

Study and Training on Creative Thinking of Gifted Children

Zha Zixiu, China

In 1978, in accordance with the need of four modernization programs of our nation, it became quite urgent to foster large numbers of talented scientists, engineers, and other experts. Thus the new project on identifying, studying, and educating the gifted children was begun.

Since we believe that various kinds of highly creative experts are needed for the future society, the gifted children should possess high creative potential too. Therefore we paid more attention to study several aspects of creativity, such as identifying creativity, creative thinking, creative personality, and cross-cultural study on creativity etc. Among them creative thinking is one of the major aspects.

The purposes of our study on creative thinking are: 1) to find the developmental process and characteristics of creative thinking of gifted children; 2) to explore the effective means for promoting the children's creative thinking.

This paper summarizes the results of the study and training on creative thinking of gifted children, which were

carried out in China within recent fifteen years.

Study on Creative Thinking

Are there any possible differences in creative thinking between gifted and normal children of the same age? How does the process of creative thinking go when the gifted engage in creative activity? In order to clarify these two problems, a series of studies have been conducted.

1. Comparative study of creative thinking between gifted and normal children

Method:

Subjects: Subjects of the experiments were 3000 normal children and 170 gifted children aged from 3 to 11, divided into 9 groups according to their age. The normal subjects were selected randomly, while the gifted were identified by means of multiple criteria and procedures.

Instruments:

Various kinds of creative thinking tests were adopted, such as:

1. "Creative Thinking Test" developed by Cooperative Research Group of Supernormal Children in China (CRGSCC),

2. Guilford's Divergent Thinking Test,
3. The Torrance Test of Creative Thinking,
4. a battery of cognitive ability tests compiled by CRGSCC.

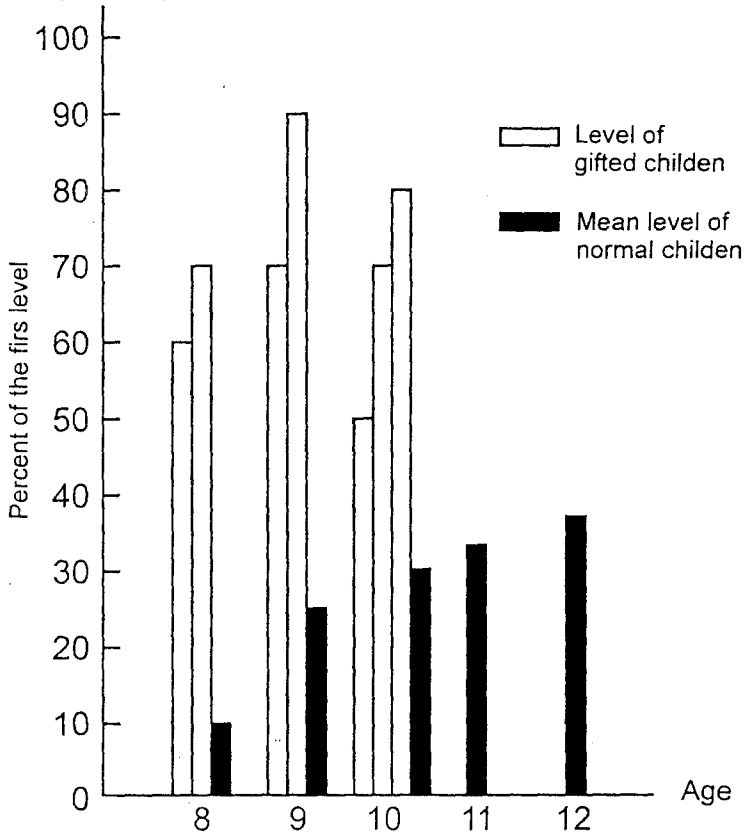


Figure 1 Comparison of the level of creative thinking between gifted and normal children age 8--12

Results and Discussions:

1. The scores of creative thinking tests of gifted children surpass the scores obtained by same aged/older normal children

Zhonglian Li et al. (1984) Zha Zixiu(1983, 1986, 1990) have compared the creative thinking between gifted and normal children aged from 3 to 15 by means of "Creative Thinking Test"

