

Factors affecting college students' self-regulated learning ability: an overall cognitive style

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Abstract: *The cognitive style (CS) has less research on the SRL process. The samples of this study mainly include 232 undergraduates from universities in Hebei Province, China. This paper analyze the relationship between college students' cognitive style and self-learning ability level by asking the volume method and through linear regression to determine whether the cognitive style significantly affects students' adaptive learning. The result is that teachers' education reform can improve the quality of adaptive learning.*

Keywords: *cognitive style, self-regulated learning, SRL, college student, a group's cognitive style*

1. Introduction

The popularization of scientific knowledge has accelerated the development of society. The demand for talents has also changed from "professional" to "multi -talented" talents. University is committed to cultivating the comprehensive development of college students and improving students' independent learning ability. Self -regulating learning (SLR) has become a means to adapt to changes in education. In order to cultivate the comprehensive development of talents, more and more colleges and universities have used SRL as one of the main learning models of college students' learning.

Group cognitive style and problem solving lead to significant differences in the self-regulated learning process of college students, and cognitive style is considered to be an important attribute of inter-individual differences ^[1]. Typically, research on SRL seems to conceptualize SRL as an individual activity, focusing on the cognitive processes within individuals that produce what is known as autonomous learning ^[2]. Scholars have proposed many theoretical frameworks to understand cognitive diversity; in general, they use the structure of cognitive level and a cognitive style to define their two key dimensions^[3].

There are significant differences in students in the process of self -adjusting learning, and their grades do not wait in self -learning. By exploring the impact of cognitive style on the self -regulating learning of college students, the reasons for the differences caused by the analysis, and then optimize the self -regulating learning ability of college students. Therefore, the main focus of this article mainly evaluates the level of self -adjusting learning ability and cognitive style of college students, and explores the relationship between cognitive style and self -regulating learning ability levels, provides reference for college students SRL learning and education, guides college students to pay attention to attention The characteristics of their own cognitive style stimulate their SRL learning ability.

2. Literature framework

When it comes to college students learning in school, teachers and researchers will focus on shifting information from the process of acquiring information from the passive teaching process of teachers to the process of actively building their own knowledge and skills. Learning style has become one of the main ways of learning for students. Higher education has a profound influence on college students' adaptive learning ability, which is mainly reflected in the influence of environmental factors on individuals, such as school learning environment, academic performance and teachers' teaching guidance.

2.1 Self-regulation learning

Adaptive learning theory is an important research topic in the field of education at home and abroad in the past 50 years. Constructivism believes that students' learning initiative is produced under the influence of students' self-consciousness, which reflects the realization of learning subjectivity and lays the foundation for the improvement of self-regulation consciousness.

SRL has been defined as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals^[4]." The three-stage cycle of Zimmerman's SRL model circulates various key SRL processes, namely cognition, motivation and metacognition^[5]. Zimmeman believes that it is a process of internalizing external learning skills into one's own abilities, which needs to go through a series of learning stages, which are mainly divided into observation stage, imitation stage, self-control stage and self-regulation stage. The SRL is associated with academic achievement, which improves time management, metacognition, effort regulation, critical thinking to learners, and self-efficacy^[6]. According to the SRL theory proposed by Zimerman, the dividing RSL into four sub -dimensions is motivation, methods, behavior performance, and social environment sources.

2.2 Cognitive style

In the process of adaptive learning of college students, not all types of students can develop their own learning paths^[7]. This leads to a number of changes that students gain from the learning process. On the one hand, the changes come from the differences in cognitive level and cognitive style, which are important factors affecting college students' adaptive learning in the process of adaptive learning. A key factor based on is CS, as it relates to users' information processing habits and represents the typical patterns of perception, thinking, memory and problem solving of individual users^[7].

However, not all types of students are able to develop their own learning paths on their own. This leads to a number of changes that students gain from the learning process. And the cause of goals, prime cognitive style has been shown to affect the amount, type, and organization of an individual's thoughts^[8]. Therefore, when judging students with different cognitive styles, there are various types of cognitive styles when there are different behaviors and learning results during the SRL. The integration of cognitive style characteristics can be divided into three dimensions, including: introverted-internal leaning-outer leaning, intuition-analysis, words-appearance.

3. Design and Methodology

3.1 Data collection procedures

Based on the above investigation, this paper determines the method of questionnaire survey and in-depth interview to evaluate the SRL level and CS level of college students. In the questionnaire part, the sample of this study mainly included 232 undergraduates from colleges and universities in Hebei Province, including 105 males, 127 females and 18 ± 23 undergraduates. College students were chosen as subjects because they mostly needed to accomplish their goals through adaptive learning, which was related to their teaching plan and learning environment factors to ensure that the sample was sufficiently adapted to the research topic. Comprehensively understand the CS status of students and the distribution of different CS students, and infer the overall SRL of students and the relationship with CS. According to the in-depth interviews with teachers, 10 teachers were selected as interview subjects through random sampling using saturation sampling method. Researchers will use questionnaires to investigate and interview guidelines to collect data.

