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Procedia - Social and Behavioral Sciences 46 (2012) 1279 – 1283

Procedia
Social and Behavioral Sciences

WCES 2012

Comparison of the critical thinking dispositions of (studying in the secondary science and mathematics division) preservice teachers

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Abstract

In this study, the critical thinking dispositions of Secondary School Science and Mathematics section prospective teachers studying in undergraduate programs (biology education, physics education, chemistry education, and mathematics education) are compared. "California Critical Thinking Disposition Inventory (CCTDI)" which was adapted in 2003 by Kökdemir is used. One-way analysis of variance was used to analyze the data.

Keywords: Critical thinking, secondary science and mathematics, prospective teachers

1. Introduction

The growth of skilled individuals is possible through quality education, which can only be provided through skilled teachers serving as model people, model citizens and model educators. Yalın, Hedges and Özdemir (1996), state that skilled educators contribute on the perfection of the educational system. The concept of skills is examined in two different categories, namely personal and vocational skills. General knowledge, subject area knowledge, vocational skills and competence (the planning of the education process, introducing variety, critical thinking, efficient usage of time, creating a participatory learning environment, keeping track of student progress, etc.) are criteria related to vocational skills (Erden, 1998). Another such skill is critical thinking. Critical thinking is essential not only to academic fields, but also to all problem solving-oriented platforms. Paul (1991) defines critical thinking as extrapolation through observation and information. The components forming the basis of critical thinking have been listed by Faccione (1998) as analysis, interpretation, self-adjustment, deduction, explanation, and evaluation. Critical thinking requires advanced thinking, that is, synthesis and evaluation over application and analysis (Moore, 2001).

Critical thinking, put simply, is the ability of individuals to take responsibility of, or to be held responsible for their thoughts. Individuals therefore develop a variety of standards and criteria to analyze and evaluate their thoughts and use these criteria and standards continuously as part of a routine (Elder and Paul, 1994). Critical

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1877-0428 doi:10.1016/j.sbspro.2012.05.288

thinking is an engine that propels the production of knowledge. It is not merely one of the options to be used during the education process but an integral part of education itself. Critical thinking is one of the conditions to being educated (Norris, 1985). Studies have shown that genetic and environmental factors affect the development of critical thinking. Mental, spiritual and emotional factors that have been inherited by an individual are factors that affect critical thinking as well as learning (Gander and Gardiner, 1993; Kazancı 1989). Various studies have examined varients such as age, gender, family, society, school, socio-economic status, academic success, and academic self-perception under the category of environmental factors. In a study done to determine the views of students on the changes in their problem solving and critical thinking skills after 4 years of college education, Appling (2001) tested the influence of the six factors related to change via path analysis. These six factors are academic skill points, socioeconomic levels, gender, academic self-perception, academic field, and activities done in their previous year at university. The obtained findings verified the five of the factors of the six factors that belong to the tested model. As a conclusion, the most influential factors that affect students' views on the changes in problem solving and critical thinking both directly and indirectly are their state of participation to the activities of the previous year and academic self-perception. No direct influence of academic field could be found. Appling (2001) states that academic self-perception influences students' views on the changes in their problem solving and critical thinking skills by affecting their chosen field and the activities they had performed the previous year. According to Fisher (1995), the most important factor in teaching the critical thinking skills is the teacher. For this reason, skilled teachers have a special place in the teaching of critical thinking skills. According to Wilk (1995), it is necessary for teachers to be trained as adorned with these skills so as for them to train students who can criticize, who are more participative, more open to discussions, who can determine the predictions and priorities, who looks for alternatives, and who can draw meaning from various views. Ann (2000) stated that teachers should be of guidance to students in enabling them to reach knowledge, how to reach it, how to criticize and locate it, how to present and use this knowledge. Likewise, Walsh and Paul (1998) argued that in order to improve students' critical thinking skills, teachers should be trained in this field in the first place, and that it is compulsory to provide classes on critical thinking cognitive skills. The number of studies on teachers' critical thinking disposition is rather low. There are not enough studies on the level of teachers' critical thinking disposition especially in terms of field. In a study run by Demirtasli (1992) on high school students, it was determined that critical thinking capacity increases as education level increases. Moreover, it was seen that mental capacity, maturity, and richness of experience are important in critical thinking. In another study by Demirtasli (1996) on male and female senior students studying at the departments related to Humanities and Positive Sciences at Ankara University, it was determined that gender and program type had no meaningful effect on critical thinking capacity.

