

Assessing and developing students' critical thinking

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The development of critical thinking is an important step in achieving the goals of holistic education, not only through helping students gain knowledge but above all through ensuring that they think effectively. The aim of this article is to explore the concept of critical thinking and to discuss possibilities to develop students' critical thinking. This article presents results of an experiment that was carried out in Vilnius Pedagogical University and designed to develop students' critical thinking skills and to strengthen their motivation to think critically. We investigated how a critical thinking development programme influenced students' critical thinking skills and motivation. Our programme of critical thinking is based on the ideas of humanistic psychology and meaningful learning, and the main learning methods deployed were based on co-operative learning. Our critical thinking development course significantly influenced all the measured components of the students' critical thinking skills and some components of their motivation. We discuss the result, draws conclusions and suggest recommendations.

INTRODUCTION

Philosophical theories about critical thinking can be traced back through the centuries to the Greeks philosophers, including Democritus, who sought to clarify the relationships between cause and effect, the Stoics and particularly Aristotle, who developed concepts of logic and their relationship to human thought and society. In the 19th Century, Dewey continued to emphasize the development of critical thinking as a cornerstone of democratic society, and Kilpatrick claimed that education must be integral, orientated to the child's interests and need for self-realization, with an emphasis on the development of critical and creative thinking.

More recently, holistic education has developed these ideas of progressive pedagogy. Holistic education is based on the premise that each person finds identity, meaning and purpose in life through connections to the community, to the natural world and to spiritual values. A holistic way of thinking seeks to encompass and integrate multiple layers of meaning and experience. Every person's intelligence and abilities are far more complex than scores on standardized tests. Therefore, developing critical thinking is very important if we wish to achieve these goals of holistic education. Psychologists in the USA, Canada and Western Europe have studied critical thinking and developed some methods to measure it. Here, in Lithuania, critical thinking has not been studied extensively.

The aim of this article is to elucidate the concept of critical thinking and to discuss the possibilities of developing students' critical thinking. Our goals are to analyse students' critical thinking skills and dispositions, to evaluate the effectiveness of our critical thinking development programme and to suggest recommendations. The focus of the research is students' critical thinking skills and their characteristics, and how these change under the

influence of the critical thinking development programme.

Today there are a growing number of conceptions of critical thinking. Perry (1981) and other cognitive psychologists associated it with reflective judgement, others with intelligence, others with logical thinking, and many with problem solving. The concepts of critical thinking were advanced by Ennis (1996), Paul (1993) and others. An important consensus, known as "the Delphi Report" (Facione, 1990), was announced in 1990 by the theoreticians of USA and Canada. Critical thinking was defined as a cognitive process, a purposeful self-regulatory judgement that has two components: cognitive skills (interpretation, analysis, inference, evaluation, explanation and self-regulation) and a motivational component (the disposition toward critical thinking). Facione, Facione and Giancarlo (1997) proposed a further classification of critical thinking cognitive skills: analysis, evaluation, inference, deductive skills, and inductive skills. *Analysis* refers to comprehension and expressing the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures or criteria. It also means identifying the intended and actual inferential relationships among statements or questions. Finally, it can also refer to the comprehension and expression of the meaning of situations, data, events or judgements. *Evaluation* means assessing the credibility of statements. *Inference* means identifying elements needed to draw reasoned conclusions and implications from data, statements, principles, judgements, beliefs or opinions. *Deductive reasoning* refers to inferences from the general to the specific, whilst *inductive skills* refer to inferences from the specific to the general. Scientific confirmation and experimental disconfirmation are examples of inductive reasoning.

But critical thinking also has, as mentioned above, a motivational component. Facione *et al.* (1997)

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determined seven components of critical thinking motivation. *Truth seeking* is the disposition of being eager to seek the truth and be objective about asking questions. *Open-mindedness* refers to the disposition of being tolerant of divergent views. *Analyticity* is the disposition of being alert to potentially problematic situations, anticipating possible results or consequences, whilst *systematicity* refers to a disposition towards organized, orderly and focused inquiry. *Self-confidence* determines the level of trust one places in one's own reasoning processes. The component of *inquisitiveness* refers to intellectual curiosity. Finally, *maturity* determines how disposed a person is to make reflective judgements.

