Peer Versus Faculty Tutoring's Impact on Mathematics Performance of First-year University Students

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Abstract:
Peer tutoring programs have become a commonstrategy employed at the early university level in efforts to improve academic performance in underprepared students. Poor mathematicsperformance in early university courses such as Algebra, Calculus and Statistics is common.This study was designed to ascertain whether peer tutoring can be more effective than tutoring by a professional faculty member in improvingmathematics performance among first-year university students. A comparison of the mathematics performance of two groups of students was done;a control group being tutored by a professional tutor and a treatment group being tutored in a same-year small-group non-reciprocal peer tutoring program. The researcher analyzed the mean gains of the two groups for any difference using Independent Samples t-test.The mean retention of mathematics content learned by the control and treatment groups werealso analyzed for any difference using Independent samples t-test. Further,the correlation coefficient between gain and retention for the control and treatment groups was compared using Fisher's method.Subjective feedback was also obtained from both tutors and tuteesin the peer tutoring program to ascertain any non-academic benefits of the peer tutoring program. The t-test comparison of mean gain for the controland treatment groups indicated that there was no significant difference ($N_1=N_1=31$, p = 0.906). The t-test comparison of mean retention for the control and treatment groups indicated no significant difference also ($N_1=N_2=31$, p=0.423). Further, the correlation coefficient between gain and retention for the control and treatment groups indicated no difference ($r_c=0.708$, $r_e=0.826$, p=0.2757). Therefore, while peer tutoring was as effective as tutoring by a faculty member, it did not prove to be more effective than tutoring by a faculty member in improving mathematics performance among first-year university students. However, benefits to tutees in the peer tutoring program included greater enjoyment, interest and understanding of course content. Peer Tutors derived enjoyment from helping others; developed useful communication, teaching, planning, organizing and social skills.
Key Words:*Small-Group Peer Tutoring, Non-Reciprocal Peer Tutoring, Same-year, First-year University, Mathematics.*

I. Introduction

In most universities, students in the first year of a bachelor's degree are required to study some mathematics and/or statistics. A trend of poor performance of first-year university students in mathematics courses is observed in the United States (Walker & Plata 2000; Hoyt & Sorenson, 2001; Adelman, 2004), the United Kingdom (Amstrong& Croft, 1999; Kitchen,1999; Hourigan&O'Donoghue, 2007), Ireland (Wilson & MacGillivray,2007) Sweden (Brandel, Hemmi&Thunberg, 2008), Hong Kong (Luk, 2005).

Various measures of success with improving students' performance in and engagement with university level mathematics, particularly in the first year, have been investigated. Some focus on entrance qualifications and the correlation to performance in first-year university mathematics while others focus on strategies that could be employed while the students are already at university. Among these strategies is a cooperative learning strategy: peer tutoring in its various forms. The use of peer tutoring programs at the university level has become widespread globally, as universities continue to seek ways to enhance the quality of their services and improve the results for tutees. It was found that at a number of universities, there were programs involving academic tutoring in a particular subject taking place between students, usually at autonomous learning centers within universities (Lassegard, 2008). Peer tutoring at the postsecondary level has been studied extensively, particularly over the last twenty years. Peer tutoring programs are common given students' preferences for tutors who share age and status similarity (Cohen, 1986; Marsh, 2001; Maxwell, 1991) as well as the cost-effectiveness for the institution (Beasley, 1997; Boylan et al., 1995; Dvorak, 2004; Lidren& Meier, 1991; MacDonald, 1993; Marsh, 2001; Maxwell, 2001; Riggio, Fantuzzo, Connelly, &Dimeff, 1991). Additionally, peer tutoring has been shown to improve student achievement in some studies (House &Wohlt, 1989; McKellar, 1986) and can compensate for low grades in traditional lecture environments (Dvorak, 2004). The use of peer

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tutoring programs at the university level has become widespread globally in an effort to improve academic performance in underprepared students especially in high risk courses such as Algebra, Calculus and Statistics. In studies on universities providing a variety of learning experiences for students where a peer tutoring program has been adopted, it has proven to be a valuable experience and resource for both tutors and tutees. The literature on the peer tutoring program as an effective, best-practice methodology continues to grow. Peer tutoring and assessment schemes have been successfully implemented in many universities worldwide to promote student learning (Magin& Churches, 1995; Cohen, Kulik&Kulik, 1982; Toppin, 1996) and a considerable amount is already known about the effectiveness of peer tutoring in further and higher education. Cross-year small-group tutoring, the format least disparate from traditional methods, can work well. Studies of achievement gains almost all indicate outcomes as good as or better than group tutoring by faculty, and student subjective feedback is generally very positive (Topping, 1996; Arco-Tirado et al, 2011).

