

STUDENTS' GENDER ATTITUDES TOWARDS THE USE OF CALCULATORS IN MATHEMATICS INSTRUCTION

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The study analyzed gender attitudes of students in learning mathematics by using a calculator, in one of Botswana's Junior Secondary Schools. Students' attitudes were sought using a questionnaire and data was analyzed by both quantitative and qualitative methods. Attitude variables used were usefulness of calculators, enjoyment and anxiety in using calculators. The findings indicated that students of both sexes did not realize the benefits of using a calculator in mathematics learning. Generally, no gender differences were noted in the variables used. While most students were accessible to calculators, they were not accessible to calculator technology.

INTRODUCTION

For many years now (since early 1970s), hand-held calculators have been widely used in mathematics instruction in many educational systems of the world. Advances in technology have improved the use of the calculator and mathematics curricula have been designed to involve this technology. Many studies have indicated that the use of calculators can enhance students' ability to learn basic facts and that students who used calculators frequently exhibited more advanced concept development and problem solving skills than those who did not use them (Cockroft, 1982; Suydam, 1982; Howson, 1991; Hembree and Dessart, 1992). These studies reduced some earlier fears that calculators could affect students' mastery of computational skills acquired from traditional paper-pencil methods (NCTM, 1974; Cockroft, 1982).

Some educationists consider the use of technology in instruction as the only way to go if not a substitute for conventional teaching and learning methods (Broekman et al, 2002). Its interactive testing and review mechanism, together with "a let-s-go-back and look-at-that-again-loop" is believed to offer the best of all worlds of learning (The Star Newspaper, 2000). Broekman (2002) argues that the use of such technologies promise power for students to control over their own learning, and promises to give "voice" to learners. The latter arguments are considered essential for a smooth learning environment for both girls and boys, as it is believed that such interactive ways of learning could minimize or eliminate gender differences in learning.

Studies on gender differences show how different ways and methods have been used to minimize the gender gap, not only in mathematics instruction, but in many fields of study especially in science, engineering and technical fields. Studies have shown that gender attitudes towards mathematics tend to influence students' performance in the subject as well as their future careers involving mathematics (Finn, 1980;

Clegg, 1984; Gilbert, 1986; Duncan, 1989; Ngameza, 1991; Clifford, 1998; Fennema, 1990 & 2000; and many others).

The interactive nature of calculators could provide the opportunity for girls especially, to work independently and become more confident in learning. Some studies have shown that the nature of interaction in class involves classroom practices that tend to influence female attitude towards the subject (Kaino, 2002). Practices in the classroom, involve for example the boys' use of verbal and non-verbal language to command more of the teacher's time in both attention and classroom control, and boys being more mobile in class than girls, which tend to influence some teachers' beliefs that boys were more competent than girls (Serbin, 1978; Barry, 1981; Jungwirth, 1991; and Lee, 1990). Furthermore, it is argued that some teachers tend to believe that boys' contributions were more impressive than those of girls (Goddard-Spear, 1989; Fennema et al, 1990; and Fennema, 1990) because of such classroom practices.

While the use of technology such as the use of hand calculators is considered an important tool to impart knowledge, critics of such technologies argue that some areas of the content that aim at developing critical thinking and reflective practice cannot be satisfied by this technology, as learning entails not only of conceptual tools but also the ability to use the tools in arguments, discussions, research and practice (Broekman, 2002). Access to such technologies has also been criticized for lack of epistemological access to students. It is argued that the theories of social construction of knowledge require the relationship between the person and the social phenomena as central to epistemological access i.e. knowledge is to be constructed and developed in and through social mediation (Vygotsky, 1987). Broekman (1992) argues that enabling epistemological access to technology requires the consideration of developmental aspects of affinity with technology, and that affinity depends on confidence which itself develops social mediation.

As part of a larger study on the use of Information and Communication Technology (ICT) in Botswana, the study on the use of calculators was considered essential at this stage, after being in use for many years in schools. Hand-held calculators are accessible to most students in schools and presently ICT materials are used in mathematics teaching, especially some new computer programs. Assessment of gender attitudes in the use of technologies in learning is important for future introduction of ICT materials in mathematics instruction. This paper presents part of the findings of the study.

Aim of the study

The study analyzed students' attitudes by gender on the use of hand-calculators in learning mathematics.

