Universe Scientific Publishing

DOI:10.18686/ahe.v7i9.8059

A Study on the Relationship Between Junior High School Students' Cognitive Style and Chinese and Mathematics Achievement

Kai Zhao

Shanghai University of Sport (SUS),Shanghai Yangpu District,200438

Abstract: Objective: to understand the status of middle school students' thinking style and academic performance, and to further understand and explore the relationship between the two. This will help middle school students improve their academic performance and understand and develop their learning advantages.Methods: Through careful collection of high school students' accurate math and Chinese scores, then under the condition of limited time, let students do cognitive style tests, finally collected three variables, and studied the relationship between the three.In this study, 657 people in the 7th, 8th and 9th grades of Datong No.7 Middle School were tested with mosaic test whose reliability and validity have been proved to be feasible for countless times, and their mathematics and Chinese scores were collected for T test, F test and variance analysis. Results: (1) the differences of cognitive styles in grades 7, 8 and 9 ($F=2.206, p<0.05$) were statistically significant; (2) the difference between male and female students in ($t=-56.513, p<0.01$) cognitive style, ($t=-3.726, p<0.01$) Chinese achievement has reached extremely significant statistical significance; (3) the differences in mathematics scores in 7, 8 and 9 years ($F=12.651, p<0.01$) were statistically significant. (4) the score of mosaic pattern test is significantly correlated with mathematics ($r1=0.633, p<0.01$) and the total score ($r2=0.438, p<0.01$) including the sum of Chinese and mathematics converted into z scores, and Chinese ($r3=0.100, p<0.05$).Conclusion: (1) In the three years when the nine-year obligation is coming to an end, there is little fluctuation in some thinking styles of middle school students. Although they have gone through a storm period, the development of field independence-field dependence cognitive style has not reached a statistically significant difference with the improvement of grade. (2) After entering the junior high school stage, the influence of gender factors on cognitive styles has become more and more important, and the differences of cognitive styles between different genders have reached statistical significance. (3) The research shows that with the grade improvement of junior high school students, the math scores and Chinese scores have changed differently. The grade variation of math scores is large, while the Chinese scores are small. (4) This study concluded that the difference in Chinese achievement between boys and girls in junior high school was statistically significant. The collected mathematics and total scores (converted into Z scores) of junior high school students are closely related to the mosaic test scores, and the correlation coefficients are statistically significant. The correlation coefficients between the Z scores of Chinese and the mosaic test scores are also statistically significant.

Keywords: Cognitive style; Embedded Figure Test (EFT); Academic performance; Field independence; Field dependence

1. Introduction

1.1 Questions

The education of young people is of great concern to all sectors of society, but academic performance is of greatest concern to parents, guardians and teachers. It is therefore crucial that we investigate what exactly influences academic performance. Cognitive style is an individual's preferred way of processing information. Some people prefer to discuss problems with others, while others prefer to think independently . The differences in people's cognitive styles are somewhat stable . Is it true that cognitive styles show some stability over time?

1.2 Literature Review

1.2.1 Research on cognitive styles

Field-independence,field-dependence,impulsivity-contemplation,and simultaneity-sequential temporality are the most common classifications of thinking styles. Here we have chosen field independence-field dependence. Witkin et al. have developed tools to test cognitive styles: from the original rod frame test (RFT) and the body conformity test (BAT) to the Embedded Figure Test（EFT）, which requires subjects to quickly identify simple figures from complex ones. Measurement. The differences between people have been studied as a problem since the time of Aristotle, and the subject is really interesting. Every person is like a leaf, and every leaf is different. The differences between people are obvious, and fortunately effective ways of measuring them have been invented by researchers, and Witkin has given us the opportunity. It is like a visible ruler to measure the difference between people.

1.2.2 Research on cognitive styles and academic performance

How can domain-independent students significantly outperform domain-dependent students in mathematics?Cognitive styles, as a dimension of inter-individual differences, can lead to differences in learning strategies, strengths and efficiency, so exploring the mechanisms by which students' cognitive styles and performance interact can help to guide and implement learning strategies that take into account the mental health and learning characteristics of different types of students.

2. Research Method

2.1 Research Subjects

In this study, 657 students in the seventh, eighth and ninth grades of the seventh middle school in Datong, Shanxi were selected as subjects. The mean age was 13.66 years with a standard deviation of 0.04. There were 326 male students and 335 female students, with a male to female ratio of almost 1:1. 443 students were in year seven, 152 in year eight and 62 in year nine. 631 valid data and 26 invalid data were collected from the schools through screening.

