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PRESERVICE CHEMISTRY TEACHERS' IMAGES ABOUT SCIENCE TEACHING IN THEIR FUTURE CLASSROOMS

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ABSTRACT: The purpose of this study is to explore pre-service chemistry teachers' images of science teaching in their future classrooms. Also, association between instructional style, gender, and desire to be a teacher was explored. Sixty six pre-service chemistry teachers from three public universities participated in the data collection for this study. A modified version of Draw a Science Teacher Test Checklist (DASTT-C) was used as a data collection instrument. The results of study showed that pre-service chemistry teachers' perspective of science teaching style is 37,9 % student-centered, 22.7% teacher-centered, and 39.4% reflect the characteristics of both student-centered and teacher-centered approaches. A significant association was found between gender and instructional style. Female pre-service teachers are more willing to use student centered approaches rather than male pre-service teachers.

Keywords: pre-service chemistry teacher, DASTT-C, science teaching

1. INTRODUCTION

We live in an age in which scientific knowledge is expanding rapidly; technological innovations are progressing swiftly and effects of science and technology have been seen in every sphere of our lives. Therefore, the main aim of modern societies has been striving for increasing the quality of science and technology education. There were many reports such as "A Nation at Risk" (1983), "Education Mastery Plan (1996-2011)", (Dulger, 2002), and "No Child Left Behind Act" (2001) which have been published related with the higher quality of science and technology education. In the direction of prior developments in science education, Elementary Science Curriculum has been completely changed and there have been some ongoing efforts in the Secondary Education Curriculum in Turkey. In these developmental initiatives, student-centered approaches are the frontiers of the reform. The main actors who reflect student-centered approaches in Turkish classrooms are both our in-service and pre-service teachers (Namsone, 2002).

Since pre-service teachers are the teachers who will implement new program, how pre-service chemistry teachers see themselves in their future classrooms has a great significance and value. Pre-service chemistry teachers begin the teacher education programs with a set of values and beliefs about the nature of knowledge, how students learn, and what strategies may best be applied in a classroom environment (Simmons et al. 1999; Laplante, 1997; Thomas & Pederson 2001). These pre-service chemistry teachers have many years of experience of textbook-driven, teacher-centered education (Tobin, Briscoe, & Holman, 1990). This instructional style affects pre-service teachers' images and beliefs about teaching and learning (Pajares, 1992; Laplante, 1997). Anderson and Holt-Reynolds (1995) found that pre-service teachers' beliefs about teaching and learning had a significant role in internalizing the information given in both subject-matter and pedagogy courses. In addition, there is not congruence between pre-service teachers' beliefs and information about teaching and learning and pedagogical information and skills tried to be achieved in the university (Whyte and Ellis, 2003). Therefore exploring the images and beliefs about science teaching may also support designing more effective pedagogical courses. The knowledge and beliefs that pre-service chemistry teachers form, as a result of their experiences, are stored in a variety of different types of cognitive structures such as associations, lists, scripts, plans, schemata, and images (Barker, van Schaik & Hudson, 1998). An image is representation of students' experiences that encloses the knowledge and beliefs in students' minds and therefore pre-service chemistry teachers' images of their science teaching may serve as a source to explore their knowledge and beliefs about science teaching and learning. The beliefs pre-

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service teachers' hold influence their perceptions and ideas which in turn affect their classroom actions and their instructional style (Pajares, 1992; Ashton, 1990; Wilson, 1990).

There are several studies which investigate pre-service teachers' illustrations about science teaching and learning. Thomas and Pederson (2001) conducted a study with the aim of comparing school-aged children and pre-service teachers' illustrations using Draw-A-Science Teacher Test Checklist (DASTT-C). They studied with 76 elementary pre-service teachers and 277 school-age children. The analysis of variance (ANOVA) comparing the mean total scores of the DASTT-C for two groups showed no significant difference (alpha = .01). The result of the study showed that pre-service teachers and elementary, middle and secondary students have similar illustrations and images, and in addition, it supported the idea that prior experiences of pre-service teachers as students affect their beliefs about science teaching and learning. A different study investigated the relationship between pre-service science teachers' self images about science teaching and learning and science teaching efficacy beliefs. The sample of this study consisted of 27 pre-service elementary teachers. In this study, DASTT-C and Science Teaching Belief Instrument (STEBI) were used as data collection instruments. Finson (2001) concluded that pre-service teachers who become less stereotypical in their perceptions of their science teaching will also develop higher levels of self-efficacy.