The reliability and validity analysis of the CS questionnaire was conducted, and the results were as follows:

Table 1: Reliability statistics

Var.	Cronbach's α	number of terms
CS	0.893	16
Te-Ti	0.920	6
IA	0.889	5
LR	0.868	5

Note: CS=cognitive style, Te-Ti=Extroversion of thinking-Introverted of thinking, IA=Intuitive analysis, LR=Linguistic representation.

It can be seen from Table 1 that the reliability of the general questionnaire of cognitive style and all dimensions is good (CS=0.893, Te-Ti=0.920, IA=0.889, LR=0.868). It indicates that the collected data has relatively good internal consistency, and the questionnaire has certain stability and reliability.

Table 2: KMO and Bartlett tests

Kaiser-Meyer-Olkin measure of sampling adequacy.		0.871
Bartlett's sphericity test	KOM	2440.791
	df	120
	Sig.	0.000

KMO and Bartlett sphericity test were conducted on the general cognitive style questionnaire. Table 2 shows that KMO value of the general cognitive style questionnaire is 0.871, higher than 0.7, Bartlett sphericity test value is 2440.791, p value is 0.000, reaching the significance level of 0.05. It shows that the general cognitive style questionnaire is suitable for factor analysis, and the specific process of factor analysis is as follows.

After passing KMO and Bartlett sphericity test, principal component analysis was used for factor analysis, and orthogonal rotation was carried out in combination with maximum variance method. The eigenvalues, variance contribution rate, cumulative variance contribution rate and factor load after rotation of the three factors were screened, as shown in the following table.

Table 3: Explains the total variance

component	IE			ESSL			RSSL		
	sum	VAR%	VP%	sum	VAR%	VP%	sum	VAR%	VP%
1	6.374	39.836	39.836	6.374	39.836	39.836	4.275	26.720	26.720
2	2.808	17.551	57.387	2.808	17.551	57.387	3.486	21.787	48.507
3	1.898	11.860	69.247	1.898	11.860	69.247	3.318	20.739	69.247

Extraction method: principal component analysis
 Note:IE=Initial eigenvalue,ESSL=Extract sum of squares and load,RSSL=Rotate sum of squares to load.

Table 3 shows that the cumulative variance contribution rate is 69.247%, indicating that the obtained factors are acceptable and the total questionnaire validity of cognitive style is good.

Table 4: Component matrix after rotation

	constituent		
	1	2	3
A6	0.902		
A2	0.872		
A5	0.839		
A3	0.811		
A1	0.725		
A4	0.716		
B2		0.831	
B4		0.804	
B3		0.797	
B5		0.789	
B1		0.748	
C3			0.849
C2			0.842
C1			0.786
C4			0.783
C5			0.728

As can be seen from Table 4, A1-A6 can be synthesized into a dimension named "introversion of thinking", B1-B5 can be synthesized into a dimension named "intuitive analysis", and C1-C5 can be synthesized into a dimension named "Linguistic representation". Therefore, the sub-dimensions of the questionnaire are introverted dimension of thinking, intuitive analysis dimension and linguistic representation dimension.

The reliability and validity analysis of SRL questionnaire was conducted, and the results were as follows:

As can be seen from Table 5, the reliability of the general questionnaire of self-regulated learning ability and all dimensions is good (SRL=0.870, Mot.=0.749, Met.=0.785, BE=0.784, SSE=0.831). It indicates that the collected data has relatively good internal consistency, and the questionnaire has certain stability and reliability.

Table 5: Reliability statistics

Var.	Cronbach's α	number of terms
SRL	0.870	16
Mot.	0.749	4
Met.	0.785	4
BE	0.784	4
SSE	0.831	4

Note: SRL=Self-regulated learning, Mot.=motivation, Met.=method, BE=behavioral expression, SSE=Source of social environment.

Table 6: KMO and Bartlett tests

The Kaiser-Meyer-Olkin measure of sample adequacy.	0.864	
Bartlett's sphericity test	KMO	1379.969
	df	120
	Sig.	.000

KMO and Bartlett sphericity test were conducted on the self-regulated learning ability questionnaire. Table 6 shows that KMO value of the self-regulated learning ability questionnaire is 0.864, higher than 0.7, Bartlett sphericity test value is 1379.969, p value is 0.000, reaching the significance level of 0.05. It shows that the self-regulating learning ability questionnaire is suitable for factor analysis, and the specific factor analysis process is as follows.

