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Türkiye'den Bir Profil: 11-13 Yaş Gurubu Matematik Öğretmen Adaylarının Eleştirel Düşünme Eğilim ve Becerileri — Source link

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Türkiye'den Bir Profil: 11-13 Yaş Gurubu Matematik Öğretmen Adaylarının Eleştirel Düşünme Eğilim ve Becerileri

Elif Beymen TÜRNÜKLÜ[*] **Sibel YEŞİLDERE**[**]

ÖZ: Bu araştırma ilköğretim matematik öğretmen adaylarının eleştirel düşünme eğilim ve becerilerini belirlemeyi amaçlamaktadır. Bir eleştirel düşünme ölçeği ve matematiksel eleştirel düşünme problemleri veri toplama araçları olarak kullanılmıştır. Çalışma grubu Türkiye'nin batısında yer alan bir büyük üniversiteden seçilmiştir. 227 matematik öğretmen adayı bu çalışmaya katılmıştır. Verilerin analizleri sonucunda, öğretmen adaylarının eleştirel düşünme eğilimleri pozitif yönde fakat yeterince yüksek çıkmamıştır. Ayrıca eleştirel düşünme eğilim ölçeği sonuçları ve matematiksel eleştirel düşünme problemleri sonuçları bir uyum göstermiştir. Elde edilen bu sonuçlar dikkate alınarak, öğretmen adaylarının güçlü ve zayıf yanları ortaya çıkarılmıştır.

Anahtar Sözcükler: Eleştirel düşünme, öğretmen eğitimi, matematik

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ÖZET

Giriş

Eleştirel düşünmenin teorik dayanağını hem bilişsel süreçler hem de düşünme odaklı felsefi yaklaşımlar oluşturmaktadır. Eleştirel düşünmenin özünü oluşturan bileşenler analiz etme, yorum yapma, öz düzenleme, çıkarımda bulunma, açıklama ve değerlendirmedir (Facione, 1998). Ennis(1989) eleştirel düşünmeye üç aşamada yaklaşmaktadır. Birinci olarak eleştirel düşünme diğer insanlarla ve çevre ile etkileşime girerek problem çözme ile başlamaktadır. İkinci olarak; daha önceden elde edilen bilgiler ile ilişki kurarak akıl yürütme süreci devreye girmektedir ve tümevarım, tümdengelim ve hüküm verme yoluyla çıkarsamada bulunma söz konusu olmaktadır. Üçüncü aşamada ise eleştirel düşünme süreci; neye inanıp neye inanmamalı konusunda bir karara varma ile son bulmaktadır (Ennis, 1989).

Araştırmanın amacı, ilköğretim matematik öğretmen adaylarının eleştirel düşünme eğilimlerini ve becerilerini belirlemektir.

Yöntem

Araştırmada iki farklı veri toplama aracından yararlanıldı. Bunlar California Eleştirel Düşünme Eğilimleri Ölçeği(CCTDI) ve Matematiksel Eleştirel Düşünme Problemleri(MCTP). Araştırmanın örneklemini bir eğitim fakültesinde ilköğretim matematik öğretmenliğinde okuyan öğretmen adayları oluşturmaktadır. Aşağıda açıklanan ölçekleri toplam 277 matematik öğretmen adayı yanıtlamıştır. Bunların 91 tanesi 3.sınıf, 136 tanesi 4. sınıf öğrencilerindendir.

Veri Toplama Araçları

California Eleştirel Düşünme Eğilimleri Ölçeği(CCTDI)

Kökdemir 2003 yılında bitirdiği doktora tezinde California Eleştirel Düşünme Eğilimleri ölçeğini Türkçe'ye uyarlamış ve uygun istatistiksel analizleri yaparak son haline getirmiştir. Çalışmada belirtilen ölçeğin Türkçe versiyonu Kökdemir'den izin alınarak kullanılmıştır. CCTDI'ın benzer eleştirel düşünme ölçeklerinden farklı olarak bir beceriyi ölçmek için değil, kişinin eleştirel düşünme eğilimini ya da daha kapsamlı bir deyimle eleştirel düşünme düzeyini değerlendirmek amacıyla kullanılmaktadır (Kökdemir, 2003). Ölçek, altı alt ölçekten oluşmaktadır. Bu alt ölçekler; Analitiklik, Açık Fikirlilik, Meraklılık, Kendine Güven, Doğruyu Arama, Sistematiklik alt ölçekleridir. Toplam 6 boyut ve 51 maddeden oluşan ölçeğin iç tutarlılık katsayısı, .88'dir.