2.2 Research Tools

（1）Datong Seventh Middle School Midterm Results for the Second Semester of the 2018-2019 Academic Year；

（2）The internal reliability coefficient is 0.90 and the correlation coefficient with students' scores in the bar frame test is 0.49. The test is divided into three parts: instruction, test questions and scoring rules, and the test questions are divided into two sections, the first section has 7 questions, all of which are simple graphics, 1 question is worth 1 point, and the time limit is 2 minutes; the second section has 18 questions, all of which are complex graphics, and the first level of slightly complex graphics includes 8, 9, 11, 12, 15, 16, 17, 19, 20, 22 and 23 questions. The first level of slightly complex graphics contains 8, 9, 11, 12, 15, 16, 17, 19, 20, 22, 23 questions, the score is relatively low, 1 question 6 points, the relatively extra complex graphics contain 10, 13, 14, 18, 21, 24, 25 questions, the score is relatively high, 1 question 7 points, time limit 9 minutes. The average score is 63, with scores above 63 being field independent and scores below 63 being field dependent. The more field independent a person tends to be, the easier it is for the student to derive a given simple figure from a complex figure, as the test is initially perceptual in nature, so the test score correlates more with the student's ability to cognitively reorganise spatial figures and mentally model and rotate them.

2.3 Research Process

2.3.1 Implementation testing

The lottery method was used to implement a mosaic graphical test for randomly selected classes of grades 7, 8, and 9, requiring students to first write their age, grade, gender, and other information on the left side of the test paper, with a special intern teacher who reads the instructions (one person from the beginning to the end of the study).

2.3.2 Verification and collection of academic results

Students' midterm scores in language and mathematics for the second semester of the 2022-2023 academic year were obtained from the classroom teacher and then entered into the computer to remove the extreme values before converting the subjects' scores into standard Z-scores as evaluation criteria.

2.3.3 Data entry and analysis

Valid data were imported into SPSS 27.0 for analysis. Correlation analysis, ANOVA, t-test, F-test, and post hoc test statistical methods were used.

3. Results and analysis

3.1 Characteristics of middle school students' cognitive styles

3.1.1 Grade Level Characteristics

Table 1 Grade level ANOVA analysis on cognitive style (M±SD)

Variables	Seventh grade	Eighth Grade	Ninth Grade	*F*
EFT Score	61.68±27.35	66.63±26.77	59.14±26.96	2.21

Note: * denotes $p < 0.05$, ** denotes $p < 0.01$ (same as below)

The above results indicate that the F-test results of the scores of the three middle school grades on the Mosaic Graph Test are not significantly different. This indicates that middle school students do not fluctuate much in some thinking styles, although it is unlikely that middle school students' cognitive styles will change dramatically in the short term as they go through a stormy period.

After further post-hoc comparisons, the difference in mosaic graph test scores between eighth and ninth grade was greater than that between seventh and eighth grade, and the difference in test scores between seventh and ninth grade was the smallest, but both reached significance. This suggests that the second year of secondary school is a major turning point in thinking styles.

3.1.2 Gender differences

Table 2 Gender t-test (M±SD) for EFT Score

Variables	Male	*Female*	*t*
EFT Score	60.56±27.68	64.76±26.71	-56.51**

After entering adolescence, the difference between genders becomes more and more obvious in the cognitive styles between boys and girls ($t=-56.51, p<0.01$) The difference is highly significant. It can be seen that the effect of gender on cognitive style is more pronounced in junior high school students.

3.2 Characteristics of junior high school students' academic performance

3.2.1 Grade Differences

Table 3 Grade level ANOVA analysis of academic performance (M±SD)

Variables	Seventh grade	Eighth Grade	Ninth Grade	*F*
Language Achievement	90.27±14.95	90.56±13.08	88.39±10.82	0.34
Math scores	90.70±22.74	89.36±27.18	69.83±23.70	12.65**

Table 3 shows that the differences in mathematics scores among the seventh, eighth, and ninth grades of middle school were extremely significant, but the differences in language scores were not significant among the three grades, and the variation in mathematics scores was large while the variation in language scores was small.

