Evaluating of Creative Thinking of Students and Creativity Development at Southeast University, China

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Abstract

On the basis of creative thinking test of students at Southeast University, characteristics of students' creative thinking and their relations to creativity are summarized in this paper. The main characteristics of students' creative thinking evaluated in the test are fluency, flexibility and elaboration. Generally speaking, marks of fluency and flexibility have direct relations to the general grade of creative thinking. Thus, it is important to train fluency and flexibility of thinking in order to develop students' creative thinking ability.

The above understanding led to the reform in engineering education. First, the authors set up a course of creativity development for students. In the course known as Creative Studies or Creatology, students took part in various exercises of fluent thinking and flexible thinking, especially divergent thinking, to facilitate their creative thinking ability. Second, the authors improved their teaching methods in class. The chief reform included self-comment, mutual-comment, debating, discussion on special items, exercise-correcting mutually and creativity-compensated examination, etc. In a word, the above reform in class meant an attempt of creative education. The investigation showed that most of the students increased their creativity effectively through creative education.

Introduction

Creativity development of students is always valued at Southeast University of China. In order to provide theoretical grounds for creativity development, we measured the creative thinking abilities of students by a test available. Referring to Torrance Test of Creative Thinking (TTCT), the test papers were designed to fit Chinese students. The questions included "list Chinese characters containing a certain texture", "list English words containing a certain letter", "list unusual uses of a common object", "list methods of solving a certain problem", "draw objects containing a certain figure, such as circle, triangle, etc.". The main characteristics of students' creative thinking evaluated in the test are fluency, flexibility and elaboration. The fluency mark refers to characters and ideas listed. The flexibility mark refers to the number of different categories of ideas and different approaches to a certain problem. The elaboration mark refers to the number of details in solving a problem. The results of creative thinking test of 72 students were collected and analyzed. We summarized some characteristics of the above factors, studied their relations to creativity and then worked out the policy of education reform.

Fluency

Fluency means the feature that someone can think or produce numbers of ideas quickly. The marks of fluency of students' thinking are listed in Table 1.

Make the range of marks of fluency abscissa and the number of students ordinate, Fig.1 is drawn to reflect the distribution of marks of fluency.

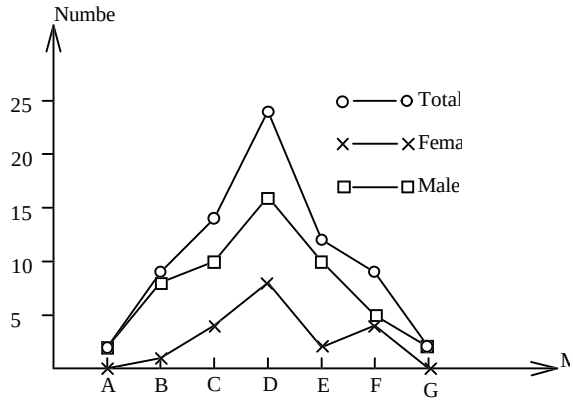

Fig.1 Normal Distribution of Marks of Fluency

As shown in Fig.1, the numbers of students who got higher or lower marks are relative less, the peak value of the curve is located at the range of marks 36-40, approaching the average and the median. The curve shows nearly a normal distribution. We found students' fluency increased slightly after training, but the shape of distribution curve did not change obviously.

Flexibility

Flexibility means the feature that someone can produce a

variety of ideas or use a variety of approaches. The marks of flexibility of students' thinking are shown in Table 2 and Fig. 2.

Table 1 Marks of Fluency of Students' Thinking

Range of Marks		A 21-25	B 26-30	C 31-35	D 36-40	E 41-45	F 46-50	G 51-55
Number of students	Male	2	8	10	16	10	5	2
	Female	0	1	4	8	2	4	0
	Total	2	9	14	24	12	9	2

Table 2 Marks of Flexibility of Students' Thinking

Range of Marks		A 21-25	B 26-30	C 31-35	D 36-40	E 41-45	F 46-50	G 51-55
Number of students	Male	4	9	10	16	7	4	3
	Female	0	3	6	6	2	1	1
	Total	4	12	16	22	9	5	4

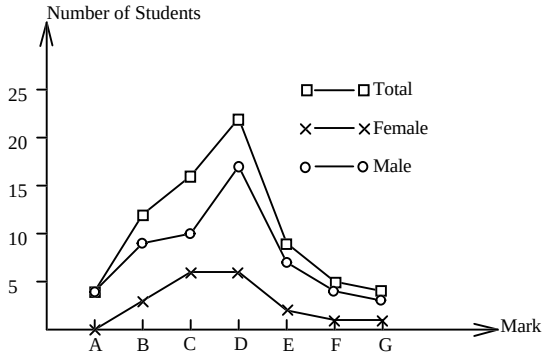

Fig. 2 Right-inclined Distribution of Marks of Flexibility

Table 2 and Fig. 2 show a right-inclined distribution of the curve of flexibility marks. The numbers of students who got higher marks of flexibility are obviously less than that of students who got lower marks. The flexibility marks of most students, especially female students, are below the average level. The statistical data also show there is no obvious relation between the marks of flexibility and the age of students. After training for a period of time, we found students' flexibility increased and the shape of distribution curve changed to normal distribution gradually.

Elaboration

Elaboration means the feature that someone can think or fill the need in detail. The marks of elaboration of students' thinking are listed in Table 4. We did not find any notable correlation between flexibility and students' age or sex.

