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Mathematics and Technology Integrated Education in Malaysia

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ABSTRACT

The goals of the mathematics curriculum reform are: to provide basic mathematics content for future university students studying the natural sciences, secure mathematics teaching time to develop mathematical creativity in communication and problem solving and solve individual differences in learning mathematics. By necessity, the Ministry of Educational (MOE) reformed the national curriculum for elementary, middle and high schools in 2017. The goals of this reform are to identify the similarities and differences between the national, district, school and individual levels, to promote learners' autonomy and creativity, to establish education with schools, teachers, students and parents, to develop school educational plans and to keep and manage their quality in achievement. Based on the goals, the 2017 mathematics curriculum has been developed. In the newest reform, the authors describe the directions of the new curriculum and the circumstances of mathematics pre-university level students in Malaysia.
Keywords: technology integrated, mathematics education, university students, mathematics achievement

INTRODUCTION

It is said that the education should be the one hundred year plan. To establish a nation, education should be established. When the education is well established, the nation keeps the peace. Recently, every nation tried to reform its national curriculum to keep its education system. Malaysia is not an exception. Since 1956, Malaysia's national curriculum through the Ministry of Educational (MOE) has tried to reform the national curriculum to nurture creative and talented students, to establish internal stability in mathematics education, and to realize school mathematic goals. In 2015, the MOE addressed the outline of the national curriculum and is developing the details of the mathematics curriculum. The MOE also made an effort to promote the education of technology integrated. In the newest reform, the authors describe the directions of the new curriculum and the circumstances of foundation education in Malaysia.

MALAYSIA NATIONAL CURRICULUM OF MATHEMATICS

The goals of the mathematics curriculum reform are: to provide basic mathematics content for future university students studying the natural sciences, for securing mathematics teaching time to develop mathematical creativity in communication and problem solving and to solve individual differences in learning mathematics. By necessity, the MOE reformed the national curriculum for elementary, middle and high schools in 2017. The goals of this reform are to identify the similarities and differences between the national, district, school and individual levels, to promote learners autonomy and creativity, to establish education with schools, teachers, students and parents, to develop school educational plans and to keep and manage their quality. Based on the goals, the 2017 mathematics curriculum has been developed with some guidelines.
(1) An emphasis on mathematical creativity.
(2) An emphasis on the student's humanity in mathematics education.

(3) Reinforcing the mathematical process.
(4) An application of the technology exposure groups.

The Emphasis on Mathematical Creativity

The curriculum revised the definition of a technology integrated from a skill-based aided to a creative aided, which shed new light on advanced education. In the future, a technology-integrated person is required to have creative abilities for finding new things. For developing creative abilities, we need to create a psychologically and intellectually stimulating educational environment. The 2017 reformed curriculum emphasizes promoting mathematical creativity. The meaning of mathematical creativity is the ability to produce various, original problem-solving methods while doing mathematical tasks, or to explore and construct knowledge from a new point of view.

In school, mathematical creativity is revealed during the process of analyzing, connecting and synthesizing prior knowledge and by experiencing meaningful methods using mathematical reasoning and insight. Also, when learners develop mathematical creativity in school, mathematical communication and expression related to creative thinking have to be developed as well. Creativity can also foster problem-solving skills, reasoning and communication in mathematics.

The Reinforcement of the Mathematical Process

The mathematical process is the activated mathematical ability that occurs during problem-solving. Comparing the mathematical process to the mathematical content prescribed to students, the process in school mathematics can be treated clearly. So the mathematical process is described concretely comparing to the current curriculum in teaching-learning methods.

The Application of the Technology Exposure Group

To avoid the rigidity of organizing and managing the curriculum, the technology exposure group is applied to organize and manage the curriculum flexibly through connection and cooperation between the groups. There are 2 groups (control group and expose group). The application of the technology exposure groups allows learning by different levels and allows making various knowledge skills. The application of the technology exposure groups admits the difference of the learning level, so when learners understand fast, they learn more when they understand slowly, they focus more on fundamental content. Also because the content is presented synthetically, it is possible that various knowledge reorganized the related content can be eliminated.

