College Algebra Instruction with Code-Switching Application: Singapore and Hongkong Practices

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Abstract

This study investigated code-switching application in College Algebra instruction in Jose Rizal Memorial State University– Main Campus during the 1st Semester of School Year 2010 – 2011. A quasi-experimental set-up using nonequivalent group, pretest-posttest design 10 was used in this study. A total of 79 students: 41 composed the experimental group while 38 composed control group were utilized. A 50-item teacher-made test with 0.871 computed KR 21 value was used. The data collected were analyzed using mean, z-test and t-test. The control group shows slight improvement as compared to the experimental group which performs significantly. Recommendations are offered in light with the results of the study.

Keywords: *Code-switching application, college algebra instruction, mathematics education, quasi-experiment*

Introduction

Mathematics proficiency is a vehicle for producing a skilled workforce needed to sustain a nation's competitive edge in today's technological and global economy. This role of Mathematics in global competition induces numerous countries to turn to international assessments conducted every four (4) years by the International Association for the Evaluation of Educational Achievement (IEA) with headquarters in Amsterdam through the famous Trends in International Mathematics and Science Study (TIMSS).

Like in many countries in the world, the Philippines went through an assessment like TIMSS. Results, however, disappointedly depicted the Filipino students' poor performance in the TIMSS surveys. TIMSS is an intercontinental assessment which was firstly administered in 1995, that provides cross-national achievement of fourth- and eighth-grade students around the world in Mathematics and Science. In 1999 TIMSS results, the country ranked third from the bottom or 36th among the 38 countries in Mathematics. TIMSS 2003 placed the country 23rd among 25 countries. Evidently, the scores registered by the Philippines in the TIMSS revealed that the country is lagging behind other Asian nations like Singapore, Taiwan, South Korea, Hongkong and Japan. According to Chua (2009), poor quality of Mathematics education of the country could be the principal cause of this poor achievement of Filipino students in the subject. While

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some cases, concentration is along the cognitive facets of Mathematics learning, others utilized the role of language in the teaching and learning the subject. The reason why the language factor needs special attention because many students are learning Mathematics in their second or third language, not in their first language just like in Singapore and Hongkong (Davidenko, 2000). According to UNESCO, the first language or mother tongue the language that a person (a) has learned first; (b) identifies with or is identified as a native speaker of by others; (c) knows best; or (d) uses most.

Setati (2002) asserted that the use of language, which is just a second tongue of the students, as a medium of instruction impedes effective teaching and learning in Mathematics. So, when students are incapable to express themselves well in English, teachers are forced to code switch rather than letting the language hinder the students from understanding the mathematical concepts (Garegae, 2008).

Code switching means to switch between the language of learning and teaching and the learners' first language. Adler & Setati (2001) who referred in many studies that have been carried out on code-switching, concluded that most of these studies have demonstrated the use of the learner' s first language as a "support" in the teaching and learning of Mathematics. Reflecting Setati (2003), Barton & Barton (2003), and Garegae (2008) affirmations, the researcher also believes that successful completion of a Mathematics course relies heavily on effective communication between teacher and student and the latter's ability to understand and communicate abstract concepts when translated into written Mathematics. Along this context, the study on the performance of college students in Mathematics, specifically in the subject College Algebra was undertaken.

Nevertheless, the intention of this study is not to investigate to what degree the language is a factor of low performance and understanding of students. Instead, it investigated the application of Cebuano-English code switching in teaching the subject.

Objectives

This study aimed to investigate code-switching application in College Algebra instruction in Jose Rizal Memorial State University– Main Campus during the 1st Semester of School Year 2010 – 2011.

Specifically, it sought to attain the following objectives:

1. Determine the pretest performance of the College Algebra students in the control group and experimental group;

2. Test the null hypothesis that there is no significant difference between the pretest performance of the College Algebra students in the control and experimental groups;

3. Determine the posttest performance of the College Algebra students in the control group and experimental group;

4. Test the null hypothesis that there is no significant difference between the posttest performance of the College Algebra students in the control and experimental groups; and

5. Test the null hypothesis that there is no significant difference on the pre-post mean gain of the control and experimental groups

Research Method and Design

Research Design. This study employed a quasi-experimental research design 10, employing the pre-test, post-test non-equivalent group. The experiment was conducted during the final term of the School Year 2010 – 2011. The class met on regular class schedules. The researcher, who is the instructor, himself, met the control and experiment groups every Monday and Thursday (M-Th) but on different time schedule. The students in the control group were taught at 5:30 PM until 7:00 PM in Room 22 while the students in the experimental group were taught at 7:30 AM until 9:00 AM in Room 27.

