

Critical Thinking and Its Relevant Factors among Undergraduates

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ABSTRACT

To explore the present status of Critical thinking and its relevant factors among undergraduates. A stratified random sampling was used to select 1013 undergraduates from 7 full-time colleges in Guangdong province. They were investigated with California Critical Thinking Disposition Inventory-Chinese Version (CTDI-CV) and a Self-Compiled Personal General Information Questionnaire. (1) The total score of CTDI-CV was (254.16±38.80). The undergraduates in the four levels of critical thinking of comprehensive strong, relatively strong, contradictory scope and serious opposition accounted for 1.78%, 5.31%, 87.4% and 5.51% of this group, respectively. (2) Multiple stepwise linear regression showed that the total score of CTDI-CV was positively correlated with the following 10 factors such as grade, family economic status, part-time experience, the teaching method used most commonly, like reading logic books, like reading reviews or essays, father's warmth, mother's warmth, openness and responsibility ($\beta=.142$ to $.701$, all $P<.05$). The following 5 factors such as father's negation, father's overprotection, mother's negation, mother's overprotection and neuroticism were negatively correlated with the total score of CTDI-CV ($\beta=-.381$ to $-.616$, all $P < 0.05$). The overall level of critical thinking among undergraduates is relatively low. College Students' critical thinking may be related to many factors such as family rearing, school education and personal characteristics.

1. Introduction

Critical thinking is a way of thinking in a reasonable, reflective and open mind, which can help individuals express clearly and accurately, reason logically and rationally, and cultivate the spirit of speculation^[1]. From the perspective of constituent factors, critical thinking includes the skills and abilities of critical thinking, as well as the tendency of critical thinking (that is, the intrinsic motivation, intention, emotion, attitude and tendency of using critical thinking). The former is the explicit expression of skills or abilities, while the latter is the

implicit attitude and tendency, which is also the basis of the former. Critical thinking helps people develop independent and logical thinking in the information society, effectively identify information and make decisions quickly and correctly, and then innovate and start businesses. Therefore, as an indispensable part of higher education, the cultivation of critical thinking of college students has been a hot topic in education in various countries^[4-6]. However, in the traditional teaching mode, critical thinking has not been well developed and cultivated and leads to the low critical thinking ability of college students, which affects their academic

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achievement and work performance^[7-9].

As for the influencing factors of college students' critical thinking, previous studies involved the following four categories: (1) Biological factors, such as the executive function of the brain^[10]. (2) Psychosocial factors. Demographic factors, for example, grade, age, gender, place of origin, major, college entrance scores, academic achievement, family economic status^[11-16], etc. Parenting style and parent-child relationship^[17,18]. Teaching and educational factors. They are mainly power distance^[19], teaching methods^[20-24], learning methods^[25,26], social practice^[27], teaching equipment and means^[28,29]. Personality characteristics such as learning motivation, self-confidence, self-esteem, optimism, emotional intelligence, metacognitive skills, problem solving skills and academic self-efficacy^[30-33].

To sum up, previous studies focused on psychosocial factors, and there are no unified opinions on the role of many factors yet. Moreover, most studies only focused on the role of one or two factors, and failed to reveal the role of various influencing factors and the relationship between different factors.

Based on the above analysis, this study intends to adopt a large sample and multi center questionnaire survey to explore the current situation and influencing factors of college students' critical thinking in Guangdong.

2. Objects and Methods

2.1 Objects

From March to May, 2020, a total of 1200 questionnaires were distributed to undergraduates from freshmen to seniors from Guangdong Medical University, Dongguan Institute of technology, Guangzhou Institute of physical education, Xinghai Conservatory of music, Guangdong University of Finance and economics, Guangdong Ocean University and Shenzhen University by a stratified random sampling. 1013 valid questionnaires were returned, with an effective rate of 84.4%. There are 481 boys and 532 girls; 994 Han and 19 minority; 264 freshmen, 250 sophomores, 245 juniors and 254 seniors; 192 in comprehensive universities, 241 in science and engineering universities, 91 in finance and economics universities, 99 in agriculture universities, 252 in medicine universities, 40 in sports universities and 98 art universities; 814 only children and 199 non only children; 11 rich families, 533 well-off families, 427 food and clothing families and 42 poor families; 629 long-term residents in cities and towns and 384 long-term residents in rural areas; 44 excellent students, 517 good students, 399 average students, 49 passing students and 4 failing students.