A TREND OF MALAYSIA EDUCATION FOR TECHNOLOGY INTEGRATED WITH MATHEMATICS

According to the 2017 Trends in International Math and Science Study (TIMSS), Malaysia's ranking in Math demolishes from 20th in 2007 to 26th in 2017. In the recently released 2015 Programme for International Student Assessment (PISA) report published, Malaysia was ranked 52nd out of 65 countries. Malaysia attained a reading score of only 398, significantly lower than the average point of 396 and a drop from the previous score of 414 achieved in the previous PISA 2014 report. In Mathematics, Malaysia did increase from the previous assessment with 412 points (compared to 404 in 2014), although this is still below the average score of 421 points. Given the challenges of the twenty-first century and other changing needs, teaching and learning strategies that have been identified include Computer-Aided Learning/Instruction (CAL/CAI). In Malaysia, a technology integrated student is defined as a student with an outstanding aided who needs special education to develop his or her potential.

Learning mathematics is compulsory for all students in Malaysia, especially for the pre-university level to further their study in a degree programme. Mathematics is important to be completed and to guarantee a good future job market. Because of technology in mathematics, introducing graphing calculator (GC) can make the intangible interactively understanding that can be reached by students substantively enlarged.

Introducing technology in mathematics is expected to motivate students and to help them see the important linkages between mathematics and the real world. On the other hand, this study will demonstrate to educators and researchers on how technology can motivate students with learning mathematics to reach their full potential. While education for the technology integrated students was focused on mathematics and science in the past years, it now has expanded into many areas including invention, information, English, literature, fine art, music, etc. This paper will focus mainly on the mathematics education for GC-aided on pre-university level students.

Selection of GC-aided Students

A mathematics test with GC is conducted with Foundation Science student intakes of 2011/2012 and 2012/2013. The questions are designed and adapted from several sets of questions equivalent to the mathematics syllabus of pre-university level for science students. The study set consist of a collection of information studies related to student demographics, family background, educational background, experience with GC and attitude towards mathematics through four approaches; belief, effort, self-efficacy and GC attitude (Kharuddin, A. F., Azid, N., Mustafa, Z., Kamari, M. N., Ibrahim, K. F. K., & Kharuddin, D., 2020).

Consequently, these data will be analyzed to identify predictor factors for students' achievement on given mathematics tests. The numbers of science students who enrolled in June 2011 and June 2012 are 2,072 pax. These students were registered according to their course of study in unequal numbers. To conduct statistical tests, students were randomly selected through a stratified sampling method based on the number of different courses.

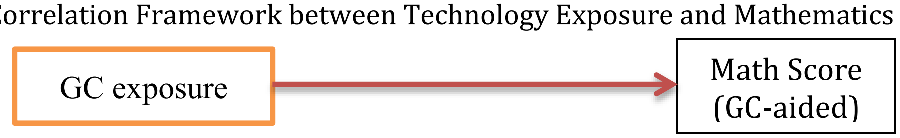
METHODOLOGY

A total of 800 students were chosen based on the available list and separated into two groups. The first group is the control group (CG) and the seconds the exposed group (EG). Both are to consist of 400 students. These two groups will follow a different mathematics workshop but will sit for the same set of tests. For CG, students will study mathematics syllabus related to graphing techniques through traditional methods while the EG will be exposed to the use of GC to answer all mathematics exercises through a method called new technology in teaching technique. Upon completion of the mathematics workshops held in stages over two hours, the students were given a week to review independently and students from the EG were allowed to discover and explore the use of GC.

A total of 763 students successfully grouped to pursue the mathematics with GC test. All of the students were allowed to use the GC to complete a mathematics test in one hour period. Then, the students have distributed a set of questionnaires to obtain information as well as the rate of student assessment on attitudes toward mathematics.

The hypothesis model explored examines whether the relationships between student's technological exposure (Group) and mathematics score (mathematics achievement with GC-aided) is significant or not (refer to Figure 1).