Matematiksel Eleştirel Düşünme Problemleri

Matematiksel eleştirel düşünme problemleri eleştirel düşünme bileşenlerini dikkate alarak bu bileşenlerin ortaya çıktığı becerileri hedeflemektedir. Matematiksel eleştirel düşünme problemleri hazırlanırken bu becerileri ortaya çıkarabilecek nitelikte sorular üretilmiştir. Bu soruların değerlendirilmesindeki kriterler de bu hedefler dikkate alınarak oluşturulmuştur.

Bulgular

California Eleştirel Düşünme Eğilimleri Ölçeğine(CCTDI) İlişkin Bulgular

Ölçeğe verilen yanıtlar 1-6 arasında bir puanlama yapılarak Spss-win programı kullanılarak istatistiksel analizleri yapılmıştır. Çalışmanın gerçekleştirildiği 227 ilköğretim matematik öğretmen adayının eleştirel düşünme düzeyleri hem bütünsel olarak hem de ölçeğin alt boyutları kapsamında belirlendi.

CCTDI bir bütün olarak değerlendirildiğinde puanı 240'dan (40 x 6) az olan kişilerin genel eleştirel düşünme eğilimlerinin düşük, puanı 300'den (50 x 6) fazla olanların ise bu eğilimlerin yüksek olduğu söylenebilir(Kökdemir, 2003). Buna göre Tablo 1'den de görüldüğü gibi uygulamanın yapıldığı ilköğretim matematik öğretmen adaylarının eleştirel düşünme eğilimleri olumlu yöndedir.

Eleştirel düşünme eğilimleri ölçeğinin Türkçe versiyonu altı alt ölçekten oluşmaktadır. Tablo1 de öğrencilerin eleştirel düşünme eğilimlerinin alt boyut ortalamaları verilmektedir.

Tablo 1. İlköğretim Matematik Öğretmen Adaylarının in CCTDI'ya göre ortalamaları ve standart sapmaları.

Alt ölçek	Ortalama	Standart Sapma	Aralık
Analitiklik	47,78	6,06	22-60
Açık Fikirlilik	43,75	7,64	12-59
Meraklılık	42,57	8,99	7-57
Kendine Güven	37,22	9,91	26-60
Doğruyu Arama	36,33	7,39	7-55
Sistematiklik	43,04	7,08	20-60
CCTDI	250,71	36,51	94-234

Öğretmen adaylarının kendine güven ve doğruyu arama alt ölçeklerinde eleştirel düşünme eğilimlerinin düşük olduğu, bunlar dışındaki dört alt

ölçeğe ilişkin eleştirel düşünme eğilimlerinin olumlu yönde olduğu görülmektedir.

Matematiksel Eleştirel Düşünme Problemlerine İlişkin Bulgular

Sorulan problemlerde öğrencilerin değişik düşünce biçimlerini ortaya koyarak kendilerine en uygun çözümü nedenleri ile birlikte ifade etmeleri istenmiştir. Alınan yanıtlar öğrencilerin göstermesini istenilen davranışlar kriterler kabul edilerek 1-6 arasında puanlama yapılmıştır. Bu kriterlere göre değerlendirilen problemler, kişilerin elde edilen toplam puanları üzerinden analizleri yapılmıştır.

Kriterlere bakıldığında eleştirel düzeyleri yüksek kabul edilebilenler 5 ve üstü puan alan kişiler olacaktır. Toplam 5 problem vardır ve toplam puan 25 (5x5=25) ve üzeri olanlar yüksek seviyeden kabul edilebilir. Araştırmaya katılan ilköğretim matematik öğretmen adaylarının bu sorulara verdikleri yanıtların analizleri Tablo 2'de verilmiştir. Tabloda görüldüğü üzere bu ölçekten toplam puan ortalamasının çok yüksek olmadığı görülmektedir.