The process involved in the experiment is presented in Figure 2. Before the treatment began, both the experimental and control groups were given a pretest on College Algebra (Pr_1 and Pr_2). After the pretest was conducted, the members of the control group were taught using the traditional medium of teaching Mathematics (T_E), while the researcher code-switched Cebuano and English (T_{E-C}) while teaching the experimental group. After the treatment, the two groups were given a posttest (Po_1 and Po_2).

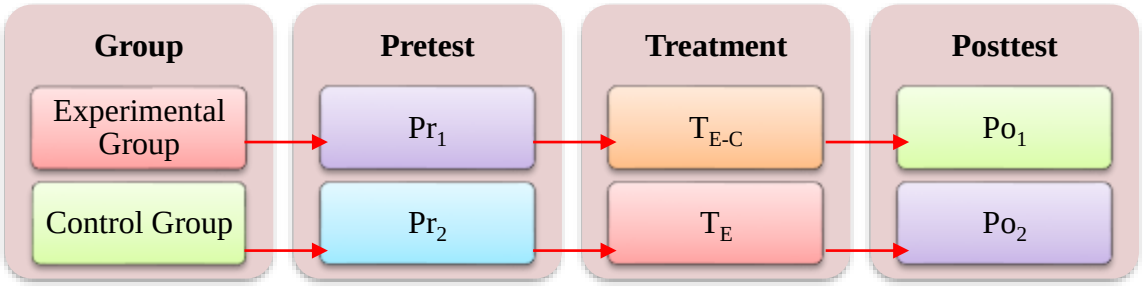

Figure 2 The Research Process

Table 1 presents the matrix of activities undertaken by the researcher during the conduct of the study.

Table 1 Matrix of Activities for the Control and Experimental Groups

Class Session	Topic	Objectives	Time Alloted	Medium of Instruction	
				Experimental Group	Control Group
1 (September 13, 2010)	**Pretest**		1 ½ hours		
2	The	A. Describe the	½ hour	English-	English

(September 16, 2010) **Table 1 Cont'd**	Cartesian Coordinate System Revisited	Cartesian Coordinate System B. Plot points on the plane C. Identify the coordinates of a given point on the plane	½ hour ½ hour	Cebuano Code-Switched	
3 (September 20, 2010)	Graphing Linear Equation in Two Variables	A. Describe the graph of the linear equation B. Graph linear equation in two variables using two points, slope and y-intercept, point and slope, and x- and y-intercepts	¼ hour 1 ¼ hour	English-Cebuano Code-Switched	English
4 & 5 (September 23 & 27, 2010)	Classification of Systems of Linear Equations in Two Variables	A. Define systems of linear equations B. Classify systems of linear equations described in terms of coefficients, slopes and graphs	¼ hour 2 ¾ hour	English-Cebuano Code-Switched	English
6 & 7 (September 30, 2010 & October 4, 2010)	Finding Solutions of Systems of Linear Equations in Two Variables	A. Solve systems of linear equations by graphing using table of values B. Solve systems of linear equations by substitution and comparison C. Solve systems of linear equations by elimination D. Solve systems of linear equations by using determinants	1 hour ½ hour ½ hour 1 hour	English-Cebuano Code-Switched	English
8 & 9 (October 7 & 11, 2010)	Problems Involving Systems of Linear Equations	A. Solve worded problems involving systems of linear equations	3 hours	English-Cebuano Code-Switched	English
10 (October 14, 2010)	**Posttest**		1 hour		

Respondents of the Study. Students in the subject Math 11 - College Algebra constituted the respondents for this study. Table 1 shows the distribution of respondents of the study. As presented in the table, 51.899% or 41 BSMT – 1C students composed the experimental group while 48.101% or 38 BSMT-1D students composed the control group. These students have officially enrolled the subject College Algebra. The researcher randomly assigned the groups to the two treatment conditions by tossing a coin.

