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Research Article

CORRELATION BETWEEN INTELLECTUAL CAPACITY AND ABILITY OF MATHEMATICAL LEARNING OF GRADES 8 AND 9 IN JUNIOR SCHOOLS IN HO CHI MINH CITY

Doan Van Dieu

Ho Chi Minh City University of Education, Vietnam

Corresponding author: Doan Van Dieu – Email: doanvandieu@hcmue.edu.vn

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ABSTRACT

The article presented the correlation between intellectual capacity and ability of mathematical learning of grades 8 and 9 in junior high schools in Ho Chi Minh City. The Otis test was used to measure intellectual capacity giving the appropriate reliability index – grade 9 had an average score higher than that of grade 8.For the validity – the average scores of the 8 and 9 graders in junior high schools in Ho Chi Minh are significant different. The general test set of ability and basic skills at level 21/22 in form A was used to measure mathematical learning ability. The results show that students sxored higher with theoretical questions than the practical ones. The correlation between intellectual capacity and ability of mathematical learning of grades 8 and 9 is significant for general and particular aspects. Therefore, it is necessary to investigate students' intellectual capacity before further decisions are made on mathematical learning contents for grades 8 and 9 in junior high schools.

Keywords: correlation; intellectual capacity; junior high school students; mathematical learning ability

1. Introduction

Determining the task of educating and training the people of the country in the new stage, the 1992 Constitution of the Socialist Republic of Vietnam stated the macro objective of national education is to "enhance the intellectual level, train human resources, and foster talents". To make a specific step, the report of the Central Committee of the Communist Party of Vietnam at the 8th National Party Congress was more specific. That is "application

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of modern methods to foster students' ability to solve problems, paying attention to fostering gifted students".

At present, the school's mission, as mentioned above, is to train "people of work, of autonomy, of dynamism and of creativity", which requires the school to maximize its own student's thinking abilities. In other words, the school must foster students' thinking skills and learning methods. Therefore, the study of "the concept of the capacity, the components that make up the capacity of Vietnamese students, its role in teaching, education from which to develop student's ability and become one of the principles for developing general teaching content. The problem was to study the capacity and its components to make education and teaching more convenient in fostering capacity for students, especially self-study capacity." (Nguyen, 1996, p.21)

Historically, mathematics in schools has been one of the subjects considered as the basis to best nurture students' thinking ability. The purpose of teaching mathematics in high school is to develop students intellectually; especially, the operations such as analysis, synthesis, comparison, abstraction, generalization, and so on.The ultimate purpose is to develop intellectual abilities so that students can solve problems independently and creatively. Therefore, it is necessary to consider the relationship between intellectual capacity and learning ability to have a better orientation to develop intelligence through students' learning of mathematics.

2. Methods

The research question is: Is there any correlation between students' intellectual capacity and mathematical learning ability of Graders 8 and 9 in Vietnam?

2.1. Terms

2.1.1. Capacity

> Capacity is specific psychological characteristics that create the conditions for speed, depth, and intensity of impact on the working objects. Thus, competency itself is an integral element of a particular activity, not just the correspondence or suitability of one side being the requirement of activity and the other being a combination of personal attributes (Tran, 1995, p.146).

Capacity is closely related to the trend. It could be said that human power is infinite. However, these abilities do notmanifest completely independently, but rather are related to other aspects such as affection as operating in a complete person.

2.1.2. Intellectual ability

> The intellectual capacity can manifest in the same cognitive aspect, knowing, quick understanding, quick remembering or thinking, finding out the rules quickly, manifested in imagination as rich imagination, immediate visualization, and exactly what others say,

expressed in actions such as quickness, resourcefulness, flexibility, creativity; embodied in qualities such as curiosity, passion, interest in work, and perseverance... (Kharlamop, 1978, p.11).

2.1.3. Purpose of teaching mathematics

Mathematics is not classified in natural sciences nor social sciences because its position and role in high school curriculumis:

- Essential tools to help students learn well in other subjects and help students work effectively in all fields.