Same-year dyadic fixed-role tutoring has been the subject of several studies over the years, research of mixed quality yielding mixed results. However, two good quality studies analyzed by Topping (1996) found improved achievement from this format, while three others found achievement the same as with faculty teaching. One recent study (Young, 2011) reported positive subjective feedback. Five out of 6 studies of same-year dyadic reciprocal tutoring analyzed by Topping (1996) have demonstrated increased attainment. There was also evidence of reduced student stress and improved transferable skills. Dioso-Henson (2012) found that reciprocating and non-reciprocating both yielded academic gains; the former yielding more than the latter. Same-year group tutoring has yielded positive subjective feedback in four studies, but no harder evidence on achievement outcomes (Topping,1996).

In summary, among the methods of peer tutoring in further and higher education that have already been widely used and have been demonstrated to be effective, are Cross-year Small-group Tutoring, Same-year dyadic reciprocal tutoring. Same-year dyadic fixed-role tutoring have shown considerable but not necessarily consistent promise and should be the focus of continuing experimentation and more research of better quality. Also, there are barely the beginnings of a satisfactory body of evaluation research in the area of group tutoring (Topping, 1996). Further, it has been observed that more research is needed on the success and effectiveness of onsite peer tutoring for specific mathematics courses (Halcrow, 2004). This research is an attempt to fill the need for more research in the area of group tutoring, for greater experimentation with same-year fixed-role tutoring, and for mathematics specific content. This research will also compare two methods: Tutoring by faculty versus tutoring by peers. It seeks to compare a same-year fixed-role small-group tutoring program with tutoring by a faculty member in a mathematics course with a very high failure rate (Calculus).

Relevant Questions being addressed in the Study:

1. How does the gain of students who were in a same-year small-group non-reciprocal peer tutoring program compare to the gain of students tutored by a faculty member?

2. How does the retention for the students who were in a same-year small-group non-reciprocal peer tutoring program compare to the retention of students who were tutored by a faculty member?

3. Besides potential gain and retention benefits, are there other benefits to tutors and tutees in a peer tutoring program?

II. Material And Methods

The subjects

The study had 67 student participants. Five students who obtained an A grade in Algebra (a previous course) volunteered as tutors. The 62 remaining students consisted of22 male and 40 female first-year calculus students. The students were randomly divided into two equal groups of thirty-one (31). The treatment group was assigned to participate in the peer teaching program while the other, the control group was assigned to be tutored by a faculty member (the researcher). This assignment was done randomly by the flip of a coin. The students in the group that will be peer-tutored were further subdivided into groups of 6 (one group ended with 7 tutees). Allocation to tutors was random.

Experimental Treatment

The treatment consisted of a cooperative learning strategy – Non-reciprocal Small-group Peer Tutoring in the form of 10-12 two-hour sessions of small-group problem solving demonstrations and discussions conducted once and sometimes twice weekly over an 8-week period. This was administered by the tutors to the tutees assigned to them. The control group was tutored by the researcher as a single group and benefitted from the same number of tutoring sessions using the same strategy. All students benefitted from the regular lectures. Additionally, tutors had an optional weekly one-hour session with the faculty member before every tutorial to answer any questions they might have related to content or otherwise. Rooms were provided for tutoring sessions at a specific time and day. Worksheets for the sessions were the regular tutorial worksheets that all students were provided with during the course. All other materials for the sessions were provided for the tutors.

The researcher has been a mathematics teacher for 16 years and has had 10 years of experience teaching at the high school and 6 at the university level.

Instruments for collecting data
There was a pretest, a posttest as well as a retest that was administered during the conduct of the study. The test was constructed by the researcher. It consisted of 25 multiple choice questions. There were also two questionnaires that were used to collect subjective feedback from tutors andtutees in the peer tutoring program.

