A STUDY OF CHILDREN'S COGNITIVE ABILITY ON MAPS

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1 Introduction

Maps are the visualized forms of the real world and the important source and medium to acquire spatial knowledge for children. Also, map is a powerful tool to enhance children's abilities of spatially imagination, abstraction, and logic thinking. The study in this field is very important for development of children's intelligence (Wang 1995) and is an important way to develop children's talent.

In China, the study on children's cognitive ability on maps still is a nearly untouched field. Therefore, we selected a group of children from some primary schools and kindergartens in the City of Nanjing and with different ages to conduct a survey. Its main purpose is to understand the present situation of children' cognitive ability on maps and promote the further studies in this field.

2 Target and methodology

2.1 Target for the test

A total of 252 children including 119 boys and 133 girls and coming from two primary schools and three kindergartens in City of Nanjing were tested. The test is consisted of two stages, i.e. pre-test and post-test. The former includes 252 children and the later 139.The percentages of the children who participated the tests are presented in Table 1 according to age groups.

Table 1. The Percentages of the Children in Different Age Groups in the Tests

Age Group	5-6	6-7	7-8	8-9
Pre-test	40	20	22	18
Post-test	21	3	40	36

2.2 Methodology

The pre-test is the test without any beforehand intervention or instruction on children from their teachers. The post-test means the test conducted after the children obtained some knowledge on maps from their teachers. There are 20 and 25 topics in the pre-test and the post-test respectively. The contents of these topics are given in Table 2 and Table 3. For each topic the answers of A (positive answer such as "I know it"), B (neutral answer such as "It's not very clear for me") and C (negative answer such as "I don't know it") were provided to children tested. The

tools used in the test are globe, atlases for children, Map of the World, Map of China and the map of the local province.

Table 2. The Content of the Pre-test

Topic number	Content
1-7	Generally understanding on map
8-10	Knowledge on the essence of map
11-12	Knowledge on the Map of China
13-14	Knowledge on orientation on map
15	Knowledge on ocean and land on globe
16-17	Knowledge on seven large continents and four large oceans on globe (topic 16) and a world map (topic 17)
18-19	Knowledge on main administrative regions (topic 18) and the river systems (topic 19) on the Map of China
20	Knowledge on the size of celestial bodies in the space

Table 3. The Content of the Post-test

Topic number	Content
1	Ability to recognize orientation on map
2-4	Ability to recognize size of a region and its location on map
5-6	Knowledge on China’s topography
7	Knowledge on the distribution of nationalities on map
8-20	As same as in the pre-test (see Table 2)
21-25	Knowledge on thematic maps, such as distribution of animals and fruits, travel lines, famous buildings and ethnic groups on the world.

3 Results and analysis

3.1 The overall cognitive ability of children in all age groups on map

As Figure 1 shown, the averaged number of children giving answer “A” was obviously larger than that of “B” and “C”**,** and children's cognitive ability on map increases with age. It shows that the cognitive ability is in a positive proportion to the development of children. Moreover, the test indicated that children at age 5-6 have had a basic idea on map and an ability to recognize maps in some degree. The children at age 7-8 have reached the higher level in the ability, which synchronizes with children's cognitive ability on geometrical patterns (Ding and Lin 2000). Since children's cognitive ability on map is controlled by their overall cognitive capability (Tian and Fang 2000) the cognitive ability will, no doubt, change greatly during the period from

childhood to early youth (Liben and Downs 1989).

3.2 The impact of children's sex on their cognitive ability on map

Figure 2 shows the cognitive ability of boys and girls of the all age groups. A1, B1 and C1 are numbers given by boys while A2, B2 and C2 by girls. It can be found that girls are obviously lower than boys in the cognitive ability in each age group (A1>A2). Also, the number of C given by girls (C2) is higher than that of boys (C1). All these shown that sex has effect on children's cognitive ability on map though it is not very large.