- Help students develop intellectual capacities and qualities, such as training abstract thinking, rigorous logical reasoning, accurate thinking, logical thinking, scientific methods in thinking, in thinking essay, in learning, and in problem-solving such as observing, experimenting, groping, predicting, using thinking skills such as inductive, similar, proving, etc. thereby, fostering creative intelligence for students.

- Help students build the basis of the scientific worldview, educate patriotism in socialism, and train many valuable virtues such as disciplined, persistent, self-reliant labor, and love exactness and truth. In addition, mathematics could contribute to the student's ability to perceive the beauty of creative laborand the beauty of the rich applications of mathematics.

In the other words, it could be said that mathematics help develop general learning skills and helps children orient and build models of intellectual and practical activities. Mathematics, in particular, helps develop the thinking at a high level that the purpose of cognitive education is aimed at. It is also important to emphasize that a high level of thinking power is creativity in life. According to this view, once the capacity for thinking is developed, learners could apply creatively the principles and rules learned in practice to solve specific tasks.

In short, the purpose of teaching mathematics in secondary schools is to develop intellectual competencies to an optimal level. It could be also seen that the mind has many elements such as language, abstract thinking, spatial imagination, observing, memory, methods of thinking, intellectual qualities, etc.

Psychologically, intellectual qualities could include flexibility, independence, and creativity:

- *The flexibility of the mind* is manifested in the following main areas:

+ The ability to change the direction of problem solving in accordance with the change of conditions, know how to find new methods to research and solve problems, easily switch from this type of intellectual activity to another one, overcome stereotypes attitude, machinery, and thinking along the trail.

+ The ability to establish the dependence between knowledge in the opposite order known way (the reversibility of the thinking process).

+ The ability to see a problem, a phenomenon under many different perspectives.

- *The independence of the intelligence* manifests itself in the ability to detect problems by itself and to find answers to them by themselves, not based on available solutions, not on the ideas and arguments of others. The flexibility and independence of thinking are the basis for creating critical thinking skills and creative thinking skills. Through the characteristics mentioned above, it could be concluded that the characteristics of "not stereotyping" and "not relying" on are the manifestations of creative thinking skills and the evaluation of other people's thoughts and assessing ideas.

- *Purpose of teaching mathematics in secondary schools*. The teaching of mathematics must be done step by step for students:

+ Understand the essence of a concept (distinguish between intrinsic and non-essential signs of the concept),

+ Apply the concepts into specific problems, solving problems into practice (Hoang Chung, 1995, p.116).

The above work is very important in teaching mathematics because the formation of concepts is the basis of all students' mathematical knowledge, which is the foundation of the ability to effectively use the knowledge and contributes to the development of intellectual capacity and materialistic worldview for learners (Leif, et al, 1970, p.180).

2.2. Research methods

2.2.1. Methods

The methods used in this study are literature review, testing, and statistical methods.

2.2.2. Sampling

- 1,074 students in grades 8 and 9 at junior high schools in Ho Chi Minh City for the Otis test to investigate students' intellectual capacity.

- 480 students in grade 8 at junior high schools in Ho Chi Minh City for the general test set of ability and basic skills at level 21/22 in form A to investigate students' mathematical learning ability.

- 480 students in grade 8 at junior high schools in Ho Chi Minh City to investigate the correlation between students' intellectual capacity and mathematical learning ability.