Recent investigations in Western Europe and USA show the low level of HE students' critical thinking skills and dispositions (for example, Facione, 1995; Guest, 2000), while the "single truth" view of education has hindered the development of critical thinking in Eastern Europe. However, psychologists claim that critical thinking skills can be learned, and that disposition toward critical thinking can also be encouraged to develop (Facione *et al.*, 1997). Critical thinking development programmes have been realized in universities in different countries, with studies showing significant differences in the test-retest scores of students' critical thinking (for example, Facione *et al.*, 1997). Psychologists have recommended fundamental teaching strategies, and the importance of the social context to learning has been emphasized

by Lipman (1991) who believes that the development of a "community of inquiry" is essential for the development of critical thinking skills within the individual. Entwistle and Ramsden (1983) have highlighted the importance of both horizontal (student-student) and vertical (student-teacher) interaction and have emphasised the importance of group learning.

A STUDY OF CRITICAL THINKING

Method

The critical thinking programme

Our investigation of students' critical thinking was carried out in Vilnius Pedagogical University. On the basis of our analyses of the literature and our individual experience we chose active learning as the main method in our critical thinking programme. Students took part in a course of critical thinking which lasted three months (four hours per week; 48 hours in total). The programme was based on the precepts of humanistic psychology and meaningful learning, and the aims were to introduce students to critical thinking theory, to develop critical thinking skills and to strengthen motivation for critical thinking. Students learned the principles and stages of critical thinking, the main criteria of successful thinking, and solved different problems. We aimed for students to gain not only knowledge but also individual experience of critical thinking. The external and internal activity of individuals was a very important factor in our seminars. On the basis of the studied literature we

Table 1

Score from the first administration of CCTDI and CCTST for the experimental (E, N=77) and control (C, N=150) groups. The t-values test differences between the two groups

	Group	Mean	Std. Deviation	t	df	p (2-tailed)
CT disposition	Truth seeking E	31.42	6.53	1.63	226	.104
	C	30.05	5.64			
	Open-mindedness E	37.25	5.94	1.45	226	.148
	C	36.16	5.03			
	Analyticity E	42.18	5.52	-0.61	226	.546
	C	42.65	5.51			
	Systematicity E	37.86	6.40	.050	226	.960
	C	37.81	7.27			
	Self-confidence E	38.84	6.63	-1.74	226	.084
	C	40.52	7.04			
	Inquisitiveness E	44.88	7.37	-1.01	226	.314
	C	45.86	6.68			
	Maturity E	41.74	7.22	1.07	119.42	.288
	C	40.75	5.33			
CT skills	Overall CCTDI E	274.17	26.96	0.11	226	.914
	C	273.80	22.92			
	Analysis E	4.31	1.54	1.59	139.99	.114
	C	3.98	1.37			
	Evaluation E	4.79	1.98	0.63	221	.532
	C	4.64	1.64			
	Inference E	4.13	1.78	0.61	130.36	.544
	C	3.99	1.45			
	Deductive E	6.13	2.16	0.61	221	.543
	C	5.96	1.90			
	Inductive E	4.73	1.85	0.39	135.60	.697
	C	4.63	1.59			
	Overall CCTST E	13.23	3.68	1.33	121.16	.187
	C	12.60	2.73			

Table 2

Scores from the first and second administration of the CCTDI and CCTST tests for the experimental group (N=77). The t-values test differences between the pre-programme and post-programme scores.

		Mean (before, after)	Std. Deviation	t	df	p (2-tailed)
CT disposition	Truth seeking	31.42 32.18	5.44	-1.237	76	.220
	Open-mindedness	37.25 38.87	4.94	-2.886	76	.005
	Analyticity	42.18 44.13	5.17	-3.306	76	.001
	Systematicity	37.86 39.70	4.30	-3.759	76	.000
	Self-confidence	38.84 40.95	4.57	-4.037	76	.000
	Inquisitiveness	44.88 45.64	6.18	-1.070	76	.288
	Maturity	41.74 44.44	5.34	-4.438	76	.000
	Overall CCTDI	274.17 285.91	20.65	-4.988	76	.000
CT skills	Analysis	4.29 4.87	1.71	-2.943	76	.004
	Evaluation	4.78 6.66	2.18	-7.509	76	.000
	Inference	4.11 6.08	1.81	-9.502	76	.000
	Deductive	6.12 8.87	2.11	-10.080	76	.000
	Inductive	4.68 6.01	2.07	-5.602	76	.000
	Overall CCTST	13.23 17.61	3.48	-11.050	76	.000

chose the following methods of active learning in our seminars: brainstorming; problem solving; reflexive writing; active listening; purposeful research; co-operative learning; conversations; discussions; debates; projects; demonstration; and goldfish bowl. We looked for and evaluated the processes of critical thinking, not just the results.

