of siblings, number of books existing in the child's home, and possession of selected economic resources in their homes. In all analyses performed these variables were used as independent variables (IVs), while PUM was used as a dependent variable (DV).

The surveys were completed in the school in the presence of the researcher to avoid collusion. The children completed the surveys first; one month later parents came to school to complete the surveys. In the third month, 10 parents were invited to participate in a one-on-one semi-structured interview. Semi-structured interviews were used to avoid deviating from the topics of interest and to allow additional questions to be asked on the spot. The selection of parents to interview was based on responses to the surveys and willingness to be interviewed. The interview protocol included the following questions: 'Does your child like mathematics?'; 'How good at mathematics is your child?'; 'Do you think mathematics is important for your child?' 'Why?'; 'Do you think mathematics is important to get a job?'; 'Why do you say so'? The inclusion of these questions in this study was inspired by previous research (e.g., Leder & Forgasz, 2010, 2011).

Data Analysis

The quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) for Windows (version 18), following Pallant's (2009) guidelines. All categorical variables were coded as 'dummy' variables. The data from quantitative variables measured on a continuous scale were inspected for out-of-range values, plausibility of means and standard deviations, and non-violation of the assumptions of parametric statistical techniques used. Parametric tests were used because they tend to be more robust than the equivalent non-parametric ones when the samples are over 200 (Tabachnick & Fidell, 2007). Multiple regression analyses, ANOVAs, independent-groups t-tests, and paired t-tests were used to answer the research questions when appropriate.

Results and Discussion

To determine whether a model composed of gender, education of parent, occupation of parent, geolocation, number of siblings, home language, and number of books predicted children's PUM scores, a standard multiple regression analysis was applied. PUM scores were entered as a DV, and the categorical variables as IVs (see Table 1)

Table 1
Summary of Standard Multiple Regression Statistics for the Predictor Variables to the Dependent Variable (Perceived usefulness of mathematics) (225<N<300).

IVs	B	SE	β	t	p
Gender	0.07	0.07	0.07	1.01	0.307 (NS)
Education of parent	0.05	0.02	0.20	2.97	0.003
Occupation of parent	0.01	0.03	0.01	0.18	0.861 (NS)
Geolocation	0.19	0.05	0.24	3.56	0.000
Siblings	0.13	0.04	0.19	2.95	0.004
Home language	0.06	0.06	0.06	1.09	0.282 (NS)
Books	0.04	0.03	0.03	1.15	0.253 (NS)

Notes. B: Unstandardized coefficients, SE: Standard error, β: beta coefficient, t: t-test statistics, p: significance value, NS. Non-statistically significant at $p < 0.01$ level (Bonferroni adjustment).

It was found that the model as a whole explained 18% of the variance of PUM scores ($R^2=0.18$) and the result was statistically significant ($F(7, 215)=6.8$, $p<0.001$). Examination of β, t and *p* values in Table 1, reveals that geolocation (β = 0.24, t = 3.6, p <0.01), parent education (β = 0.20, t = 2.97, p <0.01, and the number of siblings that a child has (β = 0.19, t = 2.95, p <0.01) are statistically significant predictors of PUM scores. Gender of the child, occupation of parent, home language, and number of books were not statistically significant predictors of PUM scores.

After observing that education of parent, geolocation, and siblings were statistically significant predictors of PUM, to identify groups that differed from each other within IVs, one-way ANOVAs were conducted followed by Tukey or Games-Howell post hoc comparisons, as appropriate (Pallant, 2009). It was noted that children whose parents had university education scored a higher PUM mean (M = 4.04; SD = 0.56) than the children whose parents had less than grade 6 education (M = 3.46; SD = 0.41; p <0.01) and children whose parents did not state their education (M = 3.54; SD = 0.47; p <0.001). The children from urban schools got a higher mean (M= 3.79; SD = 0.58) than the children from rural (M = 3.47; SD = 0.42; p <0.001) and remote region (M = 3.39; SD = 0.43; p <0.001) areas. No statistically significant differences were found in the mean scores of children from rural and remote areas. The children having fewer than three siblings got a higher mean (M = 3.89; SD = 0.56) than the children having more than two siblings (M ≤ 3.63; p <0.01).

A standard multiple regression analysis was conducted to see whether a model composed of electricity, television, computer, internet, piped water, mathematics textbook, calculator, and mobile phone predicted PUM scores. The model as a whole explained 11% of PUM variation (R^2 = 0.11) and the result was statistically significant, F(8,289) = 4.5, *p* <0.001). However, only electricity (β = 0.28, t = 2.1, *p* <0.001) was a statistically significant predictor of PUM. When combined with electricity, television was not a significant predictor of PUM due to the high correlation between these two items (r = 0.91). When electricity was excluded from the equation, the model explained 10% of PUM variation (R^2 = 0.098), and television (β = 0.19, t = 3.0, *p* <0.01) was the only significant predictor of PUM in the model.

