An Experiment to Discover Mathematical Talent in a Primary School in Kampong Air

Teh Pick Ching, Brunei Darussalam

Abstract: It is often said that many pupils have hidden talent in mathematics. This hidden ability is rarely seen in a normal classroom teaching and learning situation if the focus of the teacher is on drilling with routine exercises. To allow pupils to display their mathematical talent and to break from mental set and fixation in mathematics, they must be given opportunity to think by themselves with mininum cue or guidance. The pupils could be left entirely on their own to show their mathematical creativity even on mathematical topics which have not been exposed to them. With this approach, five non-routine questions were administered one at a time to a standard 5 class. One out of the 25 pupils in the class consistently exhibited mathematical creativity and talent is answering the questions. Her responses were shown and discussed in this paper.

Kurzreferat: *Ein Experiment, um mathematisches Talent bei Grundschülern in Kampong Air zu entdecken.* Oft wird gesagt, daß viele Schüler verstecktes mathematisches Talent besitzen. Diese verborgene Fähigkeit kann kaum in einem normalen Unterricht und in normalen Lernsituationen erkannt werden, in denen der Lehrer überwiegend das Einüben von Routineaufgaben praktiziert. Damit Schüler ihre mathematische Begabung entfalten und mit mathematischer Fixierung brechen können, muß ihnen die Gelegenheit zum Selberdenken gegeben werden bei einem Minimum an Hilfestellung. Schüler könnten ganz allein gelassen werden, um ihre mathematische Fähigkeit selbst bei ihnen noch unbekannten mathematischen Themen zu zeigen. Nach dieser Methode wurde in einer ganz normalen Klasse jeweils eine von fünf Nicht-Routine-Aufgaben gestellt. Die Antworten einer von 25 SchülerInnen der Klasse, die konsistent mathematische Kreativität und Talent bei der Beantwortung der Fragen zeigte, werden vorgestellt und diskutiert.

ZDM-Classification: C40, D40

1. Introduction

As a supervisor of teaching practice, I used to observe weekly the teaching of mathematics in the same class. After a period of observations, one could pick up the teaching style of the mathematics teacher and the types of learning activities done by the pupils. If we follow the nature of the pupils' involvement and the learning outcomes, we could tell which pupils are active, which pupils can finish their work fast and which have encountered difficulties frequently. The mathematics teacher who monitors the performance of her pupils could also distinguish who are the more able pupils in the class. This is mainly judged from the pupils' responses to the teacher's questions, the written works the pupils have done and the marks obtained by the pupils in a test.

All these observations whether by an outsider or the mathematics teacher herself could not bring out the exceptional ability and talent (if any) of the pupils in mathematics. This is mainly due to the pre-occupation of the teacher to make pupils understand the basic mathematics concepts and the acquisition of the basic skills. Hence, the focus of the classroom learning of mathematics tends to be more of the routine types of work either written or practical. Such practice could hardly provide the pupils with opportunities to display their talent and creativity in mathematics. In this respect, Kruteskii (1976) argued that merely mastery of mathematical material is not a sufficient criterion for mathematical giftedness but should be extended to an "independent creative mastery of mathematics under the conditions of school instruction." Therefore, my experiment was an attempt to stimulate the creative of pupils in an ordinary class in an ordinary school. This was done by posing some mathematics problems for the pupils to solve in their own way with practically no guidance at all.

Therefore, my experiment was an attempt to stimulate the creativity of pupils in an ordinary class in an ordinary school. This was done by posing some mathematics problems for the pupils to solve in their own way with practically no guidance at all.

2. The approach

To get the effect of pupils' creativity, I included the following considerations in designing the problems:

1. The mathematical concept involved needs not be familiar to the pupils. This means that the pupils need not be taught the concept first before they attempt the problem.
2. There should be minimum cue or hint on the solution of the problem. The idea is for the pupils to discover by themselves and have the opportunity to show their talent and creativity at the same time exhibiting true understanding.
3. Use only one problem at a time. This will allow the pupils to set their mind on one aspect of mathematics at a time.
4. Arrange similar problems in hierarchy of difficulty so as to bring the pupils to a greater height of their creativity.

3. Results of the first experiment

A set of five problems was developed involving a number of mathematical concepts. Some concepts are familiar to the pupils and others were not. One concept involves the addition of numbers in a sequence. The other two concepts were based on the idea of algebra and combination. These problems were administered one at a time to a 5B class in Sekolah Rendah Dato Godam Kampong Air. The class had 25 pupils. Outwardly, the class was just like any ordinary class with some active and some passive pupils. Most of the time the pupils would follow the teacher's instruction and did what they were asked to do.

The first problem was on finding the sum of the natural numbers from 1 to 10. My intention was to find out whether the pupils could discover the rule of finding the sum of an arithmetic progression. This was akin to Gauss's discovery of the sum of an A.P. when he was around 12 years old. This problem was given in 3 parts (questions) as shown below:

Question 1

What is the sum of the following numbers:

$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10?$

The problem was given at the end of the mathematics lesson. The pupils were told to do it as homework by themselves without seeking anybody's help. They were to submit their answers the following day. A space for working was given on the question paper.