Subjects

Two hundred and twenty-seven students from Vilnius Pedagogical University, aged 20-21, participated in the study. The sample consisted of two groups of students: experimental (77 students) and control (150 students). The students were allocated to groups by the teacher and the groups were equivalent.

Measurement instruments

We used the California Critical Thinking Skills Test (CCTST) and California Critical Thinking Disposition Inventory (CCTDI) to measure the cognitive and motivational components of critical thinking. The CCTST yields an overall score (0-34) on critical thinking skills, and five sub-scales: analysis (0-9); evaluation (0-14); inference (0-11); deductive (0-16); and inductive (0-13). Scores on the seven CCTDI scales (truth seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness,

maturity) can range from 10 to 60; scores above 40 indicate a positive inclination toward the scale's target disposition. The overall score can therefore range from 70 to 420, scores above 280 indicating a positive inclination toward critical thinking.

Procedure

Prior to the course, students in both groups took the CCTST and CCTDI tests. Experimental group subjects completed the Critical Thinking programme, at the end of which (three months later) we repeated the investigation for both groups. The control group attended only the common university courses during this time (that is, the same courses as the experimental group except for the critical thinking course).

Results

The results from the pre-course administration of CCTDI and CCTST for both groups are shown in Table 1.

We can see that there are no reliable differences between the groups ($p > .05$ in all cases). The only subscale reaching a marginal level of significance was self-confidence, with a slightly higher score in the Control group.

Table 3

Scores from the first and second administration of the CCTDI and CCTST tests for the Control group (N=150). The t-values test differences between scores for the two administrations.

	Mean (before, after)	Std. Deviation	t	df	p (2-tailed)
CT disposition	Truth seeking 30.05 30.71	7.49	-1.101	149	.273
	Open-mindedness 36.41 36.35	6.10	.174	149	.862
	Analyticity 42.65 41.21	6.24	2.814	149	.162
	Systematicity 37.81 37.21	8.39	.876	149	.382
	Self-confidence 40.52 40.71	8.34	-0.284	149	.777
	Inquisitiveness 45.86 44.19	7.72	2.644	149	.119
	Maturity 40.75 40.38	7.43	.616	149	.539
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Overall CCTDI	273.80 270.77	25.02	1.482	149	.141
CT skills	Analysis 3.98 3.65	1.91	2.100	149	.237
	Evaluation 4.64 4.17	2.58	2.247	149	.126
	Inference 3.99 4.03	1.56	-.104	149	.917
	Deductive 5.96 6.06	2.24	-.547	149	.585
	Inductive 4.63 3.87	2.18	4.848	149	.101
	Overall CCTST 12.60 11.81	3.62	2.665	149	.117

We can see that the lowest scores are on three of the critical thinking disposition subscales: truth seeking; open-mindedness and systematicity. These results are similar to those presented by Facione (1995) who noted that the lowest means for new freshmen at a private comprehensive university in USA were on truth seeking, systematicity and self-confidence. The least developed critical thinking skills are evaluation and inductive skills.

The next step in our analysis was to examine how the critical thinking programme influenced the students' critical thinking skills and motivation. Results of Student's paired samples t-test comparing the scores of the experimental group before and after the programme are shown in Table 2. Means increased in every subscale of both tests. On the CCTDI, there were significant differences ($\alpha=0.05$) in open-mindedness, analyticity, systematicity, self-confidence and maturity, as well as in the overall score. Scores in truth seeking and inquisitiveness remained virtually unchanged. There were significant improvements on the all subscales of critical thinking skills and in the overall CCTST score.

Table 3 shows the equivalent results for the Control group. We can see that there were no statistically

significant differences between the first and second test administration in this group.

Finally, we used Student's t-test (independent samples) to compare the means of the Experimental and Control groups from the second test administration (that is, after the Experimental group had completed the programme). From Table 4 we can see that the groups differed reliably on open-mindedness, analyticity, systematicity, maturity and general CT disposition, and on every subscale and overall score of the CT skills test. Scores of CT skills increased substantially. There were no significant differences in truth seeking, self-confidence and inquisitiveness. Thus our critical thinking programme didn't influence these dispositions.