Research Instrument. The researcher developed a 50-item teacher-made test to measure students' performance in College Algebra. This test was a multiple choice test constructed by the researcher with the help of books and teaching kits. In this test, the students in the control and experimental groups were presented with 50 questions or instructions called stems. They were directed to select the correct answer or response from a list of answer options. The test consisted of questions on the topics discussed.

The number of items was dependent on the number of contact hours indulged in teaching each topic. Benjamin Bloom's Taxonomy of Objectives was used. The researcher who is the teacher himself identified the level of chosen lesson objectives and created assessments to match those levels. Six (6) items were constructed to measure students understanding on the first topic, Cartesian Coordinate System Revisited as well as on the second topic, Graphing Linear Equation in Two Variables. To assess students' understanding on the topics Classification of Systems of Linear Equations in Two Variables and Finding Solutions of Systems of Linear Equations in Two Variables, 12 items from topic were constructed, while 14 items is on Solving Worded Problems Involving Systems of Linear Equations.

Validation of the Test Instrument. To make sure that the test was of good quality, its validity and reliability were carefully taken into considerations. To assure content-related validity, the researcher constructed Table of Specification (TOS) in Mathematics utilizing Bloom's Taxonomy to make certain that all major aspects are covered by the test items and in correct proportions.

In constructing the teacher-made multiple choice test, the researcher followed the TOS. To prevent student textwiseness and guessing, the researcher ensured that the order of answer options is logical or random, that all answer options are grammatically consistent with the stem, that the correct answer options are not the longest answer option, and that all answer options are plausible. After constructing the test, the researcher submitted it, including the TOS, to experts for comments and/or recommendations. These experts were Master of Arts in Mathematics holders and Doctor of Education candidate. Their suggestions and corrections were eventually incorporated.

Aside from the validity of the instrument, its reliability had also to be tested. Reliability is the degree to which a test produces scores that are not affected by chance. Before administering the test to the control and experimental groups, it was administered first to students who are not the subjects of the study. The researcher tested the reliability of the test using the Kuder-Richardson 21 method of computing the reliability coefficient.

After the test was administered and scored, a post hoc analysis was also performed in order to evaluate the test's effectiveness. Item analysis, which includes determining the p-value and d – value and the effectiveness of distracters, was conducted. Looking at an item's difficulty and discrimination assisted the researcher in determining what is wrong with individual items. Item and test analysis provided empirical data about how individual items and whole tests are performing in real test situations. It helped the researcher appraise whether the items were too easy or too difficult. It also showed how well each item discriminated between high and low achievers and most importantly, it certainly helped in determining specific technical defects of the test item. The result of the analysis was instrumental for the researcher to retain, improve, revise, discard or definitely reject the test items. Thus, the original 60-item test was reduced to 54 items. To come up with an intact 50-item test, the KR 20 coefficient was computed to determine the reliability of each item. After determining the reliability of each item using KR 20, four (4) items with lower reliability coefficient were not included in the test.

Scoring Procedure. To describe the overall pretest and posttest performance of the students in the control and experimental groups in the 50-item College Algebra exam, the following range of mean scores, its corresponding verbal description and interpretation were used.

Range of Mean Score	**Description**
43.8 - 50.0	Excellent
37.5 - 43.7	Very Good
31.2 - 37.4	Good
25 - 31.1	Fair
24 and below	Poor

To describe the pretest and posttest performance of the College Algebra students belonging in the control and experimental groups, the following range of mean scores, its corresponding verbal description and interpretation were used.

Range of Mean Scores			**Description**
For 6 items	For 12 items	For 14 items	
5.25 - 6.00	10.5 - 12.0	12.3 - 14.0	Excellent
4.50 - 5.24	9.00 - 10.4	10.5 - 12.2	Very Good
3.74 - 4.49	7.49 - 8.99	8.73 - 10.4	Good
2.99 - 3.73	5.99 - 7.48	6.97 - 8.72	Fair
2.98 and below	5.95 and below	6.96 and below	Poor

Statistical Treatment. The data gathered were interpreted using the mean, to describe the performance of the College Algebra students belonging in the control and experimental groups during the pretest and posttest; z-test, to determine the significant difference between the hypothetical mean (HM) score and the actual mean (AM) score of the students. The HM or level of expectation was set at 75 percent; and, t – test, to test the significant difference between the pretest performance, posttest performance and the pre-

post mean gain of the College Algebra students in the control group and experimental group. All statistical values were set at 0.05 level of significance.