Another study conducted with 213 pre-service elementary teachers in order to investigate their images of science teaching, gender differences in those images and evaluate education reforms in Turkey (Yilmaz, Turkmen, Pedersen, & Huyuguzel Cavas, 2007). DASTT-C was used as an instrument to gather data. It was reported that though student-centered science teaching style was found to be 20%, 41% of pre-service teachers see themselves using teacher-centered approaches and 39% between student-centered and teacher-centered methods. In addition, there was no statistically significant difference between males and females with regard to mean DASTT-C scores. The results of this study showed that male and female pre-service teachers have parallel images in science teaching and teacher-centered approaches were more popular among pre-service teachers. In a recent study, Markic and Eilks (2010) evaluated first-year science education students' beliefs about the science teaching and learning in the four domains of natural sciences. Data were collected using DASTT-C from a total of 266 science student teachers, in the phase where they had just completed high school but had not yet had any university education, from four different German universities. Analysis of data revealed that first-year science education students from both chemistry and physics tended to draw classroom situations indicating more teacher-centered beliefs. In contrast, biology and primary school science education students demonstrated student-centered beliefs of teaching their subject in school. Moreover, applied t-tests showed that physics education students expressed significantly stronger teacher-centered beliefs when compared to any other group and the chemistry education students demonstrated significantly stronger teacher-centered beliefs on average than did those students in biology or primary school science. Talsma (2007) used DASTT-C instrument with a different motive to comprehend the beliefs and mental models of teacher candidates. Talsma used the prompt "Draw Children Learnig Science" instead. She conducted the study with a convenience sample of 60 teacher candidates divided among two classes. There had been a 15 weeks of science method course which focused on learner centered constructivist perspective as a treatment. At the beginning of the semester, first set of drawings depicted %63 teacher centered approach. After the treatment, final drawings %44 even showed a teacher and less than half of those %18 depicted the teacher as the source of knowledge. Talsma reported a significant decrease in stereotypical images. The study also showed the importance of drawings as an alternative assessment tool for developing belief systems of teacher candidates.

Moreover, the relationship between teachers' teaching styles and the perceptions their students held about scientists was investigated (Finson, Pedersen & Thomas, 2006). Researchers worked with 9 teachers and with their 327 students (129 male & 198 female) who were in their classes. Students were from 5 to 8th grades in the Middle Schools in USA. Teachers' teaching styles were determined by DASTT-C on a continuum from constructivist to didactic as proposed in the instrument. Students perceptions about scientists were determined by DASTT-C in a direction as being from stereotypical to non stereotypical. Researchers tested the hypothesis that constructivist teachers are more likely to

have students who are less stereotypical images of scientists. They used non parametric correlational methods in the study. They did not found any significant relationship between the teachers' teaching style and the perceptions their students held about scientists`, however they also reported that raw data showed a supportive tendency for the hypothesis. The results indicated that the images held by students are intensely assimilated and resistant to change regarding scientist and science teaching. Anning (1997) mentioned drawing and graphicacy as a powerful tool for instruction and exploring the opinions in classrooms. The DASTT-C can be useful tool to support teachers and pre-service teachers to explore their ideas about how to teach science, consider alternative methodological approaches, and develop a preferred self image of themselves as science teachers (Thomas & Pedersen, 1998). Such reflection is crucial because teachers and pre-service teachers' educational beliefs and self images are the main factors in their acquisition and interpretation of knowledge and their prospective teaching behavior (Simmons et al. 1999). Science educators must provide opportunities for prospective teachers to examine critically the beliefs and knowledge they bring as well as those they reinforce during teacher preparation programs (Thomas, Pedersen & Finson, 2000).

1.1. Research Question

The research focuses on the following question: What images do pre-service chemistry teachers have of themselves as science teachers in their future classrooms?

