CODE-SWITCHING: A CATALYST OF CHANGE IN TEACHING COLLEGE ALGEBRA

Liezl Joy Lazaro-Quilang[1]
[1]*Isabela State University, Cauayan City, Isabela, Philippines*

ABSTRACT

As of today, many Filipinos experience not only an aversion but also a phobia from mathematics. Moreover, assessments done on the impact of reforms on the achieved curriculum showed little improvement (Nebres, 2006). Hence, it is assumed that the missing link might be the insufficient attention to the implemented curriculum and not in specialized pilot programs. In view of the fact that understanding the mathematical concepts entails understanding the language of instruction, the author believes that code-switching is an effective approach in improving the mathematics achievement of students. The author employed Pre-test-Post-test Control Group Design, using Matched Group Subject which involved first year BSBA students of Isabela State University – Cauayan Campus. Moreover, this study utilized paired-samples t-test to compare the pre-test and post-test scores of the two groups; independent samples t-test to compare the gain scores of the two groups; and ANCOVA to compare the mathematics achievement scores of the two groups, while controlling for their quantitative quotient. The students who were exposed using code-switching manifested higher post-test scores and gain scores than students who were taught using English as the medium. Thus, code-switching is an effective way to improve the performance of the Filipino students in College Algebra.

Keywords*: Mathematics, College Algebra, Code-Switching, Pre-test-Post-test Control Group Design, using Matched Group Subject, Philippines*

INTRODUCTION

One of the major concerns and challenges of Mathematics education in the Southeast Asia nowadays is the relatively weak achievement of students and the school systems in learning basic mathematics[9]. The concern is thus on success in teaching the basic content in mathematics.

Unfortunately, Philippines is one of the countries involved in the said dilemma. As of today, many Filipinos experience not only an aversion but also a phobia from mathematics. Most students consider mathematics as extremely difficult, tedious and mind-numbing[2]. As a consequence, Philippines showed no indication of improvement in its general performance. To support this premise, the results in the Trends in International Mathematics and Science Study (TIMSS) revealed that Philippines consistently ranked low[1]. These findings serve as challenge to Mathematics teachers on offering solutions to the above-mentioned impasse because if this is not properly acted upon, then the performance of the Filipino students is assumed to continue to degrade drastically.

Although the countries of Southeast Asia are geographically closer to the East-Asian countries, the mathematics education of the former has been more influenced by colonial history, notably by the United States and the United Kingdom[9]. The typical method of reform from the United States has been a new theory of mathematics education such as new math, back to the basics, problem-solving approach, realistic mathematics education, etc. But assessment done years later on the impact of this reform on the achieved curriculum shows little improvement. Hence, it is assumed that the missing link might be the insufficient attention to the implemented curriculum (what actually goes on in the classroom) and not in specialized pilot programs but in a broad range of actual classrooms.

Conversely, the teacher's knowledge of the subject matter and his ability to communicate it are the very important factors in the teaching and learning process[10]. This indicates that for understanding the mathematical ideas and concepts, one has to be able to understand the language of instruction, which means if this language is foreign to the learner then it becomes a double task of learning both the foreign language as well as the mathematics that is being taught – all at the same time[6]. She then suggested that this problem can be addressed only by allowing the movement between the languages used in the class, known as code-switching.

Code-switching takes place on account of a need felt by learners to make sense of the given instructions and also of the tortuous mathematics. Generally, there is a shift to local language as soon as there is some conceptual difficulty[8]. [9]In the classroom where English is popularly used as the medium of class instructions, first language provides an effective way of understanding the content deeply and quickly. Besides, [7]using two languages in teaching and learning Mathematics, classrooms bring additive effect on students' cognitive ability that provides students not only to be more adept in mathematics lesson, but also for both their languages proficiency.

It is for these reasons and arguments that the researcher conceived this study to find out the effect of code-switching as medium of instruction in teaching College Algebra and its effectiveness as an approach in improving the mathematics achievement of first year students.

METHODOLOGY

The Pre-test-Post-test Control Group Design, using Matched Group Subject was utilized in the study. In this specific type of design, two groups of subjects were used, with both groups being measured and observed twice. The first measurement obliges as the pre-test while the second as the post-test. Random assignment was utilized to form the groups. The measurement or observations were collected at the same time for both groups.