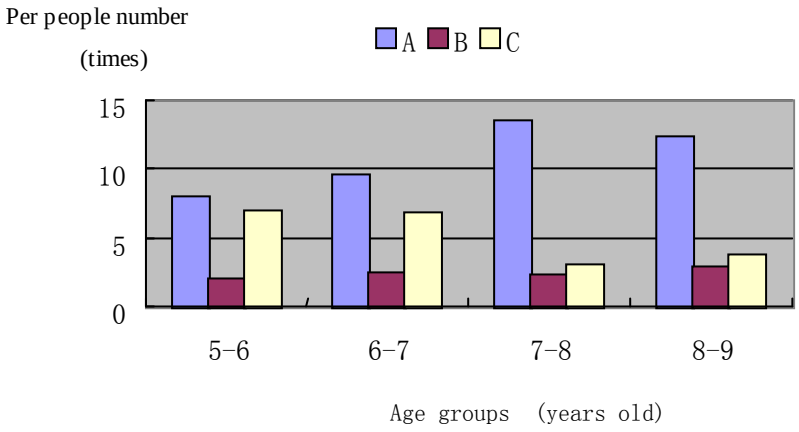

Fig.1 Per *people* number of A, B or C selection by the different age groups

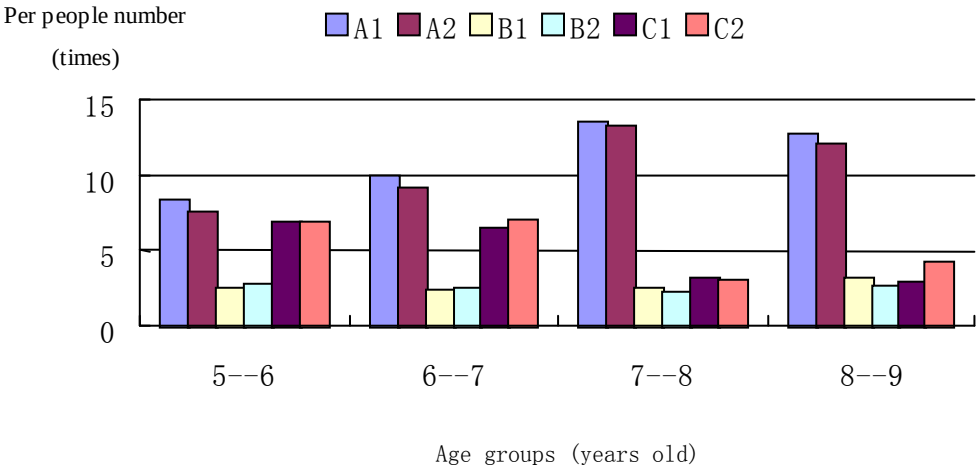

Fig.2 Per *people* number of A, B or C selection by the boys and girls of the different age groups

3.3 Impact of parent's education level on children's map cognitive ability

In the assessment of the impact of parents' education level on children's cognitive ability on maps the codes are: 1 (parents received the junior high school education), 2 (parents received

senior high school education) and 3 (parents received college education or above). Of the children tested, 28% have their parents with a combined value of 6 or more. Those with a score of 5 make up 20% of the total. Those with 3 and 2 account for 17% and 6%, respectively. There are 4 % of the children whose parents education level is unknown.

In Figure 3 there are six bars in each age group. The left three bars represent numbers of "A" selection by children with their father's education level marks of 1,2 and 3, respectively; the right three bars for mother's. Generally, the higher the parents' education level, the better the children's cognitive ability. Besides, this impact is in increase with age: for the age group 5-6, parent's education level has slight impact; for the age group 8-9, the number of "A" selection by children with parents' education level 1 is obviously lower than that of 2 and 3. Moreover, it was found that mother's impact is normally higher than father's. It indicates that mothers bear more on child than fathers do, which is coincided with the real situation in China that mothers usually spend more time on children than fathers do. So, it is urgent to improve women's education level in order to enhance children's cognitive ability.

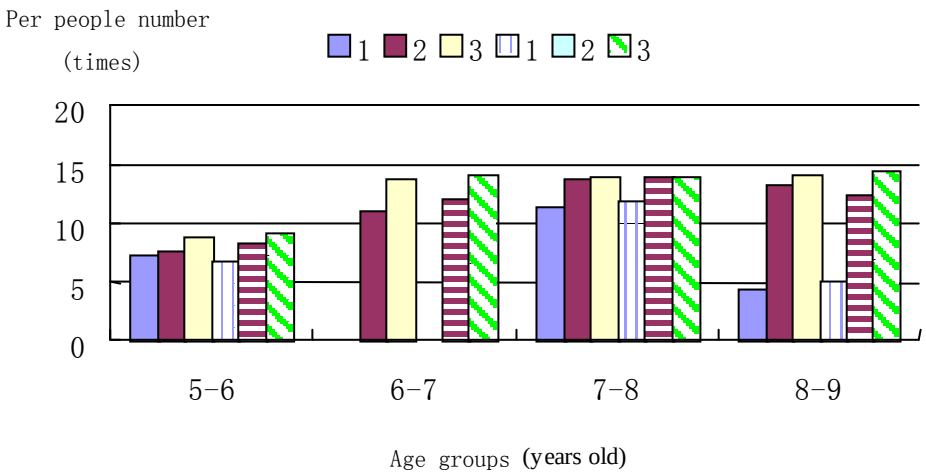

Fig.3 Per *people* number of "A" selection by the children with different parent's education levels in all age groups