Out of 25 pupils, only 15 pupils answered the question. Most of them answered correctly. However, the methods used indicate a range of mathematics ability. Examples of pupils' working are shown in Fig. 1–3.

(Omar Ali) **(Rezan)**

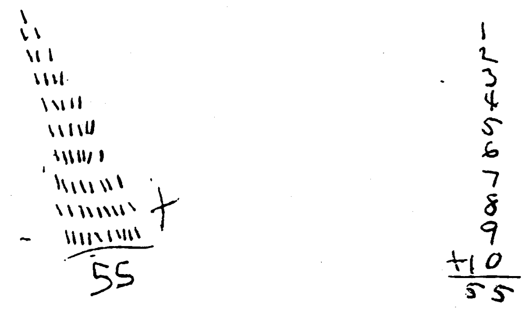

Fig. 1

(Siti Rahmah)

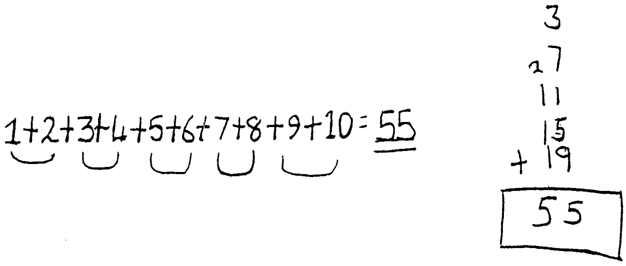

Fig. 2

(Siti Hamizah)

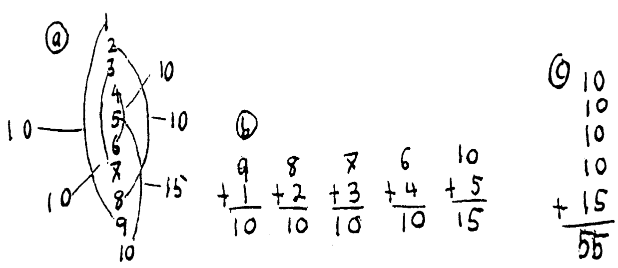

Fig. 3

From these solutions, some features of creativity in mathematics began to appear. This was evident in the last two examples shown above.

The responses of the pupils to Question 1 were not discussed. Question 2 was given a few days later with the same instructions as before.

Question 2

Can you find the answer to Question 1 by another method without adding the numbers one by one?

Only 6 pupils submitted their answers the following day. Samples of the solutions are shown in Fig. 4.

(Jamaejah) **(Siti Hamisah)**

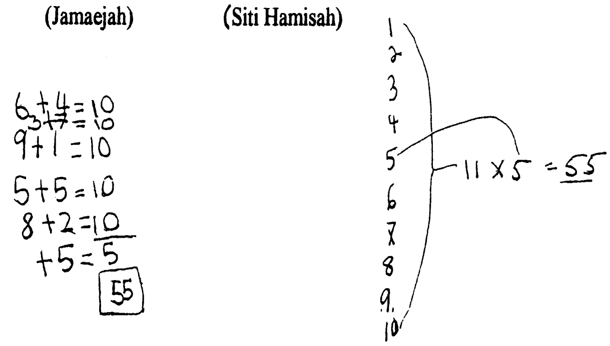

Fig. 4

From these responses, it is obvious that some pupils were trying to get the answer by forming patterns of numbers. Jamaejah attempted to find pairs of numbers whose sums were 10. The method used by Siti Hamizah was most interesting. She began to look at patterns beginning with Question 1. In this question, she had actually discovered the rule used by Gauss when he was 12. In this case Siti Hamizah was only 11 years old! From these responses, Siti Hamizah had shown some special mathematical ability as compared to others.

After a few days the experiment was continued with Question 3. This question was still on the idea of sum of the natural numbers but extended with using the symbolic notation of a series.

Question 3

What is the sum of $1 + 2 + 3 + 4 + \ldots + 50$?

Ten pupils submitted their answers including Siti Hamizah who earlier had discovered the pattern of adding the first and last numbers and so on. In this case, she mistook the missing terms as what must be added to $1 + 2 + 3 + 4$ to get 50 and gave the answer as 40. Two other pupils interpreted the same way as Siti and gave the answer as 40.

The confusion is understandable as the pupils had not been exposed to any symbol denoting the missing terms in a sequence. They assumed that the notation meant just one missing term. As the idea of the study was to allow pupils to work out solutions entirely on their own, there was no attempt to explain the meaning of the notation used. The result also showed that the pupils were solving the problems entirely on their own.

As Siti Hamizah was the pupil who had shown mathematical talent and creativity, I continued with the experiment by giving her two additional problems one at a time. The fourth problem involved the idea of two variables which could be solved by simultaneous linear equations. In this case, as the pupils had not been exposed to algebra, obviously the algebraic method would be out of their reach. Another way of solving this problem would be by trial and error.

Question 4

There are chickens and rabbits in a cage. The total number of heads is 7 and the total number of legs is 22. How many chickens and rabbits are there in the cage?