2.2.3. Tools

- Otis quick-scoring ability test for the Beta was designed for grades 4 through 9. This test consists of 80 items to measure intellectual capacity (Otis, 1954). The use of the Otis

scale in Ho Chi Minh City was carried out according to the following stages: Revision and standardization of the Otis scale in the 1995-1996 school year. The Otis scale was put into practice in the 1998-1999 school year. Otis testincludes the following factors:

+ Find antonyms (items 1, 10, 35, 38, 60);

+ Order the words in the alphabet A B C (items 2, 11, 20, 58);

+ Make the sentences according to the given words (items 28, 41, 43, 65, 80);

+ Find similarities by category (items 3, 17, 23, 29, 36, 72);

+ Find similarities in meaning (items 4, 6, 7, 9, 12, 14,15, 18, 22, 24,2 6, 42,47, 49, 57, 67, 79);

+ Arrange objects in a category (items 32, 33, 46, 51, 58, 68);

+ Find similarities in the picture (items 8, 16, 30, 50, 63);

+ Definition of words (items 13, 19, 27, 31, 39, 44,45, 53, 55, 59, 70);

+ Use words (items 21, 64, 66, 69, 74);

+ Calculating ability (items 25, 37, 50, 61, 75, 76);

+ Find the rules of a sequence of numbers (items 34, 52, 54, 56, 73, 77); and

+ Understand the meaning of sentences (items 48, 62, 71, 78);

- The system of items to measure the ability to learn mathematics includes 80 items compiled from the general test set of ability and basic skills at level 21/22 in form A (Comprehensive Tests of Basic skills, 1989, pp.33-43). This exercise system was developed based on the theories of learning mathematics. Test of mathematical learning ability consisting of 80 multiple choice questions includes the following factors:

+ Ability to understand mathematical concepts (items 1-35).

+ Abstraction ability (items 36-45).

+ The ability to calculate arithmetic (items 46-80).

When collecting data, each student was asked to perform the two above tests in parallel. The correlation between the intellectual capacity and mathematical learning ability was measured.

To find the correlation between intellectual capacity and the ability to learn math, the study conducted simultaneous data collection for two tests. That means a student took 2 tests: the intellectual ability test and the general test set of ability and basic skills at level 21/22 in form A.

The scoring method for the multiple-choice tests and the above system of exercises was one (1) point for the correct answer and zero (0) points for the incorrect answer.

3. Research findings and discussion

There are four parts in this section.

3.1. The status of the intellectual capacity and ability to learn the mathematics of graders 8 and 9

Table 1. *Results of the variances of the Otis test, and the general test set of ability and basic skills at level 21/22 in form A*

Scale	N	M	SD	Reliability
Otis test	1074	44.1099	10.25759	.864
General test set of ability and basic skills at level 21/22 in form A	480	45.98	10.483	.872

Table 1 shows that the average score of Otis test is suitable with the intellectual capacity level of students in grades 8 and 9 in Ho Chi Minh City and is equivalent to one of the US students [with Otis test score of 45, IQ = 99 is equivalent to a student nearly 14 years old]. The average score of the General test set of ability and basic skills at level 21/22 in form A is suitable with the ability to learn the mathematics for graders 8 in Ho Chi Minh City.

3.2. The status of the intellectual capacity of graders 8 and 9 with the Otis test

The following are the results evaluated through the Otis test

Table 2. *The results of Otis test in general*

Factor	M	SD	Ranking
Find antonyms	.8650	.18333	1
Find similarities in the meaning	.6102	.15669	2
Find similarities by category	.5840	.18250	3
Making sentences according to the given words	.5618	.28257	4
Definition of a word	.5419	.14723	5
Use a word	.4991	.23269	6
Find similarities in the figure	.4944	.21288	7
Find the rule of a sequence of numbers	.4736	.25087	8
Sort objects by a category	.4513	.19694	9
Ability to calculate	.4333	.24294	10
Understand the meaning of sentences	.4311	.30225	11
Arrange words according to the letters A B C	.4085	.26671	12

Table 2 show that the students achieved high level with the items: Find antonyms (1); Find similarities in the meaning (2); Find similarities by category (3); Making sentences according to the given words (4); and Definition of a word (5). However, the students achieved lower level with the items that require a higher level of thinking, which is more difficult for students: Use a word (6); Find similarities in the figure (7); Find the rule of a sequence of numbers (8); Sort objects by a category (9); Ability to calculate (10); Understand the meaning of sentences (11); and Arrange words according to the letters A B C (12).