The Procedure
1. Permission was sought from faculty as well as from the students to conduct the study by the researcher. 2. Data was collected to ascertain the Algebra (the prerequisite course for Calculus) grades of the students in the study by the researcher.
3. A pretest was administered the first week of semester by the researcher to all students in the study.
4. All students were randomly placed by the researcher into two groups – control and treatment. Equivalence of groups based on scores in the pretest was ensured.
5. Those students with an A in Algebra in the treatment group were asked to volunteer as tutors in the program.
6. Assignment of tutees to tutors was done randomly by researcher.
7. Tutorial sessions were done by the researcher and tutoring sessions involving tutors and tutees were conducted for 8 weeks in the designated rooms and times. Attendance at sessions were recorded for both tutors and tutees
8. Posttest was conducted in 8th week of the semester.
9. A retest was conducted in the 12th week of the semester.
10. The questionnaires were administered on the 13th week.
11. Analysis of Data was done during the 14th to the 16th week.

Design
The study involved both a quantitative as well as a qualitative approach. The quantitative part of the study will follow the Pretest-Posttest-Retest Control Group Design. The qualitative part will involve a survey, making use of two questionnaires to collect data.

Variables
Population – First-year University of Guyana Berbice Campus Natural Sciences and Agricultural Science students of 2013-2014. Independent Variable – A cooperative learning strategy – Same-year small-group non-reciprocal/fixed - role peer tutoring.
Dependent Variable – Mathematics scores in posttest and retest (in Calculus) of freshmen University of Guyana Natural and Agricultural Sciences students.

Quantitative Data Analysis
Before treatment begins a t-test comparison of the pretest mean scores of the control group and the treatment group was conducted to ensure that the control group and the treatment group were equivalent i.e there is no significant difference between their mean scores in the pretest.
The first research question was: How does the gain of students who were in a same-year small-group non-reciprocal peer tutoring program compare to the gain of students tutored by a faculty member? To answer this research, question the following analysis was conducted: After the posttest the gain of each student in the treatment group and control group was calculated by finding the difference between their pre-test and post-test scores. In Table 1 these gains were indicated by Gain 1c for the gain of the control group and Gain 1e for the gain of the experimental group. A comparison of the mean gain for the treatment group and the control group was analyzed for any difference of means using a t-test comparison
The second research question was: How does the retention for the students who were in a same-year small-group non-reciprocal peer tutoring program compare to the retention of students who were tutored by a faculty member? To answer this research question,the retention of each student in the control group and the treatment group was calculated by finding the difference between the pre-test score and the re-test score. In Table 1 these retention values were indicated by Gain 2c for the control group and Gain 2e for the experimental group.A comparison of the mean retention for the treatment group and the control group was analyzed for any difference of means using a t-test comparison. Further,using simple regression analysis, the correlation coefficient between gain and retention for the control group and the treatment group was calculated. a comparison of the correlation coefficient between gain and retention for the treatment and control groups was done.The rationale for this step is because means could be distorted by extreme values and the previous t-test

comparison may not be able to indicate the relationship between gain and retention for individual students in the two groups. All statistical analysis was conducted using IBM SPSS Statistics 20.

Qualitative Analysis
The third research question was:Besides potential gain and retention benefits, arethere other benefits to tutors and tutees in the peer tutoring program?To obtain subjective feedback from tutors as well as tutees to answer this question two questionnaires were used.