2.2 Tools

2.2.1 Critical Thinking Disposition Inventory-Chinese Version (CTDI-CV)

It was revised by Peng Meici et al.^[34] according to California Critical Thinking Dispositions Inventory (CCTDI). CTDI-CV has 70 items, which are divided into seven subscales: seeking truth, open mind, analytical ability, systematic ability, self-confidence of critical thinking, thirst for knowledge and cognitive maturity. The 6-point scoring method is used to score from 1 to 6 points corresponding to "very disagree" to "very agree". The higher the total score, the stronger the tendency of critical thinking. The total score is 70 to 420. The evaluation rules are as follows:

If the total score is 350 to 420, indicating that the subject's critical thinking tendency is comprehensively strong; If the total score is 280 to 349, indicating that the subject's critical thinking tendency is relatively strong; If the total score is 210 to 279, indicating that the subject's critical thinking tendency is in the range of contradiction; If the total score is 70 to 209, indicating that the subject's critical thinking tendency is seriously opposed to critical thinking. The scores of each subscale ranged from 10 to 60. The evaluation rules of each subscale are as follows: If the score is higher than 50, indicating that the tendency is very strong; A score of 40 to 49 indicates that the tendency is relatively strong, and a score of 30 to 39 indicates that the tendency is in a state of contradiction; A score of 10 to 29 indicates that the tendency deviates from the requirement of critical thinking. In this study, the Cronbach's coefficient of the total scale is 0.84, and the Cronbach's coefficient of each subscale is 0.68 to 0.77.

2.2.2 Short-Form Egna Minnen av Barndoms Uppfostran (s-EMBU)

It's a self-reported questionnaire, compiled by Marcus (2003) and revised into Chinese version by Jiang prize (2010)^[35]. s-EMBU is divided into father's subscale and mother's subscale, each with 21 items and the same content, including three dimensions: negation, emotional warmth and overprotection. The 4-point scoring method is used to score from 1 to 4 points corresponding to "never" to "always". The average score of each dimension represents the subjects' perceived parenting style. The higher the dimension score, the stronger its tendency. In this study, the cronbach's coefficient of the total scale is 0.85. The Cronbach's coefficients of the father subscale and the mother subscale were 0.87 and 0.82, respectively. The Cronbach's coefficient of each dimension is 0.69 to 0.78.

2.2.3 NEO Five-Factor Inventory (NEO-FFI)

It's a self-report scale, developed on the basis of NEO-PI which compiled by McCrae and Costa (1985), and revised into Chinese version by Yao Ruosong (2010) [36]. NEO-FFI has 60 questions, Divided into five dimensions, namely neuroticism (n), extraversion (E), openness (o), agreeableness (a) and responsibility (c). The 5-point scoring method is used to score from 1 to 5 points corresponding to "very disagree" to "very agree". In this study, The Cronbach's α coefficient of each dimension is 0.73-0.81.

2.2.4 Self-Compiled Personal General Information Questionnaire

The CNKI, Wanfang database, VIP database, Baidu, google, Pubmed and other search engines were used to search the literature about college students' critical thinking (706 in Chinese and 56749 in foreign languages). Based on that, the basic content of the questionnaire was constructed, with a total of 23 items. Combined with the results of 3 collective discussions with 10 representatives of undergraduates and 5 experts in the field of higher education, 3 items were deleted and 1 item was added. The final questionnaire for personal general information involves 21 items, which includes age, gender, grade,

school category, major category, academic achievement, family economic status, place of origin, only child or not, part-time experience, father's education, mother's education, reading habits, teaching methods, learning methods, teaching assistant section, etc.