Tablo 2. İlköğretim Matematik Öğretmen Adaylarının Matematiksel Eleştirel Düşünme Problemlerine(MCTP) İlişkin Ortalamaları

	Ortalama	**Standart Sapma**	**Aralık**
MCTP	16,63	4,37	0-25

Bu sorulardan elde edilen toplam puanlar ile CCTDI ölçeğinden elde edilen toplam puanlar arasındaki uyuma bakılmıştır. Bunun için McNemar testi kullanılmıştır. Elde edilen sonuca göre 25 ve üzeri, ve 250 ve üzeri puan alanlar ile 20 altı ve 250 altı toplam puan alanlarla diğer kişilerin sayıları arasında anlamlı fark bulunmamıştır. Dolayısıyla, CCTDI ölçeği ile matematiksel eleştirel düşünme problemleri sonuçları uyumludur.

Tartışma

Yeterlilikler doğrultusunda öğretmenlerde eleştirel düşünme eğiliminin bulunması gerekmektedir. Belirtilen temel yeterliliklerin sağlanabilmesi öğretmenlerin eleştirel düşünme eğilimlerinin yüksekliğini gerektirmektedir. Bu nedenle öğretmenlerin ve öğretmen adaylarının eleştirel düşünüme eğilimlerini geliştirecek öğrenme ortamları oluşturulmalıdır. Araştırmanın yapıldığı örneklemde, öğretmen adaylarının eleştirel düşünme düzeylerinin yüksek olduğu söylenemez ancak öğretmen adaylarının eleştirel düşünme eğilimleri pozitif yöndedir. Analitiklik; akıl yürütme, problemleri yeniden

kullanmak için verilenleri kullanma, kavramsal boyutta karşılaşılabilecek potansiyel zorlukları tahmin etmeyi içermektedir (Faccione et all., 1995).

Öğretmen adaylarının açık fikirlilik alt ölçeği perspektifinden eleştirel düşünmeye olumlu yönde eğilim gösterenlerin yüzdesi %76'dır. Öğretmen adaylarının özellikle farklı bakış açılarına değer vermeleri, öğrenciler için oldukça önemlidir. Özellikle de en önemli hedeflerinden biri öğrencilerin problem çözme becerisini kazandırmak olan matematiğin doğasında yeni fikirlere açık olmak ve esnek düşünmek vardır. İlköğretim matematik öğretmen adaylarının bu alt boyuttaki eğilimlerinin yüksek olması eğitim açısından olumlu bir sonuçtur.

Öğretmen adaylarının %75'i meraklılık, %54'ü kendine güven alt ölçeğinde eleştirel düşünmeye olumlu yönde eğilim göstermektedir. Kökdemir (2003)'de 913 üniversite öğrencisi ile yaptığı çalışmasında öğrencilerin kendine güven boyutunda eleştirel düşünme eğilimlerinin düşük olduğunu belirlemiştir. Öğretmen adaylarının kendilerine olan güvenlerinin düşük olması, öğretmenlik yeterlilikleri konusunda şüpheye düşürmektedir. Öğretmen adaylarının eleştirel düşünme eğilimleri düşük çıkanlardan bileşenlerinden bir tanesi de doğruyu aramadır. McBride, Xiang ve Wittenburg (2002) Çin'li ve Amerika'lı beden eğitimi öğretmen adaylarının doğruyu arama eğilimlerinin düşük çıktığını belirlemişlerdir. Facione ve ark.(1995) 587 üniversite öğrencisinin eleştirel düşünme eğilimlerini araştırdıkları çalışmalarında öğrencilerin doğruyu arama alt ölçeğinden düşük puan aldıklarını belirlemişlerdir. Doğruyu aramayı etkileyebilecek faktörlerden biri, öğrencilerin derin matematiksel bilgileri öğrenmelerini gereksiz olarak görmeleri ve neden öğrendiklerini anlamamalarıdır. Benzer durum yurt dışında başka ülkelerde de görülmektedir. Yunanistan'daki ilköğretim matematik öğretmen adayları arasındaki ortak görüş; ilköğretim okullarında öğretilecek kadar matematik bilmenin yeterli olduğu yönündedir (Potari, 2001). Hiebert, Morris ve Glass (2003) Amerika Birleşik Devletlerinde matematik öğretmen adaylarının derinlemesine matematik bilgisine sahip olmada ve onu etkili şekilde kullanmada yetersiz olduklarını belirtmektedir. McBride ve ark.(2002) doğruyu arama eğilimi düşük olan öğretmen adaylarının kendi öğrendikleri şekilde öğretimi gerçekleştireceklerini ifade etmektedir. Bu nedenle öğretmen adaylarının iyi bir öğretmen olabilmek için bu doğrultuda kendilerini geliştirmeleri gerekmektedir.

