OPEN ACCESS
EURASIA Journal of Mathematics Science and Technology Education
ISSN: 1305-8223 (online) 1305-8215 (print)
2017 13(7):3801-3827
DOI 10.12973/eurasia.2017.00759a

The Effects of Online Communities of Practice on Pre-Service Teachers' Critical Thinking Dispositions

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Received 3 August 2016 ▪ Revised 28 March 2017 ▪ Accepted 3 April 2017

ABSTRACT
This empirical study attempted to investigate the effect of using online communities of practice in teacher education on pre-service teachers' critical thinking dispositions. California Critical Thinking Disposition Inventory and the comments posted to the online community of practice were used as the data collection tools. Results showed that online communities of practice did not affect pre-service teachers' overall critical thinking disposition significantly. However, research results revealed that the scores that pre-service teachers have achieved from self-confidence and open-mindedness sub-factors of the inventory have significantly differentiated in favor of the pre-service teachers in the experimental group. The statements that pre-service teachers have made on their comments were weak in terms of critical thinking. Pre-service teachers have mostly expressed their own views and they have usually supported each other by providing positive opinions. Therefore, it is thought that online communities of practice affect positively only pre-service teachers' self-confidence tendency and the abilities to express their own opinions.
Keywords: online communities of practice, critical thinking, pre-service teacher

INTRODUCTION

Nowadays, pre-service teachers' experiences about learning to teach during the teacher education process are considered as an important complement of activities that have significant impact on many areas and affect the development of the countries in the long term, rather than being a process that is realized only in school environment, whose impact on the individuals can be assessed in the short term and affecting a certain part of the society. For this reason, in recent years, countries participate in international comparative research programs, such as PISA, TIMMS and IEA, in order to compare their achievements in education area and to determine the factors contributing the effectiveness of the education programs. The outcomes of these research programs are considered as an important criterion in many areas, from politics to economics (Adamson, 2012; Goldstein, 2004; Kelly, 2002; Reddy, 2005). The countries those are successful on these research programs have improved in social, economic, cultural, scientific aspects. Therefore, the training of the teachers, who are one of the most

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State of the literature

- Online Communities of Practice are technology-enriched social learning platforms that enable individuals to share their knowledge, experiences, and views.
- Online communities of practice can be used to support pre-service teachers during their practicum. These communities offer pre-service teachers the opportunity to create knowledge, share their experiences with each other and gain different skills such as analytical, critical and creative thinking.

Contribution of this paper to the literature

- This research provides an example of how online communities of practice can be used in teacher education.
- The research reports the effect of using online communities of practice in teacher education on pre-service teachers' critical thinking dispositions.
- The results of this study show that participating and online community of practice improves tendencies of pre-service teachers, such as showing tolerance towards different approaches, being sensitive to their own mistakes and relying on their own reasoning.
- In this research, pre-service teachers who participated in an online community of practice preferred to send messages that include mostly positive evaluations and supportive views each other.

important factors of education and who play a significant role on raising next generation in a qualified way in terms of knowledge and skills, is considered to be crucial.

Teacher education programs play an important role in raising teachers who keep up the changing demands of the society (Belvis, Pineda, Armengol & Moreno, 2013). The changing societal structure has also affected the expectations from teachers. Nowadays, teachers are not only expected to know scientific knowledge; they are also expected to ensure that their students use their daily experiences in the learning process and to develop their students' lifelong learning skills, such as critical thinking and problem solving (Cofre et al., 2015; Li & Pan, 2009; Nachiappan, Shukor, Veeran & Andi, 2012). Therefore, teachers should have the content knowledge as well as the pedagogical knowledge about how students can learn better and teaching methods (Mapolelo & Akinsola, 2015). Teachers acquire the content and pedagogical knowledge through theoretical and practice-based courses in the teacher education programs. In theoretical courses, they learn the concepts and principals about teaching methods, educational psychology and technology, whereas in practice-based courses they gain experience by practicing the acquired knowledge in real classrooms environments under the guidance of a counselor at the faculty. Especially, student teaching is considered as an indispensable and important element of a teacher training program. Student teaching is quite effective on student teachers' acquisition of expertise and self-confidence during their education (Faikhamta, Coll & Roadrangka, 2009). During the real-classroom based practices, student teachers can examine their experiences from different points of view and this process helps them to make sense of the complexity of teaching (Ruys, Keer & Aelterman, 2012).

Therefore, student teaching provides information to pre-service teachers about their own personal teaching capability (Tschannen-Moran, Hoy & Hoy, 1998). But, even though student-teaching has several benefits, pre-service teachers do not have enough opportunity for student teaching during their teacher education, before starting their professional life (Cheong, 2010). Most of the time, pre-service teachers learn teaching strategies but they do not have the opportunity to practice it due to time limitations (Carrier, 2009). Moreover, during the student teaching, the teachers who are employed in the practicum schools of pre-service teachers and their advisors at the university are expected to give feed-back. However, literature shows that both practice teachers and university advisors rarely offer reflective feedbacks to pre-service teachers (Rhoads, Radu & Weber, 2010). Tang and Lam (2004) emphasized that for the pre-service teachers, it is quite important to take support from peers and other professionals, share information and exchange ideas during the journey of learning to teach. Therefore, enriching the content of practice-based courses and supporting these courses with various teaching methods and technologies may be effective in eliminating the so-called limitation. Online community of practice can be suggested as a tool to use within the "student teaching" course of teacher education programs.

Online communities of practice

Practice-based learning communities are the groups that provide additional support to their members in terms of learning; have shared goals; participation is voluntary; their members share a social responsibility such as learning from the community and learning for the community (Riel & Polin, 2004). Although many communities of practice are formed without any intervention, in some cases organizations may support the creation process of certain communities (Wenger, McDermott & Snyder, 2002). Communities of practice mostly focus on gaining knowledge rather than on the establishment of a task. The life cycle of a community of practice depends on what it means to its members, rather than an academic or commercial agenda (Wenger, 1998). In recent years, the use of communities of practice in educational and organizational practices and research programs draws the attention of the professionals (Akkerman, Petter & Laat, 2008). Especially, the communities of practice that are used for educational purposes can be developed and strengthened through online environments that offer participants various facility, such as information storage and information sharing (Macia & García, 2016). Online communities of practice may differ from traditional learning environments, because the learning is realized in a social environment (Johnson, 2001). At the same time, unlike a traditional class, it provides flexibility to students, in terms of time and place, for communication, interaction, collaboration, and sharing of educational content; it allows them to discuss concepts and principals in the courses and share their views (Lee, Kim & Kim, 2014; Tsiotakis & Jimoyiannis, 2015). Online communities of practice may also be used for professional development of the teachers. As known, in universities teacher educators guide pre-service teachers and provide practice-based teaching (Tanni, 2012). Online communities of practice have a great potential for teachers and pre-

service teachers to share their resources and their experiences about teaching and to communicate each other (Barnett, 2006; Zhang, Liu & Wang 2016).