Figure 1: A Correlation Framework between Technology Exposure and Mathematics Achievement



This section of the study indicates the statistical procedures that were used to test the hypothesis. The relationship between the level of measurement and the appropriateness of data analysis is important to make sure the existence of technical and conceptual interaction. Students have started an instrumental genesis when they try to use a new technology device for the first time.

A simple regression test is used to assess whether there is a statistically significant difference between the group performances. Each participant has occupied a specific mathematics course test named Math 1 and Math 2 before entering a workshop and sit for post-test to assess achievement. Is there a statistically significant gain in achievement from the control group score to expose group scores?

Hypothesis Test

H_0: the observed distribution fits the normal

H_a: the observed distribution does not fit the normal distribution

Initially, the dependent variable, mathematics score with GC aided (MSGA) was a continuous observed variable. By using a normality test, the data distribution of this study is substantially negatively skewed for MSGA (see Appendix A). Based on Shapiro-Wilks[1] statistical test, the dependent variable (MSGA) in this study was not normally distributed because of value is not close to 0 and significant value is less than 0.05.

Then, the data is needed to be transformed into a Standardized Zscore by using a transformation method (Tabachnick and Fidell, 2007 and Howell et al, 2009) to assume for normality. A new dependent variable name called Standardized Mathematics Achievement With GC-Aided or SMAWGA (zscore) was introduced for the next analysis.

A simple regression analysis was conducted to investigate how well technology exposure predicts standardized math score with GC-aided. The direction of the correlation was positive (0.834), which means that students who have been exposed to graphing calculators tend to have higher math scores and vice versa (see Figure 2 and Table 1 & 2). The results were statistically significant ($F = 1738.618$, $p < 0.05$) and r^2 indicate that approximately 69.6% of the variance in SMAWGA (zscore) can be predicted from technology exposure (Cohen, 1992). As a result, technology exposure had a positive relationship with SMAWGA (O'Dwyer et al, 2005).

Figure 2: A Correlation Test Result between Technology Exposure and SMAWGA

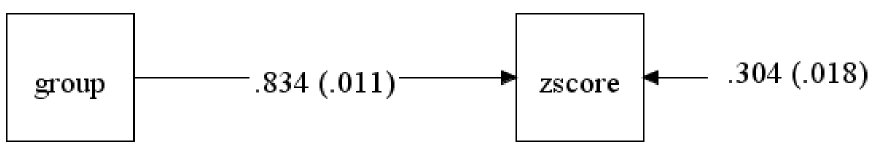


Table 1: A simple Regression Test between Technology Exposure and SMAWGA

STDYX Standardization	Two-Tailed			
	Estimate	S.E.	Est./S.E.	P-Value
ZSCORE ON				
GROUP	0.834	0.011	75.669	0.000
INTERCEPTS				
ZSCORE	-2.505	0.056	-44.969	0.000
RESIDUAL VARIANCE				
ZSCORE	0.304	0.018	16.560	0.000
R-SQUARE				
ZSCORE	0.696	0.018	37.834	0.000

[1] For tests on samples of n = 3 to 2000 use Shapiro-Wilks; for those of n > 2000 use Kolmogorov-Smirnov

Table 2: ANOVA Test between Technology Exposure and SMAWGA

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	530.011	1	530.011	1738.614	.000[b]
	Residual	231.989	761	.305		
	Total	762.000	762			
a. Dependent Variable: Zscore: Total test mark						
b. Predictors: (Constant), Group						

This study has shown that the use of GC improvised math achievement and subsequently promotes positive attitudes towards technology (GC) in doing and learning mathematics. The fact that students were able to complete the problem in worksheet with GC-emulator even though they had not gone through a proper training session on GC was encouraging. Seemingly this paper supports that it is feasible to incorporate technology in learning mathematics using the improvised GC exposure approach for under-prepared students in technology. In other words students in an exam-oriented environment or in institutions where there is a shortage of computer lab, time constraint, lack of resources or infrastructure to receive proper training can still benefit richly from the use of mathematics analysis tools (graphics calculator) complemented with proper design of instructional materials.