2. METHODOLOGY

2.1. Sampling

Sixty six (40 female, 26 male) pre-service chemistry teachers from three universities participated in the data collection for this study.

2.2. Instrument

DASTT-C was originally derived from Draw-A-Scientist-Test (DAST) which was used to explore the perceptions and images of students held about scientists (Chambers, 1983). Finson, Beaver, and Crammond (1995) revised the DAST to Draw-A-Scientist-Test Checklist (DAST-C) for ease of assessment. Then DASTT-C was modified and used by many researchers to explore the students and pre-service teachers' ideas about instruction (Thomas & Pedersen, 1998; Thomas, Pedersen, & Finson, 2000; Finson, 2001; Thomas & Pedersen, 2001; Thomas, Pedersen & Finson, 2001; Yilmaz et al. 2007). In this study, the DASTT-C was used as data collection instrument. Although it was mostly used with pre-service elementary teachers, it was recommended that this instrument and process might also be used with pre-service secondary teachers (Thomas, Pedersen, & Finson, 2001). It consists of two pages. In the first page, pre-service chemistry teachers were asked to give some demographic information including type of high school they graduated, gender, age, number of siblings, family income, educational level and working status of father and mother, major area, class, and order of choice for their major area. The second page, pre-service chemistry teachers were suggested to "Draw a picture of yourself as a science teacher at work." and to write a brief narrative describing their drawings and specifically answer the questions, "What is the teacher doing?" and "What are the students doing?" regarding their drawings. The narrative part is supportive of exploring the images of pre-service teachers in detail and more meaningfully. An oral interview with each participant is not an efficient way so these narratives might help on certain aspects of these drawings (Thomas, Pedersen, & Finson, 2001). The approximate application time for the instrument is 20 minutes.

There are three sections in The DASTT-C scoring sheet, first section is teacher part which consists of two subsections as teacher's activity and teacher's position. Second section is student part which consists of two subsections as student's activity and student's position and the last section is environment part which consists of five subsections which are desks arranged in rows, teacher desk, lab organization, symbols of teaching and symbols of science knowledge. A dichotomous fashion of

scoring is used in each subsection with a highlighting as present or absent in the drawings. If there is a teacher-centered element found in the drawing, the scorer marked that element on the checklist. Then marks can be counted to derive scores both for subsections and summed to get overall checklist score. Total checklist score is on a continuum to 0 to 13. The highest the score the more teacher-centered is the instruction. Drawing scores are grouped into three categories, with scores of 0-4 representative of student-centered instruction, 5-9 representative of neither student-centered nor teacher-centered instruction and 10-13 representative of teacher-centered instruction (Thomas, Pedersen and Finson, 2001). Student-centered instruction is defined as representing inquiry, exploratory and constructivist teaching in which students are active and taking their responsibility of learning, and teachers are the facilitators of the learning process. Middle scores are displaying a conceptual teaching showing students at the center but they also refer teacher images as a central actor of the learning process. Teachers are leading the classroom and scaffolding the concepts while students are engaged in investigation and exploration of experiments. Teacher-centered instruction is represented by explicit teaching; teachers are the transmitters of knowledge from their minds to the minds of students. Students are mostly seated in rows staying passive and doing nothing except for writing down to their notebooks what was written on the blackboard. (Simmons et al. 1999; Finson, 2001; Thomas & Pedersen, 2001; Thomas, Pedersen, & Finson, 2001).

2.3. Validity and Reliability

Validity is one of the most significant issue in a research study because its' directly related with your interpretations of the results (Fraenkel & Wallen, 2006). Researchers collected content related evidence using three science educators (other than the researchers). These three science educators asked to validate things like the clarity of the printing, size of type, adequacy of work space, appropriates of language and clarity of directions. For ensuring the reliability, coefficient alpha was calculated. Since DASTT-C produces dichotomous data, coefficient alpha is equal to Kuder-Richardson 20 (KR20). The coefficient alpha is equal to 0.75 indicating a high degree of internal consistency in the instrument. Ten pre-service teachers' drawings were randomly selected and used for determining the inter-rater reliability; four science educators separately evaluated the drawings. Since the data is categorical and there are four raters, Fleiss' kappa has been calculated as a measure of inter-rater reliability. Fleiss' kappa calculated for this study is 0.74 which shows a substantial agreement among raters.