The use of online communities for enhancing continuous improvement of the teachers and raising pre-service teachers is not new; many research has reported the benefits of using online communities (Khalid, Joyes, Ellison & Daud, 2014). Online communities of practice support the development of the teachers by providing an environment, in which they can learn together, enhancing their content knowledge and pedagogical skills (Boling & Martin, 2005). At the same time, their lifelong learning skills, such as cooperative learning and critical thinking, can also be supported within this process. Corich, Kinshuk and Jeffrey (2003) claim that "critical thinking is evident when participants construct meaning while communicating with fellow participants" (p 91). However, we cannot simply assume that this potential of communities of practice will lead to significant changes in critical thinking without tangible results. Furthermore, there is a little empirical research focusing on the relationship between online learning communities and thinking skills. This study aims to investigate the effect of participation of communities of practice on critical thinking.

Critical Thinking & Critical Thinking Dispositions

Thinking skills are important for the problems that students face in their daily life or in the future (Nair and Ngang, 2012). Since critical thinking is one of the factors contributing to the success of the individuals, it is considered as an important topic for 21st century teaching and learning (Carmichael and Farrell, 2012; Stephenson and Sadler-McKnight, 2016; Yang, 2012). Being a cognitive activity, critical thinking requires the use of many mental process, such as paying attention, classification, selection, and judgment (Kumar and James, 2015). Individuals, who can think critically, ask appropriate questions, gather information for answering their questions, think reasonably and reaches reliable results (Rezaee, Farahian and Ahmadi, 2012). Critical Thinking (CT) represents a complex thinking process including various skills, such as analyzing, decision-making, problem-solving, assessment, inquiry and reflection (Carmichael and Farrell, 2012).

CT has two dimensions; first dimension is critical thinking skills and second is *disposition* to think critically (Pascarella and Terenzini, 2005). The term dispositions gained importance in the teacher education discourse during the 1990s (Villegas, 2007). A disposition is a person's internal motivation to act toward or respond to circumstances, events or persons (Facione, 2000). With a broad sense a disposition is "tendency to do something given certain conditions" (Ennis, 1996) in the other words a tendency to behave. Dispositions identified in the CT literature include tolerating ambiguity, willing to suspend judgment, being open-minded, inquisitive, and sensitive to other ideas; in short, a willingness to engage in sustained CT (Mcbride, Xiang and Wittenburg, 2002). Critical thinking disposition is considered as complementary to critical thinking skills and habits (Şahin, Tunca, Altınkurt and Yılmaz, 2016). Critical thinking skills and dispositions have an interdependent relationship; having a strong critical thinking disposition ensures the development and use of critical thinking skills

(Stupnisky, Renaud, Daniels, Haynes and Perry, 2008). Critical thinking dispositions are as essential as critical thinking skills for both students and teachers (Arsal, 2015). So, dispositions have important implications when teaching for critical thinking (Mcbride, Xiang and Wittenburg, 2002). Considerations of the disposition toward CT have remained largely within the realm of theoretical speculations, working assumptions, anecdotal observations, and pedagogical discussions, rather than within the subject of scientific investigations (Facione, Sánchez, Facione and Gainen, 1995). Halpern (1998) stated that critical thinker exhibits the following dispositions or attitudes: (a) willingness to engage in and persist at a complex task, (b) habitual use of plans and the suppression of impulsive activity, (c) flexibility or open-mindedness, (d) willingness to abandon nonproductive strategies in an attempt to self-correct, and (e) an awareness of the social realities that need to be overcome (such as the need to seek consensus or compromise) so that thoughts can become actions.

Rapid changes in the world demands that education should develop students' critical thinking at all levels rather than teaching obsolete knowledge (Zhou, Huang & Tian, 2013). In order to raise individuals who can think critically, universities should start initiatives that support the development of students' critical thinking skills at all levels of high education (Stephenson & Sadler-McKnight, 2016). The importance of critical thinking is also emphasized in teacher training and raising teachers who can think critically and who support their students' critical thinking skills are considered to be important. Unless teachers become critically reflective it is unlikely that they can become effective life-long learners and develop themselves in their professional life (Harrington, 1992). For the students to acquire, apply and improve critical thinking skills, first of all their teachers should possess these skills and should improve themselves in this area (Yang, 2012). Kloppers and Grosser (2014) have emphasized that critical thinking dispositions of the teachers should be developed first, before expecting them to develop their students' critical thinking skills. The teachers of the future may affect the development of the community by enhancing critical thinking skills of their students (Williams, 2005). Therefore, teacher training programs should primarily focus on the development of critical thinking. Williams (2005) has mentioned that developing critical thinking in teacher education may potentially increase the effectiveness of the communities in solving national and international problems and he argued that this relationship between teacher training and social problem solving may occur in three steps:

- The increase of the importance of critical thinking in teacher education will also increase the importance of critical thinking in K-12 education.
- The increase of the importance of critical thinking in K-12 education will also increase the use of critical thinking in the community.
- The increased use of critical thinking among community leaders and citizens will produce better problem-solving at societal level.

In overall, teaching critical thinking depends on the conditions offered to the teachers and students. Among these conditions, the most important one is providing environments that increase the possibility for an individual to comfortably declare what he/she thinks and allow

them to be free and not restricted by someone's rules or ideas (Korshuk, 2014). Being one of the mentioned environments, web-based environments may support learning experiences of pre-service teachers and it can provide them a learning environment where they can use critical thinking processes effectively (Kimmons et al., 2015). Since online communities of practice provide the opportunity of free thinking, expressing their thoughts, comparing their views, gathering and sharing information, they can be used as a tool for the use and improvement of critical thinking.

Current Study

In the literature, there are two main approaches allowing the students to acquire and improve critical thinking (CT) skills. First is skill-based or process-based approach, whereas the other is topic-based approach (Şendağ, Erol, Sezgin & Dulkadir, 2015). In skill-based or process-based approach, an environment is created for students to use and improve their critical thinking skills (Carmichael and Farrell, 2012). The objective is to develop critical thinking skills of the students. On the other hand, in topic-based approach, the activities that support the development of critical thinking are integrated into the learning content (Diana, Karyanto, Suciati & Indriyati, 2016; Harrington, 1992; Korshuk, 2014; Lee, Kim & Kim, 2014). In the literature, there are studies in which students' critical thinking was enhanced through technology-supported learning environments. In these studies, technology-supported learning environments were arranged as process-based or topic-based. Carmichael and Farrell (2012) have created and used website that was focusing on developing university students' critical thinking using process-based approach. Studies using topic-based approach have investigated the effects of the followings on students' critical thinking: the use of the videos in the learning processes (Korshuk, 2014), Socratic discussion in web-supported collaborative learning environments (Lee, Kim & Kim, 2014), problem-based learning method supported by online learning (Diana, Karyanto, Suciati & Indriyati, 2016), online conferences (Harrington, 1992). Critical thinking skills provide for a person to be successful in his profession. It is very important that students acquire critical thinking skills during their higher education, as it creates a path to their career (Kumar & James, 2015). Similarly, although the literature on critical thinking in teacher education is not extensive, teacher educators are increasingly acknowledging that critical thinking skills of teachers of the future must be developed (Williams, 2005). However, the outcomes of some descriptive studies conducted with pre-service teachers in Turkey show that critical thinking disposition of pre-service teachers is either low (Temel, 2014) or medium (Kartal, 2012; Korkmaz, 2009). For this reason, the use of web-supported learning environments, which are believed to support pre-service teachers' critical thinking, in teacher education programs and discussing their efficiency is deemed to be important. Online communities of practice are one of the web-supported learning environments. The literature contains qualitative and quantitative studies that investigate the impacts of online communities of practice or online learning communities on teachers and pre-service teachers (Nambiar and Thang, 2016; Tsiotakis & Jimoyiannis, 2015; Yang, 2016; Zhang, Liu & Wang, 2016). Barnett (2006) has created a community through an online inquisitive