Results and Discussion

The data presented on Tables 2 and 3 were scores from the pretest administered by the researcher to the Control and Experimental Groups. Their pretest performances were obtained before the groups were exposed to their respective interventions.

Pretest Performance of Control Group. Table 2 presents the pretest performance of the College Algebra students in the control group. There were five topics included in the investigation, namely: the Cartesian Coordinate System Revisited, Graphing Linear Equation in Two Variables, Classification of Systems of Linear Equations in Two Variables, Finding Solutions of Systems of Linear Equations in Two Variables, Problems Involving Systems of Linear Equations. The level of expectation (HM) was set at 75 percent of the total number of items in each topic; thus, 4.5, 4.5, 9, and 10.5, respectively.

Table 2 Pretest Performance of the College Students in Control Group

Topics	No. of Items	HM	AM	SD	Z value	D
The Cartesian Coordinate System Revisited	6	4.5	5.263	4.227	1.113	Very Good
Graphing Linear Equation in Two Variables	6	4.5	3.553	8.503	-0.687	Fair
Classification of Systems of Linear Equations in Two Variables	12	9	5.789	9.089	-2.178	Poor
Finding Solutions of Systems of Linear Equations in Two Variables	12	9	8.684	6.008	-0.324	Good
Solving Worded Problems Involving Systems of Linear Equations	14	10.5	5.816	8.79	-3.285	Poor
Total	**50**	**37.5**	**25.47**	**5.135**	**-14.442**	**Fair**

d.f. = 37 c.v. = 1.686 $\alpha = 0.05$

Legend:

HM Hypothetical Mean	d.f.	Degrees of Freedom
AM Actual Mean	cv	Critical Value
SD Standard Deviation	D	Description

As to the topic Cartesian coordinate system revisited, the students in the control group obtained the Actual Mean (AM) of 5.263 having a standard deviation (SD) 4.227 described as “very good” performance, was above the expected level of performance of 4.5. The computed z-test value of 1.113 did not exceed the critical value of 1.686 at having 37 degrees of freedom which implies that it is not significant at 95 percent confidence level.

The table also shows that the group did not attain the 75% level of performance on the four succeeding topics, namely: graphing linear equation in two variables, classification of systems of linear equations in two variables, finding solutions of systems

of linear equations in two variables, and solving worded problems involving systems of linear equations with AMs of 3.553, 5.789, 8.684, and 5.816, respectively.

As to the second topic, graphing linear equation in two variables, the group obtained an AM of 3.553 with 8.503 SD, which was described as "fair" performance. On the topic finding solutions of systems of linear equations in two variables, the group obtained an AM of 8.684 having 6.008 SD which was described as "good" performance.

However, the group has "poor" performance on the topics classification of systems of linear equations in two variables and solving worded problems involving systems of linear equations obtaining AMs of 5.816 having 8.79 SD and of 5.789 with 9.089 SD, respectively.

The overall performance of the control group during the pretest was "fair" having obtained AM of 25.47 with 5.135 SD. This indicates that the group did not exceed the 75 percent level of expectation.

It is noteworthy to mention that control group passed the 75% level of performance on the topic the Cartesian Coordinate System revisited, but it did not exceed the critical value of 1.686 at 0.05 level of significance with 37 degrees of freedom. This means that the group did not attain the expected performance in a significant degree. This implies that the students in the experimental group had existing/prior knowledge of the Cartesian System before the intervention. It should be recalled that lessons about Cartesian Coordinate System were taught from first year up to the fourth year of secondary education. Finding answers to questions number one and two (1. *In a Cartesian Coordinate System, the x-coordinate is called the abscissa and the y-coordinate is called ___; and, 2. How do you call the vertical number line in a Cartesian System?*) in the teacher-made test, for instance, is purely based on knowledge, which needs not to be expounded by code-switching English and Cebuano.