3. RESULTS

Teacher-centered drawings (Figure 1) usually place the teacher in front of the class and the teacher is often teaching in front of a blackboard that supports the lecture. Classroom organization frequently indicates the traditional rows placement of desks. In addition, teacher-centered illustrations include students that are in a passive role in their learning. These evidences conceive the powerful effect of teacher centered instruction in pre-service teachers' minds.

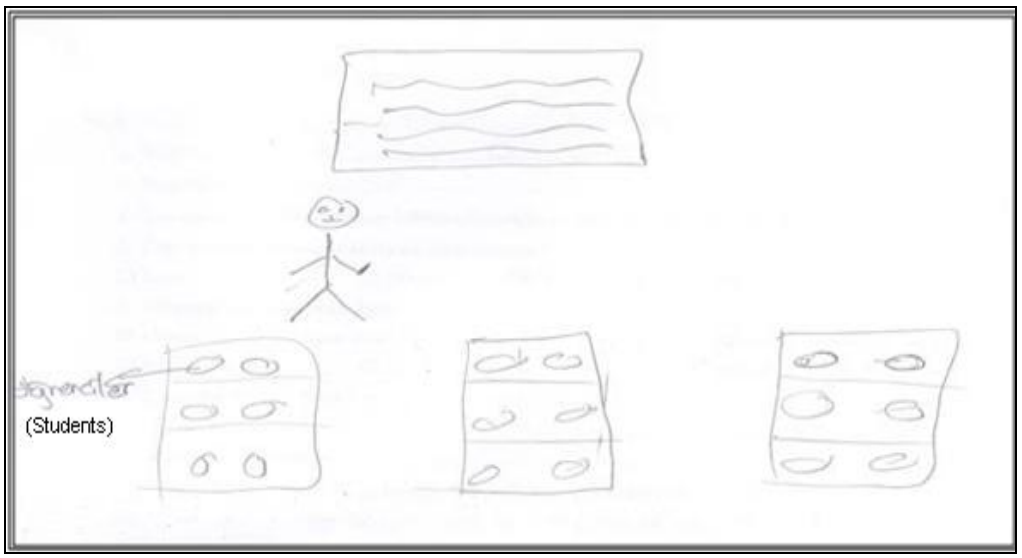


Figure 1: An example of teacher-centered drawing from the study

What is the teacher doing? What are the students doing?

"First of all, the teacher lectures and then makes a summary by asking questions. At last, s/he answers the questions of the students. The students are listening and answering the questions."

In student-centered drawings (Figure 2), usually the teacher is not in a static position instead s/he walks around among desks and rows that are not traditionally organized. The role of the teacher is not transmitting the knowledge. S/he acts as a guide for the students' learning. The students have the responsibility of their learning and work in groups. Classroom includes computer, internet and bookshelf that support students to reach information. These images fit with student-centered instructional method with encouraging students to engage in inquiry and learning process that led by students and guided by teacher.