A paired t-test was conducted to determine whether there were statistically significant differences in children's PUM mean scores and parents' PUM mean scores about their children. It was found that the mean for parents (M = 3.49, SD = 0.30) was statistically significantly lower than that of the children (M = 3.68, SD = 0.56); t(216) = 4.5, *p* <0.001) This result may reflect the differential experiences that parents had with mathematics in the past and the current experiences that their offspring have.

Independent-groups t-tests were conducted to explore for significant differences in PUM mean scores for boys and girls, mothers and fathers, and for parents of sons and parents of daughters. See Table 2 for means, SDs, and t-test results (t and *p* values).

Table 2
PUM Mean Scores, Standard Deviations (SD) and t-test Results (225 <N<300).

Groupings		PUM		t-test results	
	N	Mean	SD	t	p
Girls	164	3.61	0.57	-	NS
Boys	134	3.71	0.53		
Mothers	104	3.46	0.29	-	NS
Fathers	115	3.52	0.30		
Parents of daughters	123	3.48	0.29	-	NS
Parents of sons	96	3.51	0.31		

Note. NS: Mean differences did not reach statistically significance at *p* < 0.05 level.

Although the differences in the means did not reach statistical significance, it can be seen in Table 2 that boys had higher PUM mean scores than girls; fathers scored higher than mothers; and, parents of sons also scored higher than parents of daughters. This trend in the pattern of results suggests that mathematics may be viewed as more useful for boys than for girls.

As indicated earlier, parents were interviewed to explore further their views in regard to the usefulness of mathematics for their sons and daughters. Seven fathers and three mothers accepted invitations to be interviewed. Among other questions, parents were asked whether mathematics is important for their children and for getting a job. Two interview extracts are presented next.

Interview 1 (R: Researcher, FG: Father of a girl)

R: Do you think mathematics is important?
FG: Yes, it is important.
R: Why?
FG: It opens capacity and improves reasoning.

R: Do you think mathematics is important for your daughter?
FG: Yes, it is important because it opens mind.
R: Do you think mathematics is important to get a job?
FG: No, it is not important to get a job.
R: Why do you think so?
FG: There are many people out there with a university degree without a job. Well, if you have a job already, then mathematics can help you.
R: Which profession would you like for your daughter?
FG: A doctor.
R: Why?
FG: Doctors are important. They have employment guaranteed anywhere.

Interview 2 (R: Researcher, FB: Father of a boy)

R: Is your son good at mathematics?
FB: No, he is not.
R: Why?
FB: He hates mathematics. He likes electricity, computers, and football.
R: Do you think mathematics is important to learn about computers?
FB: No.
R: Do you know why your son hates mathematics?
FB: He is not good at calculations. But I have a daughter who is good at mathematics.
R: What is her grade?
FB: She is in Grade 12 this year.
R: Is she very good at mathematics?
FB: She is very good at numbers. She explains mathematics to her classmates.
R: Which profession would you like for her in the future?
FB: A doctor.
R: Why a doctor?
FB: Because a doctor can open her own clinic or to work for several clinics.

The two extracts above are representative of the various views of the parents interviewed. FG believed mathematics is important for his daughter because it improves reasoning, but he did not believe it contributes to having a job. Similarly, FB did not believe mathematics is important to learn about computers. One possible explanation for this is that mathematics does not stand out in most occupations, and members of the general public may not see its role in the development of science. Both parents, as many others interviewed and surveyed, aspired for their daughters to be medical doctors. Explanations for this preference are likely to be related to the context of the study because of the prevalence of disease in Mozambique and the inability of health services to tackle the problem. It is interesting to note that FB believed his daughter was better at mathematics than his son. This observation demonstrates that some parents my hold beliefs that differ from the traditional views of mathematics as a male domain. Leder and Forgasz (2010, 2011) have noted similar changes in public's gender stereotyping of mathematics.

The main reasons parents gave to aspire to an occupation for their children were: the perceived financial costs for training, and the perceived chance to get employment. Fewer parents mentioned the child's aptitude for the occupation (i.e., perceived talent and child interest). Overall, the data revealed that parents and the children themselves expected girls to be teachers, nurses, and physicians, while boys were expected to be police officers and engineers, supporting the traditional stereotypes that some occupations are viewed as more suited to one gender than the other (e.g., Eccles, 1987). These results seem to support the *Expectancy-Value Model* (Eccles, 1987), in that professions may be selected because of the subjective value of the occupations in terms of the benefit of getting employment. There was no clarity whether expectations of success motivated choices, but some parents believed their children had the aptitude for the occupation.