learning forum to support science and mathematics teachers and pre-service teachers for sharing their experiences and beliefs. Zheng, Li and Zheng (2011) have offered online community conceptual model of teacher practice for the development of pre-service teachers' teaching skills. Cho (2016) has conducted an online community of practice study with bilingual pre-service teachers, whereas Iyer and Martin (2013) have discussed the superiorities of using communities of practice within the learning content of the university for pre-service teachers who are culturally and linguistically different. Sterenberg and O'Connor (2014) underlined another point and examined the experiences of pre-service teachers in online communities of practice and the role of critical friend that they played in this process. Tang and Lam (2014) have used blog-based teaching portfolios for creating an effective online community of learning. Similarly, Yang (2009) has created a community of practice with foreign language pre-service teachers using a blog. Baran (2007) has revealed motivating and blocking factors that affect pre-service teachers' participation in the discussions of an online community of practice and information sharing in these environments. Macia and García (2016) have reviewed the research papers in this field and examined teachers' characteristics of participating in professional online communities, their participation mechanisms, the factors affecting the participation in these communities and the effect of the participation on their professional development. As a result, it can be said that the studies featuring online communities of practice are usually descriptive. The literature contains extensive conceptual and theoretical studies about communities of practice, but there are very few experimental studies about how the communities of practice work and how to support educational communities through communities of practice. Although there is an increasing interest towards online communities, the effects of these communities on teachers' professional development is still controversial (Macia & García, 2016). Especially, the factors that contribute increasing the potential of web-based learning environments are not clear in the literature. Therefore, more studies, which examine to what extent web-based learning environment can enrich the critical thinking skills required for effective learning, are needed (Lee, Kim & Kim, 2014). Şendağ, Erol, Sezgin & Dulkadir (2015) have also state that the effectiveness of a content formed by combining various web 2.0 tools with appropriate teaching and learning strategies should be discussed in future studies for developing pre-service teachers' critical thinking. As a result, it can be said that the literature mostly contains studies including the limitations of the use of online communities of practice in teacher education, their impacts on teachers and the analysis of the posts that teachers shared in this communities. However, this study differs from the others by the use of qualitative and quantitative data collection tools together. Within the study, topic-based approach was used for web-based learning environments included in student teaching course. The research primarily attempted to determine how and to what extent online communities of practice affect pre-service teachers' critical thinking disposition. In addition, how and to what extent pre-service teachers' use these skills was revealed by examining the characteristics of pre-service teachers' communication within online communities of practice.

Research Questions

This research aims to determine the effect of using online communities of practice in student teaching course, on pre-service teachers' critical thinking dispositions, considering previous studies conducted in the field. In addition, pre-service teachers' comments sent to the web site were evaluated in terms of critical thinking. Research questions are as follows:

1. What is the impact of using online communities of practice in in student teaching course, which is included in teacher education programs, on pre-service teachers' critical thinking disposition?

2. Do online communities of practice significantly affect the analyticity, open-mindedness, inquisitiveness, self-confidence, truth-seeking, and systematicity disposition of teacher candidates?

3. What are the characteristics of pre-service teachers' communication (comment and response) within the online communities of practice?

METHODOLOGY OF RESEARCH

Research Design

The design of the research is pre-test / post-test quasi-experimental design with control group. The two groups, namely experimental and control groups, were randomly selected. Separate experimental and control groups were formed for science and math pre-service teachers. Critical thinking disposition inventory, which the data collection tool of the research, was administered to pre-service teachers twice, before and after the experimental operation. During the implementation process of the research, students of experimental group participated in online communities of practice for at least three days in a week, whereas students of control group have performed the activities required within the content of student teaching course and presented the reports that they have prepared daily. Pre-service teachers in the experimental group also presented their reports about diaries and activities. The comments that pre-service teachers have posted to the community of practice were used for supporting quantitative findings of the research. The implementation of the research was realized in 8 weeks, during spring semester of 2013-2014 academic year.

Participants

The research was conducted with pre-service teachers who are studying in the education faculty of a middle-size university in Turkey. 112 science and math pre-service teachers have participated in the study. But 6 pre-service teachers were absent the day when data collection tool was applied, thus quantitative data analysis of the study were performed with 106 pre-service teachers. 46.2% of the participants were assigned to the control group (n=49), whereas 53.8% of them were assigned to the experimental group (N=57). Since the qualitative data of the research were only collected from the online community of practice, this data was solely obtained from the experimental group. Pre-service teachers who participated

Table 1. Descriptive statistics to gender and department of pre-service teachers in experimental and control group

Participants		Female		Male		Total	
		n	%	n	%	n	%
Pre-Service Science Teachers	Experimental Group	15	75	5	25	40	37.7
	Control Group	14	70	6	30		
Pre-Service Math Teachers	Experimental Group	23	62.2	14	37.8	66	62.3
	Control Group	22	75.9	7	24.1		

in the study were 4th grade students. Pre-service teachers, who were studying in four different classes were divided into small groups for student teaching course. They worked with a faculty member, as an advisor, and with an internship advisor teacher in the schools to which they were assigned. The distribution of pre-service teachers according to gender and departments is shown in **Table 1**.

Procedure (Practice Process)

In this research, an online community of practice, which allows science and math pre-service teachers to share their knowledge, experience, documents and views, has been created through a web-site. The most important objective of online communities of practice is allowing individuals to share their experiences, to exchange their views, and to learn from each other in a social environment. The mentioned communities may occur spontaneously, or may be created by various institutions or individuals for a specific purpose. In order to create a community of practice, three main elements should be present; a particular topic, a community and a practice process (Nambiar & Thang, 2016). In this study, an online learning environment has been prepared using web-based technology for pre-service teachers to share their experiences and practices that they have acquired during the student teaching course.