Pretest Performance of Experimental Group. The pretest performance of the College Algebra students in the experimental group is shown in Table 3. The students in the experimental group, like those in the control group, were also provided with a test where five topics having the abovementioned items were included. The level of expectation (HM) was also set at 75 percent of the total number of items in each topic.

The table below reveals that the experimental group failed to attain the 75% level of expectation in all the five (5) topics in College Algebra, namely: the Cartesian coordinate system revisited, graphing linear equation in two variables, classification of systems of linear equations in two variables, finding solutions of systems of linear equations in two variables, and solving problems involving systems of linear equations with Actual Means (AMs) of 4.475, 4.2, 6.6, 7.275, and 7.15, respectively, all described as below the expected performance level.

Results showed that like those in the control group, the students in the experimental group did not succeed in obtaining the 75% performance or 37.5 score. Obtaining the AM

of 26.90 and SD of 10.75, the z value of -6.078 did not exceed the critical value of 1.684 at 0.05 significance level with 40 degrees of freedom, which means that the group did not attain the level of expectation to a significant degree. The group's AM of 26.61 was described as "fair" performance.

Specifically, the group obtained AMs of 6.6, 7.275, and 7.15, respectively, on the topics: classification of systems of linear equations in two variables, finding solutions of systems of linear equations in two variables and solving worded problems involving systems of linear equations which were all described as "fair".

On the topics the Cartesian Coordinate System revisited and graphing linear equation in two variables, the group obtaining AMs of 4.475 and 4.2 which were both described as "good".

Table 3 Pretest Performance of the College Students in Experimental Group

Topics	No. of Items	HM	AM	SD	Z value	D
The Cartesian Coordinate System Revisited	6	4.5	4.475	1.941	-0.0794	Good
Graphing Linear Equation in Two Variables	6	4.5	4.2	2.449	-0.755	Good
Classification of Systems of Linear Equations in Two Variables	12	9	6.6	6.339	-2.334	Fair
Finding Solutions of Systems of Linear Equations in Two Variables	12	9	7.275	5.562	-1.912	Fair
Solving Worded Problems Involving Systems of Linear Equations	14	10.5	7.15	8.501	-2.429	Fair
Total	**50**	**37.5**	**26.90**	**10.75**	**-6.078**	**Fair**
		d.f. = 40		c.v. = 1.684		$\alpha = 0.05$

Numerous foreign studies like that of Catian (2005) substantiate the findings of the current study as they also found out that the experimental group did not perform well during the conduct of the pretest. Indeed, making Algebra accessible and understandable is vital for each of students. Algebra is largely based on logical concepts, and is meant to progress step by step. Students that come into a situation where they do not have a foundation of skills or where they have missed key elements can find themselves very confused. Hence, teachers need to employ strategies or approach so that learning the subject will be easy and teaching the subject can be more meaningful. The concepts that students need to understand and comprehend, if missing, can prevent a student from learning other concepts.

Table 5 depicts the t-test table comparing the pretest performance of the students in the experimental and control groups. It shows that the experimental group scores were slightly higher with a mean score of 26.90 as compared to the control group which obtained a 25.47 mean score. The students in the experimental group, therefore, performed better than those in the control group prior to the intervention. However,

scores in the control group are less dispersed from the mean, having 5.135 SD, than the scores in experimental group, having 10.75 SD.

The table also shows that the absolute value of t-statistic (0.734) with 77 degrees of freedom is less than the critical value of 1.665 at 0.05 significance level. This data provide sufficient evidence to accept the null hypothesis. There was therefore no significant difference between the pretest performance of students in the control and experimental groups. This indicates that there is no significant difference in the performance of the two groups before the intervention. This implies the control and experimental students' existing knowledge on the topics included was equivalent or significantly comparable before the intervention. Knowing this equivalence was crucial as it allowed the researcher to administer posttest with confidence.

The results clearly suggest that the students in the two groups needed reinforcement so that their performance level will be elevated from good to very good or perhaps to excellent level. Teachers should find ways and apply these to increase students' performance in College Algebra. He may utilize code-switching approach in teaching the subject so that learning will be fast-tracked (Sert, 2005).

