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Remedial Help in Inclusive Classrooms: Gender Differences in the Enhancement of Mathematics Achievement of Students Through PAL (Peer-Assisted Learning)*

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This study investigated gender differences in the effect of PAL (peer-assisted learning) on students' mathematics performance in Enugu State of Nigeria. It used pre-test and post-test non-randomized control group design. Four research questions and four hypotheses guided the study. The population was SS II (senior secondary school class II) students in the state. The sample consisted of 597 students: 342 male and 255 female students. Multi-stage random sampling and purposive sampling were used at different stages. Subjects were marched 1:1—high achiever: low achiever. Treatment consisted of one term of PAL which commenced after orientation to both students and guidance counselors who monitored them. Pre-test and post-test scores were obtained from school records. Students' grades in mathematics were obtained in the term preceding the PAL term and at the end of the PAL term. Data were analyzed using means and *t*-test. Findings show that PAL was effective in enhancing the mathematics performance of all male and female LAS (low achieving students) but did not improve the performance of female HAS (high achieving students). The results were discussed and one of the recommendations made was that PAL be taught to student teachers on training and teachers during in-service training so that they can acquire the knowledge and use it to improve academic performance of children with specific learning disabilities, LAS as well as HAS.

Keywords: special education, psychology, counseling

Introduction

Background

Mathematics is an important and basic school subject. An "O" level pass or credit in it is a basic requirement for admission into virtually all faculties of Nigerian universities, yet about 4%–7% of the school population suffers from MD (mathematics disability) (Fuchs, 2006). School certificate results have been consistently poor. Inclusive education encourages equal access thus the teaching together in the same classroom of students with varied abilities and biodata. Techniques have been designed to help the situation and PAL (peer-assisted learning) was used. Gender differences in enrolment and performance of students have

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constituted serious issues in education in Nigeria. It thus necessitates the investigation of PAL to know if it is equally effective for both genders.

Inclusive education like its roots in human rights and social justice has gained increasing international popularity since the 1980s. Nigeria made her commitment to inclusive education when it declared as one of its aims of education, "To give meaning to the idea of equalizing educational opportunities for all children their physical, sensory, mental, psychological, or emotional disability not withstanding" (FGN (Federal Government of Nigeria), 2004). Inclusive education is the full integration of learners with special needs and other learners into the same classrooms and schools thereby exposing them to the same learning opportunities while providing for the optimal development of every learner (Obidoa & Onwubolu, 2011). The CSIE (Centre for Studies in Inclusive Education) (2003, as cited in Afoi, Tajudeen, & Atukum, 2008, p. 471) defined inclusive education as, "All children and young people with and without disabilities or difficulties learning together in ordinary pre-primary, primary schools, colleges, and universities with appropriate network support". And further, CSIE elaborated on this and listed 11 factors that describe inclusive education (CSIE, 2011).

The three most important factors in inclusive education as outlined by Evans (2007, p. 1) are: "Setting suitable learning challenges, responding to pupils diverse learning needs, and overcoming potential barriers to learning and assessment for individuals and groups of pupils". "Removing Barriers to Achievement" (2004) stated that inclusive education is about the quality of children's experiences, how they are helped to learn, achieve, and participate fully in the life of the school. It aims at reducing educational failure and maximizing potential for all children with schools supporting children's holistic development and helping to remove barriers to achievement (Evans, 2007).

Inclusive education in practice, therefore, means that a teacher could have a class of students with a wide variety of abilities. Teachers usually teach the average especially large classes leaving several students' needs unmet. The highly able (HAS (high achieving students)) and the slower learners (LAS (low achieving students)) suffer most. A programme that taps into the needs of these two groups of students could be a panacea. In providing remedial work for students, a variety of approaches have been used. Teacher-student remedial approaches have proven efficacy and are very logical but student-student remedial approaches are also gaining popularity.