Since the research was conducted on the students of two different departments, two different sites were prepared for science (fen.uygulamagunlukleri.org) and math pre-service teachers (matematik.uygulamagunlukleri.org). Pre-service teachers have prepared reflective diaries about the activities recommending for the teaching practice course in teacher education program that they realized in internship schools and shared them through the web site. Faculty members who are responsible of the course or internship teachers did not share any documents in the site. Pre-service teachers were asked to participate this process voluntarily, without any intervention or enforcement. Pre-service teachers had the opportunity to read and comment to the diaries that they have shared at the web site. In this process, they have observed and evaluated administrative and social affairs in a school, lesson instruction of the internship teacher, lesson instruction of a teacher from a different discipline, and teaching experience of their pre-service teacher friends. At the same time, pre-service teachers have also presented their views and evaluations about the teaching experience that they have lived through the diaries. In order to check the impact of the activities realized during the experimental operation and the process of student teaching on pre-service teachers, a control

Table 2. Sub-factors, examples of items and Cronbach alpha values of California Critical Thinking Disposition Inventory

Sub-factors of CCTDI	Examples of items	Original Alpha
Analyticity	You can define me as a reasonable person.	.75
Open-mindedness	Everything is like it seems.	.75
Inquisitiveness	I'm willing to learn challenging things.	.78
Self-Confidence	I'm known for my neat approach to complex problems	.77
Truth-Seeking	Everyone discuss for their own benefit, including me	.61
Systematicity	People say I made a decision very quickly	.63
Total Inventory		.88

group was also added to the study. The students of the control group were asked to realize the same activities and present them by forming a portfolio. The difference between experimental group and control group students is the students of experimental group shared their diaries and they had the opportunity to see the diary of the others and exchange their views. The prepared online community of practice was used as a platform that allows this sharing.

Data Collection Tools

California Critical Thinking Disposition Inventory was used as the quantitative data collection tool while determining pre-service teachers' critical thinking disposition. The comments that pre-service teachers have posted to the web site were used to identify the characteristics of pre-service teachers' communication.

California Critical Thinking Disposition Inventory: It was developed as a result of Delphi project that has been realized by American Philosophical Society in 1990, for determining individuals' critical thinking disposition (Facione, 1990). The inventory was adapted to Turkish by Kökdemir (2003). Turkish version of the inventory consists of six sub-factors, which are analyticity, open-mindedness, inquisitiveness, self-confidence, truth-seeking, and systematicity. Analyticity factor of the inventory includes items such as being alert to situations that might cause a problem and reasoning when faced with complex problems; open-mindedness factor contains items expressing the tolerance for different approaches and the tendency to be sensitive to own faults. Inquisitiveness factor of the inventory reflects the tendency of acquiring information and learning new things without expecting any earnings or interest, whereas truth-seeking factor expresses the assessment of different thoughts. Systematicity factor of the research reflect the tendency of planned and careful research, self-confidence factor reflects the confidence of one's own reasoning process. Cronbach alpha coefficient of the inventory, which is formed by 51 Likert-type items, was found to be .88. Cronbach alpha values of each sub-factor of the inventory are shown in **Table 2**. The total variance explained by the inventory was 36.13%. When the inventory is considered as a whole, it can be said that overall critical thinking disposition of the people, whose score is below 240, is low, whereas the disposition of the people, whose score is over 300, is high.

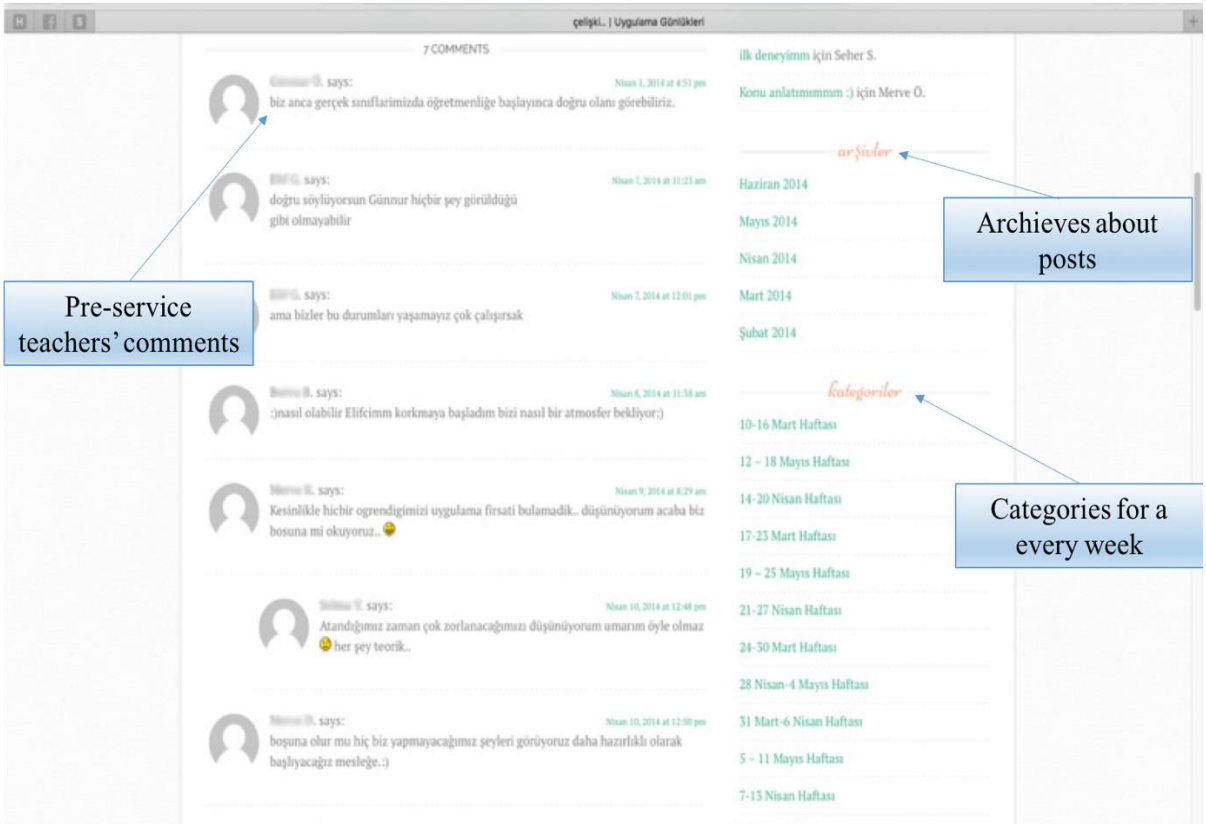

Figure 1. An example of the web page that contains comments of pre-service teachers

Pre-service teachers' comments and answers in the online community of practice: During the study, science and math pre-service teachers have first loaded posts to the site, then they have made various comments under the posts (**Figure 1**). During the experimental process, science pre-service teachers have loaded 180 reflective diaries, whereas math pre-service teachers have loaded 300 reflective diaries to the site. Pre-service teachers have voluntarily made various comments about the posts and shared their ideas with the others. The number of all comments was calculated as 152 for science pre-service teachers, and 518 for math pre-service teachers. In all of the process, the average number of comments is 8 for per pre-service science teachers and 14 for per pre-service math teachers. The comments made by pre-service teachers were used as the qualitative data collection tool while determining the character of their communication within the online community of practice and evaluating them in terms of critical thinking disposition. Faculty members and internship teachers did not post any comments to the web site. The so-called comments of pre-service teachers have provided a rich data source about how and to what extent the communication have took place within the community of practice.