Tables 6 and 7 show the posttest performance of the students of the Control and Experimental Groups. These were obtained after the students were exposed to different interventions: English and Cebuano code-switching with application of Singapore and Hongkong practices in the experimental group and English language only using the same practices in the control group.

Table 5 T-test Comparison of the Pretest Performance

Group	N	Mean	SD	t-value	d.f.	c.v.	Decision
Control	38	25.47	5.135	0.734	77	1.665	Ho not
Experimental	41	26.90	10.75				rejected
						$\alpha = 0.05$	

Legend:

SD - Standard Deviation d.f. - Degrees of Freedom cv - Critical Value

Posttest Performance of Control Group. Table 4 reveals the posttest performance of the College Algebra students in the control group. Similar to the pretest, there were also five topics included in the posttest, to wit: the Cartesian Coordinate System Revisited, Graphing Linear Equation in Two Variables, Classification of Systems of Linear Equations in Two Variables, Finding Solutions of Systems of Linear Equations in Two Variables, Problems Involving Systems of Linear Equations. The same level of expectation (HM) of 75 percent was set in each topic, namely; 4.5 for topics I and II, 9 for topics III and IV and 10.5 for topics V with 37.5 overall expected posttest performance.

It is evident in the table that the students in the control group obtained AMs of 5.722, 5.639, and 10.78, respectively, on the topics, namely: the Cartesian coordinate system revisited, graphing linear equation in two variables, and finding solutions of systems of

linear equations in two variables, which were all described as "excellent" performance. The AMs were above the 75 percent level of expectation. These findings imply that the students in the control group have learned the three mentioned topics during the conduct of the lesson employing the traditional way of teaching Math that is using English language.

The group also succeeded in reaching the expected performance level on the topic classifying systems of linear equation in two variables obtaining AM of 10.03 having 5.368 SD which was described as "very good" performance, however, the z-value of 1.183 is less than the critical value of 1.686 having 37 degrees of freedom implying that it did not attain the expected mean score of 9 to a significant degree.

Furthermore, the group also failed in obtaining the expected mean score of 10.5 on the topic solving worded problems involving linear equations as confirmed in the computed z-value of -1.139 at 37 degrees of freedom. The AM of 9.917 having 3.176 SD the group obtained was described as "good".

Generally, the students in the control group failed to attain the HM score of 37.5 in the posttest since they only obtained the mean score of 34.44 with SD of 6.254 which was described as "good" performance. The z value of -3.016 did not exceed the critical value of 1.686 at 0.05 level of significance with 36 degrees of freedom. This means that the group did not attain the 75% expected performance in a significant degree.

Determining whether the system of linear equation is consistent, inconsistent, dependent or independent would be difficult for the students, especially those who are weak in the language of instruction. The use of English as a medium of Mathematics instruction to Cebuano-speaking students poses a big dilemma to them due to lack of communication skills in the language.

Table 4 Posttest Performance of the College Students in Control Group

Topics	No. of Items	HM	AM	SD	Z value	D
The Cartesian Coordinate System Revisited	6	4.5	5.722	3.615	2.084	Excellent
Graphing Linear Equation in Two Variables	6	4.5	5.639	2.858	2.456	Excellent
Classification of Systems of Linear Equations in Two Variables	12	9	10.03	5.368	1.183	Very Good
Finding Solutions of Systems of Linear Equations in Two Variables	12	9	10.78	3.985	2.753	Excellent
Solving Worded Problems Involving Systems of Linear Equations	14	10.5	9.917	3.156	-1.139	Good
Total	**50**	**37.5**	**34.44**	**6.254**	**-3.016**	**Good**

d.f. = 37 c.v. = 1.686 $\alpha = 0.05$

Indeed, the fact that many students are currently learning Mathematics in their second or third language, not their first language, proves why the language factor needs special attention (Davidenko, 2000). Barton & Barton (2003) averred that the language problem is one of the major factors which contribute towards the poor performance of several students in Mathematics particularly among those who are bilingual and multilingual. Setati (2003) reviewed various studies indicating that students who are found to be weak in the language of instruction have the tendency towards ill comprehension as well as poor participation in classroom discourse.