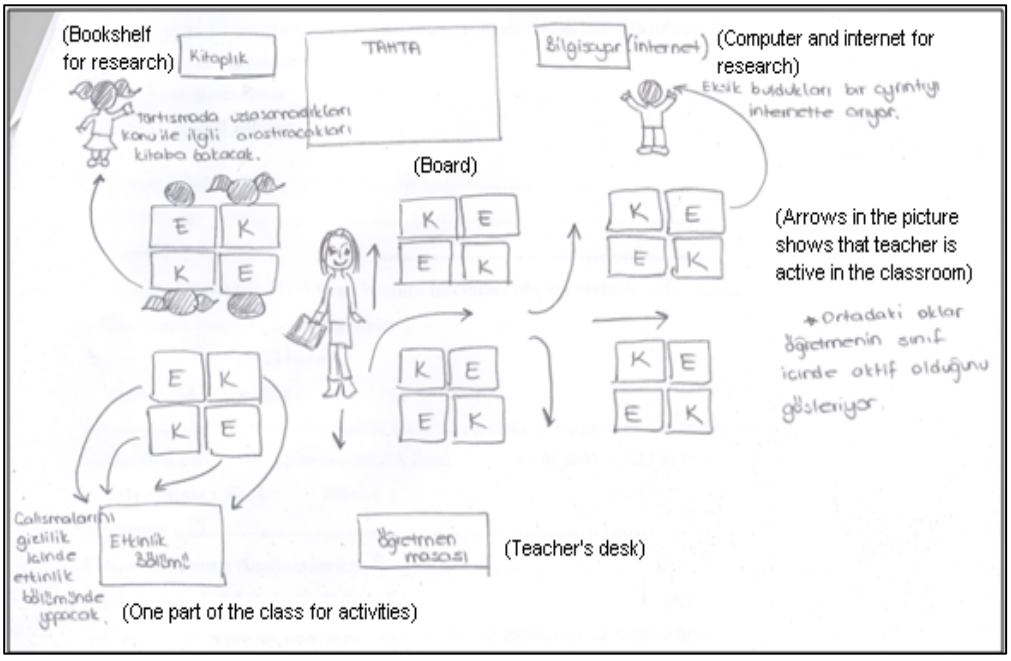


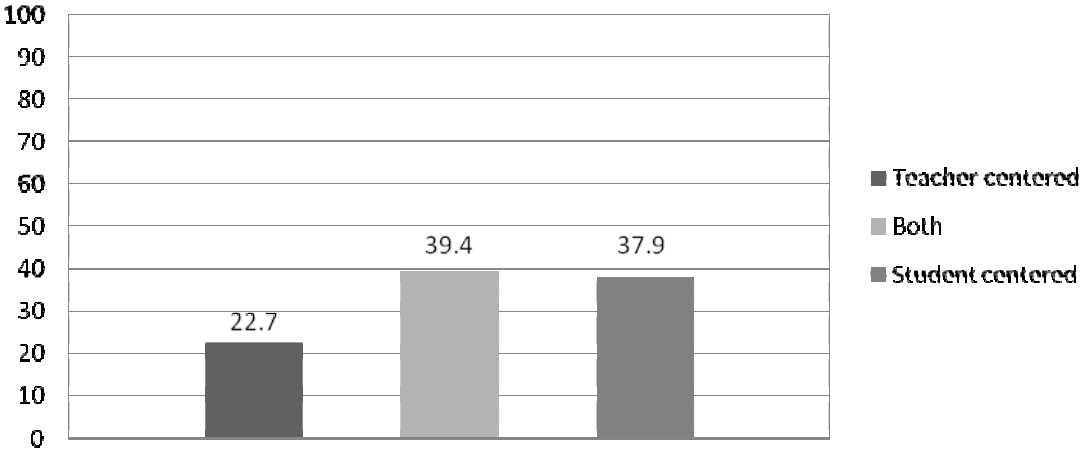
Figure 2: An example of student-centered drawing from the study

What is the teacher doing? What are the students doing?

"A teacher who is walking around the classroom and does not teach, acts as a guide for students' learning instead. She warns students about studying in a cooperative way. She ensures discipline through walking round the classroom. The students are working cooperatively. Like the saying "I hear and I forget. I see and I remember. I do and I understand", they learn by doing. Their self-esteem is increasing since they have the responsibility of their learning. Guidance of the teacher makes students confident and adapts students to the lesson. The students are active."

The mean of total DASTT-C score of students is 7.65 that represent an instructional method including characteristics of both student-centered and teacher-centered instruction. The results of the study emphasized that pre-service teachers have been affected by their school experiences as learners however they are aware of the student-centered instruction. One possible reason for this may be the science teaching method courses that pre-service teachers take during their undergraduate program. They see themselves using both student-centered and teacher-centered instructional methods during chemistry teaching. Table 1 shows the percentages of students related to different instructional styles.