Variations exist in the nomenclature given to the learning situation that provides either one-way or two-way interchange of information and skills among two or more students. There include collaborative learning, co-operative learning, paired reading, student literacy coaches, PAL, cross-age tutoring, and combined groping formats (L. S. Fuchs & D. Fuchs, 2000; Fisher, 2001; Vasay, 2010; Obidoa & Onwubolu, 2011). Some of these forms like PAL involve 1:1—high achiever: low achiever, or one high achiever to more than one low achiever. This learning strategy has been applied to different learning situations, school levels, and subject areas especially English and mathematics.

PAL is a structured peer-tutoring programme that was awarded the "best practice" status by the US Department of Education. In the simplest terms, it can be described as students working together to support each others learning. This strategy has proven advantages to the student-tutors, the tutees, and their teachers. It strengthens the students' academic skills and gives them the opportunity to practice their social skills with peers in a natural setting. The tutors have also experienced improved academic achievement, more positive attitude about school, improved self-concept, and development of personal relationships. Teachers are enabled to focus on teaching new information, creating, and simultaneously implementing different lessons to address a greater

range of learning needs (Rivera, 1996; L. S. Fuchs, D. Fuchs, & Karns, 2001; Adediran, Obidoa, Zakariya, Oyedeji, & Nwamuo, 2009; Vasay, 2010; Obidoa & Onwubolu, 2011).

Poor performance in mathematics has been identified as a serious societal problem, "4%–7% of school-age populations in the US suffer from MD… MD is a serious public-health problem leading to life-long difficulties in school and in the workplace and creating financial burdens on society" (Fuchs, 2006, p. 4). Enugu State of Nigeria experiences high failure rates and low performance in mathematics at the senior school certificate level, yet a credit or a minimum of pass is required as an entry qualification into Nigerian universities. This negatively impacts on the career development of several students.

Despite the importance of mathematics in the school curriculum and the life of students, its teaching is still plagued with lots of problems. Most of these problems have been associated with the abstract nature of the subject. Thomas (2000) recommended that for mathematics to achieve maximum effectiveness, learning experiences should involve students as much as possible. He recommended such things as manipulation of real objects, real-life situations, and interactions. PAL extends this to using peers tutees which come with it, peer language and patterns of thought and communication, peer relevant examples, and contextualization.

PAL has been found effective for the enhancement of mathematics performance. Vasay (2010) found a significant difference in the mean gain between experimental and control groups. Her experimental group (which used peer teaching) made a significantly greater gain in their performance in college algebra than the control group which did not. Math PAL, according to Fuchs et al. (2001), showed positive results in low and average achieving students with learning disabilities. They reported that the students were able to elaborate and create more meaningful memories of concepts through their peer interaction and activities. Obidoa and Onwubolu (2011) found a significant difference in the post-test means of students in the experimental and control groups when they compared the effect of PAL on the mathematics performance of students in Enugu State of Nigeria. Positive influences of PAL on teachers have also been reported. L. S. Fuchs and D. Fuchs (1995) reported that teachers who used PAL devoted more time to one-to-one instruction, less time to independent seat work, and more time to peer-remediated instruction and relied more on systematic reinforcement methods.

Studies (Robinson & Noble, 1991; Arnold, 1993) have reported a gender disparity in the academic performance of gifted students. They observed that although gifted girls make up half of the academically able population, they seem to think out making them one of the most vulnerable special populations of gifted learners. Van Tassel-Baska (1983) and Tomlinson (1994) reported that gifted girls in order to be socially accepted, skillfully conceal their talent and this tends to dull their intellectual capabilities. Could this cause a disparity in the effect of PAL on their mathematics performance? Robinson, Schofield, and Steers-Wentz (2005) found out from their research on PAL that mixed sex pairs do not consistently reap benefits equal to those of the same sex pairs.

Inclusive education is basically about giving equal chances to all to have successful education. PAL has great potentials of helping to realize this. It is, therefore, important to find out if its effects are gender sensitive. Hardly any study has investigated this.

