

Meeting the Needs of Malaysian Mathematically Talented Students by An Enrichment Program: A Module For Primary School Students

Memenuhi Kebutuhan Siswa Berbakat Matematika di Malaysia Pada Program Pengayaan: Modul Untuk Siswa Sekolah Dasar

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School holiday enrichment program annually organized by PERMATApintar National Gifted Centre was to uncover hidden talents in science and mathematics. Students in this program were grouped into different courses. In order to run the Introduction to Cryptology course for primary school students, a new module has been developed. This module has been implemented for the first time during the school holiday program in December 2017. Thus, this study aimed at determining mathematics achievement of 34 Malaysian primary school students in Introduction to Cryptology course. An examination consisting of a set of questions on mathematical concepts was being given to each of the students during the final day of the program. Student scores were being evaluated to assess their achievement. Findings indicate that 73.6% of students scored between 80 and 100 in the examination. Students have good achievement in the concept of integers but they have deficiency in the concept of matrices. Hence, it can be concluded that the students indeed have special ability in doing mathematics. Since matrices were new to Malaysian primary school students, thus interesting activities relating to matrices will be included in the module to intensify students' motivation in mathematics.

Introduction

Students exhibiting mathematical promise or mathematically talented students understand mathematics differently than other students. Lester and Schroeder [1](#) listed twelve cognitive characteristics of mathematically talented students. One of the attributes was the ability to reverse the reasoning process (switch from a direct to a reverse train of thought) which talented students performed with relative ease. Thus, the students' thinking was not only different, it resembles the way that professional mathematicians work with the only difference is in the degree of sophistication [2](#).

In order to address the learning needs of mathematically talented students', experts in gifted education suggested accelerative programs, enrichment programs and modified curriculum. Enrichment programs are recommended for moderately talented students as the programs give students motivation. [1](#) indicates that when pupils were motivated to carry out a complex and in-depth investigation, they often sought new and more advanced knowledge. [3](#) designed an inquiry-based enrichment program and discovered that using higher-level math concepts engaged students and kept them excited about learning. Besides that, [4](#) developed and field tested advanced curriculum for mathematically promising elementary students. They found that the curriculum which focused on disciplinary thinking [5](#) had positively affected the students' achievement.

School holiday enrichment program organized by PERMATApintar National Gifted Centre was a program to uncover hidden talents in science and mathematics. Each course in the program was handled by course instructors and teaching assistants. One of the courses offered in this program was Introduction to Cryptology course. Students who attend this course were from different schools

in Malaysia and had passed UKM 1 and UKM 2 identification tests. They have already mathematical knowledge learned at primary school level. In this Introduction to Cryptology course, students were introduced to the higher level of mathematical concepts behind cryptology which were integers and matrices. Thus, in this study we would like to determine whether or not students have mastered each concept in the integers and matrices.

Methodology

This study was carried out to 34 12-year old students attending Introduction to Cryptology course in the school holiday enrichment program. During this 3-week program, students were taught some basic mathematical concepts and elements of cryptology based on a module. After learning all mathematical concepts, students were being given a set of questions to assess their achievement in mathematics. [Table 1](#) displays the distribution of mathematical concepts covered in each questions.

Question number	Mathematical concept
1 and 2	Integers: Operation on integers
3 and 4	Integers: Division
5 and 6	Integers: Operation on integers modulo n
7	Matrices: Subtracting matrices
8	Matrices: Addition of matrices modulo n
9 - 10	Matrices: Multiplication of matrices
11	Matrices: Inverse of a matrix

Table 1. Distribution of questions on mathematical concepts

Results and discussion

Student scores in the examination were tabulated in [Table 2](#) .

Score range	Number of students
80 - 100	25 (73.6%)
75 - 79	2 (5.9%)
70 - 74	5 (14.7%)
55 - 59	1 (2.9%)
45 - 49	1 (2.9%)

Table 2. Scores in examination

From the above table, most students scored 80 - 100 while only one student scored 45 - 49 in the examination. This shows that 73.6% students have mastered all mathematical concept learned in this course. Scores for each questions in the examination were displayed in Table 3 to determine scores for each mathematical concept using the following formula.

students mark in the related questiontotal marks for that questionsx 100%

Mathematical concept	Score range	Number of students
Integers: Operation on integers	80 - 100	34

Integers: Division	80 - 10065 - 69	322
Integers: Operation on integer modulo n	80 - 10065 - 6950 - 55	3211
Matrices: Subtracting matrices	80 - 10060 - 650 - 34	3112
Matrices: Addition of matrices modulo n	80 - 10060 - 650 - 34	3211
Matrices: Multiplication of matrices	80 - 10070 - 7560 - 6550 - 5540 - 450 - 34	2412313
Matrices: Inverse of a matrix	80 - 10060 - 6540 - 450 - 34	164311

Table 3. Scores on mathematical concepts

From **Table 3**, all students scored 50 - 100 on the concept of integers which shows that this concept dominates the matrices. For the concept of integers, 2 students have difficulty in solving the division problems while 2 students have difficulty in solving operation on integer modulo n problems. Meanwhile, for the concept of matrices, 11 students scored 0 - 34 in finding the inverse of a matrix, 2 students scored 0 - 34 in subtracting matrices, 1 student scored 0 - 34 in adding matrices modulo n and 3 students scored 0 - 34 in multiplying matrices.

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Conclusion

From the results, it is observed that students have mastered the concept of integers but were deficient in the concept of matrices. Integers were the extension of natural numbers hence the concept can be easily understood by the students. Matrices were new to students, thus interesting activities relating to matrices should be included in the module to intensify students' motivation in mathematics.

References

1. Sriraman, B. (2004). Gifted ninth graders' notions of proof: Investigating parallels in approaches of mathematically gifted students and professional mathematicians. *Journal for the Education of the Gifted*, 27, 267-292.
2. Tsui, B. P. H. (2017). How to address the needs of mathematically gifted students?
3. McAllister, B. A., & Plourde, L. A. (2008). Enrichment curriculum: Essential for mathematically gifted students. *Education*, 129(1), 40-49.
4. Gavin, M. K., Casa, T. M., Adelson, J. L., Carroll, S. R., & Sheffield, L. J. (2009). The impact of advanced curriculum on the achievement of mathematically promising elementary students. *Gifted Child Quarterly*, 53(3), 188-202.
5. Tomlinson, C. A., Kaplan, S. N., Renzulli, J. S., Purcell, J., Leppien, J., & Burns, D. (2002). *The parallel curriculum: A design to develop high potential and challenge high-ability learners*. Corwin Press.