Table 3 Marks of Elaboration of Students' Thinking

Range of Marks		≤15	16-20	21-25	26-30	31-35	36-40
Number of students	Male	3	8	7	21	6	9
	Female	0	4	3	6	6	0
	Total	3	12	10	27	12	9

Summary

Many researchers think that creative thinking is not a unitary ability, a number of factors are involved in it (Guilford, 1967; Davis, 1986; Torrance &Goff, 1989). We only measured some of them in the test, and found that different factors play somewhat different roles in creative thinking ability.

The computer processing of data suggests the following points of view. The marks of fluency as well as flexibility have close relevance to the total marks of creative thinking. The relevant coefficient are 0.7421 and 0.7358 respectively. The marks of elaboration have low relevance to the total marks of creative thinking. Their relevant coefficient is between 0.3-0.5. The relevant coefficient of flexibility and elaboration is only 0.2454. It seems that there exists no linear interrelation between flexibility and elaboration.

In brief, the normal distribution of marks of fluency indicates that fluency is mainly a natural factor of thinking. Due to its close relevance to creative thinking, it is very important to develop students' fluency of thinking from their childhood.

The right-inclined distribution of marks of flexibility

indicates that flexibility is chiefly an acquired factor concerning education and training. It has close relevance to creative thinking but uncertain relations to age. Therefore, it is very important to train flexible thinking of students, especially of university students, who were short of flexibility training in their former study at school.

Aim at the aforesaid situation and the weak links of our traditional education in China, we practice the following reformatory steps.

Starting a New Course

From the beginning of 1994, we started a new course to train students' creative thinking at Southeast University. The course is called Creative Studies or Creatology, which was introduced into China from U. S. A and Japan in 1980s. The course is set up for the students who want to develop their creativity. Many students from different departments of engineering selected the course every semester.

We compiled a textbook, An Introduction to Creative Studies, on the basis of material collection and our own experience. The contents of the textbook include creativity, creative thinking, creative skill and technique, creativity development, etc. We focused our attention on practice and training in the process of teaching. The students spent nearly half of their class time doing exercises. The 14 main categories of the exercises were fluency of thinking, flexibility of thinking, elaboration of thinking, sensitivity of thinking, redefinition of thinking, divergent thinking and convergent thinking, common-seeking thinking and difference-seeking thinking, forward thinking and backward thinking, observation and memory, imagination, creative technique, brainstorming, creative problem solving, invention designing and paper composing. After every exercise, the students would exchange their answers or opinions and discuss any problem they were interested in.

At the end of the course, every student should hand in a final homework substituting for examination. The homework might be an design of invention, a treatise on a certain subject, an idea of innovation, a reform suggestion, etc. As the results of learning Creative Studies, these homework embodied fully the growing creativity of students, then were compiled into a collection by themselves.

The investigation after the course showed that most of the students (more than 95%) who took part in the course thought their creativity had been developed. One student wrote in the investigation sheet, "After learning the course of Creative Studies, what I have learnt most is methods rather than knowledge, is creative thinking rather than methods. I shall certainly benefit from it all my life." Another student wrote, "From the first class of Creative Studies, a power of creating what is new and original, a function of producing fantastic ideas have been growing immediately in my heart."

Reform in Teaching Methods

It is not enough to develop students' creativity in short-term training. We also practiced creative education in specialized courses. The principal aspect was reform in teaching methods. Some of the new ways to facilitate students' creative thinking ability were as follows.

Self-comment and mutual-comment. After a student answers the teacher's question, his (her) answer should be analyzed and evaluated first by himself (herself), then by the classmates, for training the ability of reviewing and error-finding.

Debating. Directed the students debating on some confusable concepts or principles in class. The debating time was controlled within 15-20 minutes one time. If the students argued intensely, the debating might continue in next class or out of class.

Discussion on special items. When a stage of a specialized course ended, a discussion on a special item was arranged. The subject of discussion was put forward by the teacher, but the discussion was prepared and organized by students themselves.

Exercise-correcting mutually. When a class-exercise or classwork was finished, the students would exchange their answer sheets or exercise-books and correct the exercises each other. Then, asked the students to say what they had learnt form their classmates' exercises and what new ideas they had produced.

Creativity-compensated examination. In a final examination of a subject, questions of specialized knowledge were limited to 80% of the examination content. Some questions concerning creative application of specialized knowledge and creative problem solving were put in (about 20%) as a supplementary part. If a student answered the supplementary questions well, he (she) would get a corresponding mark and the mark would add to the total mark of the examination as compensation.

Table 4 Investigation Results of Experimental Class

Be ..... in Creative Education	very Interested	Interested	Not interested	Total
Number of students	17	22	1	40
Percentage (%)	42.5	55	2.5	100
from Creative Education	Very Profitable	Profited Somewhat	Not Value	Total
Number of students	25	15	0	40
Percentage (%)	62.5	38.5	0	100
Creativity	Great Increased	Increased Somewhat	Did not Increase	Total
Number of Students	19	21	0	40
Percentage (%)	47.5	52.5	0	100

In a word, the above reform in class means an attempt of creative education. It creates an open environment which is advantageous to learning from each other, to flexible thinking and divergent thinking, and to creativity development of students.

The investigation of the experimental class (No. 40957) shows that most of the students are interested in and profited from creative education and their creativity also increased evidently (Table 4).

Conclusions

1. Creative thinking is an important ability formed by some factors. Different factors play somewhat different rolls in the comprehensive ability. There are some laws to follow for developing creative thinking.
2. Considering the characteristics of students' creative thinking and real situation of our education, it is necessary to develop students' creativity, particularly flexibility and fluency of thinking at universities of China.
3. On the basis of the course of Creative Studies, creative education is an effective way for creativity development of students.

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