III. Results
Table 1: Pretest/Posttest/Retest Scores

No	Control Group					Treatment Group				
	Pretest Score	Posttest Score	Retest Score	Gain 1c	Gain 2c	Pretest Score	Posttest Score	Retest Score	Gain 1e	Gain 2e
1	6	19	21	13	15	10	20	15	10	5
2	5	16	11	11	6	1	17	17	16	16
3	2	11	6	9	4	9	10	8	1	-1
4	5	10	11	5	6	4	7	13	3	9
5	9	11	11	2	2	12	15	16	3	4
6	4	11	11	7	7	3	19	16	16	13
7	6	11	14	5	8	9	14	13	5	4
8	7	19	15	12	8	9	8	5	-1	-4
9	5	14	8	9	3	4	20	18	16	14
10	5	9	7	4	2	3	11	8	8	5
11	7	9	18	2	11	9	15	15	6	6
12	6	7	9	1	3	4	7	7	3	3
13	3	6	6	3	3	9	11	9	2	0
14	5	12	14	7	9	11	16	16	5	5
15	6	18	17	12	11	7	13	10	6	3
16	8	16	14	8	6	6	8	10	2	4
17	3	13	16	10	13	14	20	22	6	8
18	4	16	17	12	13	6	14	9	8	3
19	4	10	9	6	5	5	20	15	15	10
20	4	9	10	5	6	7	10	8	3	1
21	5	16	15	11	10	10	17	17	7	7
22	8	13	13	5	5	6	11	5	5	-1

No	Control Group					Treatment Group				
	Pretest Score	Posttest Score	Retest Score	Gain 1c	Gain 2c	Pretest Score	Posttest Score	Retest Score	Gain 1e	Gain 2e
23	6	14	13	8	7	4	16	18	12	14
24	6	13	14	7	8	7	9	11	2	4
25	2	17	16	15	14	8	21	21	13	13
26	6	9	11	3	5	5	13	13	8	8
27	5	10	13	5	8	3	11	9	8	6
28	7	15	14	8	7	5	9	15	4	10
29	11	12	11	1	0	8	15	14	7	6
30	6	12	14	6	8	6	15	13	9	7
31	13	25	24	12	11	4	16	18	12	14

Pretest Comparison of Treatment and Control Groups
The equivalence of the control group and the treatment group was tested using the pretest scores in table 1and tables 2 and 3 summarize the result. The Independent sample t- test for a difference of means atthe 95% confidence level, showed that the null hypothesis is not rejected (p=0.178). Therefore, there was no significant difference between the means of the control and the experimental groups. This indicated that the two groups were equivalent at the beginning of treatment.

Table 2: Pretest Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest Score	0*	31	5.7742	2.34819	.42175
	1**	31	6.7097	3.01323	.54119

*Group 0=Control **Group 1=experimental Group

Table 3: Pretest Independent Samples t-test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	3.848	.054	-1.363	60	.178	-.93548	.68612	-2.30793	.43696
Equal variances not assumed			-1.363	56.620	.178	-.93548	.68612	-2.30961	.43865

Posttest Comparison of Treatment and Control Groups
The first research question was: How does the gain of students who were in a same-year small-group non-reciprocal peer tutoring program (treatment) compare to the gain of students tutored by a faculty member (control)? To answer this question, a hypothesis test for a difference in the mean gain of the control group (Gain 1c) and the mean gain of the treatment group (Gain 1e) was conducted using SPSS 20 (refer to table 1). The hypothesis test for a difference of means at the 95% confidence level, showed that the null hypothesis was not rejected (p=0.906; refer to tables 4 and 5). Therefore, there was no significant difference between the means of the control and the experimental groups' gains.

Table 4: Posttest Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Gain 1	0*	31	7.2258	3.80972	.68425
	1**	31	7.0968	4.73536	.85050

Group 0=Control Group **Group 1=Treatment Group

Table 5: Posttest Independent Samples t-test

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	1.069	.305	.118	60	.906	.12903	1.09158	-2.05444	2.31251
Equal variances not assumed			.118	57.369	.906	.12903	1.09158	-2.05650	2.31457

Comparison of Retention of Control and Experimental Groups

The second research question was: How does the retention for the students who were in a same-year small-group non-reciprocal peer tutoring program compare to the retention of students who were tutored by a faculty member? To answer this question, a hypothesis test for a difference of mean retention of the control group (Gain 2c) and the mean retention of the treatment group (Gain 2e) was conducted using SPSS 20 (refer to table 1). The hypothesis test for a difference of means at the 95% confidence level, showed that the null hypothesis was not rejected (p=0.423); refer to tables 6 and 7). Therefore, there was no significant difference between the means of the control and the experimental groups' retention.