The Statement of the Problem

There is a consensus among education stakeholders that inclusion is the best practice for providing services for students with special needs. Mathematics is very vital in the life of the student and society but it

still records the highest failure rate at terminal secondary school examinations, PAL is advantageous to student-tutors, tutees, and their teachers. It can also provide the much needed remedial work in inclusive classrooms. Its efficiency has been confirmed by several studies but will it be equally effective for boys and girls?

This work set out to investigate gender differences in the effect of PAL on students' mathematics performance. It asks the question: Will there be differences due to gender in the effect of PAL in the mathematics achievement of students and will the effect of gender be comparable among high and low achieving male and female students?

Research Questions and Hypothesis

Research Questions

The following research questions guided the study:

(1) Will there be any difference due to gender in the post-test mean scores of LAS exposed to PAL?

(2) What are the post-test mean scores of HAS exposed to PAL by gender?

(3) Will there be gender difference in the post-test mean scores of LAS who were exposed to PAL (experimental group) and those in control group?

(4) Will there be gender difference in the post-test mean scores of HAS who were exposed to PAL (experimental group) and those in control group?

Hypothesis

The hypotheses of the research are as follows:

Ho1: There is no significant difference between male HAS exposed to PAL and those not so exposed;

Ho2: There is no significant difference between female HAS exposed to PAL and those not so exposed;

Ho3: There is no significant difference between male LAS exposed to PAL and those not so exposed;

Ho4: There is no significant difference between female LAS exposed to PAL and those in the control group;

Ho5: These will be tested at 0.05 level of significance.

Methodology

Design

The pre-test and post-test non-randomized control group design was used.

Area of the Study

The study was carried out in Enugu State one of the five south eastern states of Nigeria. A high premium is placed on education in this state.

Population

The population for the study was all SS II (senior secondary school year two) students in the state.

Sample and Sampling Technique

The sample was made up of 597 students: 342 males and 255 females. Multi-stage random sampling was done. Through simple random sampling, three out of the six education zones in the state were selected. From each zone, five schools were randomly selected. In each school, stratification was done and 30 HAS (students who earned a termly Grades A or B in mathematics, the previous term) were selected to be tutors and 30

students who earned grades D, E, or F (LAS) were selected to be tutees. After the selection, they were matched 1:1—HAS: LAS.

Treatment. Treatment in the study consisted of one term of PAL for the experimental group only. The students were first given orientation on PAL using a manual that was face validated by two of the researcher-peers in the Department of Educational Foundation, Guidance, Counseling, and Special Education units. The manual explains what PAL is, how it works, its advantages, schedules, and so on.

The students were then matched 1:1—HAS: LAS and encouraged to work together for a term. The pairs were monitored by the research assistants who were the schools guidance counselors previously trained on PAL. The control group was a non-contact control group.

Data collection. Data used in the study to measure maths achievement are the students' report. Their scores in maths were collected from official school records for the term proceeding the study and at the end of the study.

Data analysis. *T-test* was used to test the hypotheses and mean analysis was done to answer the research questions.

Findings

Research Question 1

Will there be any difference due to gender in the post-test mean score of LAS students exposed to PAL?

Table 1

The Mean Analysis of Mathematics Score of LAS Exposed to PAL by Gender

Gender	Achievement group	Pre-test	Post-test
	LAS mean	28.40	42.14
Male	*N*	101	101
	SD	1.02	15.04
	LAS mean	25.90	39.70
Female	*N*	74	74
	SD	1.34	16.5

Table 1 shows that among LAS, males had a pre-test mean of 28.40 and a post-test mean of 42.14. Similarly, the female LAS moved from a pre-test mean of 25.90 to a post-test mean of 39.70. Both males and females in the LAS made comparable gains from the exposure to PAL.

Research Question 2

What are the post-test mean scores of HAS exposed to PAL by gender?

Table 2

Mean Analysis of Mathematics Scores of HAS Exposed to PAL by Gender

Gender	Achievement group	Pre-test	Post-test
	HAS mean	58.32	57.75
Male	*N*	241	241
	SD	1.34	17.35
	HAS mean	64.85	61.67
Female	*N*	181	181
	SD	1.66	16.13

Table 2 (mean analysis of mathematics scores of HAS exposed to PAL) shows that the male HAS had a pre-test mean of 58.32 and post-test mean of 57.75, while female HAS had a pre-test mean of 64.85 and a

post-test mean of 61.67. This shows a decrease in means of both male and female HAS at the post-test.