2.3 Data Manipulation

SPSS 20.0 was used for statistical analysis. Descriptive statistics were used to calculate the average score and standard deviation of each scale; Pearson product correlation was used to explore the correlation between variables; multiple stepwise linear regression was used to analyze the related factors of CTDI-CV total score.

3. Results

3.1 Descriptive Statistics of Each Scale Scores

There were 18 (1.78%), 54 (5.31%), 885 (87.4%) and 56 (5.5%) college students whose critical thinking was in the level of comprehensively strong, relatively strong, contradictory range and serious opposition, respectively.

It can be seen from table 1 that the overall level of critical thinking of college students in this group (average score of CTDI-CV = 217.84 ± 49) is in the scope of contradiction.

Table 1. Descriptive statistics of total score and dimension (subscale) scores of each scale (n = 1013)

Dimension	Min	Max	M	SD	Number of items	Average score of items	Standard deviation of each item
seeking truth	23	54	41.57	5.94	10	4.16	0.59
Open mind	21	52	39.28	6.23	10	3.93	0.62
Analysis ability	19	53	35.85	4.57	10	3.59	0.46
Systematic ability	12	45	34.20	6.60	10	3.42	0.66
Self-confidence of critical thinking	16	50	33.56	3.74	10	3.36	0.37
Thirst for knowledge	18	32	34.61	7.29	10	3.46	0.73
Cognitive maturity	15	39	35.09	4.43	10	3.51	0.44
Total score of CTDI-CV	169	338	254.16	38.80	70	3.63	0.55
Father's negation	6	17	13.55	2.56	6	2.26	0.45
Father's warmth	9	31	19.13	4.01	7	2.74	0.58
Father's overprotection	8	21	12.72	1.78	8	1.61	0.25
Mather's negation	7	17	11.93	1.64	6	1.99	0.27
Mather's warmth	18	35	23.18	5.04	7	3.32	0.72
Mather's overprotection	9	28	19.02	4.49	8	2.38	0.58
Openness	27	57	42.16	6.25	12	3.51	0.52
Responsibility	25	50	37.04	4.69	12	3.09	0.39
Extraversion	22	45	38.25	6.43	12	3.19	0.54
Agreeableness	28	52	39.12	3.92	12	3.26	0.33
Neuroticism	19	47	33.87	5.57	12	2.82	0.47

3.2 Correlation analysis of s-EMBU, NEO-FFI and CTDI-CV

It can be seen from Table 2 that the total score of CTDI-CV was significantly correlated with the six dimensions of s-EMBU and the scores of openness, responsibility and neuroticism in NEO-FFI (all $P < 0.01$).

3.3 Multiple Stepwise Linear Regression Analysis on the Related Factors of College Students' Critical Thinking

3.3.1 Variable Assignment

First, the possible situations (alternative answers) of the demographic classification variables that may affect the total score of CTDI-CV are assigned, and the results are shown in Table 3.

3.3.2 Multiple Stepwise Linear Regression Analysis of Related Factors of College Students' Critical Thinking

Taking the total score of CTDI-CV as the dependent variable and the factors that may be related to the total score of CTDI-CV (including demographic variables, six dimension scores of s-EMBU and five dimension scores of NEO-FFI) as the independent variables, a multiple stepwise linear regression is carried out within the 95% confidence interval, the results are shown in Table 4.