Data Analysis

In this study, ANCOVA (Analysis of covariance) was preferred in order to eliminate the pre-test differences between the groups, which occurred before the experimental operation and to be able to do a reliable comparison. The comments and answers of pre-service teachers within the community of practice, which have constituted qualitative data of the study, were evaluated using discourse analysis. The analysis was performed by two specialists. In order to perform the analysis of the discourses realized on an online platform, the studies included in the literature were reviewed and the categories were set considering these studies. Schallert et al. (2009) have identified and defined nine major themes while evaluating discourse functions of online class discussions. Similarly, Tang and Chung (2016) have identified a new category in addition to these themes and they have performed the discourse analysis of the comments that pre-service teachers have made in an online community of practice using these categories. Moreover, for measuring critical thinking of pre-service teachers Lee, Kim and Kim (2014) have evaluated their web-based messages through content and flow analysis; in their study, six message types have been defined and pre-service teachers' messages have been analyzed accordingly. Considering the categories (discourse functions) defined in these studies and the comments of pre-service teachers who participated in the study, nine categories were defined, which are experience sharing, elaboration/explanation, positive evaluation, negative evaluation, social message, expressing views, making suggestions, showing support and expressing hope. **Table 3** shows the definitions of the categories and some examples of them. After defining the themes, the comments of science and math pre-service teachers were evaluated under these themes, their frequencies and percentages were calculated. For ensuring the reliability, agreement level between specialists was calculated and found to be 74%.

RESULTS OF RESEARCH

Differences Between Critical Thinking Dispositions

ANCOVA-one-way covariance analysis was performed for determining the effect of using online communities of practice in teacher education, on pre-service teachers' critical thinking dispositions. Pre-test critical thinking disposition inventory scores of pre-service teachers were taken as covariate variable and the effect of the experimental process on the scores of post-test critical thinking disposition inventory, which has been taken as the dependent variable, was determined. Post-test scores of pre-service teachers from experimental and control groups, which were adjusted by setting pre-test scores as covariate variable, were compared. Arithmetic means and standard deviations of pre-test and post-test scores that both groups have achieved from critical thinking disposition inventory and its sub-factors are given in **Table 4**.

One-way covariance analysis was used to test if the difference between pre-test and post-test critical thinking disposition inventory scores of the groups is statistically significant or not. Regression coefficients indicated that the interaction between covariate variables and

Table 3. Codes, definitions and examples of discourse analysis of pre-service teachers' comments

Discourse Functions	Definitions	Examples
Experience sharing	Giving examples from their own experience	"My primary school teacher was doing the same. He was asking questions; we were going to his side to show if we did it correctly or not."
Elaboration/Explanation	Explaining the reasons of a situation, analyzing and evaluating	"I think most teachers, according to my observations, unfortunately, is sticking to the book. Learning by doing, by living is desired but there are major shortcomings in the implementation."
Positive Evaluation	Supporting the opinion of the person who wrote the post. Agreeing.	"As you mentioned in your post, I think that new models stay on the paper."
Negative Evaluation	Disagree with the opinion of the person who wrote the post. Stating another opinion.	"Yes experience is an important factor but we cannot say that the class size is not important."
Social Message	Thanking, starting a conversation	"Thank you honey"
Expressing views	Expressing his/her personal opinion	"In fact there is no need for material. If the teacher is really smart and intelligent, he/she will teach the topic appropriately."
Making suggestions	Makes suggestions according to his/her personal views	"I think, both the curriculum and the books should be revised."
Showing support	Supporting his/her friend and expressing faith	"I can sincerely say that I see you as the most appropriate peer for teaching."
Expressing hope	Expressing the desire, hope, expectation for something to happen	"Hopefully we would be teachers who do not make mistake. God bless your hands."

Table 4. Arithmetic means and standard deviations that pre-service teachers in experimental and control groups have achieved from critical thinking disposition inventory and its sub-factors

	Experimental Group				Comparison Group			
	Pre-test		Post-test		Pre-test		Post-test	
Sub-factors of CCTDI	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Analyticity	47.655	5.066	47.810	5.148	48.500	4.598	48.083	11.271
Open-mindedness	52.310	7.544	52.527	7.351	49.875	8.444	47.729	9.337
Inquisitiveness	40.706	5.337	41.500	5.607	40.666	6.550	40.395	6.976
Self-Confidence	29.069	4.073	30.896	4.719	29.687	5.128	29.083	6.214
Truth-Seeking	24.206	4.919	24.620	4.564	24.458	5.299	25.437	5.527
Systematicity	26.551	4.193	26.534	4.197	25.958	4.312	25.812	4.569
Total Inventory	220.500	20.398	223.879	22.088	219.145	23.393	216.541	28.989

independent variables was not significant (F=.173, p=.679). In addition, the insignificance of Levene's test's results (F=2.378, p=.126) showed that the variance distributions of the groups were homogenous. Therefore, since the assumptions of covariance analysis were met, it was

Table 5. Comparison of critical thinking disposition post-test scores of the groups

Source of variance	SS	df	MS	F	p
Covariates	27846.430	1	27846.430	72.683	.000
Intergroup/Group	1048.476	1	1048.476	2.737	.101
Intragroup/Error	39461.461	103	383.123		
Total (After Correction)	68722.160	105			

Table 6. Comparison of open-mindedness and self-confidence post-test scores of the groups

	Source of variance	SS	df	MS	F	p
Open-mindedness	Covariates	2670.747	1	2670.747	61.083	.000
	Intergroup	269.079	1	269.079	6.149	.015
	Intragroup	4507.215	103	43.759		
	Total (After Correction)	7780.085	105			
Self-confidence	Covariates	1251.719	1	1251.719	70.324	.000
	Intergroup	136.108	1	136.108	7.647	.007
	Intragroup	1833.327	103	17.799		
	Total (After Correction)	3171.396	105			

concluded that ANCOVA analysis can be used for comparing post-test scores of the groups. The results given in **Table 5** shows that there are no significant differences between post-test scores of the groups (F=2.737, p=.101).