Research Question 3

Will there be a gender difference in the post-test mean scores of LAS who were exposed to PAL (experimental group) and those in the control group?

As shown in Tables 3 and 4, male LAS in the experimental group moved from a pretest mean of 28.86 to 41.11 in the post-test. Similarly, the females in the experimental group moved from 27.56 to 43.71. Both male and female LAS in the experimental group, therefore, made remarkable gains in their mean scores. In the control group, male LAS moved from a pretest mean of 28.07 to 42.86 and the females from 24.50 to 36.30. Male and female LAS in both experimental and control groups made good gains in their mean scores.

Table 3

Mean Analysis of Score of Male and Female LAS in Control and Experimental Groups

Group	Gender	Achievement group	Pre-test	Post-test
		Mean	28.86	41.11
	Male	*N*	42	42
		SD	1.14	15.19
		Mean	27.56	43.71
Experimental	Female	*N*	34	34
		SD	1.49	18.34
		Mean	28.28	42.28
	Total	*N*	76	76
		SD	1.30	16.61
		Mean	28.07	42.86
	Male	*N*	59	59
		SD	9.39	15.02
		Mean	24.50	36.30
Control	Female	*N*	40	40
		SD	1.21	14.17
		Mean	26.63	40.21
	Total	*N*	99	99
		SD	1.06	14.97

Table 4

Mean Analysis of Gender Differences in the Mathematics Scores of HAS in Experimental and Control Groups

Group	Gender	Achievement group	Pre-test	Post-test
		Mean	59.23	60.35
	Male	*N*	138	138
		SD	18.91	1.45
		Mean	64.88	63.02
Experimental	Female	*N*	92	92
		SD	16.08	16.08
		Mean	61.48	61.41
	Total	*N*	230	230
		SD	15.57	1.7.84
		Mean	57.10	54.26
	Male	*N*	103	103
		SD	1.19	1.437
		Mean	64.82	60.26
Control	Female	*N*	89	89
		SD	16.8	1.615
		Mean	60.68	57.0469
	Total	*N*	192	192
		SD	14.9	1.547

Research Question 4

Will there be gender difference in the post-test mean scores of HAS who were exposed to PAL and those in the control group?

Table 5

T-test Analysis of the Mean Difference Between Male HAS Experimental and Control Groups

Group	No.	Mean	*SD*	*df*	*T*-cal.	*T*-crit.	Decision
Experimental	138	60.35	18.91	239	2.73	± 1.96	Null hypothesis rejected
Control	103	54.26	14.38				

Table 5 shows a *t*-calculated of 2.73 and *t*-critical of 1.96. Since the *t*-calculated is greater than the *t*-critical of 0.05 level of significance, the null hypothesis which states that there is no significant difference between males exposed to PAL and those not so exposed is therefore rejected. The male HAS in the experimental group performed significantly better than those in the control. This shows that PAL was effective in promoting higher performance of male HAS.

Ho2

As it can be seen in Table 6, the *t*-calculated of 1.15 is less than the *t*-critical of 1.96, the null hypothesis is accepted. There was no significant difference between female HAS in the experimental group and those in the control.

Table 6

T-test Analysis of the Mean Difference Between Female HAS Experimental and Control Groups

Group	No.	Mean	*SD*	*df*	*T*-cal.	*T*-crit.	Decision
Experimental	92	63.02	16.08	179	1.15	± 1.96	Null hypothesis rejected
Control	89	60.27	16.13				

Table 7

T-test Analysis of the Mean Difference Between Male LAS Exposed to PAL and Those Not so Exposed

Group	No.	Mean	*SD*	*df*	*T*-cal.	*T*-crit.	Decision
Experimental	43	41.00	15.03	100	0.62	1.98	Null hypothesis rejected
Control	59	42.00	15.02				

As shown in Table 7, the *t*-critical of 1.98 is greater than the *t*-calculated of -0.62. The null hypothesis that states that there is no significant difference between male LAS experimental and control group is accepted. Low achieving males in both experimental and control groups made comparable gains.