It can be seen from table 4 that 10 factors such as grade, family economic status, part-time experience, the teaching methods used most commonly, like reading logic books, like reading reviews or essays, father's warmth, mother's warmth, openness and responsibility are positively correlated with the total score of CTDI-CV ($\beta = .142$ to $.701$, all $P < 0.05$). Five factors such as father's negation,

Table 2. Correlation analysis of s-EMBU, NEO-FFI and CTDI-CV scores (n = 1013)

Dimension	Seeking truth	Open mind	Analysis ability	Systematic ability	Confidence of critical thinking	Thirst for knowledge	Cognitive maturity	Total score of CTDI-CV
Father's negation	-.226**	-.253**	-.011	-.022	-.124**	-.131**	-.233**	-.278**
Father's warmth	.374**	.276**	.023	.035	.436**	.213**	.198**	.328**
Father's overprotection	-.310**	-.198**	-.014	-.030	-.173**	-.244**	-.169**	-.261**
Mather's negation	-.246**	-.220**	-.007	-.019	-.107**	-.188**	-.208**	-.252**
Mather's warmth	.270**	.236**	.014	.026	.383**	.179**	.186**	.274**
Mather's overprotection	-.283**	-.164**	-.009	-.041	-.162**	-.157**	-.205**	-.218**
Openness	.347**	.811**	.148**	.059	.268**	.183**	.148**	.530**
Responsibility	.392**	.033	.019	.044	.324**	.338**	.309**	.351**
Extraversion	.044	.053	.026	.036	.028	.032	.035	.037
Agreeableness	-.039	-.018	.034	-.037	-.049	.041	.122**	-.027
Neuroticism	-.321**	-.236**	-.125**	-.150**	-.235**	.192**	-.347**	-.346**

Notes: * $P < 0.05$, ** $P < 0.01$

Table 3. Variable assignment

Items Options and assignment
Grade 0 =freshman, 1= sophomore, 2=junior, 3=senior
Gender 0=Male,1=Female
3. Major categories: 0 =Engineering, 1 = science, 2 = economics and trade, 3 = management, 4 = linguistics, 5 = medicine and pharmacy,6 = art and design
4. School categories 0=science and engineering, 1=liberal arts, 2=agriculture 3=medicine, 4=sports, 5=art, 6= comprehensive
5. Only child or not 0=No,1=Yes
6. Family economic status 0 = poverty, 1 = food and clothing, 2 = well-off, 3 = rich
7. Origin 0 = city or town, 1 = country
8. Do you have part-time experience? 0 = none, 1 = yes
9. Academic achievement 0 =unqualified, 1 =qualified, 2 = medium, 3 = good, 4 = excellent
10. Father's education 0 = primary school and below, 1 = junior high school, 2 = senior high school or technical secondary school, 3 = junior college, 4 = Bachelor's degree, 5 = Master's degree, 6 = doctor's degree
11. Mather's education 0 = primary school and below, 1 = junior high school, 2 = senior high school or technical secondary school, 3 = junior college, 4 = Bachelor's degree, 5 = Master's degree, 6 = doctor's degree
12. Do you like reading philosophy monographs? 0 = not at all, 1 = not very much, 2 = it doesn't matter, 3 = a little, 4 = very much
13. Do you like reading logic monographs 0 = not at all, 1 = not very much, 2 = it doesn't matter, 3 = a little, 4 = very much
14. Do you like reading math books 0 = not at all, 1 = not very much, 2 = it doesn't matter, 3 = a little, 4 = very much
15. Do you like reading scientific papers 0 = not at all, 1 = not very much, 2 = it doesn't matter, 3 = a little, 4 = very much
16. Do you like reading reviews or essays 0 = not at all, 1 = not very much, 2 = it doesn't matter, 3 = a little, 4 = very much
17. Do you like reading prose 0 = not at all, 1 = not very much, 2 = it doesn't matter, 3 = a little, 4 = very much
18. Do you like reading novels 0 = not at all, 1 = not very much, 2 = it doesn't matter, 3 = a little, 4 = very much
19. Which teaching method do you adopt most often? 0 = traditional teaching method, 1 = role play, 2 = PBL teaching method, 3 = evidence-based practice teaching, 4 = simulation debate
20. What kind of learning style do you use most often? 0 = individual learning, 2 = cooperative learning
21. Which teaching aids do you used most commonly 0 = traditional teaching means, 1 = conventional multimedia, 2 = network teaching platform

Table 4. Multiple stepwise linear regression analysis of main influencing factors of CTDI-CV total score