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A Profile from Turkey: Critical Thinking Dispositions and Abilities of Pre-Service Mathematics Teachers of 11-13 Year

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ABSTRACT: This research aims at investigating critical thinking dispositions of elementary mathematics teacher candidates in Turkey. A critical thinking dispositions inventory and mathematical critical thinking problems were used as data collection tools. The study group was chosen from a large public university located in the West part of Turkey. 227 mathematics teacher candidates participated to this study. According to the analysis of the data, critical thinking dispositions of teacher candidates of elementary mathematics were positive but not high enough. Additionally, the results of CCTDI Inventory and the results of mathematical critical thinking problems are consistent. Based on this discussion and the results taken from the inventory, the mathematics teacher candidates' weaknesses and strengths were drawn.

Key Words: Critical thinking, teacher education, mathematics

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INTRODUCTION

This study aims at investigating the critical thinking dispositions and abilities of mathematics teacher candidates. Theoretical bases of critical thinking consist of both cognitive and emotional approaches. Disposition means to love, want or frankly to tend something to do; and skill means ability of a person for achieving a mission and to conclude a procedure in accordance with its aim depending upon his or her predisposition and education. Facione and his colleagues claim that one may have higher order thinking skills but that person could not be oriented to use them (Facione, Giancarlo, Facione & Gainen, 1995).

Critical thinking skills are considered as higher order thinking skills (Marzano, 1998; White & Hargrove, 1996; Ikuenobe, 2001) and as abilities derived based on this view. Some researchers perceive critical thinkers as good thinkers and intellectual persons (Facione, 1998).

Ennis' (1989) approach to critical thinking has three stages. Firstly, the critical thinking begins with problem solving by means of interaction with other people and the environment. Secondly, reasoning comes into force through forming relations with previously acquired knowledge. As for the third stage, the critical thinking ends with deciding on what to believe and not (Ennis, 1989). According to Maiorana (1992), the target of critical thinking is to perform understanding, evaluation and problem solving. Facione (1998) on the other hand, describes the components that form the fundament of critical thinking as analysis, interpretation, self regulation, inference, explanation and evaluation.

Some researchers work on identification of critical thinking skills and some of them work for developing critical thinking skills at every level of education. In order to develop critical thinking skills, some practical or theoretical ways are recommended at the end of a number of research. Some of them focus on problem solving situations in order to develop critical thinking skills (Quinn, 2000; White & Hargrove, 1996; Turnuklu & Yesildere, in press) as well as critical thinking dispositions (Facione, 1998; Leader & Middleton, 2004; Kökdemir, 2003).

Based on Facione and his colleagues' discussion, some studies have empirical data that shows one-to-one connection between each critical thinking dispositional attribute and a given critical thinking skill. According to Facione and his colleagues (1995) critical thinking dispositional attributes help predicting critical thinking skills.

There is not a specific result that shows critical thinking dispositions related directly to career and academic success. But according to Facione and his colleagues (1995), this relationship is strong and positive. Additionally, many educational programs aim at educating critically thinking individuals.

One of the general aims of mathematics teaching in primary and secondary schools is to enable students to acquire skills of solving non-routine problems. In order to solve these kinds of problems, students should judge the availability of the given data and the difference between them. They should also have such skills as sorting the irrelevant information out, asking effective questions that would enable him/her to reach the solution of the problem. It can be clearly seen that those skills are very much relevant to the skills that are the targets of critical thinking to be brought in students. Some critical thinking skills such as being aware of his/her self level, searching the accuracy of given information, holding discussions about it and proving his/her opinion, and convincing others about it are important for mathematics education.

