The Critical Thinking Dispositions of Prospective Science Teachers

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Abstract

The purpose of the study is to evaluate the critical thinking dispositions of the prospective science teachers. In this study, the survey methodology was used. The sample of the study consisted of 309 prospective science teachers (freshman, sophomore, junior, senior) at Elementary Science Education Department, Faculty of Education of a public university. Data was collected by using “The California Critical Thinking Disposition Inventory (CCTDI)” which was developed by Facione et al. (1998) and was adapted to Turkish by Kökdemir (2003). According to the results indicated that the critical thinking dispositions of prospective science teachers’ were in general at medium and low levels.

1. Introduction

Thinking is unique for human beings in the sense that the ability to think makes them the most developed creatures of all over the world (Elder & Paul, 2001). All we do and produce, in other words our quality of life, depends on our thoughts (Scriven & Paul, 2004). In a democracy, it is important that citizens develop habits of independent and critical thinking. For educated citizens to make appropriate decisions regarding how they vote, what they value, and when they become engaged in political and social issues, they would ideally develop habits of seeking out multiple views and learning how to look at each critically (Levine, 2010). One of the primary aims of undergraduate education is to educate citizens who are able to engage in critical thinking. However, there is ample evidence that suggests university graduates are not widely perceived as possessing these traits. And, as well as there is almost universal consensus among faculty that teaching critical thinking is a principal aim of undergraduate education (Bok, 2006).

While there is consensus that enhancement of students’ critical thinking skills is a primary and important outcome of undergraduate education, there is less consensus about what exactly constitutes critical thinking. According to Facione and Facione (2006) critical thinking is “purposeful, self-regulatory judgment which results in...
interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual methodological, criteriological, or contextual consideration upon which that judgment is based”. Furthermore Hudgins and Edelman (1988) defines it as “one of the aspects of thinking, which is accepted as a way of overcoming problems and facilitates the way of reaching the information in our lives”. In general, four different conceptions of critical thinking were evident: critical thinking as a generic skill (Ennis, 1962, 1989; Halpern, 1997); critical thinking as an embedded skill (McPeck, 1990); critical thinking as a component of the skills of lifelong learning (Candy, 1991); and critical thinking for critical being (Barnett, 1997). A student’s disposition to think critically is a necessary precondition for critical thinking, and it greatly affects critical thinking capability. Though disposition is not a skill, it remains to be determined whether a stronger tendency towards cognitive maturity predicts greater skill at making mature judgments (Yuksel & Alci, 2012). From a report on the assessment of college student learning, there appears to be consensus on definition of critical thinking emerging from surveys of college/university faculty, employers and policy makers representatives— that it includes interpretation, analysis, evaluation, inference, presenting arguments, reflection, and dispositions (Jones, et al., 1995).

Empirical research on critical thinking and its dispositional component has only recently started to evolve. In fact, the first tool to measure the disposition toward critical thinking - the California Critical Thinking Disposition Inventory (CCTDI) (Facione and Facione 1992, Facione et al. 1994) - which uses established psychological testing strategies, has been constructed; it is based on the 1990 Delphi study expert consensus description of the ideal critical thinker (Facione 1990). So far, the CCTDI has been applied, primarily, in colleges, in the context of nursing education (Facione et al. 1994). It has also been applied in high schools (Giancarlo and Facione, 1994; Zoller et al., 2000), but not specifically with the prospective science teachers respectively according to gender, grade levels and cumulative grand point averages scores.

1.1. Objectives of the Research

The specific objectives of the research were:
(1) To define ‘base-lines’ of disposition toward Critical Thinking of the prospective science teachers
(2) To compare the prospective science teachers’ Critical Thinking Disposition (CTD) scores, according to gender and grade levels.
(3) To examine the relationship between CTD and cumulative grand point averages (CGPA).

2. Method

In this study, the survey methodology was used and participants of the study were selected purposively.

2.1. Participants

The sample of the study consisted of 309 prospective science teachers who enrolled in Science Education Department, in Faculty of Education at a public university. Table 1 presents frequency distribution of the sample according to gender and grade levels.

| Gender | 1st | 2nd | 3rd | 4th | Total |
|--------|-----|-----|-----|-----|-------|
| Female | 74  | 51  | 47  | 45  | 217   |
| Male   | 29  | 25  | 20  | 18  | 92    |

2.2. Instrumentation

Data was collected by using CCTDI which was developed by Facione et al. (1998) and was adapted to Turkish by Kokdemir (2003). This instrument, was designed to measure the overall disposition profile of students. The Turkish version of the original scale contains 51 items and has 6 factors which are Analyticity, Open-mindedness,
Inquisitiveness, Self-confidence, Truth-seeking, Systematicity. The internal consistencies of the subscales were .75, .75, .78, .77, .61, .63 respectively and the scale’s total consistency was 0.88 (Kokdemir, 2003). A score of 40 and below on any of the six subscales indicates consistent opposition or weakness to that given disposition while a score of 50 or higher represents a positive impact of that attribute. A total score above 240 reflects a positive overall disposition toward critical thinking (Kokdemir, 2003). And also studies using the CCTDI consistently report satisfactory reliability measures on the instrument and its subscales (Facione et al., 1995; Jacobs, 1995; Bers et al., 1996).