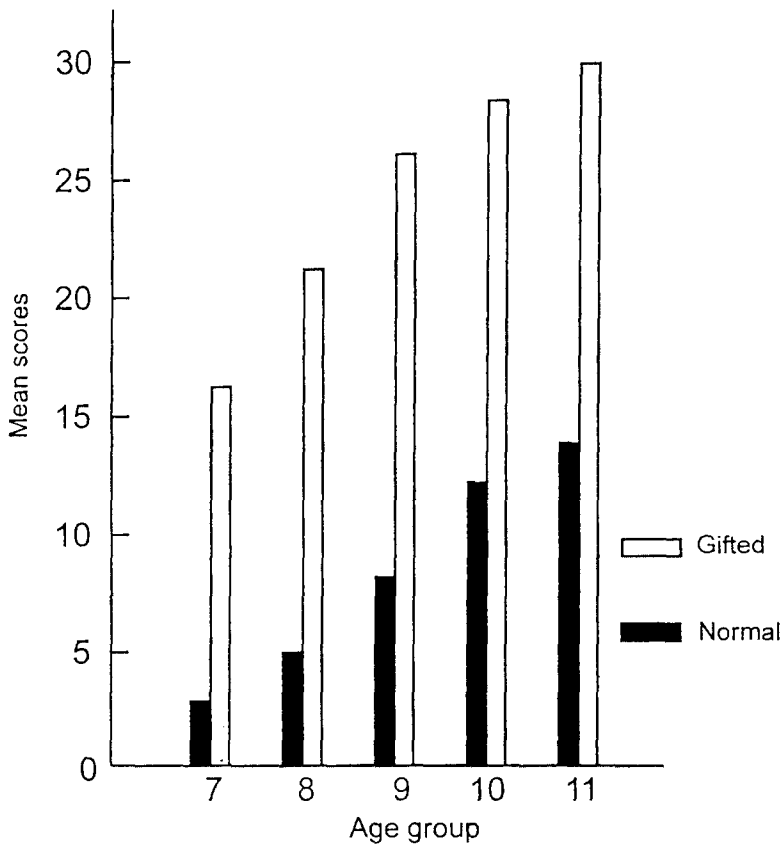


Figure 2 Comparison of creative thinking between gifted and normal children 7--11 years old (mean scores)

developed by CRGSCC. Figure 1 and 2 are part of the results.

Data of Figure 1/Figure 2 were taken from different periods and different subjects. However, both the results show that mean scores of gifted children are two to three standard deviations higher than the mean scores of the same aged normal children. Namely, gifted children are superior obviously to the normal.

Pan Jie (1983) tested 52 gifted youth class students, average aged 16.7, of the Chinese Science and Technology University (CSTU) by means of Guilford's Divergent Thinking Test. The control group was 525 undergraduate students, average aged 20. Results are listed in Table. 1

From Table 1 we can see that the gifted youths are superior to the average undergraduate students, who are two years older, in most items except the symbolic fluency.

Zhu Yuan et al. (1990) tested 43 sophomores of gifted youths class of CSTU (average age 16. 1) by means of Torrance Tests of Creative Thinking. The control groups were: (1) 21 outstanding sophomores of regular class of CSTU (average age 18. 1); (2) 500 regular high school students (average age 16.6), The results are listed in Table 2.

From Table 2 we can see that: (1) The creative thinking of gifted youth class sophomores excel obviously the normal high school student of the same

Table 1. Comparison of the mean scores of Guilford's test

	Fluency		Flexibility		Originality	
	G	A	G	A	G	A
Figure	52.20 ***	36.66	16.31 ***	11.06	7.32 **	2.75
Symbolic	69.02	73.83	19.43 ***	15.79	5.97 **	3.40
Sematic	58.83 *	49.10	19.70 ***	13.59	6.38 **	2.73

Note: G - Gifted youth class student A - Average undergraduate student
 *P<0,05 ** P<0,01 *** P<0,001

age (the difference reached significance);
(2) The creative thinking of gifted youth class sophomores are similar to the regular class outstanding sophomores who are two years older in age.

2. The cognitive ability of gifted children is characterized by highly developed creative thinking.

Results of the cognitive ability test show that the difference of creative thinking between the gifted and the

normal is the highest (i.e. gifted children surpass normal children of the same age by two to three deviations), while analogical reasoning of number takes second place, and observation is lowest. (Zha, 1990) (figure 3.)

In order to get more evidence, we analysed the mean scores of cognitive ability of gifted and normal children tested during various periods.