Through the analysis above, it was found that students' thinking development was related to the language development shown through some factors of the Otis test. In other words, the level of language development and thinking of graders 8 and 9 in Ho Chi Minh City was commensurate with age and grade.

Table 3. *Results of partial comparisons of the Otis test by grades*

Factor	Grade				F (df = 1)	P
	8 (N = 537)		9 (N = 537)			
	M	SD	M	SD		
Find antonyms	.8399	.19349	.8901	.16905	20.564	.000*
Arrange words according to the letters A B C	.3724	.25740	.4446	.27117	20.003	.000*
Making sentences according to the given words	.5207	.29046	.6030	.26848	23.254	.000*
Find similarities by category	.5782	.18037	.5897	.18459	1.063	.303 NB
Find similarities in the meaning	.5882	.15928	.6322	.15103	21.505	.000*
Sort objects by a category	.4311	.20567	.4714	.18582	11.379	.001*
Find similarities in the figure	.4909	.21840	.4980	.20736	.296	.586 NB
Definition of a word	.5231	.15053	.5607	.14152	17.769	.000*
Use a word	.4689	.22548	.5292	.23607	18.343	.000*
Ability to calculate	.4038	.24060	.4628	.24191	16.041	.000*
Find the rule of a sequence of numbers	.4261	.24055	.5211	.25221	39.874	.000*
Understand the meaning of sentences	.3715	.29693	.4907	.29597	43.395	.000*

If the comparisons are marked with an asterisk (*), that factor is statistically significantly different at 95% (p < .05). NB means insignificant

Table 2 shows that there are statistical differences in grade 9 and grade 8 with 10 factors: Find antonyms; Arrange words according to the letters A B C; Making sentences according to the given words; Find similarities in the meaning; Find similarities in the figure; Definition of a word; Use a word; Ability to calculate; Find the rule of a sequence of

numbers; and Understand the meaning of sentences. Grade 9 has higher average scores than grade 8. There are not statistical differences in grade 9 and grade 8 with two factors: Find similarities by category, and Find similarities in the figure. In the other words, the intellectual development of grade 9 was almost higher than the that of grade 8. The validity of the Otis test is good.

Therefore, it could be said that learning activities contribute to students' intellectual development. If the students wanted their intellectual capacity to be developed, they must participate in related cognitive development activities.

Table 4. *Results of partial comparisons of Otis force test by gender*

Factor	Sex				F (df = 1)	P
	Male (N = 475)		Female (N = 599)			
	M	SD	M	SD		
Find antonyms	.8459	.19573	.8801	.17152	9.312	.002*
Arrange words according to the letters A B C	.3889	.26167	.4240	.26984	4.602	.032*
Making sentences according to the given words	.5259	.29032	.5903	.27317	13.936	.000*
Find similarities by category	.5796	.18156	.5874	.18331	.474	.491 NS
Find similarities in the meaning	.5953	.15806	.6220	.15471	7.754	.005*
Sort objects by a category	.4537	.20040	.4494	.19430	.128	.721 NS
Find similarities in the figure	.4884	.20810	.4992	.21665	.675	.412 NS
Definition of a word	.5225	.14761	.5573	.14522	14.998	.000*
Use a word	.4880	.24149	.5078	.22529	1.929	.165 NS
Ability to calculate	.4316	.24888	.4346	.23833	.041	.839 NS
Find the rule of a sequence of numbers	.4719	.25187	.4750	.25028	.039	.844 NS
Understand the meaning of sentences	.3774	.27624	.4737	.31516	27.580	.000*

If the comparisons are marked with an asterisk (*), that factor is statistically significantly different at 95% ($p < .05$). NB means insignificant.

Table 4 shows that there are statistical differences regarding gender with six factors: Find antonyms; Arrange words according to the letters A B C; Find similarities in the meaning; Making sentences according to the given words; Definition of a word; and Understand the meaning of sentences. The female students had higher average scores than the male students.