Conclusions and Recommendations

The aim of this study was to examine the contribution of gender, education and occupation of parent, geolocation, language, siblings, books, and selected economic resources to the prediction of children's PUM. Gender differences in PUM scores were also explored. The main findings of the study are summarized as follows:

1. The children from urban schools, with more educated parents, and with fewer siblings were more likely to report higher PUM scores than the other children.
2. Having electricity, and a TV set at home predicted children's PUM.
3. Although not reaching statistical significance, children and parents were more likely to view mathematics as more useful for boys than for girls, indicating that the traditional view that mathematics is more important for males than for females may still prevail in Mozambique.
4. Interviews conducted with ten parents revealed that mathematics is viewed as important for reasoning and calculations. Most parents did not see how important mathematics is for getting a rewarding job, and how mathematics influences other fields including technology.
5. Most parents interviewed or surveyed expected their daughters to be teachers, nurses, and medical practitioners, and their sons to be police officers and engineers.

In many countries mathematics is considered a 'critical filter' for further education and better paid occupations (Leder, Pehkonen, & Töner, 2002), and to be able to use modern technologies (Schoenfeld, 2002). Based on the findings from this study, it is recommended that to improve the level of PUM by children and parents in Mozambique, as well as in other countries with similar contexts, schools should develop activities to demonstrate the power of mathematics, since most people equate mathematics with calculations. In Mozambique it seems that the gender stereotyping of occupations goes alongside the misunderstanding of what mathematics is all about and how it influences other fields.

Acknowledgements

I would like to express my gratitude to my supervisor Associate Professor Helen Forgasz from Monash University for reading an earlier draft of this paper.

References

Aiken, L. R. (1974). Two scales of attitude toward mathematics. *Journal for Research in Mathematics Education, 5*(2), 67-71.

Asimeng-Boahene, L. (2006). Gender inequity in science and mathematics education in Africa: The causes, consequences, and solutions. *Education, 126*(4), 711-728.

Cassy, B. (2002). *Effect of classroom interaction and gender on mathematics performance and attitudes towards mathematics of secondary pupils in Mozambique*. Unpublished PhD dissertation, University of Witwatersrand, Johannesburg, South Africa.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative and mixed methods approaches* (2nd ed.) SAGE, Thousand Oaks, London.

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly*, *11* (2), 135-172.
Fagilde, S. A. M. (2001). *Towards a characterization of communication and gender patterns in secondary mathematics classrooms in Mozambique*. Unpublished PhD dissertation, University of Western Cape, Bellville, South Africa.
Fennema, E., & Sherman, J. (1976). Fennema-Sherman mathematics attitude scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal supplement abstract service. American Psychological Association* (Ms. 1225), Washington, D.C.
Leder, G. C., & Forgasz, H. J. (2010). I liked it till Pythagoras: The public's views of mathematics. In L. Sparrow, B. Kissane, & C. Hurst (Eds.). *Shaping the future of mathematics education.* (Proceedings of the 33rd annual conference of the Mathematics Education Research Group of Australasia, Fremantle, pp. 328-335): Sydney: MERGA.
Leder, G. C., & Forgasz, H. J. (2011). The public's views on gender and the learning of mathematics: Does age matter? In J. Clark, B. Kissane, J. Mousley,T. Spencer, & S. Thornton (Eds.), Mathematics: Traditions and [new] practices (pp. 446-454). Adelaide: AAMT and MERGA.
Leder, G. C., Forgasz, H. J., & Solar, C. (1996). Research and intervention programs in mathematics education: A gendered issue. In A. J. Bishop, K, Clements, C. Keitel, J. Kilpatrick & C. Laborde (Eds.). *International handbook of mathematics education* (pp. 945-985). Dordrecht, The Netherlands: Kluwer.
Leder, G. C., Pehkonen, E., & Töner, G. (2002). Setting the scene. In G. C. Leder, C. E. Pehkonen & G. Töner (Eds.), *Beliefs: A hidden variable in mathematics education?* (pp. 1-10). Dordrecht, The Netherlands: Kluwer Academic Publishers.
Luttrell, V. R., Callen, B. W., Allen, C. S., Wood, M. D., Deeds, D. G., & Richard, D. C. S. (2010). The mathematics value inventory for general educational students: Development and initial validation. *Educational and Psychological Measurement*, *70*(2), 142-160.
Murimo, A. E., & Forgasz, H. J. (2007). Depictions of females and males in Mozambican and Victorian (Australia) mathematics textbooks. *Pythagoras, 66*, 85-96.
Pallant, J. (2009). *SPSS survival manual. A step by step guide to data analysis using SPSS* (3rd ed.). NSW: Allen & Unwin.
Saito, M. (2010). The gender gap in learning: Back to square one. A need to change the focus from access and participation to learning achievement. *IIEP Newsletter*, *28*(3), 6-6. Retrieved October 25, 2010, from http://www.iiep.unesco.org/fileadmin/user_upload/Info_Services_Newsletter/pdf/eng/2010/2010_3En.pdf
Schoenfeld, A. H. (2002). Making mathematics work for all children: Issues of standards, testing and equity. *Educational Researcher, 31*(1), 13-25.
Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology, 42*(1), 70-83.
Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Pearson Education.