From Figures 3/4 we can see that:

(1) The creative thinking develops most

Table 2. Comparison of the mean scores of TTCT

Subject	N	Verbal			Figure				
		Fluency	Flex.	Orig.	Fluency	Pond.	Orig.	Elab.	Title
1 Soph. of Y. C.	38	116.1	121.6	112.8	102.2	119.3	114.3	130.8	109.5
2 Soph of R. C.	21	113.2	121.4	109.5	107.7	115.3	123.8	132.7	114.5
3 H. S. Stud.	286	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
† test	1 -- 2	0.43	0.04	0.56	0.98	0.65	1.27	0.22	0.78
	1 -- 3	3.8***	6.23***	3.44***	0.63	5.94***	3.52***	6.17***	2.24*
Note: Flex. -- Flexibility Y.C. -- Gifted Youth Class Elab. -- Elaboration * P < 0.05 *** P < 0.001 Soph. -- Sophomore Orig. -- Originality Pond. -- Ponderation R.C. -- Regular Class H.S. -- High School Stud. -- Student									

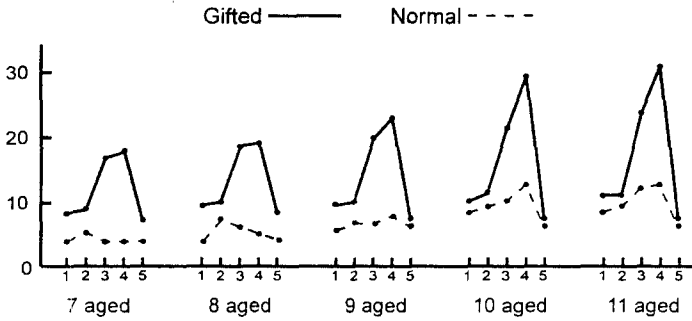


Figure 3 Profile of the comparison of cognitive development between gifted and normal children aged from 7 to 11

1: verbal, 2: figure, 3: number
4: creative thinking, 5: observation

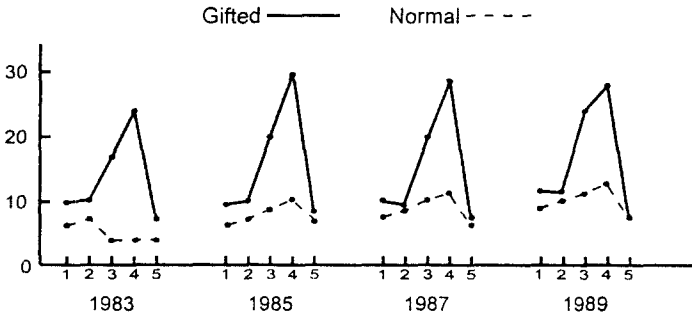


Figure 4 Profile of the comparison of cognitive development between gifted and normal children aged from 7 to 11

1: verbal, 2: figure, 3: number
4: creative thinking, 5: observation

highly in various aspects of cognitive component of gifted children; (2) Since giftedness is characterized by highly developed creative thinking in their component, obvious difference in the pattern of cognitive structure between the gifted and the normal is formed.

The above results might provide the foundation of psychological theory for the identification and education of gifted children.

It seems that in order to identify gifted children effectively, the most significant differences between the gifted and the normal should be found. Similarly, in order to enhance well-development of the gifted, education must be appropriate to their characteristics or pattern of cognitive/mental structure.

II. Study on the process of creative thinking of gifted children

In my opinion, creative thinking is sprouted, expressed, and developed through practical activity of children. Therefore practical activity is an important orientation for studying the process of creative thinking. The major practical activity of children includes learning activity, problem solving, invention, artistic creation, and play games etc.

Since there are certain unrelated factors in the practical activity which might bring on difficulties to the research method, we have tried to do case study, together with investigation, observation, interview, and analysis of product/performance etc. Although it is a tentative study, analysing the process of creative thinking in practical activities, we found gifted children possesses certain characteristics as follows:

1. The whole process of creative thinking is a complete and continued process.

- 2 It is a dynamic process together with insight.

3. The divergent thinking is in connection with convergent thinking, intuition thinking, and creative imagination.

4. The operation of thinking is multiple hierarchy. It proceeds from problem finding to final solution of the problem by stages.

5. Development of creative thinking is influenced by related situation and conditions which are provided.

The summary as mentioned above is preliminary, and necessary to be revised and completed in future study.

Creative Thinking Training

Studies show that creative ability of children could be promoted through training. For ten years, a series of explorations have been achieved to improve the creative thinking of children by Chinese researchers and educators.

1. To develop creative thinking through special courses

An experimental course has been held to develop the creative (divergent) thinking of the children directly. Zhou Lin, Zha Zixiu et al. (1987) have carried out a divergent thinking training experiment in the gifted experimental class of the Beijing No. 8 middle school.