Table 8

T-test Analysis of the Mean Difference Between Female LAS Experimental and Control Groups

Group	No.	Mean	*SD*	*df*	*T*-cal.	*T*-crit.	Decision
Experimental	33	43.94	18.57	71	1.99	1.98	Null hypothesis rejected
Control	40	36.30	14.17				

The *t*-calculated of 1.99 is greater than *t*-calculated of 1.98 at 0.05 level of significance, so the null hypothesis is rejected (see Table 8). The female LAS in the experimental group performed significantly better than their counterparts in the control. The PAL, therefore, improved the mathematic performance of female LAS.

Discussion

Gender, HAS, and PAL

The post-test means of HAS, male, and females exposed to PAL showed a slight decrease in the performance of both groups. Compared with the control group (see Table 5), male HAS performed significantly better than those in the control group. The female HAS, however, did not perform significantly higher than their control.

The findings of this study are in agreement with previous studies that demonstrated that academic achievement can be enhanced with PAL (L. S. Fuchs & D. Fuchs, 1995; Vasay, 2010; Obidoa & Onwublu, 2011). These studies, however, did not separate males from females and that could make some details about gender difference in response to PAL.

That female HAS did not perform significantly higher than their control. It is not a surprise because Robinson et al.'s (2005) earlier report found from their research on PAL that mixed sex pairs do not consistently reap benefits equal to those of the same sex pairs. Could it be the females that contributed to this? However, noting the reports of Van Tassel-Barka (1983) and Tomilinson (1994) that gifted girls unlike their male counterparts skillfully conceal their talent in order to be socially accepted and this tends to dull their intellectual capabilities. The girls HAS in the study could be regarded as academically gifted. There is a possibility therefore that social acceptance (especially for the purpose of marriage) in the culture of the area could have affected them.

It is also possible that HAS most of whom are academically gifted, with their perfectionist tendencies may have spent more time on PAL than their individual studies.

Gender, LAS, and PAL

The analysis of means showed that PAL made a positive impact on both girls and boys who are low achieving. There was no significant difference between LAS male experimental and control groups but there was a significant difference between female LAS in the experimental group and those in the control. Results from the LAS, therefore, showed all groups exposed to PAL benefited positively as confirmed by studies cited above. It is, however, interesting to note that female LAS differed from female HAS. The female LAS probably did not have the constraints (i.e., the need to conceal their talents) of the female HAS thus their superior gain.

Of special interest is the fact that male LAS in both control and experimental groups made significant positive gains. Although the study did not set out to investigate this, PAL could have stimulated learning and through social learning, the boys in the control could have worked harder. It may also be explained from cultural point of view. The men observing the PAL partners' work may have felt challenged and refused to be left behind. This incidental learning could also be an advantage of PAL. Related to this is the possibility that teachers had and devoted more time to teaching less able as reported by L. S. Fuchs and D. Fuchs (1995).

Conclusions and Recommendations

This study confirmed the positive effect of PAL in enhancing mathematics performance of students generally. It, however, exposed to some subtle risk factors in its use especially with HAS tutors and the females in particular. While strongly recommending its use in inclusive classrooms especially at the secondary school level, it strongly recommends that special educators and guidance counselors should monitor the process closely ensuring that the tutors in particular still have their own study times for self-improvement.

The researchers recommend that PAL should also be used in other subject areas, so tutees poor in

mathematics, for example, but strong in English could become tutors for the sake of their self-concept and other socio-emotional benefits of PAL too.

In addition to these, they recommend that PAL should be taught to both student-teachers and serving teachers through workshops and seminars to enable them to acquire the knowledge and use it to improve academic performance of children with specific learning disabilities, LAS as well as HAS.

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