THE MISSION OF GC-AIDED EDUCATION: EXCELLENCE AND EQUITY

When we speak of equity, it must be agreed that having equal opportunity does not mean having the same opportunity. Equity means making experiences available that are uniquely appropriate for each individual. A Van Tassel-Baska (1997) state, equity is present when all students have equal access to potential opportunities based on reasonable standards of competence. Offering a skilled musician and a brilliant scientist the same experience is not equity; equity is offering them equal opportunities to pursue their paths toward excellence. Kharuddin, A. F., & Ismail, N. A. (2017) reminds us, excellence for all, if it means the same standards, same curriculum, same instructional emphases, becomes inequitable for all since it fails to recognize individual differences.

What should be changed in the future for GC-aided learners?

a) Differentiating the standard curriculum for GC-aided students
   More and more educators seem to be convinced that differentiating the standard curriculum is the key to the effective education of GC-aided students.
b) Graphing calculator and Differentiating curriculum for GC-aided students
   How can we use Graphing calculator to develop differentiating curriculum for GC-aided students? First, we can use Graphing calculator to accelerate the GC-aided students' current status.

$$f(x) = ax^2, f(x) = ax^2 + bx, f(x) = ax^2 + bx + c$$

   For example, GC-aided student can be asked to explore the properties of graphs.
   Second, students using graphing technology have verified a better understanding of functions and variables and accomplished better in solving algebra problems in applied contexts and interpreting graphs.
   Third, technology that supports multiple representations is shown to increase students' use of visualization in problem solving and gains in understanding.

$$(x + y)^2, (x + y)^3, (x + y)^4, \ldots$$

Example: Evaluate a higher degree polynomial problem.
Fourth, if GC-aided student uses GC, they can explore many mathematics topics which they are interested in. The appropriate practice of GC is shown to afford all students at various levels greater access to complex mathematical concepts.

$$(x+1)^4 = 1x^4 + 4x^3 + 6x^2 + 4x + 1$$

Example: Expand to see a relationship with Binomial Expansion. Find the patterns among numbers in rows and columns in Binomial Expansion.

CONCLUSION AND DISCUSSION

The Malaysian national curriculum of mathematics is well established through plentiful reforms since 1956. Changing the society of Malaysia, creative people are needed to make new things. So, the MOE emphasizes mathematical creativity and also humanity in mathematics education. Now some mathematical research organizations are developing new mathematics curriculums, applying mathematical creativity and humanity. The mathematics syllabi are more focused on daily life situations and more focused on fun. They reduce the mathematical content and try to support the internal stability of mathematical education. Fostering mathematics education and mathematical creativity, technology integrated students are tested by observation and experiment. The programs for GC-aided students are various. With the knowledge and skills, they can search-related information, adapt, modify and innovate in deduce alternatives and solutions upon faced with future changes and challenges. The Mathematics Curriculum is frequently seen as consisting of numerous separate and distinct fields related to measurement, geometry, algebra and problem-solving. However, to further avoid this and separate learning of their concept and skill, mathematics is linked to daily life and experiences, whether in or outside of learning institutes. Students have the opportunity to relate mathematics in different contexts and see its relevance in daily life. Giving opinion and solving problems either oral or written, students is also coached to use correct mathematical language and character. Students are trained to choose the presented information in a mathematical language such as translating and presenting information in table forms, graphs, diagrams, equations or non-equation and further present clear and accurate information, without veering from the original meaning. Meanwhile, technology in education is seen as an advantage especially in supporting achievement in the desired results of learning. Technology being used in teaching and learning mathematics such as calculators should be seen as tools that enrich the teaching and learning process and not to replace teachers. Likewise, the beauty of mathematics is also emphasized. Introducing students to the history of famous mathematicians or important mathematical events in the past may motivate students to appreciate the subject in a long term. Mathematics' intrinsic value especially in systematic, accurate, overall, dedicated and confident thinking applied indirectly or continuously during the teaching and learning process contribute to personal building and nurturing of a positive attitude towards mathematics. Besides, good values are also introduced in the teaching and learning context. Assessments are performed to measure student achievements in tests and examinations as well as other sources which all provide useful information regarding student development and growth. Continuous and daily assessment enables the determination of student strengths and weaknesses as well as the effectiveness of teaching activities. The information gained from answers, group works and home works also help improve the teaching process and then help to enable effective teaching preparation.