At this point educating students as critical thinkers may depend on the quality of teachers. It is the teacher who will secure the development of those skills in students. The assumption here is that developed critical thinking of a teacher leads to an accelerated development of his/her students in this respect. For that reason it will be appropriate to develop teacher's critical thinking and educate them about teaching methods and techniques that will enable the students to develop critical thinking as well.

In reviewing the teacher qualifications in Turkey published by the General Directorate of Teacher Training and Education division in the Turkish Ministry of Education, there are some standards in general teacher competencies such as "teachers should have the ability to develop critical thinking of students" to ensure that teachers utilize these competencies (Anonymous, 2002). Hence, the importance of development of students' critical thinking skills is being exerted.

Regarding the importance of critical thinking both in mathematics education and teacher training, it seems necessary to establish the critical thinking dispositions and abilities of mathematics teacher candidates and necessary precautions to be taken regarding the case. The study asserts that finding out the importance of critical thinking and its results in mathematics education would have an important role to develop requirements for courses of teacher training.

The purpose of this research is to determine the level of critical thinking disposition and abilities of the mathematics teacher candidates attending the third and fourth (last) years of elementary mathematics teacher training program in a Faculty of Education in Turkey.

METHOD

Participants

Participants were 277 teacher candidates attending the third year (n=91) and the fourth year (n=136) of teacher training program in a large public university located in the West part of Turkey. These participants are going to be a teacher of 11-13 year old pupils.

Instruments

Two separate data collection tools were utilized in the research. These are the California Critical Thinking Dispositions Inventory (CCTDI) and Mathematical Critical Thinking Problems (MCTP).

California Critical Thinking Dispositions Inventory (CCTDI)

Kokdemir (2003) has adapted California Critical thinking dispositions Inventory (CCTDI) to Turkish in his Doctoral thesis and he made the final modifications on it by performing the proper statistical analyses. The Turkish version of the mentioned inventory was used by permission of Kokdemir. Unlike its precedents, (such as Watson – Glaser Critical Thinking Skills Inventory) CCTDI is not used for evaluation of a skill. It is used for evaluation of critical thinking dispositions of an individual, speaking broadly, critical thinking level (Kokdemir, 2003). This inventory is a 6-point likert response scale. Answering options are the agreement levels ranged from 'Agree Strongly' to 'Disagree Strongly'. The inventory consists of six subscales and 51 items. These subscales are analyticity, open-mindedness, inquisitiveness, self-confidence, truth-seeking and systematicity. These subscales consist of ten, twelve, nine, seven, seven and six items respectively. Cronbach's alpha coefficients on the six subscales ranged from 0.61(truth-seeking) to 0.78 (inquisitiveness). The total test score coefficient is 0.88. The definitions of these sub-scales by Facione and his colleagues (1995) are as follows:

Analyticity – prizing the application of reasoning and the use of evidence to resolve problems, anticipating potential conceptual or practical difficulties, and consistently being alert to the need to intervene.

Open-mindedness – addresses being tolerant of divergent views and sensitive to the possibility of one's own bias.

Inquisitiveness – measures one's intellectual curiosity and one's desire for learning even when the application of the knowledge is not readily apparent.

Self-confidence –measures the trust one places in one's own reasoning processes.

Truth-seeking – targets the disposition of being eager to seek the best knowledge in a given context, courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support one's self-interests or one's preconceived opinions.

Systematicity – measures being organized, orderly, focused, and diligent in inquiry (p.4-6).

Mathematical Critical Thinking Problems (MCTP)

The developed problems are called Mathematical Critical Thinking Problems (MCTP), which are being prepared in order to assess those skills of the mathematics teacher candidates who are going to be qualified teachers of 11-13 years old.

When Facione's (1998) components of critical thinking and Ikuenobe (2001) and Marzano (1998)'s critical thinking abilities are taken into consideration, some common points arise in either developing the mathematical problems or assessing them. All addresses argumentation, use of logic, problem solving, decision making, hypothesis testing and scientific inquiry. According to these researchers a critical thinker is able to identify and analyse different relations and conditions for the problem; to construct valid argument and solution and express them in well organized way; to articulate and organize ideas (Ikuenobe, 2001; Marzano, 1998; Facione, 1998).