Posttest Performance of Experimental Group. The posttest performance of the College Algebra students in the experimental group is presented in Table 5. The same level of expectation (HM) of 75 percent was set with 4.5 for topics I and II, 9 for topics III and IV and 10.5 for topics V.

A closer look at the table reveals that the group passed the expected performance on all five topics covered obtaining AMs of 5.973, 5.865, 10.84, 11.46 and 11.06, respectively. It can also be gleaned in the table that the group has "excellent" performance on the topics: the Cartesian Coordinate System revisited, graphing linear equation in two variables, classification of systems of linear equations in two variables and finding solutions of systems of linear equations in two variables, obtaining AMs of 5.973, 5.865, 10.84, and 11.46, respectively, which were all beyond the 75 percent level of expectation.

The group only obtained an AM of 11.06 having 5.989 on the topic solving worded problems involving systems of linear equations which was described as "very good" performance.

Table 5 Posttest Performance of the College Students in Experimental Group

Topics	No. of Items	HM	AM	SD	Z value	D
The Cartesian Coordinate System Revisited	6	4.5	5.973	0.408	22.256	Excellent
Graphing Linear Equation in Two Variables	6	4.5	5.865	0.983	8.559	Excellent
Classification of Systems of Linear Equations in Two Variables	12	9	10.84	1.443	7.860	Excellent
Finding Solutions of Systems of Linear Equations in Two Variables	12	9	11.46	3.114	4.869	Excellent
Solving Worded Problems Involving Systems of Linear Equations	14	10.5	11.06	5.989	0.576	Very Good
Total	**50**	**37.5**	**38.79**	**7.349**	**1.082**	**Very Good**
	d.f. = 40		c.v. = 1.684		$\alpha = 0.05$	

The table shows that the students belonging to the experimental group passed the expected mean score of 37.5 as they obtained the AM of 38.79 with SD of 7.349 which was described as "very good" performance. However, the z-value of 1.082 does not

exceed the critical value of 1.684 at 40 degrees of freedom, implying that the group did not achieve the 75 percent performance level to a significant degree.

The current findings reveals that code switching Cebuano – English during the discussion of the Cartesian Coordinate System, graphing linear equations, classifying systems of linear equations, finding solutions of the systems and solving worded problems involving systems certainly helped the students in improving their performance in Mathematics.

Finding the correct answer to question number 13 (*Which is TRUE about a system of linear equations*) of the test, for instance, would be very easy for the students when the precise definition of what a system of linear equation means is used and expounding the definition using the language of the students.

Answering question number 44 (*Nona is one-third as old as her mother. Five years ago, she was only one-fifth of the age of her mother. How old is Nona now?)* of the test, for example, was simple when the teacher made Cebuano translation of the problem. Code-switching English to Cebuano was found to be of immense help in minimizing student language difficulty in learning Mathematics as evidenced by an increased teacher-student interaction in the classroom since it provided an opportunity for the students to think of alternative ways of solving mathematical problems.

Table 6 T-test Comparison of the Posttest Performance

Group	N	Mean	SD	t-value	d.f.	c.v.	Decision
Control	38	34.44	6.254	2.732	77	1.665	Ho
Experimental	41	38.79	7.349				rejected
						$\alpha = 0.05$	

Table 6 reflects the test of significant difference between the posttest performance of the students in the experimental and control groups. It can be gleaned from the table that the experimental group has a higher mean score of 38.79 with SD of 7.349 than the control group which has only 34.44 mean score with SD of 6.254. This means that the experimental group performed better than the control group after the intervention.

The table further reveals that that since the absolute value of t-statistic (2.732) with 77 degrees of freedom exceeds the critical value of 1.665. This finding provides sufficient evidence to reject the null hypothesis. Thus, there is a significant difference between the posttest performance of students in the control and experimental groups. This indicates that there exists a significant difference in the performance of the two groups after the intervention. This implies a significant variation between the performance of the students taught using English-Cebuano code-switching control and those who were taught using the standard language of instruction (English).

Akinwumi and Olarewaju (cited in Makinde & Olabode, 2006) were indeed right that instruction in mother tongue facilitates more meaningful learning than instruction received in a foreign language. In their study exposing some Junior Secondary School

(JSS) students to a treatment of teaching Integrated Science in Yoruba and English languages, it was shown that the students in the experimental group (yoruba language) significantly performed better than those in the control group (English language).