Post-test scores that pre-service teachers have achieved from the sub-factors of critical thinking disposition inventory were also compared. The results show that there are significant differences between the scores achieved from self-confidence and open-mindedness sub-factors of the inventory. The difference between open-mindedness scores of pre-service teachers from experimental group (Estimated Means=51.815, SD=.873) and control group (Estimated Means=48.577, SD=.961) is statistically significant (F=6.149 $p<0.05$). Similarly, the difference between self-confidence scores of pre-service teachers from experimental group (Estimated Means=31.109, SD=.555) and control group (Estimated Means=28.827, SD=.610) is also statistically significant (F=7.647, $p<0.05$). This outcome of the research shows that self-confidence and open-mindedness tendency of the pre-service teachers, who shared their views through online community of practice, has been significantly improved compared to the pre-service teachers of the control group, who only participated in student teaching and performed expected activities (**Table 6**). It was found that there are no significant differences on the post-test scores of the other four sub-factors of the inventory, namely analyticity, truth-seeking, inquisitiveness, and systematicity.

Comments and Answers of Pre-Service Teachers in the Community of Practice

During the qualitative data analysis of the study, the comments and answers that science and math pre-service teachers have shared in two web sites were examined and

Table 7. Comments of science and math pre-service teachers in the online community of practice

	Science pre-service teachers		Math pre-service teachers		Overall	
Categories	f	%	f	%	f	%
Experience sharing	7	4	19	4.88	26	4.52
Elaboration/Explanation	16	8.64	27	6.94	43	7.49
Positive Evaluation	**44**	**23.78**	**113**	**29.04**	**157**	**27.35**
Negative Evaluation	15	8.10	35	8.99	50	8.71
Social Message	13	7.02	15	3.85	28	4.88
Expressing views	**21**	**11.35**	**66**	**16.96**	**87**	**15.15**
Making suggestions	14	7.56	27	6.94	41	7.14
Showing support	14	7.56	19	4.88	33	5.74
Expressing hope	**41**	**22.16**	**68**	**17.48**	**109**	**18.98**
Total	185	32.22	389	67.77	574	100

gathered under defined themes; then their frequencies and percentages were calculated. The comments of both groups (science and math) are similar. The review of science pre-service teachers' comments showed that most of their comments include positive evaluations and views about the others (**Table 7**). Pre-service teachers often agreed with the others opinion and expressed similar thoughts. Pre-service teachers have emphasized the importance of the use of the laboratory in science education and agreed with their friends' opinion who shared his diary by stating that "Yes, not handling the course at the laboratory is one of the biggest omissions that I've seen.", another one commented as "Similarly I would like to see my internship teacher teaching the course at the laboratory, however I witnesses a plain instruction at the classroom". It has been seen that only few pre-service teachers have submitted their opinions by evaluating the facts from another point of view. Negative evaluations have remained at a low level, which is a remarkable result of the research. Experience sharing and elaboration/explanation are the two factors that are rarely encountered on pre-service teachers' comments. A pre-service teacher pointed that the teachers as the reason of the failure of properly implementing instructional programs by stating that "I think most teachers, according to our observations, unfortunately, is sticking to the book. Learning by doing, by living is desired but there are major shortcomings in the implementation." Some pre-service teachers presented their personal views as well. Pre-service teachers indicated that the can learn teaching by doing, one stated that "the training that we received during the university education fulfill only a part of the equipment required to be an ideal teacher. In my opinion, we will learn this job by doing and experiencing, as we expect from the students to learn by doing and experiencing", another one "I wish to do more practice but…, it will allow us to see what we can do.". A pre-service teacher shared his experience stating that "In the internship school that I go, some students are willing to ask questions, learn something, which is very good… some of the questions are surprisingly

interesting and tough. Even the teachers have difficulty in answering them". Pre-service teachers have often supported each other with their comments, they expressed their hopes and emphasized their faith that they will successfully perform their profession. "Since these are our first experiences, we will indeed have difficulty. But it will get stable in time, I believe in you", "My dear friend, even though it was your first experience, you instructed really well. It is especially difficult to ripple through the class with eye contact. Being able to do it in your first experience is a big advantage for you", "The first thing that a teacher should have is a smiling face … like yours" are the examples of comments showing the support of science pre-service teachers to each other. As a result, it can be seen that science pre-service teachers agreed each other's opinion, supported each other, expressed their hopes and wishes through the comments that they have shared at the web site. The comments such as explanation of possible causes of a fact, elaboration, giving examples from their own experiences, evaluating the facts from another point of view were not took a considerable place in the online community of practice.

Comments and Answers of Pre-Service Teachers in the Community of Practice

During the qualitative data analysis of the study, the comments and answers that science and math pre-service teachers have shared in two web sites were examined and gathered under defined themes; then their frequencies and percentages were calculated. The comments of both groups (science and math) are similar. The review of science pre-service teachers' comments showed that most of their comments include positive evaluations and views about the others (**Table 7**). Pre-service teachers often agreed with the others opinion and expressed similar thoughts. Pre-service teachers have emphasized the importance of the use of the laboratory in science education and agreed with their friends' opinion who shared his diary by stating that "Yes, not handling the course at the laboratory is one of the biggest omissions that I've seen.", another one commented as "Similarly I would like to see my internship teacher teaching the course at the laboratory, however I witnesses a plain instruction at the classroom". It has been seen that only few pre-service teachers have submitted their opinions by evaluating the facts from another point of view. Negative evaluations have remained at a low level, which is a remarkable result of the research. Experience sharing and elaboration/explanation are the two factors that are rarely encountered on pre-service teachers' comments. A pre-service teacher pointed that the teachers as the reason of the failure of properly implementing instructional programs by stating that "I think most teachers, according to our observations, unfortunately, is sticking to the book. Learning by doing, by living is desired but there are major shortcomings in the implementation." Some pre-service teachers presented their personal views as well. Pre-service teachers indicated that the can learn teaching by doing, one stated that "the training that we received during the university education fulfill only a part of the equipment required to be an ideal teacher. In my opinion, we will learn this job by doing and experiencing, as we expect from the students to learn by doing and experiencing", another one "I wish to do more practice but…, it will allow us to see what we can do.". A pre-service teacher shared his

experience stating that "In the internship school that I go, some students are willing to ask questions, learn something, which is very good… some of the questions are surprisingly interesting and tough. Even the teachers have difficulty in answering them". Pre-service teachers have often supported each other with their comments, they expressed their hopes and emphasized their faith that they will successfully perform their profession. "Since these are our first experiences, we will indeed have difficulty. But it will get stable in time, I believe in you", "My dear friend, even though it was your first experience, you instructed really well. It is especially difficult to ripple through the class with eye contact. Being able to do it in your first experience is a big advantage for you", "The first thing that a teacher should have is a smiling face … like yours" are the examples of comments showing the support of science pre-service teachers to each other. As a result, it can be seen that science pre-service teachers agreed each other's opinion, supported each other, expressed their hopes and wishes through the comments that they have shared at the web site. The comments such as explanation of possible causes of a fact, elaboration, giving examples from their own experiences, evaluating the facts from another point of view were not took a considerable place in the online community of practice.