In addition to a comparison between humanities and positive sciences, no study making a comparison among science and mathematics fields among themselves was come across with. Although the first year curriculum of prospective teachers studying at positive sciences and mathematics are the same, the curricula of the following years continue in a different line as their classes become more field-related. To what extent the critical thinking dispositions of prospective teachers differ since they are trained with different self-perception is not known. In recent years where teacher proficiencies have been specifically emphasized, the lack of the existence of a similar study makes this one an important one.

1.1. Objective

The aim of this study is to put forth whether prospective teachers studying at the undergraduate programs of secondary school positive sciences and mathematics fields (biology education, physics education, chemistry education, and mathematics education) have differentiated critical thinking dispositions. To this end, whether the critical thinking dispositions of teachers show differences was examined according to the department they study.

2. Method

2.1. Study Model

In this study, critical thinking dispositions of prospective teachers according to their department will be tried to be determined. This study is a survey-type one which tries to describe the situation related to the topic. Survey models are studies that aim to describe a situation as it is or as it was in the past (Karasar, 2006).

2.2. Study Group

The study group is consisted of 254 prospective teachers studying at the undergraduate programs of secondary school positive sciences and mathematics fields (biology education, physics education, chemistry education, and mathematics education). Dispositions of the study group are given in Table 1.

Table 1. Dispositions of the study group

Field of Study	N	%
Biology Teaching	72	28.35
Physics Teaching	47	18.50
Chemistry Teaching	57	22.44
Mathematics Teaching	78	30.71
Sum	254	100.00

2.3. Collection of the Data

"California Critical Thinking Disposition Inventory" (CCTDI) which was adopted into Turkish in 2005 was used by Kökdemir in order to determine the dispositions of teacher candidates to think critically. Different from the similar critical thinking scales of the CCTDI, it is used for assessing critical thinking disposition or, in a more comprehensive saying, critical thinking level of the person instead of assessing a skill (Kökdemir, 2003). The scale is comprised of six sub-scales. These sub-scales are analyticity, open mindedness, inquisitiveness, self-confidence, truth seeking and sistematicity. The scale is comprised of 51 items and its type is 1-5 Likert scale which ranges from "I completely disagree" to I completely agree".

3. Findings

This section provides descriptive statistics on scores teacher candidate students got for critical thinking scale, and findings on comparisons according to departments.

Descriptive statistics on the whole study group are given in Table 2.

Table 2. Descriptive statistics on critical thinking dispositions of the study group

	N	Average	Standard Deviation	Coefficient of Skewness	Coefficient of Kurtosis
Total	254	182.84	18.07	-0.44	-0.46

When Table 2 is examined, it is seen that the average of the critical thinking scores of the whole group is 182.84. When the scale is assessed as a whole, it can be said that persons scoring lower than 240 (40 x 6) generally have a low critical thinking disposition and those who score higher than 300 (50 x 6) have a higher disposition. According

to that, it can be deduced that critical thinking disposition of the group is low. Table 3 shows the descriptive statistics on critical thinking scores according to departments.

Table 3. Descriptive statistics on critical thinking scores according to departments

Field of Study	N	Average	Standard Deviation
Biology Teaching	72	149.00	17.52
Physics Teaching	47	133.00	22.13
Chemistry Teaching	57	148.00	16.38
Mathematics Teaching	78	154.00	17.08

Kolmogorov-Smirnov and Shapiro-Wilk tests on whether the data is distributed normally or not were applied. The results are given in Table 4.

Table 4. Normality Tests on whole group scores and department scores

	Kolmogorov-Smirnov		
	Statistic	**sd**	**Significance Level**
Total	0.52	254	0.97
Biology Teaching	0.62	72	0.20
Chemistry Teaching	0.78	57	0.20
Mathematics Teaching	0.65	78	0.20
	Shapiro-Wilk		
	Statistic	**sd**	**Significance Level**
Physics Teaching	0.97	47	0.37

When Table 4 is examined, it is seen that the score distribution of the whole study group displays a normal distribution (sig.>0.05). Similarly, the score distributions of the Biology Teaching, Physics Teaching, Chemistry Teaching and Mathematics Teaching are normal distributions (sig.>0.05).

The results of the one-way analysis of variance on the significance of the difference between the department averages are given in Table 5. The equality of the variances of the groups was checked through “Levene F Test” and variances were found out to be homogeneous. Variances of dependant variables are equal for each sample. (p>.01).