DISCUSSION

From the literature we know that disposition toward critical thinking appears to be stable over a period of years, but yet there is a space for significant growth (Facione *et al.*, 1997). Our investigation has corroborated this view. Some dispositions developed significantly as a result of our programme, while some remained unchanged. In addition, scores on all

Table 4

Scores from the second administration of CCTDI and CCTST for the experimental (E, N=77) and control (C, N=150) groups. The t-values test differences between the two groups.

		Group	Mean	Std. Deviation	t	Df	p (2-tailed)
CT disposition	Truth seeking	E	32.18	6.63	1.289	127	0.200
		C	30.71	5.93			
	Open-mindedness	E	38.87	5.72	2.624	127	0.010
		C	36.35	4.77			
	Analyticity	E	44.13	5.50	2.9354	127	0.004
		C	41.21	5.59			
	Systematicity	E	39.70	6.13	2.302	127	0.023
		C	37.21	5.88			
	Self-confidence	E	40.95	5.69	0.208	127	0.835
		C	40.71	7.05			
	Inquisitiveness	E	45.64	6.29	1.246	127	0.215
		C	44.19	6.70			
	Maturity	E	44.44	5.90	3.900	127	0.000
		C	40.38	5.63			
CT skills	Overall CCTDI	E	285.91	26.33	3.399	127	0.001
		C	270.77	22.37			
	Analysis	E	4.87	1.43	5.605	176	0.000
		C	3.65	1.45			
	Evaluation	E	6.66	2.56	7.253	127.01	0.000
		C	4.17	1.79			
	Inference	E	6.08	1.77	8.449	138.71	0.000
		C	4.00	1.40			
	Deductive	E	8.87	2.51	8.386	126.45	0.000
		C	6.06	1.74			
	Inductive	E	6.01	2.12	7.349	176	0.000
		C	3.87	1.76			
	Overall CCTST	E	17.61	4.32	10.164	126.05	0.000
		C	11.81	2.91			

measures of CT skills increased significantly. This result conforms to the general principles of skill acquisition (Butkiene, 1996; Facione *et al.*, 1997).

Truth-seeking scores did not increase and were the lowest of all the dispositions measures (in both test and retest phases). In many studies with which we are familiar, truth-seeking mean scores are also worrisome indicators of weakness in this important aspect of the CT disposition. However, statistically significant increases in truth-seeking can occur over a period of years (Facione *et al.*, 1997). Truth-seeking can be considered as a personality dimension (Butkiene, 1996) and as such may be slow to develop or change.

Means of the scores for self-confidence were slightly (though not significantly) different before the programme, with the mean greater for the control group. After the completion of the programme, the mean of the experimental group increased significantly, although the difference between both groups after the programme remained insignificant. This pattern suggests that our programme of critical thinking did influence the growth of students' self-confidence. In order to test whether the change in self-confidence differed between the two groups, we calculated the difference scores for each subject (score on second test minus score on first test) and

performed a t-test on these difference scores (mean difference score for E: 2.104; mean difference for C: 0.193; $t(224.01) = 2.28$, $p = 0.027$, two-tailed). This therefore provides evidence that our programme influenced self-confidence.

There were no significant changes in inquisitiveness scores, although the pattern indicated an increase in scores for the experimental group and a decrease in scores for the control group. The literature indicates that inquisitiveness is a mostly inherent feature, and this could be one reason why the scores did not change significantly. A further cause could be that insufficient attention was given to this attribute in our programme.

CONCLUSIONS

From our investigation we can conclude that not all CT dispositions and CT skills are developed to the same extent. We observed weaknesses in truth seeking, open-mindedness and systematicity, and in evaluation and inductive skills. Future work might focus on these aspects.

A second conclusion is that our programme influenced all the CT skills and a great number of the CT dispositions of our students. This suggests that educators in many academic disciplines can guide

students to use their thinking skills more effectively and become more motivated toward thinking – they can influence the development of students' CT skills and dispositions.

Our third conclusion is that cooperative learning is one of the possible learning methods that can be used to develop students' CT skills and dispositions.

Finally, our programme of critical thinking influenced some features of CT more than others. It is important to pay attention to this fact in the future, and to create new CT development programmes oriented to the features that our programme did not address.

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