Based on Leader and Middelton (2004), and White and Hargrove (1996)'s papers the mathematical problems were developed by considering both promoting their dispositions of critical thinking and critical thinking abilities. The contents of the developed problems are limited to teacher candidates' extent of mathematical knowledge, which the teacher training program requires. Mainly, the problems do not ask specific mathematical content knowledge. The solutions were checked in accordance with the expectations from mathematics teacher candidates.

These problems were developed by the researcher and validated by two experts (one in psychology and one in mathematics) in terms of the critical thinking skills each was intended to elicit.

Of the five problems, the first problem asked the teacher candidates to think about the reasons why the surface of the covers (manholes) of sewage, telephone and drainage systems are made in circular shape. They were requested to state all of the probable reasons occur in their minds and to make reasoning and make the most proper explanation according to them by stating reasons. The solution of the problem allowed the researcher to assess teacher candidates' ability to develop different perspectives and to sort information in a systematic and programmed way.

In the second problem, the teacher candidates were asked about how they would have calculated the area of an irregular geometrical shape if they had not known to calculate integration. This problem requires teacher candidates to make reasoning, produce different ideas, evaluate them, and explain these ideas rationally by using objective proofs.

In the third problem, the teacher candidates were requested to evaluate the presented data and find all of the probable solutions for the problem. The target of this problem is to evaluate how systematic, organized, planned, and careful the teacher candidates are in their searching of different opinions by using objective proofs and finding out different perspectives.

In the fourth and fifth problems, the students were given a period regarding a game and they were requested to make reasoning about the information they had at the beginning of the game. The aims of these questions are to measure the application of the teacher candidates reasoning, how the candidates use the evidence to resolve problems and being organized, systematic in inquiry.

All of the problems requested the teacher candidates to explain their thinking manner in details, and express all of the possibilities occurred in their mind with their reasons, and determine the most consistent expression according to them with its reasons. It is important for all of the problems that the students' expressions be simple and clear and stated their opinion clearly.

The criteria for evaluation of those problems were generated taking components of critical thinking into consideration. Responses of students were evaluated with respect to categories given in Table I.

Table I. MCTP's criteria for evaluation.

Points Given	*Solution*	*Relation And Condition for Problem*	*Argument Reason*	*Relevancy*	*Clarity Satisfactory Organization*
6	Correct and logical, based on scientific truth	All conditions and (or) relations stated	Argument and reasons support the thought (solution)	No irrelevant information	All explanations are clear, satisfactory and well organised
5	Solution correct but not cover all conditions	Not all conditions or/and relations are stated	Argument and reasons support the thought (solution)	No irrelevant information	All explanations are clear, satisfactory and well organised
4	Not cover all conditions and stages of solutions are not explained exactly/ clearly	Not all conditions or/and relations are stated	Some explanations are in adequate	No irrelevant information	Explanations are not satisfactory
3	Not logical and scientific, it is not an exact solution, there are some mistakes	Not all conditions or/and relations are stated	Some explanations are in adequate	Irrelevant information	Explanations are not satisfactory
2	Not exact solution, claims or in correct or not depend on scientific truths	Not all conditions or/and relations are stated	Not coherent within its scope	Irrelevant information	Explanations are not satisfactory
1	Full of mistakes, far from scientific truth and not logical	Not all conditions or/and relations are stated	It is not support the thought	Irrelevant information	Explanations are not satisfactory, clear and well organised
0	No Response				

FINDINGS

Findings Obtained by California Critical Thinking Dispositions Inventory

The responses given to the scale was scored between 1 and 6 point. The statistical analysis was carried out in Spss-win programme. Descriptive statistics were used to profile the critical dispositions of mathematics teacher candidates.