Table 6: Retest Descriptive Statistics for Control and Treatment Groups' Retention

	Retention	N	Mean	Std. Deviation	Std. Error Mean
Scores	Control Group Retention	31	7.2258	3.74797	.67316
	Treatment Group Retention	31	6.3226	4.97586	.89369

Table 7: Independent Sample t-test of Control and Treatment Retention

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	2.085	.154	.807	60	.423	.90323	1.11885	-1.33480	3.14126
Equal variances not assumed			.807	55.752	.423	.90323	1.11885	-1.33832	3.14477

The researcher also compared the correlation coefficient between gain and retention for the treatment and control groups. The correlation coefficient between gain and retention for the control group and the treatment group was calculated using SPSS 20. The correlation coefficient between Gain 1c and Gain 2c was 0.708 while between Gain 1e and Gain 2e was 0.826 (refer to tables 1, 8and 9). However, using Fisher's method (1921, cited in Soper, 2016) for comparing thecorrelation coefficients showed that there was no differencebetween the two groups (p=.2757, see Table 10). Fisher's method tests the null hypothesis $r_a = r_b$,using the formulas:

$$r' = (0.5)\log_e \left[\frac{1+r}{1-r} \right] \qquad z = \frac{r_1' - r_2'}{\sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}}$$

Table 8: Correlation for Control Group Gains

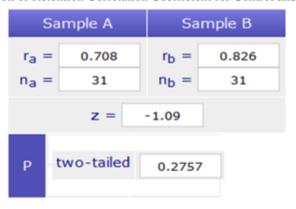|		Gain 1c	Gain 2c
Gain 1c	Pearson Correlation	1	.708**
	Sig. (2-tailed)		.000
	N	31	31
Gain 2c	Pearson Correlation	.708**	1
	Sig. (2-tailed)	.000	
	N	31	31

**. Correlation is significant at the 0.01 level (2-tailed).

Table 9: Correlation for Treatment Group Gains

		Gain 1e	Gain 2e
Gain 1e	Pearson Correlation	1	.826**
	Sig. (2-tailed)		.000
	N	31	31
Gain 2e	Pearson Correlation	.826**	1
	Sig. (2-tailed)	.000	
	N	31	31

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10: Comparison of Retention Correlation Coefficient for Control and Treatment Groups

Sample A		Sample B	
r_a =	0.708	r_b =	0.826
n_a =	31	n_b =	31
z =	-1.09		
P	two-tailed	0.2757	

Subjective Feedback

The third research question was: Besides potential gain and retention benefits, are there other benefits to tutors and tutees in the peer tutoring program? To obtain subjective feedback from tutors as well as tutees to answer this question two questionnaires were used.

Tutee Feedback

The questionnaire was distributed to all 31 tutees. Of the lot, 74% (23) of the questionnaires were completely filled out and returned. The average age of the respondents was 19 years. There were seven (7) males and sixteen (16) females. The majors of the respondents were: Agricultural Science (2); Biology (14); Chemistry (4); Computer Science (4) and Mathematics (1). Of the 23 respondents 17 were attended between 8 to 12 tutoring sessions while 6 attended between 4-7 sessions.

The first section of the tutee questionnaire was designed to elicit feedback regarding 'Interest/Enjoyment/Camaraderie'. The feedback from this section of the questionnaire was very positive. More than 90 % of the respondents felt that they enjoyed having a peer tutor; it was helpful to them in understanding course content, and that it made the course more interesting. These results also indicate that communication between tutors and tutees was excellent.

The second section was designed to obtain feedback regarding 'Understanding of the Subject'. The responses from tutees in this section of the questionnaire revealed that more than 85% believed that they were helped to understand course content and their confidence in their ability to comprehend the subject was increased. Furthermore, more than 90% thought that they learned a lot due to the peer tutoring program and felt that it improved their performance/grade.

The third section of the questionnaire helped to measure how well executed and coordinated the program was. The responses indicate that scheduling for the sessions was easy for more than 90% of the tutees. The tutors were knowledgeable in the opinion of more than 90% of the tutees. More than 85% of the tutees said they would recommend tutoring services to other students. The rooming facilities were also very adequate for more than 65% were content with their suitability/adequacy. Satisfaction of the participants in the program was very high (96%).