Subjects:

1. Experimental group: 35 students of the gifted experimental class, average age 10, average IQ 138.

2. Control Group: 33 students of the gifted experimental class, average age 10, average IQ 143.

Instructional material and training procedure (for experimental group exclusively):

1. Instructional material: According to the purpose of the study, ten problems concerning natural science and technology have been adopted to compile the material. Each problem is a lesson which lasts 45 minutes in class.

2. Training procedure: Each lesson includes:

(1) The teacher puts the problem of the lesson before the students who are asked to answer questions in written form.

(2) To solve the problem, students should think independently, list possible solutions, note the best one, and describe the reason, the result, and the process of their own thinking. All must be in written form.

(3) To exchange and inspire ideas, especially the best solutions in the group is reviewed and discussed.

Table 3. Comparison of the mean scores of pre-test and post-test of training experiment

Test	Flex.	Fluency	Orig.	Impl.	Prob.	Resesoning
post-test	17.58 **	22.08 **	29.82 **	16.76 **	18.24	21.21 **
pre-test	13.94	15.96	24.21	13.03	16.61	18.33

** significant at the .01 Level

Flex. --- Flexibility Impl. --- Implication Orig. --- Originality Prob. --- Problem solving

The process is recorded by audio and video recorders.

(4) The teacher instructs the students to evaluate and summarize the various solutions, to judge which is the best one.

(5) Each student evaluates his/her own idea, and write by what he/she has been inspired in the procedure.

Check of the training effect:

"Creative Thinking Test" compiled by CRGSCC has been adopted as a means of pre- and post-test of the experimental course. It includes six sub-tests, namely: (i) Flexibility, (ii) Fluency, (iii) Originality, (iv) Implication, (v) Problem solving, and (vi) Reasoning

Students of the experimental group were tested before and after the training experiment. Interval between the two tests was three months. In the mean time, students in the control group were tested also. However, they were not trained as the experimental group did, Main results are shown in Table 3.

Table 3 shows that through the training experiment, mean scores of the post-test of the experimental group are higher than those of the pre-test obviously ($P < 0.01$) except the reasoning sub-test, while differences between mean

scores of pre-test and post-test of the students of the control group are not obvious statistically.

Similarly, more than ten training experiments such as: "Use your brain" training course (Wu Tianming, 1983), and "Creative thinking" training course et al. have been established.

II. To develop creative thinking in combination with general courses

In many experimental classes for the gifted and regular classes, the teacher, according to the characteristics of the subject which he/she is teaching, explore the means of promoting the development of creative thinking of students. For example, in a mathematics class, the teacher enlightens students to give multi-solutions to one problem, or gives an example at first, then instructs students to find other methods to solve the same kind of problems, choose the best one, at last asks students to design some other problems of the same kind and appraise through comparison. In a physics class, the teacher directs students to design physical experiments, operate themselves, and make conclusion through analysis and comparison. In a chinese class, the teacher enlightens students to understand

various aspects of a text through asking questions and state their views; encourages them to express new opinions. All the above mentioned examples have got fruitful results (Wu liangqi et al. 1989; Zha zixiu 1991; Ge Qiyu, 1993).

III. To develop creative thinking through minor inventions.

Here minor invention includes scientific invention, technical making, and literary/artistic creation.

The process for organizing an invention activity is as follows: At first, the researcher/educator gives a lecture on creative invention concerning its principle, knowledge, and technical skill to the students, to develop their creative consciousness, inspire their interests and confidence, and make them understand the process of discovering and solving problems. Then in the main process of the invention activity, the researcher/educator directs the students concretely and purposefully, provides them with specific help, encourage them to overcome difficulties and strive for success indomitably. At the end of the activity, recommends their products to a competition or exhibition of different level. A lot of invention, creation, thesis, and

painting won prizes domestically or abroad. (Zhang Wu Sheng, 1993).

Students could draw useful lessons of combination of theory with practice from invention activity. In general, invention could not only raise creative thinking and creative ability of the students, but also develop their creative consciousness and enhance their confidence and will-quality in engaging creativity/invention. Creative ability possessed by human beings exclusively, is a specific psychological ability. Excellent development of creative ability is an important criterion of the growth of gifted children and creative person. Distinguished creative experts in various fields are necessary in the near future in China. Therefore, to strengthen the study and training of creative ability of the gifted children is attractive to Chinese psychologists and educators. However, the complexity of the creativity itself brings certain difficulties to researchers. Besides, in China, the work began late, theoretical research and methodology are to be improved. Much work remains to be done by the Chinese psychologists/educators.

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