Research questions

What were the students' views by gender on :

- 1) the usefulness of calculators

- 2) enjoyment when using calculators in learning mathematics
- 3) anxiety when using calculators

DEFINITION OF TERMS

In this study, students' attitudes have been restricted to three variables, i.e. usefulness of calculators, enjoyment and anxiety in using calculators.

Usefulness is referred to as whether students viewed calculators as helpful tools in learning mathematics, in their daily activities and for their future careers.

Enjoyment is referred to as whether students liked using calculators during mathematics activities or not.

Anxiety is referred to as students' worries when using or when have to use calculators in mathematics class activities.

METHODOLOGY

The target of the study was students in Junior secondary schools in Botswana. Junior level consists of forms one, two and three. In this study, form three level was considered. As a case study, one district was selected at random, from which one school was also selected at random. One stream of students was again selected at random to involve 20 girls and 20 boys. Data was collected using a questionnaire. The questionnaire was validated before it was administered and the reliability was tested using Cronbach's alpha. Cronbach's alpha estimates the internal consistency by determining how the items used in the instrument are related to each other. Both qualitative and quantitative methods were employed for analysis. The quantitative data involving closed-ended questions was analyzed using the Statistical Package for Social Sciences (SPSS). Responses were analyzed using the 4-point Likert scale. The t-test method was used to determine any differences that existed between boys' and girls' responses. Furthermore, an estimation of the standard error of the difference between the two gender samples was tested by using Levene's method of one-way analysis of variance on absolute deviation of scores. The significance or probability value was set at less than or equal to 0.05.

From the qualitative data, involving open-ended responses, individual responses were analyzed and dominant views determined for comparison with responses from the closed responses in the qualitative part.

A 4-point Likert scale used the following: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD).

Quantitative variables used are as follows:

Usefulness of calculators:

- (i) I do not have any use for calculators on a day to day basis
- (ii) I do not think a calculator will be useful to me in my future job
- (iii) Anything that a calculator can be used for, I can do just as well some other way.

(iv) I do not see how a calculator can help me to learn some new skills.

Enjoyment of using calculator:

- (i) I enjoy using a calculator in mathematics activities
- (ii) A calculator is interesting, fascinating and easy to use
- (iii) I enjoy investigating mathematics problems using a calculator
- (iv) A calculator is very interesting and challenging to use..

Anxiety in using calculators:

- (i) I do not feel comfortable when I learn mathematics using a calculator
- (ii) The thought of using a calculator in mathematics activities frightens me
- (iii) I am worried about using a calculator because I do not know what to do if something goes wrong
- (iv) The use of a calculator confuses me.

FINDINGS

Usefulness of calculators (Q1)

The average score for usefulness of calculators in mathematics learning (from the 4-point scale) was 3.10 for girls and 2.81 for boys, indicating that majority of students of both sexes felt calculators were not useful in mathematics learning. This shows that more girls than boys felt calculators were not useful. Levene’s test showed no significant differences in variables (i), (iii) and (iv), Table 1. The test on variable (ii) showed significant differences on the view that the calculator was useful to students’ future job. The main reasons given by students of both sexes were that; calculators were confusing, not easy to use and needed much time to understand. The common view among students of both sexes was that the calculator was useful in addition, subtraction, multiplication and division operations.

Levene’s test for equality of variances						
		F	Sig.	T	DF	Sig. (2-tail)
(i)	Var. ¹	0.340	0.564	0.690	35	0.495
	Var. ²			0.684	33	0.499
(ii)	Var. ¹	3.064	0.089	2.593	35	0.014
	Var. ²			2.515	28	0.018
(iii)	Var. ¹	4.667	0.038	1.118	35	0.271
	Var. ²			1.085	28	0.287
(iv)	Var. ¹	0.001	0.979	0.000	35	1.000
	Var. ²			0.000	34	1.000

Table 1: Summary of t-test for female and male students’ mean responses on usefulness of calculators (Q1)

*Var.¹ Assumed equal variances *Var.² Not assumed equal variances

* (i), (ii), (iii) and (iv) are Usefulness of calculators

Enjoyment of using calculators (Q2).

The average score for boys was 3.11 and 2.96 for girls, which indicated that majority of students enjoyed working with calculators, with boys enjoying more than girls. The Levene test showed no significant differences in the on four enjoyment variables between boys and girls, Table 2. The general scores on variables (i) and (iii) for both sexes were low (2.2 and 2.1 respectively) compared to other variables, indicating that most students enjoyed working with calculators on things other than mathematics activities. Many students said that calculators needed a lot of skills and knowledge in learning, that they were time consuming and that they did not indicate whether the answer was right or wrong.