The subjects of this study were taken from two sections of first year Bachelor of Science in Business Administration students who were enrolled in College Algebra at Isabela State University – Cauayan Campus during the First Semester of the Curriculum Year 2012-2013. The toss-coin method was used to decide which of the two groups would form the Code-switching group and English group. The participants of the two groups were harmonized depending on the result of their Mathematics Quotient to guarantee the group equivalence. As a result of the matching procedure, there were thirty-one (31) students from the Code-switching and another thirty-one (31) students from the English group.

The following data gathering instruments were used and administered in this study.

Mathematics Achievement Test. This teacher-made test was developed by the researcher to quantify the achievement of the participants in the study. This was given to both groups as a post-test at the end of the treatment. The researcher formulated 20 multiple choice items. The specific contents covered were Rational Expressions (Simplification of Rational Expressions, Multiplication and Division of Rational Expressions, Lowest Common Denominator, Addition and Subtraction of Rational Expressions, and Complex Fractions) and Radicals (Laws of Radicals, Sum and Difference of Radicals, Multiplication of Radicals, and Division/Rationalizing the Denominator). To further scrutinize the content validity of the test, the mathematics instructors who had been teaching for more than 5 years in the university were consulted to check if there are poorly constructed items. The instructors were asked to read carefully the items in the test in relation to the prepared table of specifications which are based on the syllabus in College Algebra. For the reliability test of the mathematics achievement test, the Cronbach's Alpha value was 0.716 which indicates that the 40-item test turned out to be an internally consistent measure of the mathematics achievement. In other words, it is an indication of the content to which respondents' answers are consistent. Moreover, another section of the Bachelor of Science in Business Administration students of ISU-CC was considered as the try-out group.

Scholastic Abilities Test for Adults. This is a standardized test developed by Briant, Patton, and Dunn which is designed to be a general measure of scholastic accomplishment. This test was utilized to measure the Quantitative Quotient and Mathematics Quotient of the students. The Quantitative Quotient has four (4) composites, these are: Quantitative Reasoning, Math Calculation, Math Application, and Nonverbal Reasoning. This variable was utilized as the control variable in the study. On the other hand, Mathematics Quotient is derived by combining the scores of the two composites Math Calculation and Math Application. This variable is included as a datum to fortify the comparability of the students grouping. This has seven levels, there are: very superior for students with above 130 mathematics quotient, superior for students with 121 – 130 mathematics quotient, above average for students with 111 – 120 mathematics quotient, average for students whose mathematics quotient is 90 – 110, below average for

students with 80 – 89 mathematics quotient, poor for students with 70 – 79 mathematics quotient, and very poor for students with below 70 mathematics quotient.

Voice Recorder. Data were transcribed using recorder during the actual teaching. The transcribed data were included in the appendix of this study. This was done to serve as evidence that code-switching really took place during the teaching-learning process.

On the process of collecting data, the researcher followed three phases namely: Pre- experimental phase, Experimental Phase and Post-experimental phase respectively.

Pre-experimental Phase

Before the conduct of the study, the researcher prepared a letter addressed to the Campus Guidance Officer to administer the Scholastic Abilities Test for Adults (SATA). Afterwards, a mechanical matching was done for the groupings using their Mathematics Quotient scores as the matching variable. Lastly, the Mathematics Achievement Test was administered for pilot testing.

Independent Samples t-Test for Equality of Quantitative Quotient between the English and Code-Switching Group

There is no significant difference between the quantitative quotient mean scores of the English (mean = 93.45) and Code-switching (mean = 92.74) groups as tested in the 0.05 level of significance. The magnitude of the differences in the means was very small (eta squared = 0.002) which means that only 0.22% of the variance in quantitative quotient can be explained by the two groups. This implies that the English group and the Code-switching group are statistically the same. Moreover, this furthers that the mechanical matching done by the researcher was successful.

Meanwhile, independent-sample means was carried out to find out if the English and Code-switching groups were comparable in terms of mathematics quotient.

