

Analysis of Mathematics Ability Structure in Chinese Mathematical Gifted Student¹

Li, Mingzhen

Southwest University, 1 Tiansheng St., Beibei, Chongqing 400715, China;
E-mail: lmz110@sohu.com

Pang, Kun

Southwest University, 1 Tiansheng St., Beibei, Chongqing 400715, China;
Chinese People's Armed Police Forces Academy, Langfang, Hebei 065000, China;
E-mail: wj_pk@sina.com

(Received September 24, 2005)

Based on author's practice of instructing Chinese gifted students to join the Chinese Mathematics Olympic (CMO), the paper adopted test analysis model of the Scholastic Aptitude Test of Mathematics (SAT-M), tested mathematics ability of 212 mathematical gifted students to join the CMO, applied correlation analysis and factor analysis and proposed the mathematics ability structure in Chinese gifted students including comprehensive operation ability, logic thinking ability, abstract generalization ability, spatial imagination ability, memory ability, transfer ability and intuition thinking ability. And it analyzed the expression form of these abilities respectively and gave some suggestion on mathematics teaching about gifted Chinese students.

Keywords: gifted students, mathematics ability structure, CMO

ZDM Classification: D50

MSC2000 Classification: 97C20, 97D70

INTRODUCTION

To a great degree, that mathematical gifted students' mathematics academic achievement is better than ordinary students' is attributed to higher mathematics ability (Junda & Ying 1996). What mathematics ability structure is? How does form of all ability

¹ This paper has been presented at Poster Session of the Tenth International Seminar of Mathematics Education on Creativity Development at Korea Advanced Institute of Science and Technology, Daejeon, Korea, October 8, 2005.

express? Though many educational psychologists, mathematicians and mathematical educationalist have given out lots of good opinions (Hettinger, Kipp & Goldman 2003; Tannenbaum 1983; Renze & Menda 1997; Zhixiu 1993) there is no agreed understanding about them.

Based on authors' practice and research of instructing mathematical gifted students to join the Chinese Mathematics Olympic (CMO) in Henan Province of China, the paper will propose the mathematics ability structure of Chinese gifted students and give form of every ability in order to offer some suggestions for scientific mathematics education in gifted students.

GIFTED STUDENT'S MATHEMATICS ABILITY STRUCTURE

Adopting test analysis model of the Scholastic Aptitude Test of mathematics (SAT-M) (Bikai 2001), we tested mathematics ability of 212 mathematical gifted students to join the CMO, and the test content included 10 items (Renze & Menda 1997; Cai 1995) and total points were 120 (see Table 1).

Table 1. Test items of mathematics ability

test sequence	point	test item
T 01	21	understanding concept and operation
T 02	15	proposition analysis and comprehensive operation
T03	14	proposition analysis and decision
T 04	13.5	logic analysis and judgement
T 05	13.5	algebra symbol comprehension and operation
T 06	12	graph analysis and operation
T 07	10	number form operation
T 08	8	writing comprehend and operation
T 09	7.5	spatial concept and operation
T 10	5.5	understanding and applying new concept

We applied correlation analysis and factor analysis and gained seven kinds of mathematics abilities of Chinese gifted students. There are

- (1) comprehensive operation ability,
- (2) logic thinking ability,
- (3) abstract generalization ability,

- (4) spatial imagination ability,
- (5) memory ability,
- (6) transfer ability, and
- (7) intuition thinking ability.

Concrete expression form of all ability is as follows.

Comprehensive operation ability is the ability that makes operation to number and formula according to arithmetic and algorithm. It shows that mathematical gifted students are good at not only discovering and applying regular pattern to operate, but also finding problem nature and the connection between problems, using mathematical skills flexibly, paying special attention to objective and thinking actively.

Logic thinking ability is the ability that makes concrete thinking and abstract thinking to known mathematical formation with mathematic reasoning. It is core ability of mathematics ability of gifted students (Xiaoya 2003, pp. 198-199). It shows that mathematical gifted students are good at not only associating number, formula and other knowledge, but also in many ways, thinking about how to solve problem.

Abstract generalization ability is the ability that abstract and generalize relationship and operation of all kinds of mathematical objectives. It includes

- (1) concept generalization,
- (2) operation generalization,
- (3) pattern generalization,
- (4) proof methods generalization, and
- (5) logic generalization.

It shows that mathematical gifted students are good at abstracting their nature, generating model and applying the model to operate and reason.

Spatial imagination ability is the ability that applies spatial figures or images, grasp spatial specific properties (form, size and position) and relationship. It shows that mathematical gifted students are good at not only applying geometric phenomenon to explain operation formula and changeable law, but also forming and understanding geometric concept nature.

Memory ability is the ability that memorizes symbols, mathematical formula, logic models, graph and geometric figures. It shows that mathematical gifted students are good at reasoning, generating operation patterns, keeping and expressing information what is gained concisely by concrete data.

Transfer ability is the ability that promotes known mathematics knowledge, skills, methods and attitude to learn new knowledge and grasp new skills and methods. It shows that mathematical gifted students are good at applying flexibly known mathematical formula, theorem and problem-solving pattern in new situation.

Intuition thinking ability is the non-logic ability that synthesizes and judge quickly visual and non-visual sense form through higher concrete thinking process. It shows that mathematical gifted students are good at comprehending the nature of mathematical objective in a whole, having an insight into mathematics structure and mathematics relationship and grasping directly problem-solving trains of thought and the result of problem.

ENLIGHTENMENT

According to mathematics ability structure of gifted students and form expression of all ability, corresponding mathematical strategies should be adopted (Junda & Ying, 1996; Wenzhong 1994). In mathematics education, mathematical gifted students should be distinguished from ordinary students, and higher requirement should be given in many ways (Kranzler, Whang & Jensen 1994) such as teaching speed, contents depth and learning intensity, in order that mathematics ability structure of gifted students is developed fully.

REFERENCES

- Bikai, N. (2001): Cross cultural research of international mathematics education. *Journal of Guizhou China Normal University* 2, 11–13.
- Hettinger, H. R.; Kipp, K. & Goldman, M. M. (2003): *Cognitive Inhibition in Gifted Children*. A paper presented at Poster Session of the Annual Meeting of the American Educational Research Association, Chicago, IL.
- Kranzler, J. H.; Whang, P. A. & Jensen, A. R. (1994): Task complexity and the speed and efficiency of elemental information processing: Another look at the nature of intellectual giftedness. *Contemp. Education Psychology* 19(4), 447–459.
- Cai, J. (1995): *A cognitive analysis of U. S. and Chinese students' mathematical performance on tasks involving computation, simple problem solving and complex problem solving*. Reston, VA: National Council of Teachers of Mathematics.
- Junda, Z. & Ying, L. (1996): Mathematical intelligence development of gifted children. *Journal of Capital China Normal University* 2, 94–99.
- Renze, C. & Menda, C. (1997): Analysis of mathematical learning ability. *Journal of Psychology* 29(2), 172–177.
- Tannenbaum, A. J. (1983): *Gifted Children Psychology and Education Perspective*. New York: Macmillan.

- Wenzhong, T. (1994): Mathematical education strategies of gifted children. *Educational Science Research* **5**, 28–32.
- Xiaoya, H. (2003): *Mathematical Learning Psychology*. Guangzhou, China: South China Engineering University Press.
- Zhixiu, Z. (1993): *Gifted Children Psychology*. Beijing, China: People Education Press.