Levene's test for equality of variances						
		F	Sig.	T	DF	Sig. (2-tail)
(i)	Var. ¹	2.261	0.142	1.198	35	0.239
	Var. ²			1.151	26	0.260
(ii)	Var. ¹	3.632	0.065	-0.920	35	0.364
	Var. ²			-0.895	29	0.378
(iii)	Var. ¹	2.917	0.096	1.301	35	0.202
	Var. ²			1.275	30	0.212
(iv)	Var. ¹	5.456	0.025	0.902	35	0.373
	Var. ²			0.868	25	0.394

Table 2: Summary of t-test for female and male students' mean responses on Enjoyment of using calculators (Q2)

*Var.¹ Assumed equal variances

*Var.² Not assumed equal variances

* (i), (ii), (iii) and (iv) are Enjoyment of using calculators

Anxiety in using calculators (Q3).

A mean of 3.14 and 2.75 for girls and boys respectively was obtained from the anxiety scale. This revealed that most students were of the view that calculators caused anxiety, with more girls being affected. The Levene test on variables (i), (ii) and (iv) showed no significant differences students' anxiety in using calculators. There were significant differences between boys and girls on variable (iii) on students' worries when something went wrong when using calculators. Views from many students of both sexes indicated that students were afraid when required to use calculators as they were not sure of the methods to use, that the process by the

calculator would not tell whether the solution was correct or wrong, that the calculator could terminate the solution without a track of the process, that without using a calculator could mean the solution was wrong.

Levene's test for equality of variances						
		F	Sig.	T	DF	Sig. (2-tail)
(i)	Var. ¹	2.235	0.144	0.982	35	0.333
	Var. ²			0.949	27	0.351
(ii)	Var. ¹	1.595	0.215	1.399	35	0.171
	Var. ²			1.357	28	0.186
(iii)	Var. ¹	20.542	0.000	2.214	35	0.033
	Var. ²			1.085	28	0.287
(iii)	Var. ¹	11.250	0.002	-0.173	35	0.864
	Var. ²			-0.165	24	0.870

Table 3: Summary of t-test for female and male students' mean responses on Anxiety in using calculators (Q3)

*Var.¹ Assumed equal variances

*Var.² Not assumed equal variances

* (i), (ii), (iii) and (iv) are variables of Anxiety in using calculators

SUMMARY

While most students, of both sexes, did not consider the calculator to be useful, with more girls than boys holding this view, majority of students from both sexes enjoyed working with calculators. Boys enjoyed more to work with calculators than girls. However, students enjoyed working with calculators in other things other than mathematics. Students' dislike of working with calculators in mathematics is realized from their anxiety when on calculators. Anxiety of majority students to use or when using calculators to learn mathematics, with girls affected more than boys, can well be explained by students' lack of enjoyment in using this technology to learn the subject. Generally, the findings showed no gender differences in the three considered variables, i.e. usefulness, enjoyment and anxiety between girls and boys. Component variables that showed some differences, were on students' view whether the use of calculator was useful to their future careers, and worries when using calculators to solve mathematical problems.

CONCLUDING

The findings provide some clues on the nature of perception held by students on using calculators in mathematics instruction. Some students' views that calculators required skills and knowledge to work on them, was an indication that students

lacked knowledge to apply the technology in learning. Lack of knowledge to apply calculators in learning, could have led students to find no use of calculators in mathematics and in their daily activities as well. The latter could also have led students to believe that calculators were not useful to their future careers as they dealt with only arithmetical operations, that could not necessarily be required to their careers. Lack of enjoyment to work on mathematical problems using the calculator should have greatly contributed to their anxiety in learning.

While the findings of this study indicate that boys were more advantaged in using this technology, it is concluded that most students of both sexes did not benefit from the use of calculators in mathematics learning. It can further be argued that accessibility to technology did not necessarily mean accessibility to technology use and application. As realized from this study, most students in Botswana are accessible to calculators, but it did not necessarily imply their access to calculator technology. The mathematics syllabus (of Botswana) stipulates clearly the objectives of using calculators in teaching, and as teachers were aware of the role of calculators (Masimaneotsile, 1999), teachers' knowledge on the use of calculators in instruction has to be revisited.

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