Dependent variable	Independent variable	Nonstandard coefficient		β	t	P	R^2	R_{adj}^2
		B	Standard error					
of CTDI-CV	Total score Grade	.271	.047	.157	7.414	<.001	.539	.534
	Family economic status	.257	.071	.194	2.640	.008		
	part-time experience	.278	.063	.201	2.903	.006		
	teaching method	.838	.106	.701	4.566	<.001		
	Like logic monographs	.797	.086	.689	4.734	<.001		
	Like reviews or essays	.589	.093	.412	8.471	<.001		
	Father's negation	-.691	.089	-.616	-2.029	.040		
	Father's warmth	.503	.139	.457	2.785	.005		
	Father's overprotection	-.352	.048	-.298	-4.279	<.001		
	Mather's negation	-.477	.062	-.399	-5.488	<.001		
	Mather's warmth	.418	.054	.356	7.343	<.001		
	Mather's overprotection	-.501	.137	-.381	-8.611	<.001		
	Openness	.664	.097	.603	4.492	<.001		
	Responsibility	.387	.094	.286	2.468	.014		
	Neuroticism	-.528	.083	-.468	-2.091	.036		

father's overprotection, mother's negation, mother's overprotection and neuroticism are negatively correlated with the total score of CTDI-CV ($\beta = -.381$ to $-.616$, all $P < 0.05$).

4. Discussion

The total score of CTDI-CV and the scores of each subscale in this group are in the contradictory range, with 87.4% of the students in the contradictory range, and 5.9% of them in serious opposition, which is consistent with the results of previous studies^[7-9], suggesting that the level of critical thinking is not high, which is common among college students.

Multiple stepwise linear regression shows that 10 factors such as grade, family economic status, part-time experience, the teaching method used most commonly, like reading logic books, like reading reviews or essays, father's warmth, mother's warmth, openness and responsibility are positively correlated with the total score of CTDI-CV. Five factors such as father's negation, father's overprotection, mother's negation, mother's overprotection and neuroticism are negatively correlated with the total score of CTDI-CV.

Grade positively predicts the total score of CTDI-CV, which is consistent with the results of the research of nipod^[37], but age can't enter the regression equation, suggesting that natural physiological maturity is not the main influencing factor of critical thinking, and relatively speaking, mental maturity (including the expansion of knowledge and the improvement of understanding ability) can promote the development of critical thinking.

Family economic status and part-time experience are independent positive predictors of CTDI-CV total score, which is consistent with the results of previous research^[15], suggesting that the superficial capital partition between classes has changed into the deep ability partition. Family economic status reflects the adequacy of family members' living conditions and the richness of learning and practical activities. Good family economic status can provide sufficient living conditions for family members, so that they have opportunities to participate in more diverse learning and practical activities, so as to expand their knowledge and improve their ability of analysis and criticism. Part time job is the most practical activity close to social life, which makes individuals contact with diversified social phenomena and promotes the development of individual's ability of comparison, identification and criticism.

Three factors such as the teaching method used most commonly, like to read logic books, like to read reviews or essays positively predict the total score of CTDI-CV,

which is consistent with the results of previous studies^[20-26], suggesting that learning materials and methods which are rich in organization and can inspire thinking can improve critical thinking.

Father's warmth and mother's warmth positively predict the total score of CTDI-CV, while father's negation, father's overprotection, mother's negation and mother's overprotection negatively predict the total score of CTDI-CV, consistent with the results of previous studies^[17,18], suggesting that moderate emotional connection and democratic and respectful family atmosphere are helpful for the children to be good at thinking, exploring and questioning.

Openness and responsibility positively predict the total score of CTDI-CV, while neuroticism negatively predicts the total score of CTDI-CV, which is consistent with the results of previous studies^[33] suggesting that people with curiosity and imagination, wide interests, sensitive to things, stable emotions and strong self-control ability are more able to think patiently, analyze deeply, find problems and trigger critical thinking.

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