Siti Hamizah's solution was very interesting. She found the right answer by drawing the heads of rabbits an chickens with the number of legs below the respective head. She might have worked out the answer by trial and error and only recorded the right answer. We can see in this example how imaginative are childen when they come to use drawings and sketches. Siti Hamizah's solution to Question 4 is shown in Fig. 5.

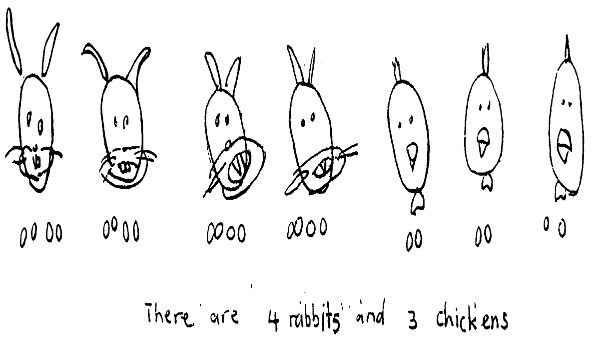

Fig. 5

The last problem in my experiment was a combination problem. Again, the concept was not taught to the pupils. I gave this problem to Siti Hamizah to see whether she could use her creativity in mathematics to come out with a logical answer. Her method of solution was very innovative and logical. By creating five names and drawing figures to represent them in a circle. Beginning with a different person each time in a circle, she counted the number of handshakes. Each round had 4 handshakes and there were 5 rounds. Therefore, she got the answer of 20 handshakes which was double that of the correct answer. What Siti Hamizah did not recognise was the double counting for the same two persons. As no hint whatsoever was given, her method could be considered excellent. Her answer is shown in Fig. 6.

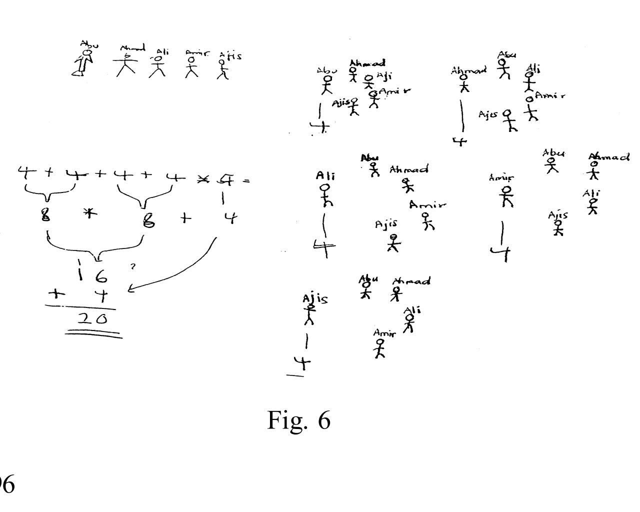

Fig. 6

Question 5

There are 5 pupils. If each pupil shakes hand with everyone, how many different handshakes are there?

Later discussion with the class teacher of 5B confirmed that Siti Hamizah was a top pupil in the class. Her performance was very good in all subjects. Her innovativeness and creativity were further proven when the class teacher told me that Siti Hamizah had produced 4 workbooks which she sold to her schoolmates at 20 cents a copy.

4. Conclusions

This simple experiment confirms that some pupils can discover some interesting ways of solving problems in mathematics if they are given the opportunity to think by themselves. It also has shown that although the mathematics concept where the question depends on has not been exposed, they will try in some way to interpret the problem according to their own understanding. The vital aspect of this study hinges on the condition that minimum cue or guidance be given. The pupils should be left entirely on their own in order to truly display their mathematical creativity and talent.

Although this was the only class the study was done, I was lucky to discover one out of 25 pupils who had shown creativity and talent in mathematics. I believe that in every school there exist pupils who are like Siti Hamizah whose talent and creativity in mathematics have to be discovered by the teachers.

The case of Siti Hamizah in this study conforms to the criteria of creativity ability in mathematics i.e. the ability to break from mental sets and to overcome fixation in mathematics (Haylock 1984). In other words Siti Hamizah has the flexibility of the mental process which breaks away from the stereotyped method of solution of mathematical problems.

Pupils like Siti Hamizah who dare to try different ways of solving mathematical problems have shown the ability to produce original responses to situations which they never encountered before. Such pupils hold great potential if their ability is discovered early and nurtured to attain greater height of development.

5. References

Haylock, D. W.: Mathematical Creativity in Schoolchildren. – In: The Journal of Creative Behavior 21 (1987) No. 1

Krutetskii, V. A.: The Psychology of Mathematical Abilities in School-Children. – In: J. Kilpatrick, I..Wirzup (Eds.), University of Chicago Press, 1976

Teh Pick Ching: A non-routine Question a Day Makes a Pupil Mathematically Happy and Wise. – In: Teaching & Learning 14 (1994) No. 2. Nanyang Technological University, Singapore

Author

Ching, Teh Pick, University of Brunei, Dep. of Science and Mathematics Education, Brunei Darussalam