3.4 Impact of intervention on children's cognitive ability on map

In order to understand the impact of education intervention on children's cognitive ability on map, the topics 8-20 are tested both in pre-test and post-test. The time lag is one month. It was found that the scores gained by each age group, especially younger age group, in post-test are higher than those in the pre-test (Fig. 4, 5, 6 and 7), indicating that map education bears much on children's cognitive ability on map, particularly on younger age group. This clearly shows that there is a process in the development of children's cognitive ability (Gu 2000) and, therefore, it should be fully considered while compiling children's maps.

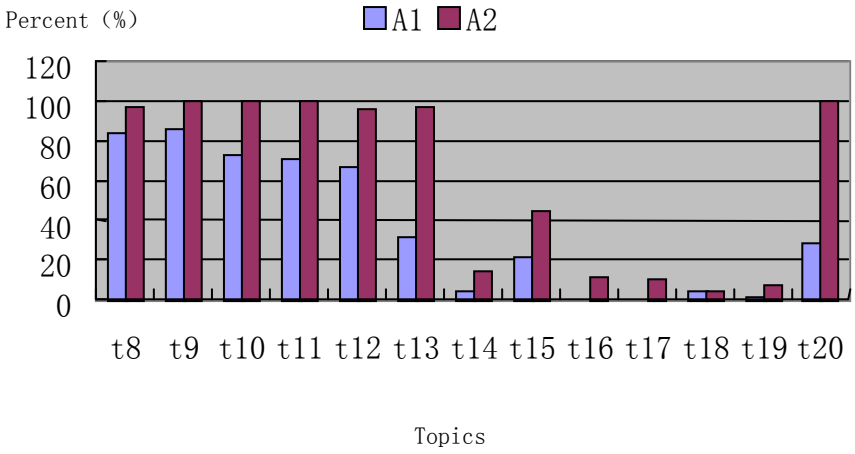

Fig.4 Comparison of the number of A selection by the 5-6 age group on the topics 8-20 in *pre*- and *post*- tests

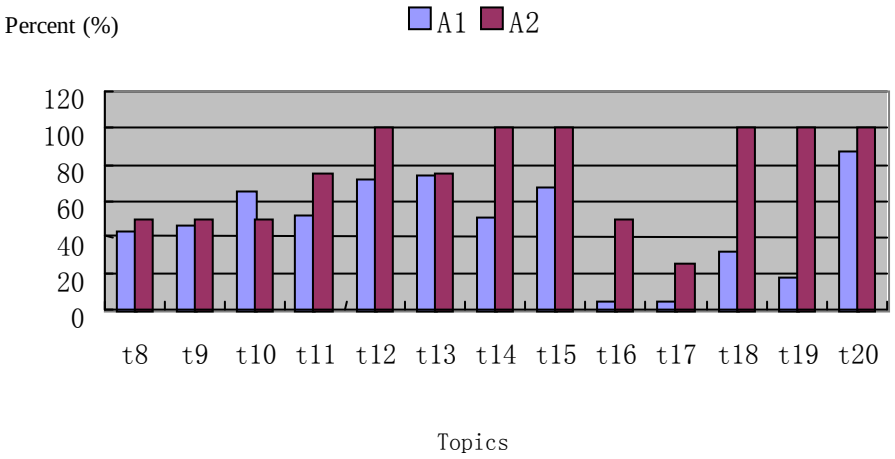

Fig.5 Compare of the number of A selection by the 6-7 age group on topics 8-20 in *pre*- and *post*- tests