In summary, the responses to the tutee questionnaire revealed numerous positive outcomes. The majority of the respondents felt that they enjoyed having a peer tutor and it was helpful to them in understanding course content, and that it made the course more interesting. Most tutees believed that they were helped to understand course content and their confidence in their ability to comprehend the subject was increased. Remarkably the majority thought that they learned a lot due to the peer tutoring program and felt that it improved their performance/grade and expressed their satisfaction with the program.

Tutor Feedback

The questionnaire was distributed to all 5 students that volunteered as tutors. All questionnaires were completely filled out and returned. The average age of the respondents was 24 years. There were three (3) males and two (2) females. Agricultural Science was the major of two (2) of the tutors, while Biology was the major of the other three (3). All tutors conducted between eight (8) and fifteen (15) sessions of tutoring. The first section of the questionnaire elicited comments regarding 'Interest/Enjoyment/Camaraderie'. Allof the tutors found tutoring interesting/enjoyable; all tutors felt that tutoring their peers was worthwhile and derived a good feeling from helping their peers. Eighty percent of the tutors felt that their tutees valued their services and 100% thought that they were able to help the tutees assigned to them in understanding course content. All tutors thought that they were able to work along well with their fellow tutors.

The second section of the questionnaire was designed to obtain feedback regarding 'Understanding of the Subject'. Tutor response to this section of the questionnaire revealed that they were all helped with course content themselves; they understood and learned subject matter better as result of having to tutor others.

The third section of the questionnaire elicited comments regarding 'General Competences/Attitudes'. Tutors indicated a number of benefits from the program. Their responses indicated that they have learned communication skills (100%), teaching skills (100%). All learned how to plan organize their time. The ability to work as team was enhanced (100%); confidence in ability to cope with subject (100%) as well as confidence in self was increased (100%). Useful social skills were developed by 100% of the tutors and 100% said that they have developed skills and insights that will be useful in their future career. Tutors indicated that tutoring helped to improve their grade/performance (80%) and personal growth (100%). And 80% would recommend tutoring to potential tutors.

The last section of the questionnaire furnished feedback about 'Program Coordination'. The responses for this section of the questionnaire indicated that the peer tutoring program was well coordinated by the instructor of the course since 100% of the tutors indicated that the orientation/training they received were sufficient; materials and resources were adequate and even communication with the course instructor was good (100%). All of the tutors thought that the workload involved was reasonable and 80% indicated that scheduling tutoring sessions was easy. It was noteworthy that 80% of the tutors were not in agreement that they should be paid for their services. Finally, 100% were in favor that the rooming facilities were adequate for the sessions.

In summary, the subjective feedback received through the response to the tutor questionnaire also revealed numerous benefits to the tutors. The majority of the tutors found tutoring interesting and enjoyable; all of the tutors felt that tutoring their peers was worthwhile and derived a good feeling from helping their peers from knowing that they have been able to help their peers to understand course content. There was overwhelming evidence that tutors' understanding of the subject matter was positively impacted; useful revision was done, and they felt they learned a lot.Also there was clear indication that their communication, teaching, planning and organizing skills have been positively impacted. Further their ability to work as a team; their confidence in their ability to understand the subject as well as self-confidence increased. Tutors also claimed they developed useful social skills and insights that will be useful in their future career and indicated that tutoring helped to improve their grade/performance and personal growth.

IV. Discussion

The first goal of the researcher was to determine whether peer tutoring was more effective than tutoring by a faculty member in improving mathematics performance. To achieve this goal the researcher sought to answer the question: How does the gain of students who were in a same-year small-group non-reciprocal peer tutoring program compare to the gain of students tutored by a faculty member? The researcher used hypothesis testing to compare the mean gain for the group taught by the faculty member and the mean gain for the group involved in the peer tutoring program and found that there was no significant difference in the mean gains (p=0.906). This finding indicated that while same-year small-group non-reciprocal peer tutoring was as effective as tutoring by a professional faculty member it was not more effective in improving mathematics performance of the students in the study. This finding agrees with what was found in earlier studies. There were a number of studies that compared teaching by a professional and various forms of peer tutoring. These formats include Cross-year small-group tutoring, Same-year dyadic fixed-role tutoring, Same-year dyadic reciprocal peer tutoring, and Same-year group tutoring. Of these, nine (9) reported that peer tutors were as effective as professional tutors (Topping, 1996). These studies are indicative that the outcomes from peer tutoring while comparable to tutoring by a professional, was not more effective. A point to note is that the studies reviewed were not specific to mathematics content; also note that the course used in this study was not a first course but a second course and the grades of students in a prerequisite course was used as the criterion for choosing the peer tutors.