Independent Samples t-Test for Equality in College Algebra between the English and Code-switching Groups before the treatment

There is no significant difference in the pre-test mean scores of students with average mathematics quotient of the English group (mean = 3.8) and Code-switching group (mean = 5.2); t (8) = -0.80, p = 0.45 (two-tailed). The moderate effect (eta squared = 0.074) indicates that 7.41% on the variance in College Algebra mean scores before the treatment is explained by the two groups. Moreover, the same is true with the pre-test mean scores of the students with poor mathematics quotient of English group (mean = 2.57) and Code-switching group (mean = 3.71); t (12) = -1.69, p = 0.12 (two-tailed). The magnitude of the differences in means was large (eta squared = 0.19) which implies that 19.23% of the variance in College Algebra mean scores is explained by the two groups. On the other hand, the students with below average mathematics quotient manifested significant difference between the pre-test mean scores of English (mean = 2.89) and Code-switching (mean = 4.16) groups; t (36) = -2.83, p = 0.01 (two-tailed). The eta square statistics (0.18) indicated a large effect size.

Generally, it is evident that the achievement of the English group and Code- switching group when categorized according to their mathematics quotient level was comparatively equal. In relation, the researcher affirms that any difference that exists between the two groups after the treatment was brought by the media of instruction.

Experimental Phase

In this phase, five sessions (sixty minutes per sessions) were executed to the English and Code-switching groups. The said sessions lasted for five days and were set both to English and Code-switching groups. Identical lessons, illustrative examples, exercises and assignments were taught and were given to both groups. However, a specific strategy was applied to each of the group, that is, the medium of instruction to be used by the researcher varied.

Post – Experimental Phase

Post-test on Mathematics Achievement was given at the end of the treatments. The result of the

post-test was analyzed and examined to evaluate and assess comparative effects of using English language and Code – switching as media of instruction.

The different statistical tools that were used to treat the data which were tallied, tabulated and analyzed are: t-test of independent sample means which was used to test if the two groups of students have the same performance in mathematics before the conduct of the experimental treatment; paired – samples t-test at 0.05 level of significance was employed to determine if there is a significant difference on the pre-test and post-test mathematics achievement mean scores of the English group and Code-switcing group; and Analysis of Covariance (ANCOVA) was utilized to test if the two groups of respondents have the same mathematics achievement, considering the effect of the quantitative quotient as the covariate. Finally, the gathered data was processed using a statistical package.

RESULTS AND DISCUSSION

Paired-Samples t-Test for Equality in Mathematics Achievement of the English Group

There is a statistically significant increase in the mathematics achievement mean scores of the students with an average mathematics quotient from pre-test (mean = 3.8) to post-test (mean= 16.4); t (4) = - 4.47, p = 0.01 (two-tailed). Same scenario is shown in students with below average mathematics quotient level from pre-test (mean = 2.89) to post-test (mean = 14.42), t (18) = -8.82, p < 0.005 (two-tailed). Lastly, it also revealed a statistically significant increase in the mathematics achievement scores of the students with poor mathematics quotient from pre-test (mean = 2.57) to post-test (mean – 14.71); t (6) = -13.33, p < 0.005 (two – tailed).

In over-all class performance, combination of students with various levels of mathematics quotient exposed under the control methodology had a significant increase in the performance in pre-test (mean = 2.97) and post-test (mean = 14.81); t (30) = -12.89, p < 0.005 (two-tailed). Hence, the use of English as a medium of instruction in teaching College Algebra significantly increased the mean scores of the students at different Mathematics Quotient levels.

Paired-Samples t-Test for Equality in Mathematics Achievement of the Code- switching Group

There is a statistically significant increase in the achievement test scores of the average students from pre-test (mean = 5.2) to post-test (mean = 22.2); t (4) = -5.43, p = 0.01 (two-tailed). Parallel to this is the statistically significant increase in the achievement test of the below average students from pre-test (mean = 4.16) to post-test (mean = 17.11); t (18) = -8.99, p < 0.005 (two- tailed). Finally, students with poor mathematics quotients showed the same significant increase in mathematics achievement from pre-test (mean 3.71) to post-test (mean = 20.29); t (6) = -11.6, p < 0.005 (two-tailed). As a whole, students that were taught using code-switching as the medium of instruction exhibited a remarkable increase of scores before the treatment (4.23) and after the treatment (18.65); t (30) = -13.27, p < 0.005 (two-tailed). Hence, the data divulge that the participants of the Code-switching group perform significantly higher on the post-test regardless of their mathematics quotient level as an effect of code-switching as medium of instruction in teaching. [4] Bilingualism has no effect on mathematical problem solving.