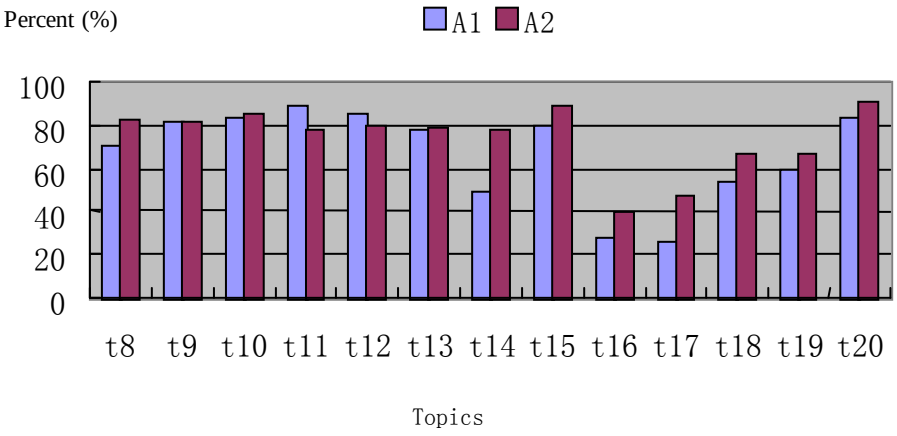

Fig.6 Comparison of the numbers of A selection by the 7-8 age group on topics 8-20 in *pre*- and *post*- tests

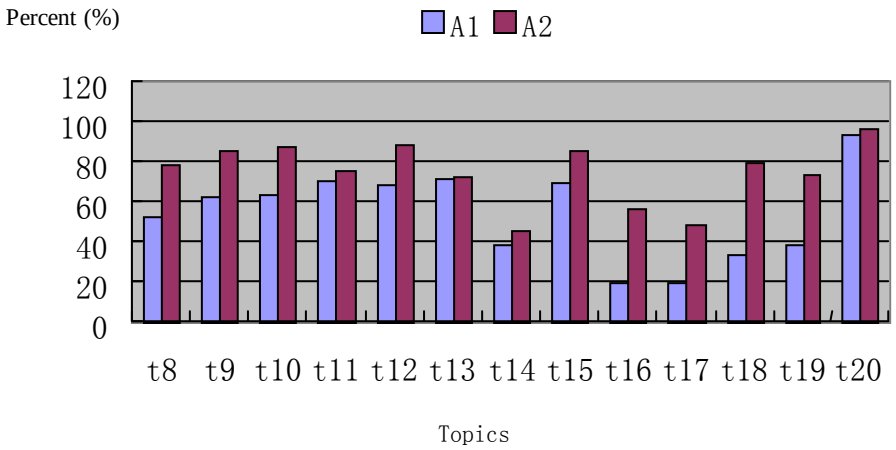

Fig7. Comparison of the number of A selection by the 8-9 age group on topics 8-20 in *pre-* and *post-* tests

3.5 Children's fondness on maps and its effect

Topics 1-7 in the pre-test were designed to test children's understanding and fondness on maps (Fig. 8). Among them, topic 3 is “Are there any maps hanging on wall in you home?” and topic 4 is “Have your parents bought any maps for you?”. The result shown that the percentages of children who gave positive answer are 25% (topic 3) and 40% (topic 4). However, these percentages of children with age 7-8 are the highest in all age groups, which seems one of reasons why the children in this age group obtained the highest scores in the test. It indicates that the more and longer the children use maps the better the children’s performance in the test.

Topic 5 and 6 are about children's fondness on maps and reasons. It was found that average of 80% of children tested like map. The reasons of the fondness are ‘maps are useful (59%) and ‘maps are in good appearance’ (17%). Only 13% of children tested don’t like maps. Among them, 1% is ‘maps are useless’, 7% is ‘no any interests on maps’, and the remaining is ‘not clear’.

The test indicates that children’s maps should be more attractive to children in both content and appearance. In other words, they should have more function to stimulate the children’s fondness and desire for maps (Ni and Lu 1997).

3.6 Children's cognitive ability on thematic maps

The study has indicated that children with age 5-6 have better cognitive ability on concrete and vivid maps and, however, those with age 8-9 do on abstract maps (Blad and Spencex 1995). The present study has confirmed it.