The comments that math pre-service teachers have shared in the web site were also evaluated according to defined themes. Similar to science pre-service teachers, math pre-service teachers have also exhibited positive evaluations and agreed each other's view (**Table 5**). Pre-service teachers have shared the view of their friends and expressed that there are shortcomings on the use of materials in schools stating that "I totally agree. For three years, our teachers have insisted that we should use various materials during lessons. But when we entered to the classroom, the teacher did not explain any of the gains by using the material", another one wrote "As you have mentioned, unfortunately many schools lack material utilization". Similar to science pre-service teachers, only a portion of math pre-service teachers have stated that they do not totally agree to the others view by making negative evaluations and explained the reasons. Some of the math pre-service teachers have shared their experiences with the others and they tried to explain probable causes of a fact. A pre-service teacher who pointed the effects of the parents on students' learning, stated and explained his view saying that "overprotective attitude of the parent is reflected to the family, to the kid and even to the school, which reminds me that we are faced with a sociologic problem". Another pre-service teacher gave example from the experiences that he encountered in the past, "my primary school teacher was doing the same. He was asking questions; we were going to his side to show if we did it correctly or not. I do not think that this is the right technique, especially giving rigid feed-back. Those who made mistakes may get discouraged". One of the common themes found in the posts of pre-service teachers is expressing their personal opinions. A pre-service teacher expressed his view about student participation and the role of the teacher saying that "it is better to have something motivating students, letting them to participate to the course; teacher's job will not be easy if students do not settle down to the course", whereas another pre-service teacher presented his personal opinion about the use of material in the classroom stating "in fact there is no need for material, all depends on the

teacher. If the teacher is really smart and intelligent, he/she will teach the topic appropriately". As pre-service science teachers, pre-service math teachers have used supporting, hope-inspiring words in their comments and posts. The following statements are the examples of supporting posts sent by different pre-service teachers: "I believe we will not do the things that we criticize. If we do not have tools on our hands, we will do as much as we can", "I hope we will be useful teachers, who always renew themselves", "I am sure that you will be a successful teacher as your willingness to teach math continue", "I am sure that you will do your best and you will be a very good teacher". As a result, it can be said that in their posts both science and math pre-service teachers have agreed the others views, they expressed their personal opinions, they sent supporting and hope-inspiring statements. On the other hand, only a few pre-service teachers have made negative evaluations and offered different points of views, gave examples from their own experiences and attempted to explain probable reasons of a fact.

DISCUSSION

Discussion about Quantitative Findings of the Research

The objective of this study is to determine the effect of using online communities of practice in student teaching course included in teacher education program, on pre-service teachers' critical thinking disposition. In addition, the comments that pre-service teachers have shared at the web-site were examined for identifying the characteristics of their communication and especially for evaluating their critical thinking tendency. Quantitative findings obtained from the inventory of the research showed that critical thinking disposition of pre-service teachers of experimental group did not changed significantly compared to control group. The results of the analysis performed on the sub-factors of the inventory revealed that the disposition of the pre-service teachers towards self-confidence and open-mindedness sub-factors of the inventory have significantly differentiated in favor of the pre-service teachers of the experimental group. There are studies reporting that the participation of pre-service teachers to online communities of practice affected their learning positively (Iyer & Martin, 2013), it provided a convenient platform for pre-service teachers to share instructional techniques and methods (Yang, 2009), problem-based online communities may improve critical thinking ability of the students (Diana, Karyanto, Suciati & Indriyati, 2016) and an online environment that has been designed for improving critical thinking supported university students' critical thinking (Carmichael & Farrell, 2012). In this study, pre-service teachers assigned to the experimental group had the opportunity of sharing their views about their experiences, see the others' experiences and make comments through a web-site. It is believed that sharing their views openly, making various comments to each other and the absence of any limiting or blocking factor has increased pre-service teachers' tolerance towards different approaches and their sensitiveness to their own mistakes. During the process, pre-service teachers have realized their own mistakes and they had the opportunity of learning the experiences of their friends, which allowed them to see that the problems that they encountered were similar. It can be said that this effect leaded to increase pre-service teachers'

self-confidence. This outcome can be associated with the change of pre-service teachers' self-efficacy perception about realizing their professions. Pendergast, Garvis & Keogh (2011) stated that teachers' self-efficacy perception is associated with the beliefs of their capacity perception about undertaking certain teaching assignments. In addition, it can be said that online communities of practice had an impact on the realization of social persuasion by providing individuals the opportunity of sharing their experience and making comments. Social persuasion is a special form for encouraging an individual before performing a duty (Gurvitch & Metzler, 2009). People may affect each other's' views and capabilities positively or negatively through social persuasion. Zhang, Liu and Wang (2016) reported that teachers have provided emotional support to each other in the online environment where they have communicated about student teaching and shared their teaching practices. It has been stated that the emotional support has created an environment of trust between teachers, which leaded them to consider the recommendations they offer to each other and to convince each other. For this study, it can be said that pre-service teachers' self-confidence disposition was increased as a result of convincing each other that they can be successful, through supportive comments. However, it has been found that there are no significant differences on pre-service teachers' disposition for the other four sub-factors of the inventory, namely analyticity, truth-seeking, inquisitiveness, and systematicity. It was observed that pre-service teachers have mostly used online community of practice for sharing experience and views; they have not performed other activities, such as obtaining information by asking question, conducting careful and planned research. It has been reported that, in the content of high education, the success of using online resources for the development of students' critical thinking depends on students' developmental levels, their experience with the technology used in academic content and the level of their engagement (Carmichael and Farrell, 2012). Another study identified that there is no correlation between pre-service teachers' internet usage and critical thinking disposition; it has been emphasized that critical thinking skill requires high level cognitive and emotional participation, such as truth-seeking, analyticity and systematicity (Şendağ, Erol, Sezgin & Dulkadir, 2015). Moore and Chae (2007) have also reported that pre-service teachers' use of real online resources and communities remains at a superficial level within their daily learning content. In this study, the framework of the online community of practice was already set, but the sharing and comments of pre-service teachers were not intervened by a moderator. Therefore, it can be said that the web environment used without any intervention has mostly focused on sharing views and supporting each other. The lack of pre-service teachers' high level participation in the online community of practice may be the reason of the mentioned outcome.