Another measure of effectiveness is retention of material learned. The researcher sought to answer the question: How does the retention for the students who were in a same-year small-group non-reciprocal peer tutoring program compare to the retention of students who were tutored by a faculty member? The researcher used hypothesis testing to compare the mean retention for the group taught by the faculty member and the mean retention for the group involved in the peer tutoring program and found that there was no significant difference in the mean retentions (p=0.423). Further, the correlation coefficient between gain and retention for the treatment group was 0.806 while for the control group was 0.798. Both correlation coefficients were strong. However, the Fisher's test comparing these coefficients did not reveal any difference. Therefore, same-year small-group non-reciprocal peer tutoring did not help students in this study to retain more mathematical content than those that were tutored by a faculty member. No study could be found by the researcher that measured retention in peer tutored groups and compared it with any other treatments. Therefore, the finding in this study about retention for students in a peer tutored group in comparison to those tutored by a professional is possibly new.

The researcher sought insight as to whether there are benefits to tutees and tutors in the peer tutoring program. The subjective feedback from the questionnaires indicateda number of benefits to both tutees and tutors.Most Tutees in the peer tutoring program enjoyed having a peer tutor and it made the course more interesting.The majority of tutees indicated that they were helped to understand course content; their confidence in their ability to comprehend the subject was increased and felt the program improved their performance/grade. Young (2011) reported similar comments from tutees in her study.

The subjective feedback received through the response to the tutor questionnaire revealed numerous benefits to the tutors. The majority of the tutors found tutoring interesting and enjoyable; all of the tutors felt that tutoring their peers was worthwhile and derived a good feeling from helping their peers. Most tutors indicated that their understanding of the subject matter was positively impacted; useful revision was done and they felt they learned a lot. The majority also indicated that their communication, teaching, planning and organizing skills have been positively impacted. Further their ability to work as a team; their confidence in their ability to understand the subject as well as self-confidence increased. Tutors claimed they have developed useful social skills and insights that will be useful in their future career. Tutors also indicated that tutoring helped to improve their grade/performance and personal growth. These benefits to tutors were similar to those reported by Young (2011) in her study of a same year tutoring program for mathematics teachers. In view of these benefits to tutors and tutees, peer tutoring can add variety to the learning experiences of students and fosters the development of invaluable skills and qualities that should be the product of university experience. In other studies on universities where a peer tutoring program has been adopted, it has proven to be a valuable experience and resource for both tutors and tutees; among the benefits were also greater enjoyment, useful communication, teaching, planning, organizing and social skills (Cohen et al, 1982; Magin et al, 1995; Toppin, 1996 Young, 2011).

In this study no peer tutor indicated that they wanted payment for their services. Peer tutors in all of the studies reviewed in this research were not offered nor indicated that they are desirous of obtaining financial compensation for their services (Topping, 1996). Therefore, with peer tutoring producing outcomes comparable to faculty tutoring, universities now have a potentially valuable cost-effective resource that they can now tap into while at the same time still offering to their students quality learning opportunities. So, since quality, outcomes and cost-effectiveness of methods of teaching and learning in colleges and universities are being

scrutinized more closely now (Topping, 1996); universities can achieve all of this through peer tutoring programs. Therefore, Peer tutoring programs can be among the cost-saving strategies by universities.

V. Conclusion

The findings in this study have led the researcher to conclude thatsame-year small-group non-reciprocal peer tutoring was not more effective than tutoring by a faculty member in improving mathematics performance. Instead both strategies were equally effective for tutoring mathematics. However, there were additional benefits to tutees and tutors in the peer tutoring group. Benefits to tutees include greater enjoyment, interest and understanding of course content. Tutors were able to maintain or improve their grades as well as derived enjoyment from helping others. They also developed useful communication, teaching, planning, organizing and social skills.

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