Topics 1-7 and 21-25 in the post-test were designed to test children’s cognitive ability on thematic maps (Fig. 9). It can be found that the scores obtained by children with 5-6 are lowest in all age groups except for topic3, 21 and 22, while the scores of the other age groups are

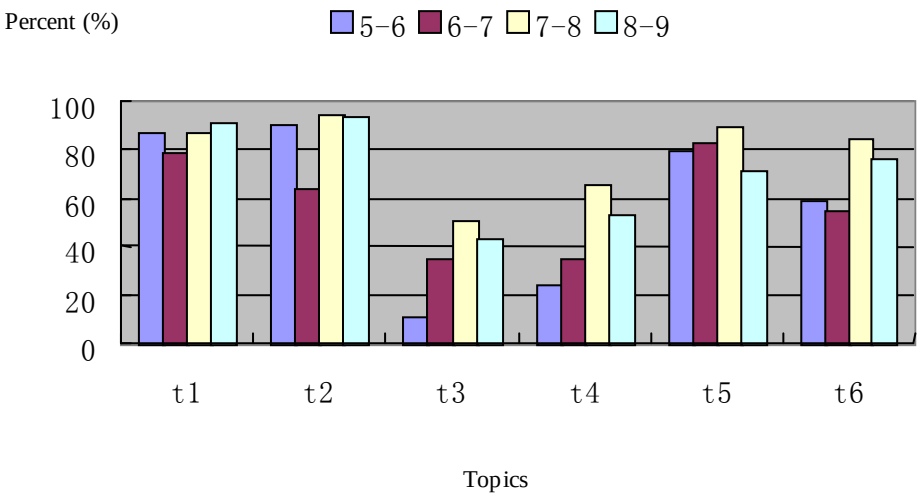

Fig.8 The number of A selection by the different age groups on topic 1-6 in the *pre*- test

only 60% or more. Meanwhile, the test shown that the degree of visualization and abstraction of map symbols has an obvious impact on children's cognitive ability on maps. For instance, although the children with age 5-6 performance well on recognizing animals and fruits expressed by visualized symbols on maps and, however, the scores of the children in all age groups on some highly abstracted targets such as railways are as low as only 48%, even below 10% for the children with age 5-6. Topography (topic 5 and 6) is another example. Although there are 59% of children tested can recognize colors and their corresponding altitude levels on map only less than 40% of children of 5-6 age group do. As to landform type, 62% of children tested are capable to make recognizing and only 20% or less children of 5-6 age group do. It clearly shown that there are more or less difficulties for children to recognize thematic features on maps.

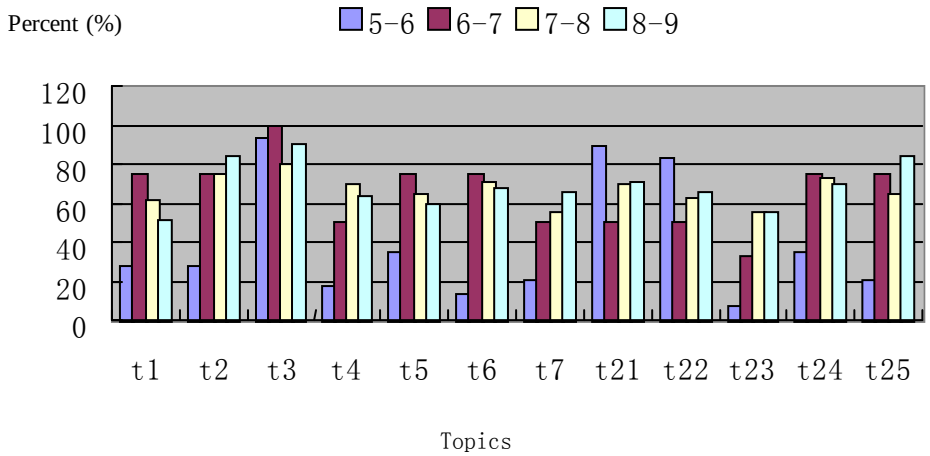

Fig.9 The number of A selection by the different age groups in the *post*- test including 12 topics

4 Conclusions

From this test the following conclusions can be obtained:

(1) Children above 5 years old have an ability to a certain degree to recognize maps and this cognitive ability is in increase with children's age. The performance of children with age 7-8 is the best in all age groups.

(2) Boys' scores are normally higher than girls in the test.

(3) The higher the parents' education level, the better their children's scores in the test, and mothers' education level has stronger effect on fathers' in terms of children's scores.

(4) A prior intervention by teachers on children can much improve children's cognitive ability on maps.

(5) The more and longer the children use maps the better their performance in the test.

(6) The test indicates that while compiling children's maps it should be considered to improve contents and appearance, making the maps having more functions to stimulate children's fondness and desire for maps.

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