Discussion about Qualitative Findings of the Research

Critical thinking can be reflected into students' writings, class discussions and even into students' multiple-choice test performances (Williams, 2005). Therefore, pre-service teachers' comments in the online community of practice were evaluated and discussed by associating with quantitative outcomes. Analyticity factor of the inventory represent the

tendency of reasoning when faced with complex problems and using objective evidences. This factor of the inventory can be associated with inquiring probable causes of a fact, explaining and elaborating. Pre-service teachers usually made superficial remarks in the comments, they did not explain the facts in detail. Ebrahimi, Faghih and Dabir-Moghaddam (2016) emphasized that online educators should find the ways of encouraging students to express their opinions clearly and criticizing others' views because most of the pre-service teachers gain cognitive benefits from their participation in the discussion, rather than affective and communal benefits. As a result, the dialogues occurred in online environment, which include unguided explanations and views of pre-service teachers, stay at basic level and lack detailed views of pre-service teachers. Truth-seeking factor of the inventory is related to the skill of asking questions, students' willingness to see different thoughts. The development of this factor is related to asking question to each other in the online community to get information, presenting examples from their own experiences and being able to do negative evaluations by considering the events from different angles. In the study, only few pre-service teachers talked about their own experiences in their comments and made negative evaluations. There is no comment in which pre-service teachers asked each other questions for getting information. This outcome may be due to pre-service teachers' lack of skills such as questioning or criticism. Çalık, Artun and Küçük (2013) have also emphasized that pre-service teachers were lacking on skills such as critiquing their own friends, giving feedback, questioning and interpreting at the web environment. Similarly, Yang (2009), in his study conducted with foreign language pre-service teachers through a blog, pointed that 43 pre-service teachers have made 243 posts related to the definition of learning inputs whereas the number of posts making critics was 82. Due to the fear of being criticized or feeling inadequate, pre-service teaches preferred to read their peers posts rather than writing posts including negative evaluations (Nambiar and Thang, 2016), which may be considered as the cause of this outcome.

Quantitative findings of the research showed that there is no significant difference between pre-service teachers regarding the systematicity factor of the inventory, which reflects the tendency of planned and careful research. The activities that pre-service teachers should undertake during the process have been already defined. However pre-service teachers have planned how to make observation and the activities that they will develop and use in teaching. Pre-service teachers have mentioned their experiences rather than the knowledge that they have acquired and lesson plans, which may be shown as a possible cause of the mentioned outcome. Regarding inquisitiveness factor of the inventory, no change has been occurred on the development of pre-service teachers. Inquisitiveness tendency includes the willingness of acquiring information without expecting any profit. In the study, the pre-service teachers' participation in the online community of practice was realized voluntarily. But active participation was not at the sufficient level, which may have caused this outcome. Similarly, some studies that have used web environment also concluded that the participation of teachers and pre-service teachers in the online community was not sufficient (Çalık, Artun & Küçük, 2013; Tsiotakis and Jimoyiannis, 2015; Nambiar & Thang, 2016). Researchers emphasized that social interaction in an online environment did not make a direct contribution to the learning

process alone, instead of this more cognitive discussions and active participation should be established among participants (Rehm, Hulder, Gijselaers & Segers, 2016; Tang & Lam, 2014). There may be various factors affecting pre-service teachers' active participation. In a study reported the followings as the limitations affecting teachers' active participation in online community: lack of time, lack of prior knowledge about e-learning experience, peers' feedback does not contain rich information and peers are unwilling to cooperate, the need for continuous coordination (they have preferred a community organized around a coordinator), low level of interest towards certain topics and discourses (Tsiotakis & Jimoyiannis, 2015). Baran (2007) reported that some of the factors that prevent pre-service teachers' participation in discussion and information sharing at these environments are: unwillingness to dispute, minimum effort maximum benefit, feeling the presence of the others, internet and computer access. In addition, no moderator was employed on the management of online community of practice. This fact might have caused a fall on the participation of pre-service teachers over time. Macia and García, (2016) emphasized that the role of the moderator and the leader is also important on increasing the participation in online communities; the moderator may encourage the participation and information sharing of the participants at the beginning of the community formation process and in the cases where participants are unwilling to share. Many studies emphasized that, in an online learning community, the cognitive level of the discussion among teachers remains low without the assistance of teacher educators (Yang, 2016). In this study, the low level of student participation may be associated with the lack of a moderator who could increase their inquisitiveness. For future research, it is suggested to investigate the factors affecting pre-service teachers' participation in online communities of practice and identifying the activities that will improve their participation. Finally, self-confidence factor of the inventory reflects the confidence of one's own reasoning process and open-mindedness factor represent the tendency to be sensitive to own faults and considering the views of the others. Positive evaluations and supportive messages of pre-service teachers might have increased their self-confidence and open-mindedness dispositions. Because positive evaluations, messages of support, wishes and requests were the most common themes encountered in the analysis of the comments. In the study examining the experiences of pre-service teachers in online communities of practice and the role of critical friend that they played in this process. Sterenberg and O'Connor (2014) have concluded that the factors affecting pre-service teachers most positively are their friends' experiences and suggestions. In the study, pre-service teachers stated that they have used the experiences of their group friends and learned how the others handle certain problems and experiences. Tang and Lam (2014) also concluded that pre-service teachers receive practical suggestions and emotional support from their peers and internship teachers. In this study, pre-service teachers supported each other's views, expressed their faith that they will be better teachers, offered positive views and wrote messages indicating that they did not lost their hopes despite the negative aspect of their profession, which might have improved their self-confidence and open-mindedness disposition.

CONCLUSION

As a result of quantitative findings, it was found that online communities of practice do not affect some tendencies of pre-service teachers, such as reasoning when faced with complex problems, getting information and learning new things, evaluating different thoughts, planned and careful investigation. On the other hand, it was found that it improved some other tendencies of pre-service teachers, such as showing tolerance towards different approaches, being sensitive to their own mistakes and relying on their own reasoning. Qualitative findings of the research support the results obtained from quantitative data. The review of the comments that pre-service teachers have shared at the online community of practice showed that the comments mostly includes positive evaluations, supportive messages. It can be said that these comments have positively affected self-confidence disposition of pre-service teachers. On the other hand, it has been observed that the comments did not include detailed explanations, information sharing was not sufficient, the platform was mostly based on sharing the experiences. Within the study, a moderator was not employed in the community of practice, the comments of pre-service teachers were not evaluated and criticized, they were only asked to share their experiences in diary format indicating the activities that they were asked to perform. In other words, the creation of a spontaneous and semi-structured online community was accomplished. As stated by Tsiotakis and Jimoyiannis (2015), the creation of structured and more demanding communities of practice, in which the duties and responsibilities of the teachers are defined, can be suggested for future studies. Thus, the participation of pre-service teachers in the online communities of practice can be increased and their development of different skills such as critical thinking and inquiry can be supported. In addition, in order to ensure professional development of the teachers and to allow them reflecting their teaching practices, their motivation towards participating in online communities should be increased and the guidance should be provided using moderators (Nambiar & Thang, 2016). Intervening the group and guiding the comments of pre-service teachers may affect the utilization and improvement of their critical thinking skills. Another option is using online communities of practice with active learning methods, such as Socratic questioning, problem-based learning, and evaluate the efficiency by conducting new research.

LIMITATIONS AND SUGGESTIONS

Science and math pre-service teachers, who were 4th grade students in only a university in Turkey, participated in the study. For this reason, the low generalizability of the results of the study is a significant limitation of the study. At the same time, the features of the website used in the study may have influenced the participation in online communities of practice and the effectiveness of the community on pre-service teachers positively or negatively. So, it can be suggested that various qualitative and quantitative research should be carried out with pre-service teachers who are studying at different grade levels and in different departments. Besides, in further research, the effectiveness of online communities of practice created by preparing web sites with different features and interfaces to use in teacher education can be compared and discussed.

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