The CCTDI was administered at fall semester, in October. Data were analyzed by using Statistical Package for Social Sciences (SPSS) software. Data analyses involve determination of descriptive statistics, correlation coefficient, use of t-test and Anova (p<0.05).

3. Findings

An independent samples t-test was conducted to evaluate whether prospective science teachers CTD scores change with gender. There was a statistically significant difference in CTD subscales of Inquisitiveness (t_{307}=-3.971, p<.05) and Systematicity (t_{307}=-2.707, p<.05) in favour of male prospective science teachers. In other CTD dimensions, no significant difference were found.

| Disposition      | Gender       | N   | \( \bar{X} \) | SD  | df  | t    | p   |
|------------------|--------------|-----|--------------|-----|-----|------|-----|
| Inquisitiveness  | Male         | 92  | 42.76        | 5.75| 307 | -3.971| .000|
|                  | Female       | 217 | 39.86        | 5.91|     |      |     |
| Systematicity    | Male         | 92  | 26.88        | 4.15| 307 | -2.707| .007|
|                  | Female       | 217 | 25.48        | 4.15|     |      |     |

One way ANOVA was conducted to evaluate whether prospective science teachers’ CTD scores change with grade levels. Results of the analysis was presented in Table 3.

| Disposition      | Source of variance | df  | Sum of squares | Mean square | F    | p   |
|------------------|--------------------|-----|----------------|-------------|------|-----|
| Open-mindedness  | Between Groups     | 3   | 1575.294       | 525.098     | 8.643| .000|
|                  | Within Groups      | 305 | 18529.929      | 60.754      |      |     |
|                  | Total              | 308 | 20105.223      | 60.754      |      |     |
| Analyticity      | Between Groups     | 3   | 237.771        | 79.257      | 3.369| .019|
|                  | Within Groups      | 305 | 7176.218       | 23.529      |      |     |
|                  | Total              | 308 | 7413.989       | 23.529      |      |     |
| Total (CTD)      | Between Groups     | 3   | 4802.214       | 1600.738    | 3.593| .014|
|                  | Within Groups      | 305 | 135880.628     | 445.510     |      |     |
|                  | Total              | 308 | 140682.842     | 445.510     |      |     |

The results of the variance analysis reveal that prospective science teachers’ scores on Open-mindedness \( F_{(3,305)} = 8.64 \), Analyticity \( F_{(3,305)} = 3.36 \) subscales and in total \( F_{(3,305)} = 3.59 \), changed with respect to grade level. Tukey test was done to designate the differences within groups, indicated that seniors’ open-mindedness scores (\( \bar{X}=55.87 \)) were higher than both freshman’s (\( \bar{X}=50.59 \)) and junior’s scores (\( \bar{X}=49.58 \)). Meanwhile, seniors’ analyticity scores (\( \bar{X}=50.12 \)) were higher than juniors’ scores (\( \bar{X}=47.65 \)). Similarly, seniors total CTD scores (\( \bar{X}=229.22 \)) were higher than juniors’ total CTD scores (\( \bar{X}=217.24 \)).

To examine the relationship between CTD and cumulative grand point averages (CGPA) scores of the prospective science teachers’ correlation analysis was conducted and results was presented in Table 4. In this analysis, freshman prospective science teachers were exclude from the analysis due to lack of CGPA scores.

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Table 4. The Correlation Between CTD and CGPA Scores of Prospective Science Teachers
In table 4, there was low, positive significant relationship between CTD scores and CGPA scores ($r=0.158$, $p<.05$). According to the correlation results, when CDT scores were increased, CGPA scores were increasing.

4. Discussion and Conclusion

Teachers play a great role in developing critical thinking skills and dispositions of students. Therefore determining critical thinking skills and dispositions of teachers and developing these skills were essential for the provision of effective education (Yücel & Koçak, 2010). Current study aimed to evaluate the critical thinking disposition scores of the prospective science teachers. The results indicated that the critical thinking dispositions of prospective science teachers’ were in general at medium and low levels. Results were obtained by Besoluk and Onder (2010) were similar to these findings. In addition, there was a statically significant difference between male and female prospective science teachers’ critical thinking disposition scores in subscales of inquisitiveness and systematicity in favour of male prospective science teachers.

Critical thinking is related to students’ grades (Gadzella et. al., 1997). Nisbett, Lehman, Fong and Cheng (1993) indicated that university education itself has a strong effect on the improvement of critical thinking. However, Norris (1985) said that students in higher education do not possess these higher order skills. According to the results the current study prospective science teachers’ total CTD scores and open-mindedness and analyticity scores differed in terms of grade levels. In the literature, similar (Shin, Lee, Ha & Kim, 2006) and opposite results (Ip, Lee, Lee, Chau, Wootton & Chang, 2000; Zhang & Lambert, 2008) were presented. Preparing students to think critically is a goal of many professionals in higher education. So, future research should be done to determine how to improve prospective science teachers’ critical thinking dispositions.

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