Table 7 T-test Comparison of the Pretest-Posttest Performances

Group	Pretest		Posttest		Mean Difference	t-value	d.f.	c.v.	Decision
	Mean	SD	Mean	SD					
Control	25.47	5.13	34.44	6.25	8.9708	1.881	77	1.665	Ho
Experimental	26.61	10.8	38.79	7.35	12.182				rejected

$\alpha = 0.05$

Table 7 presents the test of significant difference on the pre-post mean gain between the students in control and experimental groups. It discloses that the t-value of 1.881 exceeds the critical value of 1.665 at 95% confidence level with 77 degrees of freedom thus leading to the rejection of the null hypothesis. This means that there exist a significant difference on the pre-post mean gain between the control and experimental groups. The pretest-posttest mean difference of the experimental group (12.182) is greater than that of the control group (8.9708) implying that code-switching English to Cebuano in teaching Math using Singapore and Hongkong practices really did translate to better performance of the students in the experimental group than those in the control group.

The results of the experiment clearly show that code-switching when teaching Mathematics in a language that is not the mother language of the students leads to better results than teaching in the foreign language.

Blake and Van Sickle (2001), cited in Vizconde, (2006) identified code switching from the standard teaching to local dialect as a strategy in alleviating the dilemma of the language of instruction, which seemed to work well as it improved the academic achievement of students in Mathematics. Tien and Liu (2006) claimed that code switching has socializing effects. In order to obtain students' recognition and to maintain interest, code switching is used to win the students' hearts. Code-switching had to be used to allow weaker students better comprehend the text being used and to aid learning. If students are not able to understand what the teacher tries to explain, it is necessary to use code switching.

Summary and Conclusion

The prior knowledge of students belonging in the control and experimental groups was equivalent or comparable before the intervention (AMs of 25.47 and 26.90). Their pretest performances were both described as "fair" means that they generally lack knowledge and skills on the topics included. There was no significant difference between the pretest performance of control and experimental groups (t-value of 0.734 < c.v. of 1.665).

Furthermore, there exists a significant variation between the performances of the students taught using code-switching than those who were taught using the standard language of instruction (English). The posttest performance of control group was "good" (AM of 34.44) while that of the experimental group was found to be "very good" (AM of 38.79). The control group shows slight improvement as compared to the experimental group which performs significantly. The computed t-value of 1.881 is greater than the critical value of 1.665 which means that there was a significant difference on the pre-post mean gain of control and experimental groups. The mean difference of 12.182 goes to prove that code-switching English and Cebuano is effective in Mathematics instruction as it improves the students' performance in the subject.

Recommendations

Based on the conclusions formulated, the researcher suggests the following recommendations.

Introduce code-switching in Math classroom. As the results of the current investigation clearly showed, code-switching had a positive effect on the results of the students. In order to give the students the best possible environment conducive for learning, it is proposed to introduce this strategy on a provisional basis, until the results of the broader studies are available, or at least to empower those teachers that are in favor of this strategy to use it. Aside from this, they should include code-switching during preparation of Math syllabi and other instructional materials. In-service training/seminar focusing on code-switching application should be conducted by school administrators with Math teachers as participants. University Administration should encourage Mathematics instructors/professors to utilize code-switching not only in College Algebra but in all Mathematics subjects so as to improve the performance of the students on the subject.

Repeat the experiment on a broader scale. One of the weak points of the study employing experimental method of course was the small size of the experimental and control groups, which certainly could not be avoided under the circumstances and was accepted by the panel when agreeing to the initial proposal of the study. In order to obtain results which could, with more confidence, be used as a basis for recommendations to any educational institution, it is proposed to repeat the experiment on a broader base, be it in the entire JRMSU System, or even on a provincial, regional, or national scale.

Study the effect of code-switching on the social interrelations between students and teachers. This study raises an additional question and opens up a new avenue for future research and discussions: to eliminate the hypothesis that the two styles of teaching could lead to differences in attitude in the teacher, himself. Another study should be set up which will analyze the impact on social interrelations in the classroom between teachers and students using the two approaches. It would be crucial to include teachers who favor code-switching and those who do not in this set-up.

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