Table 1. Percentages of Instructional Style



Investigating the associations among gender, instructional style, and desire to be a teacher was another purpose of this study. Since all the variables, gender with two sub-categories as female and male, instructional style with three sub-categories as teacher-centered, student-centered and both teacher and student-centered, and desire to be a teacher with three sub-categories as want, do not want and undecided were nominal, chi square test of homogeneity data analysis procedure would be conducted. A chi-square test should not be performed considering size of the expected frequencies of some cells is less than five (Gravetter & Wallnau, 2000). In order to investigate the relationship between pre-service chemistry teachers' gender and preference for instructional method Cramer's V was calculated, since the table is larger than 2 by 2 to measure the strength of the relationship between the variables (Hinkle, Wiersma, & Stephen, 2003). The result showed there is significant relationship between gender and instructional style of pre-service chemistry teachers (Cramer's V=.368, n=66, $p < .05$). That is, male pre-service teachers see themselves using teacher-centered instructional styles while female teachers see themselves using student-centered instructional styles (see Table 2).

Table 2: Female and Male Pre-service Teachers' Percentages in Each Instructional Style

	Female		Male		
	Frequency	Percent (%)	Frequency	Percent (%)	Total
Student centered	**13**	**32.5**	**2**	**7.7**	**15**
Both (Teacher and Student)	**17**	**42.5**	**9**	**34.6**	**26**
Teacher centered	**10**	**25**	**15**	**57.7**	**25**
Total	**40**	**100**	**26**	**100**	**66**

In the first page of DASTT-C instrument, asking pre-service chemistry teachers the question of "whether they would like to be a teacher" enabled us to investigate whether there is a tendency for particular categories of desire to be a teacher and be associated with particular categories of the instructional style There are three categories of pre-service teachers that "want", "do not want" and "undecided" to be a teacher. Table 3 shows percentages of students in each category.

Table 3: Percentages of Students

	Frequency	Percent (%)
Undecided	**12**	**18.2**
Do not want	**4**	**6.1**
Want	**50**	**75.8**

Although desire to be a teacher and instructional style variables are nominal, the chi-square test could not be used to investigate whether there is a tendency for particular categories of desire to be a teacher to be associated with particular categories of the instructional style since size of the expected frequencies of some cells is less than five. Cramer's V was calculated because the table is larger than 2 by 2 to measure the strength of the relationship between the variables. The result showed that there is no significant tendency for some categories of desire to be a teacher to be associated with some categories of the instructional style (Cramer's V=.129, n=66, $p > .05$). Table 4 shows the percentages of students with different desire to be a teacher across different instructional technique.

Table 4: Distribution of Students According to Their Desire to be a Teacher

	Student		Both		Teacher		
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Total
Undecided	1	6.7	5	19.2	6	24.0	12
Do not want	1	6.7	2	7.7	1	4.0	4
Want	13	86.7	19	73.1	18	72.0	50
Total	15	100	26	100	25	100	66

An interesting result of this study is that 42% (28) percent of pre-service chemistry teachers see themselves in a laboratory environment. Including laboratory environment, materials and experiments in drawings may stem from pre-service teachers' matching science lessons with laboratory.

4. DISCUSSION

Most of the students are enrolled in their academic fields during university education and almost all of them in many fields have no idea or well developed theories about their field of study unlike pre-service teachers (Posner et al, 1982). Medical students enter the hospitals and law students enter the court rooms but pre-service teachers enter the classes which they were already in. Their educational ideas and images needed a paradigm shift according to new educational trends. Pre-service teachers are the key factors that have to be prepared and stimulated for these transitions.

The results (teacher centered=22.7, conceptual teaching=39.4, student centered=37.9) of this study showed that pre-service chemistry teachers see themselves using an instructional method including characteristics of both student-centered and teacher-centered instruction (mean of total DASTT-C score is 7.65). This result indicated that there is an awareness of the student-centered instruction among pre-service teachers at least on some level despite pre-service teachers have been affected by their teacher-centered school experiences as learners (Laplante, 1997; Pajares, 1992; Tobin, Briscoe, & Holman, 1990). The total percentage of 62.1% (teacher centered plus conceptual