After passing KMO and Bartlett sphericity test, principal component analysis was used for factor analysis, and orthogonal rotation was carried out in combination with maximum variance method. The eigenvalues, variance contribution rate, cumulative variance contribution rate and factor load after rotation of the four factors were screened, as shown in the following table.

Table 7: Explains the total variance

component	IE			ESSL			RSSL		
	sum	VAR%	VP%	sum	VAR%	VP%	sum	VAR%	VP%
1	5.549	34.683	34.683	5.549	34.683	34.683	2.665	16.658	16.658
2	1.745	10.909	45.592	1.745	10.909	45.592	2.623	16.391	33.050
3	1.546	9.663	55.255	1.546	9.663	55.255	2.517	15.730	48.780
4	1.285	8.031	63.286	1.285	8.031	63.286	2.321	14.506	63.286

Extraction method: principal component analysis.
Note:IE=Initial eigenvalue,ESSL=Extract sum of squares and load,RSSL=Rotate sum of squares to load.

Table 8: Component matrix after rotation

	constituent			
	1	2	3	4
F1	0.783			
F3	0.780			
F4	0.753			
F2	0.655			
S1		0.801		
S2		0.773		
S4		0.722		
S3		0.709		
X3			0.770	
X4			0.757	
X1			0.740	
X2			0.694	
D1				0.762
D4				0.751
D3				0.747
D2				0.609

As can be seen from Table 7, the cumulative variance contribution rate is 63.286%, indicating that the obtained factors are acceptable and the total questionnaire validity of self-regulating learning ability is good.

As can be seen from Table 8, D1-D4 can be synthesized into a dimension named "motivation", F1-F4 can be synthesized into a dimension named "method", X1-X4 can be synthesized into a dimension named "behavior expression", and S1-S4 can be synthesized into a dimension named "social environment".

source".

3.2 Treatment of Data

After the data is collected, the data uses SPSS Windows 8.0 software to conduct statistical analysis of the data. Researchers use general weighted average to answer the overall level of SRL and CS, and use a 5 -pound storage meter to evaluate the self -regulating learning ability level.

Through the simple linear regression of independent variables (SRL) and due to variables (CS), the relationship between cognitive style and adaptive learning is verified. Determine the linear correlation between CS and SRL through data.

4. Results

According to the survey data of cognitive style questionnaire, the average value is calculated to judge the overall cognitive style level and various dimensions of current college students. The results are as follows:

Table 9: Results of descriptive statistical analysis of cognitive style

	N cases	MIN	MAX	AVG	SD
Te-Ti	232	1.17	5.00	3.78	1.01
IA	232	1.20	5.00	4.04	0.94
LR	232	1.40	5.00	3.62	1.02
CS	232	1.94	4.94	3.81	0.74

Note: N cases=number of cases, MIN=minimum value, MAX=maximum value, AVG=average value, SD=standard deviation, Te-Ti=Extroversion of thinking-Introverted of thinking, IA=Intuitive analysis, LR=Linguistic representation.

Table 9 shows that the mean value of cognitive style is 3.81 and the standard deviation is 0.74. The mean and standard deviation of introversion of thinking were 3.78 and 1.01. The mean and standard deviation of intuitive analysis were 4.04 and 0.94. The mean and standard deviation of linguistic representation were 3.62 and 1.02. On the whole, the cognitive style and all dimensions are above average level.

Table 10: Results of descriptive statistical analysis of self-regulated learning ability

	N cases	MIN	MAX	AVG	SD
Mot.	232	2.50	5.00	4.52	0.51
Met.	232	2.25	5.00	4.42	0.63
BE	232	1.75	5.00	4.16	0.78
SSE	232	1.50	5.00	3.90	0.94
SRL	232	2.31	5.00	4.25	0.54

Note: SRL=Self-regulated learning, Mot.=motivation, Met.=method, BE=behavioral expression, SSE=Source of social environment.

Table 10 shows that the mean value of self-regulated learning ability is 4.25 and the standard deviation is 0.54. The mean and standard deviation of motivation were 4.52 and 0.51 respectively. The mean and standard deviation of the method are 4.42 and 0.63 respectively. The mean and standard deviation of behavioral performance were 4.16 and 0.78. The mean and standard deviation of social environment sources were 3.90 and 0.94. On the whole, the cognitive style and all dimensions are above average level.