3.2.2 Gender differences

Table 4 Gender t-test for academic performance (M±SD)

Variables	Male	*Female*	*t*
Mathematics Performance Rating	87.24±26.00	91.02±22.64	-1.941
Language Performance Rating	88.06±15.08	92.28±13.22	-3.726**
Grading	-0.23±1.80	0.21±1.52	-10.637**

From the analysis of the data in Table 4, it can be concluded that first, the t-value corresponding to the chi-squared difference was taken for the significant difference of Levene's equivalence test, and vice versa for the t-value without chi-squared difference (same below). This suggests that the language performance of secondary school students is more influenced by gender.

4. Discussion

4.1 Characteristics of middle school students' cognitive styles

4.1.1 Analysis of Grade Differences

In the three years towards the end of the nine-year compulsory period, secondary school students do not fluctuate much in some thinking styles, and although they experience a stormy period, the development of field-independent-field-dependent cognitive styles does not reach a statistically significant difference as the grade level rises, and students from the first to the third year of junior high school experience changes as they grow older, learn more complex knowledge, and face difficulties in life and learning, and the structural functions of the brain are further complicated and perfected, and the way of thinking about things is gradually stabilized, unlike the previous elementary school period when they were volatile.

4.1.2 Gender difference analysis

Witkin argued that there are significant gender differences in the cognitive development of boys and girls entering middle school. The results of the study by Hou-Chong Chang et al. also showed that boys tended to be more domain independent. Then, we can understand the gender differences in cognitive styles from the following two aspects, which are consistent with previous studies: One is the gender role criteria given by culture and subculture and parenting philosophy and style; the other is the own physiological

genetic aspect, that is, it is related to the different secretion of hormones, speed, onset time, and secondary sexual characteristics of male and female students at the time of physiological development; those who secrete more hormones, develop faster, mature early, and students with more hormones, faster development, early maturity, and outstanding secondary sexual characteristics often tend to be more independent in the field.

4.2 Characteristics of junior high school students' academic performance

4.2.1 Analysis of Grade Differences

The field-independent students performed significantly better than the field-dependent students in the ANOVA analysis of grade differences in academic performance, and found that the differences in mathematics performance were extremely significant in the seventh, eighth, and ninth grades of middle school, but the differences in language performance were not significant among the three grades, and the variation in mathematics performance was large while the variation in language performance was small, which was basically consistent with the findings of previous studies.

4.2.2 Gender difference analysis

There are no studies that show gender differences in adolescents' academic achievement, and this study concludes that there are significant gender differences in language achievement. This researcher believes that this gender difference in language achievement can be explained from two aspects, one is the way of feeling about everything: boys and girls in junior high school mainly show that the way of feeling about things is different in three dimensions: memory, boys are born with stronger abstract thinking ability, and tend to memorize knowledge by understanding the basic principles of some things to In terms of memory; in terms of thinking, boys are more inclined to step by step just like the nine linked rings, solving mathematical proof problems. As a result, boys are better at remembering and processing abstract symbols and deducing them step by step according to logic, such as proofs in mathematics, while girls are more inclined to think about images, such as in language activities.

5. Conclusion

5.1 Study results

(1) In the three years towards the end of the nine-year compulsory schooling period, middle school students did not fluctuate much in some thinking styles, and the development of domain-independent and domain-dependent cognitive styles did not reach statistically significant differences as they progressed through the grades, although they went through stormy periods.

(2) The weight of the influence of gender factors on cognitive styles increased after the middle school stage, and the differences in cognitive styles between genders reached statistical significance.

(3) This study concluded that as junior high school students progressed through the grades, mathematics and language scores changed differently, with greater grade-level variation in mathematics scores and less in language scores.

5.2 Research limitations

First of all, the selection of subjects was not comprehensive enough, more students were selected from the seventh and eighth grades, while fewer subjects were selected from the ninth grade due to the examination; in addition, other subjects, such as physics, chemistry, biology, English, geography, etc., were not studied more thoroughly; and the important factor of IQ was not excluded as a covariate.

References:

[1] Peng Danling. General psychology [M]. Beijing: Beijing Normal University Press, 2019: 466-467.

[2] Ye Qi. Differences in children's field independence, field-dependent cognitive styles and mathematics learning [R]. Shanghai: Primary School of East China Normal University, 2008.

[3] Witkin H A, Goodenough D R, Cognitive Style:Essence and Origins [M]. Madison: 1981, 66-72.