Analysis of Covariance between the Mathematics Achievement Scores of the English Group and Code-switching Group, while controlling for their Quantitative Quotient

There is no statistically significant increase in the mathematics achievement of students with an average mathematics quotient (covariate = 99.90, F = 2.61, p = 0.15) and with a below average mathematics quotient having quantitative quotient as the covariate (covariate = 93.55, F = 1.88, p = 0.18). Therefore, the performances of average and below average students can increase whether or not they are exposed to code-switching. On the other hand, the mathematics achievement of the students with poor mathematics quotient having the quantitative quotient as covariate suggests that a difference existed between the mean scores of English (mean = 14.71) and Code-switching (mean = 20.29) groups, in favor of the students who were exposed in code-switching (covariate = 87, F = 8.83, p = 0.01). This implies that students with poor quantitative quotient can learn more in an environment where code- switching is permissible.

In general, differences in the mathematics achievement scores were largely due to the type of treatment (covariate = 93.10, F = 7.15, p = 0.01). This exemplify that participants who were taught using code-switching (mean = 18.65) as the medium of instruction demonstrate significantly higher College Algebra achievement than those who were taught using English (mean = 14.81). This is a manifestation that the increase in the achievement of students can be attributed to the use of code-switching as the medium of instruction and not because they are naturally good in mathematics.

[8]Code-switching fosters a positive learning ambiance, makes challenging subject matter comprehensible to students and may remedy the poor language competence of speakers. This serves as an advent in uplifting the mathematics achievement level of students.

CONCLUSION

The use of either English or code-switching as media of instruction in teaching College Algebra significantly increased the mean scores of the students at different Mathematics Quotient levels. Thus, students can learn whether they are exposed to code-switching or not.

Moreover, the students with poor Mathematics Quotient level in the Code-switching group significantly achieved more than their counterparts in the English group. Thus, code- switching is remarkably better than that of English in teaching concepts to students with poor Mathematics Quotient level. However, students with average and below average Mathematics Quotient levels can have significant improvement in learning Contemporary Mathematics whether they are instructed using English or code-switching as medium.

As a whole, students who are exposed using code-switching significantly performed better than students who were taught using English as the medium. Thus, code-switching is an effective way to improve the performance of the students in Contemporary Mathematics.

RECOMMENDATIONS

On the basis of the conclusions, it is recommended that teachers should use code- switching when they are teaching College Algebra to students with poor Mathematics Quotient. Moreover, trainings should be conducted that is focused on Mathematics educators to help them understand how code-switching can be implemented in mathematics teaching. Furthermore, educational planners, curriculum developers, textbook authors and teachers need to be aware of the uses of language skills in mathematics teaching so that they consciously incorporate them into the curriculum policy, syllabuses, textbooks and lessons. Lastly, other researchers should conduct the same investigation to look the possibility on how code-switching could enhance the achievement of learners which leads to the development of higher order thinking skills.

References

[1] Amante, I. 2005. Math anxiety. Retrieved July 12, 2012, from website: http://www/questia.com.ph/speakout/viewarticle.php

[2] Antonio, L. 2009 Motivational factors that influence students' performance in mathematics as perceived in the Integrated Schools of Angadanan, Isabela as perceived by students and their teachers. Unpublished M.A. Thesis.Philippine Normal University.

[3] Barton, B. & Barton, P. 2003 Language issues in undergraduate mathematics: A report of two studies. New Zealand Journal of Mathematics.

[4] Bialystok, E. 2001 Bilingualism in development: language, literacy, and cognition. National Council of Teachers of Mathematics.

[5] Francisco, A. T., Narag, M. A., & Teel, M. R. 2012 The effect of using scientific calculator on the mathematics achievement of college students. Undergraduate Thesis, Philippine Normal University- Isabela Campus.

[6] Halai, A. 2009 Multilingualism in mathematics classrooms: Global perspectives. Bristol: Multilingual matters.

[7] Lim, C. & Presmeg, N. 2010 Teaching mathematics in two languages: A teaching dilemma of Malaysian Chinese primary school. International Journal of Science and Mathematics Education, Online First.Retrieved July 2012, from SpringerLink database.

[8] Metila, R. A. 2009 Decoding the switch: looking at classroom code-switching as a guide in teaching and learning. Education Quarterly, Vol. 67(1).

[9] Nebres, B. F. 2006 Mathematics education in Southeast Asia: major concerns and challenges. Unpublished M.A. Thesis, Ateneo de Manila University.

[10] Seng, T. O. et al. 2003 Education phychology. Seng Lee Press, Singapore.