Gender does not affect six factors: Find similarities by category; Sort objects by a category; Find similarities in the figure; Use a word; Ability to calculate; and Find the rule of a sequence of numbers.

3.3. Grades 8 students' ability to learn mathematics

The following are the results of 8th graders' ability to learn mathematics.

Table 5. *8th graders' ability to learn mathematics in general*

Factors	M	SD	Ranking
Ability to understand mathematical concepts	.6917	.12274	1
Abstraction ability	.6142	.19171	2
Ability to calculate arithmetic	.4467	.16920	3

Table 5 shows that the students achieve scores according to ranking with the items as following: Ability to understand mathematical concepts (1); Abstraction ability (2); [higher than average]; and the ability to calculate arithmetic (3) [lower than average]

The students had Ability to understand mathematical concepts and Abstraction ability better than Ability to calculate arithmetic. In the other words, they needed to improve their practice ability.

Table 6. *8th graders' ability to learn mathematics by gender*

Factors	Sex				F (df = 1)	P
	Male (N = 237)		Female (N = 243)			
	M	SD	M	SD		
Ability to understand mathematical concepts	.6913	.12607	.6921	.11965	.005	.943
Abstraction ability	.6165	.19729	.6119	.18648	.067	.796
The ability to calculate arithmetic	.4459	.16725	.4474	.17143	.009	.925

Table 6 shows that there are no statistical differences in average scores between male and female students in Ability to understand mathematical concepts; Abstraction ability; and Ability to calculate arithmetic.

It could be said that male and female students had the equivalent ability to learn mathematics.

3.4. Correlation between the intellectual capacity and the mathematics ability learning

For calculating a correlation between the intellectual capacity and the mathematics ability learning, the research sampling had to be equal in size. The investigation of the ability to learn mathematics was conducted on 480 8th graders. The author had to choose the same student number from the Otis test on the intellectual capacity.

The following are the results of the correlation between the intellectual capacity and the ability to learn mathematics in grades 8

Table 7. *The results of correlation between the intellectual capacity and the ability to learn mathematics in grade 8 in general*

Correlation between intellectual capacity and:	N	r	P
the mathematics ability learning	480	-.095*	.038

**. Correlation is significant at the 0.05 level (2-tailed).*

Table 6 shows that there is a statistical difference in correlation between intellectual capacity and the ability to learn mathematics. It could be said intellectual capacity contributes to the ability to learn mathematics.

Table 8. *The result of the correlation between the intellectual capacity and the factors of ability to learn mathematics in grade 8:*

Correlation between intellectual capacity and	N	r	P
Ability to understand mathematical concepts	480	-.058	.206
Abstraction ability	480	-.158	.000**
Ability to calculate arithmetic	480	-.074	.104

***. Correlation is significant at the 0.01 level (2-tailed).*

Table 8 shows that there is a statistical difference in correlation between intellectual capacity and abstraction ability (one factor in ability to learn mathematics). It could be said the ability to learn mathematics requires more abstraction.

Table 9. *The results of correlation between the ability to learn mathematics and the factors of intellectual capacity in grade 8*

The ability to learn mathematics and	N	r	P
Find antonyms	480	.545**	.000**
Arrange words according to the letters A B C	480	.594**	.000**
Making sentences according to the given words	480	.657**	.000**
Find similarities by category	480	.506**	.000**
Find similarities in the meaning	480	.823**	.000**
Sort objects by a category	480	.587**	.000**
Find similarities in the figure	480	.349**	.000**
Definition of a word	480	.591**	.000**
Use a word	480	.591**	.000**
Ability to calculate	480	.616**	.000**
Find the rule of a sequence of numbers	480	.590**	.000**
Understand the meaning of sentences	480	.600**	.000**

***. Correlation is significant at the 0.01 level (2-tailed)*

Table 9 shows there are statistical differences in correlation between the ability to learn mathematics and each factor in intellectual capacity. It can be said all the factors of intellectual capacity contribute to the ability to learn mathematics.