teaching) of pre-service teachers have some level of tendency or prone to teacher centered instruction and this indicated a serious confusion of pre-service teachers concomitant to very extensive reform movements in elementery and secondary science curriculums. Students insisted on teacher-centered pedagogies might be for two reasons (Allamong, 1976). First one is, their ideas were resisted to change because of their previous experiences and ideas that envision the teachers as the center of the learning environment. The second reason might be a preference, they thought that most of the students might be much more succesful in a more structured learning environments. In both cases, teacher educators have to bring much more evidences and exemplary materials to support the idea of student-centered instruction in method courses. In addition also the method courses have to be designed according to constructivist principles. Teacher educators must prevent pre-service teachers becomming accustomed to teacher centered classroom environments. Our education system in the direction of the new reforms in the elementery and secondary curriculums must begin and maintain a student-centered learning environments from elementery level. These educational processes should support the understanding of the effectiveness and importance of student centered instructional pedagogies. Although there is a great transition in the system from teacher-centered to student-centered approaches, how much this transformation affects the pre-service teachers is not very clear.

Analysis of relationship between gender and instructional style of pre-service chemistry teachers revealed that there is a significant relationship between the variables that the gender of the pre-service teacher has a considerable effect on the teaching style which was envisioned in the classroom. In the literature, there are some supportive research evidences for female teachers who are using active and constructivist approaches in the learning environments (Chen, 2000; Nelson Laird, Garver, & Niskode, 2007; Chudgar & Sankar, 2008; Kuh, Nelson Laird, & Umbach, 2004). The effect of gender on teaching style might be also affected by the communication skills of the pre-service teachers, some studies found that females feel more comfortable sharing their expertise with others in contrast to males (Tannen, 1992; Bress, 2000) and males are more comfortable in a lecturing role (Tannen, 1992). In addition One of the reasons for male pre-service teachers to chose more likely to be teacher-centered instructional style might be that they would like to be authorative figure concomitant to their social role in the community. Also there are some studies in the literature that did not capture the effect of gender on instructional style (Yerdelen Damar & Demirdogen, 2008; Yilmaz, Turkmen, Pedersen, & Huyuguzel Cavas, 2007). As a conclusion there are many more reasons that influences the teaching style of the teacher, it is a complex construct (Liu, Qiao, & Liu, 2006), we discussed the affect of gender in the perspective of our study.

5. IMPLICATIONS / CONCLUSIONS

Reflective thinking is important for a teacher to be aware of his or her knowledge about teaching and learning and to organize his/her subsequent teaching behavior. Therefore, DASTT-C is one of the valuable instruments providing opportunities for reflection considering both teachers and teacher educators (Yilmaz et al. 2007). Teacher educators may utilize these reflections as a basis for reviewing and reflecting on efficiency of teacher education programs, especially science teaching method courses (Thomas, Pederson, & Finson, 2001). This study also has a contribution to evaluate the reform movements in some level, there is a great emphasize on student-centered constructivist methods nowadays in Turkey but its' reflection to prospective teachers are not as clear as expected. Most of the pre-service chemistry teachers see themselves using both student-centered and teacher-centered instructional methods during chemistry teaching and this finding was supported by both the mean of the total DASTT-C score and frequencies in each instructional style. Also there is evidence in the literature that both of the instructional styles are valuable and applicable according to the situation in which we are in. In addition, there might be some economical and chronological restrictions in the educational system that might affect the decision of teaching style and lack pre-service chemistry teachers' integration with the constructivist approach. Pre-service chemistry teachers have to be supported and encouraged by teacher educators to use supplementary materials, design student-centered activities and experiments and to design creative and supportive learning environments in their future classes. School practices while taken as a prerequisite course to be a chemistry teacher

have to show pre-service teachers good examples of student-centered constructivist teaching and this supposed to have a very important effect to engage them to new educational trends. Reflections on their teaching also with the technological tools like video cameras might be a considerate way to acknowledge them about their teaching choices and style. Maybe some of the pre-service teachers are not aware of the consequences of their educational choices in the classroom.

The results would be taken as a case in point only in three universities. Besides that, our study showed evidence of some problems in the new reform movements in Turkey in accordance with the literature (Elmas & Pilot, 2009; Elmas & Geban, 2010). Although a significant association was found between gender and instructional style, what caused this still remains a mystery that is far beyond our predictions. Therefore, it would be much more tempting to say that additional interviews or observations might be beneficial for an adequate understanding of the underlying causes of females' choice to use student-centered approaches and males to use teacher-centered approaches.

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