Declaration of Conflicting Interests
We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

References

Baruah, N., Ellis, E., Gill, M. & Greenhow, M. (2005) Recent Developments in Setting and using Objective Tests in Mathematics using QM Perception, in Proceeding of CAA Conference 2005.

Chalmers, D., and McAusland, W.D.M. (2002) Computer-assisted Assessment. In The Handbook for Economics Lecturer: Assessment. Edited by J. Houston and D. Whigham, Economics LTSN.

Cohen, J. (1992). Statistical power analysis. *Current directions in psychological science*, *1*(3), 98-101.

Foltz, P. W., Landauer, T. K. and Laham, D. (2004) The Intelligent Essay Assessor: Applications to Educational Technology, Interactive Multimedia Electronic Journal of Computer-Enhanced Leaning, Vol. 2, No. 4.

Horan, M. J. (1987). Report of the second Task Force on Blood Pressure Control in Children—1987. Pediatrics, 79(1), 1-25.

Howell, D. C, Crawford, J. R., & Garthwaite, P. H. (2009). On comparing a single case with a control sample: An alternative perspective.*Neuropsychologia*, *47*(13), 2690-2695.

Kharuddin, A. F., & Ismail, N. A. (2017). Graphing calculator exposure of mathematics learning in a partially technology incorporated environment. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(6), 2529-2537.

Kharuddin, A. F., Azid, N., Mustafa, Z., Kamari, M. N., Ibrahim, K. F. K., & Kharuddin, D. (2020) Determination of Sample Size in Early Childcare Centre (TASKA) Service Project in Malaysia: Classification and Analytical Approach.

Kish, L. (1965). Selection techniques for rare traits. Genetics and the epidemiology of chronic diseases, 165-176.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educ Psychol Meas.

Larson, R., Hostetler, R. P., & Edwards, B. (2007). College algebra: A graphing approach. Cengage Learning.

NCTM (2000) National Council of Teachers of Mathematics: Principle and Standards for School Mathematics. Reston, Virginia, USA.

Neumann, D. A., Houskamp, B. M., Pollock, V. E., & Briere, J. (1996). The long-term sequelae of childhood sexual abuse in women: A meta-analytic review. Child maltreatment, 1(1), 6-16.

O'Dwyer, L., Russell, M., Bebell, D., & Tucker-Seeley, K. R. (2015). Examining the relationship between home and school computer use and students' English/language arts test scores. *The Journal of Technology, Learning and Assessment*, *3*(3).

Patel, A., Kinshuk, K. and Russel, D. (1998) A Computer Based Intelligent Assessment System for Numeric Disciplines, Information Services & Use, Vol. 18, No. 1-2, pp. 53-63, Amsterdam.

Ross, S. M., & Anand, P. G. (1987). A computer-based strategy for personalizing verbal problems in teaching mathematics. ECTJ, 35(3), 151-162.

Tabachnick, B. G. & Fidell, L. S. (2007). *Using Multivariate Statistics*. New York: Allyn and Bacon.

Texas Instrument Incorporated (2010), Automated Online Testing & Assessment, online at http://education.ti.com/en/us/customer-support/training_online_tutorials/graphing-calculators?keyMatch=graphing%20calculator&tisearch=Search-EN.

Thomas, R., Ashton, B., Beevers, C., Edwards, D. and Milligan, C. (2014) Assessing Higher Order Skills Using Simulations, proceeding of CAA Conference 2004.

Van Tassel-Baska, J. (1997). Excellence as a standard for all education. *Poeper Review,*20(1), 9-12.

Whittington, D. and Hunt, H. (1999). Approaches to the computerized assessment of free text responses, proceeding of the Third Annual Computer Assisted Assessment Conference, pp. 207-219.