4. Conclusion

Using the intellectual tests revised and standardized in the educational institutions to discover students with many levels of mental development; so that educators could "enhance the intellectual level, train human resources, and foster talents".

Based on the psychological research findings, the educational institutions develop students' intellectual qualities including flexibility, independence, and creativity in subject matters taught in junior high schools:

The flexibility of the mind was manifested in the following main areas:

+ The ability to change the direction of problem solving in accordance with the change of conditions, know how to find new methods to research and solve problems, easily switch from this type of intellectual activity to another one, overcome stereotypes attitude, machinery, and thinking along the trail.

+ The ability to establish the dependence between knowledge in the opposite order known way (the reversibility of the thinking process).

+ The ability to see a problem, a phenomenon under many different perspectives.

The independence of the intelligence manifested itself in the ability to detect problems by itself and to find answers to them by themselves, not based on available solutions, not on the ideas and arguments of others. The flexibility and independence of thinking are the basis for creating critical thinking skills and creative thinking skills. Through the characteristics mentioned above, it could be seen that the characteristics of "not stereotyping" and "not relying" on are the manifestations of creative thinking skills, and the evaluation of other people's thoughts, and assessing ideas.

In short, we can develop the higher-order thinking skills for students – the current tendencies in education around the world.

The Otis test is used to measure intellectual capacity giving the appropriate reliability index – grade 9 has an average score higher than that of grade 8.

The General test set of ability and basic skills at level 21/22 in form A is used to measure mathematical learning ability that shows the students have theoretical ability scores higher than the practical ones.

The correlation between intellectual capacity and ability of mathematical learning of grade 8 is significant in general and for certain factors.

❖ ***Conflict of Interest:*** *Author have no conflict of interest to declare.*

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HỆ SỐ TƯƠNG QUAN GIỮA NĂNG LỰC TRÍ TUỆ VÀ KHẢ NĂNG HỌC TOÁN CỦA HỌC SINH LỚP 8 VÀ LỚP 9 CÁC TRƯỜNG TRUNG HỌC CƠ SỞ Ở THÀNH PHỐ HỒ CHÍ MINH

Đoàn Văn Điều

Trường Đại học Sư phạm Thành phố Hồ Chí Minh, Việt Nam

Tác giả liên hệ: Đoàn Văn Điều - Email: doanvandieu@hcmue.edu.vn

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TÓM TẮT

Bài báo trình bày hệ số tương quan giữa năng lực trí tuệ và khả năng học Toán của học sinh lớp 8 và lớp 9 các trường trung học cơ sở ở Thành phố Hồ Chí Minh. Trắc nghiệm Otis được sử dụng để đo lường năng lực trí thông minh cho ra hệ số tin cậy phù hợp – lớp 9 có điểm trung bình cao hơn lớp 8, và tính giá trị – điểm trung bình của học sinh lớp 8 và lớp 9 của các trường trung học cơ sở ở Thành phố Hồ Chí Minh có sự khác biệt ý nghĩa thống kê. Bộ trắc nghiệm tổng quát của khả năng và kĩ năng cơ bản ở mức độ 21/22 form A được sử dụng để đo lường khả năng học Toán chỉ ra rằng học sinh đạt điểm số khả năng lí thuyết cao hơn điểm số thực tế. Hệ số tương quan giữa năng lực trí tuệ và khả năng học Toán của học sinh lớp 8 và lớp 9 có ý nghĩa thống kê tổng quát và từng phần. Do đó, cần nghiên cứu năng lực trí tuệ trước khi đưa ra quyết định về nội dung học môn Toán cho học sinh các lớp 8 và 9 trung học cơ sở.

Từ khóa: hệ số tương quan; năng lực trí tuệ; học sinh trung học cơ sở; khả năng học Toán