For this study, both scores of each subscale and the total score were taken into account to profile critical thinking dispositions of the sample. According to Facione and Facione, every person has strengths and weaknesses about critical thinking dispositions; therefore, the total score of the overall inventory reflects the real level of disposition towards critical thinking (Facione & Facione, 1992, cited in McBride, Xiang & Wittenburg,

2002). Scores of 40 or above in any of the seven scales show that the person has a positive tendency towards this disposition (Facione & Facione, 1994, cited in Kong, 2004). Scores between 50 and 60 mean that a person has a strong positive tendency towards that disposition. Similarly, Kokdemir (2003) adapted this evaluation to his new version of CCTDI with six subscales. According to Kökdemir (2003) the highest and the lowest scores are fixed for each subscale. The highest score could be taken in CCTDI is 60 for each subscale and teacher candidates' scores are transformed in respect of Kokdemir's computation which is stated in his thesis detailed. Scores of less than 40 in total 240 (40 x 6) can be considered as having a negative tendency towards critical thinking disposition and scores of 50 in total 300 (50 x 6) or above indicate positive tendency on that CCTDI with six subscales.

Taking this scoring guide into consideration, critical thinking dispositions of mathematics teacher candidates (mean=250.71) are positive (as it can also be seen from Table II).

Table II. CCTDI mean scores and standard deviation (SD) of Elementary Mathematics Teacher Candidates

Subscale	Mean	SD	Range
Analyticity	47.78	6.06	22-60
Open-mindedness	43.75	7.64	12-59
Inquisitiveness	42.57	8.99	7-57
Self-confidence	37.22	9.91	26-60
Truth-seeking	36.33	7.39	7-55
Systematicity	43.04	7.08	20-60
CCTDI (n=227)	250.71	36.51	94-324

The teacher candidates scored between 22 and 60 from analyticity subscale, between 12 and 59 from open-mindedness subscale, between 7 and 57 from inquisitiveness subscale, between 26 and 60 from self-confidence subscale, between 7 and 55 from truth-seeking subscale, and between 20 and 60 from systematicity subscale. It is seen that critical thinking dispositions of the student teachers are low in self-confidence and truth-seeking subscales

whereas their critical thinking dispositions are positive regarding the remaining four subscales.

The percentages regarding the teacher candidates who have high and low critical thinking dispositions are stated in Table III from the perspective of subscales.

Table III. The Percentages Regarding the Teacher Candidates Who Have High and Low scores of Critical Thinking Dispositions

Subscale	Percentage of low scores (%)	Percentage of high scores (%)
Analyticity	6	94
Open-mindedness	24	76
Inquisitiveness	25	75
Self-confidence	54	46
Truth-seeking	64	36
Systematicity	27	72

It is seen that the percentage of low scores on self-confidence and truth-seeking are higher than the percentage of high scores on self-confidence and truth-seeking. Hence, it can be stated that critical thinking dispositions are positive as for other dimensions constituting the inventory.

Findings Obtained by Mathematical Critical Thinking Problems

As discussed in the introduction section, an individual who has critical thinking should exhibit some skills. The teacher candidates were requested to exhibit different kinds of thoughts and to state the most proper solution according to them with its reasons in their solutions of mathematical critical thinking problems. Scoring was made between 1 and 6 based on the given criteria.

The total score of individuals for each problem was taken. In order to ensure the reliability of the coding, the consistency between the two coding made by the same researcher on different times was calculated as .86.

Taking the criterion into consideration, the ones whose critical thinking may be regarded as high levels are those who received 5 or more points. There are five problems and ones whose total points are 25 (5 x 5=25) and above are thought as high level. Analysis of the responses of mathematics

teacher candidates who participated in the research are given in Table IV. As can be seen from the table, total average point received from this inventory is not high.

Table IV. MCTP mean scores and standard deviation (SD) of Elementary Mathematics Teacher Candidates

	Mean	**SD**	**Range**
MCTP	16.63	4.37	0-25

McNemar test is used to inspect the consistency between total points received from these problems and the ones from CCTDI Inventory. According to the results (Table V), there is no significant differences among the total points received 25 and above, and 250 and above; and below 20 and below 250.

Table V. The results of McNemar Test indicating the consistency between CCTDI and MCTP.

		MCTP Low	**MCTP High**	**p**
CCTDI Low	N	216	1	
	%	95.15	0.44	
CCTDI High	N	10	0	.012
	%	4.40	0	

That is, the results of CCTDI Inventory and the results of MCTP are consistent. It can be stated that the developed problems which were constructed can evaluate critical thinking levels of people in scope of the criterion already constructed.