Table 11: Results of correlation analysis between SRL and CS ability

	Mot.	Met.	BE	SSE	SRL
Te-Ti	.277**	.315**	.372**	.535**	.524**
IA	.234**	.211**	.627**	.411**	.522**
LR	.226**	.200**	.233**	.288**	.321**
CS	.331**	.330**	.537**	.559**	.612**

As can be seen from Table 11, there is a significant positive correlation between cognitive style and self-regulated learning ability (0.612), a significant positive correlation between motivation (0.331), a significant positive correlation between methods (0.330), and a significant positive correlation between behavioral performance (0.537). There was a significant positive correlation with social environmental sources, and the correlation coefficient was 0.559.

There was a significant positive correlation between introversion of thinking and self-regulated learning ability. The correlation coefficient is 0.524, showing a significant positive correlation with motivation (0.277), the correlation coefficient is 0.315, the correlation coefficient is 0.372, and the correlation coefficient is 0.535.

Intuition analysis has a significant positive correlation with self-regulation learning ability (correlation coefficient is 0.522), with motivation (correlation coefficient is 0.234), with method (correlation coefficient is 0.211), with behavior (correlation coefficient is 0.627), and with social environment source (correlation coefficient is 0.211). The correlation coefficient was 0.411.

Language representation is positively correlated with self-regulating learning ability (correlation coefficient is 0.321), motivation (correlation coefficient is 0.226), method (correlation coefficient is 0.200), behavior (correlation coefficient is 0.233), and social environment (source). The correlation coefficient was 0.288.

Table 12: Regression analysis results of cognitive style on self-regulated learning ability

	Unstandardized-Coefficients		Standardized Coefficient	t	significance
	B	error	Beta		
constant	2.550	0.148		17.274	<0.001
CS	0.446	0.038	0.612	11.723	<0.001

Dependent variable: self-regulated learning ability, $R^2=0.374$, $AdjR^2=0.371$, $F=137.428$, $p<0.00$

As can be seen from Table 12, the coefficient of determination of the regression equation is 0.374, indicating that the cognitive style of the predictor variable can explain 37.4% of the variation of the self-regulated learning ability of the dependent variable. The corrected coefficient of determination was 0.371, suggesting that the predictive variable cognitive style could explain 37.1% of the variation in self-regulated learning ability of the dependent variable. The regression equation was significant overall ($F=137.428$, $p<0.001$). Cognitive style ($\beta=0.612$, $t=11.723$, $p<0.001$) was a positive predictor of self-regulated learning ability.

The non-standardized regression equation is: self-regulated learning ability = $0.446 \times$ cognitive style + 2.55.

Table 13: Regression analysis results of cognitive style on self-regulated learning ability

	Unstandardized-Coefficients		Standardization coefficient	t	SIG	Tol	VIF
	B	Standard error	Beta				
Constant	2.549	0.149		17.154	<0.001		
Te-Ti	0.175	0.032	0.328	5.401	<0.001	0.732	1.367
IA	0.181	0.035	0.313	5.121	<0.001	0.720	1.389
LR	0.085	0.029	0.160	2.956	0.003	0.916	1.092

Dependent variable: self-regulated learning ability, $R^2=0.386$, $AdjR^2=0.378$, $F=47.874$, $p<0.001$

As can be seen from Table 13, the determination coefficient of the regression equation is 0.386, indicating that the three dimensions of the predictive variable cognitive style can explain 38.6% of the variation of the self-regulated learning ability of the dependent variable, and the corrected coefficient of determination is 0.378, indicating that the three dimensions of the predictive variable cognitive style can explain 37.8% of the variation of the self-regulated learning ability of the dependent variable. The regression equation was significant overall ($F=47.874$, $p<0.001$). Thinking introversion ($\beta=0.328$, $t=5.401$, $p<0.001$), intuitive analysis ($\beta=0.313$, $t=5.121$, $p<0.001$) and verbal representation ($\beta=0.160$, $t=2.956$, $p<0.001$) were all positive predications of self-regulatory learning ability.

The non-standardized regression equation is: self-regulated learning ability = $0.175 \times$ introversion of thinking + $0.181 \times$ intuitive analysis + $0.085 \times$ linguistic representation + 2.549.

5. Conclusion

Through the assessment of cognitive style and independent learning level of college students, the research results show that the cognitive style and adaptive learning ability of college students are above the average level. In addition, through the establishment of regression equation, it is observed that there is a significant positive correlation between college students' adaptive learning ability and cognitive style. It can be seen that the higher the level of CS, the higher the level of SRL ability, and vice versa. Moreover,

through the establishment of regression equation to further observe the impact of CS on SRL, the higher the level of CS, the higher the adaptive learning ability of college students. The relationship between the overall CS level and SRL level will provide references for educators to make interpretation and evaluation, so as to fully understand the characteristics of CS level and SRL learning of college students, and lay a foundation for using other assessment methods to measure students' adaptive learning.

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