Table 5. Comparisons of the scores critical thinking dispositions based on group averages

Critical Thinking Disposition	Sum of Squares	Degrees of Freedom	Average of Squares	F	Significance
Intergroup	791.78	3	263.93	0.806	0.491
In-group	81846.60	250	327.37		
Total	82638.38	253			

As it is also seen from Table 5, the difference between the average scores of the departments is insignificant (F= 0.806; p>.05). Critical thinking disposition does not differ by fields of biology teaching, physics teaching, chemistry teaching and mathematics teaching.

5. Discussion, Conclusion and Suggestions

According to the Piaget, the principal goal of education is to create men and women who are capable of doing and creating new things, not simply repeating what other generations have done. For this reason education should be

capable of creating men and women who can be critical and creative and who can verify and do not accept everything they are offered. (quoter: Fisher, 1995). Therefore, a teacher of the modern society should be a person who adopts constant learning as a principle, is sophisticated and democratic, is able to overcome problems, is capable of solving problems and thinking critically and can render his/her class into an active learning environment (Kuran, 2002).

In this context, this study aims to compare, within the scope of the study fields of science and mathematics, the critical thinking dispositions of future teachers and current teacher candidates who will educate future generations and shape the society. The result of the one-way analysis of variance showed no significant difference between critical thinking dispositions for the study fields of biology, physics, chemistry and mathematics teaching ($F= 0.806$; $p>.05$). This result can be attributed to such common characteristics that all four disciplines are basic sciences and are gathered under the said roof, and have similar methodologies. Besides this, the results of this study can gain a new perspective through new studies which will incorporate such variables as academic self-concept and academic field.

References

Ann, F.M. (2000). "Critical Thinking 101: The basics of evaluating information", *Knowledoe Quest,* s.29,ss.13-20

Appling, S. A. (2001). *A Model of Influences on Students' Self-Rating of Change in Problem Solving and Critical Thinking Abilities After Four Years of College*. ERIC No. 464087

Demirtaşlı, N. (1996). "Eleştirel Düşünme: Bir Ölçme Aracı Bir Araştırma", *III. Ulusal Psikolojik Danışma ve Rehberlik Kongresi*. Çukurova Üniversitesi, Adana, ss.208–216.

Elder, L., & Paul, R. (Fall 1994). "Critical Thinking: Why We Must Transform Our Teaching." *Journal of Developmental Education* 18:1.

Erden, M.(1998). *Öğretmenlik Mesleğine Giriş*. İstanbul, Alkım Yayınları.

Faccione, P. (1998). *Critical Thinking: What İt İs and What İt Counts.* California Academic Pres.

Fisher, R. (1995). *Theaching Children to Think* . UK., Stanley Thornes Publishers Ltd.

Gander, M.J., & Gardiner, H.W. (1993). *Çocuk ve Ergen Gelişimi*. (Çeviren: B.Onur). Ankara, İmge Kitabevi.

Karasar, N. (2006). *Bilimsel Araştırma Yöntemi.* Ankara. Nobel Yayın Dağıtım.

Kazancı, O. (1989). Eğitimde Ne Düşünmek mi Nasıl Düşünmek mi?. *ÇağdaşEğitim Dergisi* 14 (145):19-24.

Kökdemir, D. (2003). *Belirsizlik Durumlarında Karar Verme Ve Problem Çözme*, Ankara Üniversitesi, Sosyal Bilimler Enstitüsü Doktora Tezi, Ankara.

Kuran, K. (2002). "Öğretmenlik mesleği (niteliği ve özellikleri)", Adil Türkoğlu (Ed). *Öğretmenlik Mesleğine Giriş*, Ankara: İnci Ofset.

Moore, K.D. (2001). *Classroom Teaching Skills*. 5th Edt. Boston: Mcgraw-Hill.

Norris, P.S. (1985). "Synthesis of research on critical thinking", *Educational Leadership*, c.42, s.8, ss.40-45

Paul, R.W. (1991). *Devoloping Minds (A resource Book for Theaching Thinking).* Volume 1. Virginia: ASCD

Walsh, D., & Paul, R. (1988). *The Goal of Critical Thinking: From Educational İdeal to Educational Reality.* Washington, DC. American Federation of Teachers.

Wilks, S. (1995). *Critical and Creative Thinking: Strategies for Classrool Inquiry,* Portsmouth, NH. Heinmann.

Yalın, H., Hedges, L., & Özdemir, S. (1996). *"Her Yönüyle Öğretmen Olabilme".* Milli Eğitim Bakanlığı Yayınları, Ankara.