DISCUSSION

Mathematics is a human activity in which problems are encountered, interpreted and refined, assumptions are made and clarified, and arguments are created (Szydlik, Szydlik & Benson, 2003: 253).

However, many studies indicate that teacher candidates think that mathematics is an authoritative discipline and they perceive doing mathematics as the application of memorized formula and the procedures

given in text books (Szydlik, Szydlik &Benson, 2003). It is necessary that the teacher candidates meet the proficiency standards in mathematics as well as the proficiency standards in pedagogy. In other words, they must meet the required standards in terms of mathematical content knowledge and pedagogical content knowledge. It can be said that reaching those mathematical proficiency components require critical thinking of teacher candidates.

The close relationship between critical thinking dispositions components and teacher proficiency standards is prominent. One of the criteria for teacher proficiency in Turkey which supports critical thinking dispositions is the utilization and development of the programs which encourage students to ask question regarding the domain, to see different perspectives to thoughts and to produce information.

In this study, it could not be stated that the levels of the teacher candidates are high enough, however critical thinking dispositions of teacher candidates are in a positive direction. But for some dimensions, the scores of critical thinking dispositions are high.

Critical thinking dispositions of the teacher candidates are high at analyticity dimension. Analyticity covers reasoning, using the given data for re-using the problems and prediction of the potential difficulties (Faccione, Giancarlo, Facione & Gainen, 1995). The lessons that the teacher candidates participated from the beginning of the first year such as abstract/academic mathematics, analysis and algebra had been conducted depending upon re-discovery of the mathematical knowledge and reasoning. For that reason this is the expected result.

From the perspectives of teacher candidates, open-mindedness subscale, the percentage of the ones who have shown positive disposition to critical thinking is 76 %. The fact is very important for their students that the teacher candidates assign different perspectives especially. Being open to new idea and a flexible thinking exist in the nature of the mathematics especially one of the most important targets of which is to get the students to gain problem solving skills. Unless that is performed, we meet the teacher model who wants students to solve the problems in the way he or she has been taught them. It is a positive result for education that the dispositions of the teacher candidates of elementary mathematics are high at this dimension.

From the perspectives of teacher candidates, self-confidence subscale, the percentage of the ones who have shown positive dispositions to critical thinking is 46 %. The other studies had also the same results. For example Kokdemir (2003) established in his research on 913 university students that

critical thinking dispositions of the students were low at the dimensions of self-confidence and truth-seeking. A low level self-confidence of teacher candidates has us scratch our heads about their teaching skills. The information which is trying to be gained by a teacher who not has confidence about himself/herself or his/her own reasoning would not be permanent.

Based on the results obtained in this study, one of the components in which critical thinking dispositions of the teacher candidates are low is truth-seeking. McBride and his colleagues (2002), and Facione and his colleagues (1995) reached the same result in their studies. According to some studies, the common conception among the teacher candidates of elementary mathematics is that it is not necessary to know deep and detailed mathematical knowledge and why they learn (Ay, 2004; Potari, 2001). Hiebert, Morris and Glass (2003) state that the mathematics teacher candidates in United States of America are inefficient at having detailed mathematical information and nor using it effectively. The changing of that kind of view of teacher candidates and develop their skills may depend upon developing truth-seeking dimension of critical thinking disposition. McBride, Xiang & Wittenburg (2002) argued that the teacher candidates whose dispositions of truth-seeking are low would perform the instruction in a manner they have learnt.

To sum up, it was the expected result that the scores of some subscales of the critical thinking dispositions inventory were high for mathematics teacher candidates. On the other hand, for teacher candidates especially for mathematics teacher candidates, the low scores of some subscales and the low scores of mathematical critical thinking problems were under expectations. This result requires questioning teacher education programs. Learning environments should be constructed which develop critical thinking of teacher candidates and the teacher candidates should improve themselves in this respect in order to be qualified teachers.

In addition, the finding consistent with the California Critical Thinking Dispositions Inventory and Mathematical Critical Thinking Problems shows that it is possible to trust developed problems in order to evaluate critical thinking abilities of mathematics teacher candidates. Furthermore, mathematical problems, such as the developed problems which were used for evaluating critical thinking abilities in this study, may be used for developing critical thinking of mathematics teacher candidates.

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