



# PRE-SERVICE SECONDARY SCIENCE TEACHERS' IMAGES ABOUT THEMSELVES AS SCIENCE TEACHERS

**Huseyin Akkus**

## Introduction

The beliefs of pre-service teachers about science teaching are a study field that attracts the attention of science educators and researchers. Developing or organizing pre-service teachers' beliefs is one of the purposes of science education programs (Talsma, 2007). Because prior positive or negative experiences and beliefs that pre-service teachers bring with them when entering university seem not only to have an effect on their learning during their training, but also on their later behavior as teachers at school (Markic & Eilks, 2008; Thomas & Pedersen, 2003). Teachers and pre-service teachers are the key factors of changes in education and pre-service teachers have to be prepared for new educational trends. Moreover, the realization of the educational changes largely depends on teachers and pre-service teachers (Elmas, Demirdögen & Geban, 2011; Namsone, 2002). In order to reorganize or change the teaching behaviors of teachers and pre-service teachers, they should be aware of their images and knowledge about themselves and teaching (Elmas, Demirdögen & Geban, 2011). Making the teachers and pre-service teachers aware of their images and beliefs which have an influence on their decisions and actions may be a good starting point to organize or change these images and beliefs (Markic, Valanides & Eilks, 2006).

Drawings usually provide us with a perspective that is not easily recognizable with written texts or verbal descriptions. Drawings are useful tools to evaluate teaching images, because they can express many things which are not easily put into words. The role of images in education cannot be understood if they are not explored and examined (Weber & Mitchell, 1996). The images of pre-service teachers and teachers about themselves can be evaluated by using The Draw-A-Science-Teacher-Test Checklist (DASTT-C) which was developed by Thomas, Pedersen and Finson in 2001. DASTT-C is

**Abstract.** *The purpose of this study is to explore pre-service secondary science teachers' images of themselves as science teachers. Also, the association between instructional style, and domains was explored. 130 secondary science teachers (biology, chemistry and physics) from 26 public universities participated in the data collection for this study. The Draw a Science Teacher Test Checklist (DASTT-C) was used as a data collection instrument. The results of study showed that pre-service science teachers' images is 24.62% student-centred, 53.85% between student and teacher-centred, and 21.4% teacher-centred teaching style approaches. A significant association was found between domain and instructional style. Pre-service chemistry teachers were more willing to use student-centred teaching style rather than pre-service biology and pre-service physics teachers.*

**Key words:** *DASTT-C, pre-service science teacher, secondary science education.*

**Huseyin Akkus**  
Gazi University, Turkey



a useful instrument that can be used to measure the effectiveness of teacher training programs and pre-service teachers' images of teaching science and themselves as teachers (Louca, Rigas & Valanides, 2003; Thomas & Pedersen, 2003; Yilmaz, Turkmen, Pedersen & Huyuguzel Cavas, 2007). Inviting teachers to draw themselves and then talk about their images provide an excellent chance for critical reflection on teaching (Weber & Mitchell, 1996). DASTT-C forces a teacher or a pre-service teacher to think deeply about teaching and draw an image of himself or herself as a teacher in a classroom (Markic Valanides & Eilks, 2006).

In the light of new changes in education, secondary school curriculums have been organized with a shift from teacher-centred approach to student-centred approach, but how much this shift affects the pre-service teachers is not very clear yet (Elmas, Demirdogen & Geban, 2011). If pre-service teachers begin to think about themselves as teachers in the scheme of what learning and teaching is about, educational changes may be at hand (Thomas & Pedersen, 2003). Pre-service teachers' drawings and writings about their images of themselves open a window that allows us understanding of what they are thinking about teaching (Whyte & Ellis, 2003). Because of this reason, the teacher images in pre-service secondary science teachers' minds were investigated via DASTT-C in this study. The purpose of this study is to investigate the images of pre-service biology, chemistry and physics teachers about how they will be like as a teacher in their future classrooms.

#### *Problem of Research*

The purpose of this study is to investigate the images of pre-service secondary science teachers have of themselves as science teachers and the teaching styles of them as student-centred, between student and teacher-centred, and teacher-centred.

#### *Research Focus*

Beliefs that pre-service science teachers hold about teaching and themselves should be explored in order to be modified or developed. By this way, awareness can be created in pre-service teachers to implement the teaching and learning process effectively in their future classrooms (Ambusaidi & Al-Balushi, 2012). The main focus of this research was to investigate the pre-service secondary science teachers' images of themselves as science teachers.

### **Methodology of Research**

#### *General Background of Research*

There are several studies which investigate pre-service teachers' and teachers' images of themselves in the literature. Ambusaidi and Al-Balushi (2012) investigated pre-service science teachers' beliefs about themselves as science teachers and about science teaching styles in a longitudinal study via DASTT-C. They concluded that pre-service science teachers were at the conceptual teaching style. DASTT-C was applied three times to 45 pre-service science teachers before the Science Method I course, after finishing this course and after finishing the Science Method II course and the Practicum. The results revealed that after completing the Science Methods I course, pre-service science teachers shifted significantly from a teacher-centred approach to the intermediate state between the teacher-centred and student-centred.

Uner, Akkus and Turan (2012) conducted a study in Turkey with 20 pre-service chemistry teachers to determine the images of pre-service chemistry teachers about how they become a chemistry teacher by using DASTT-C. The results of the study showed that pre-service chemistry teachers mostly had conceptual teaching style with the proportion of 55%. Also, results showed that 40% of pre-service chemistry teachers saw themselves as exploratory teachers. The proportion of explicit teachers was 5% in their study.

Al-Amoush, Markic, Abu-Hola and Eilks (2011) conducted a study with 23 chemistry student teach-



ers and 44 in-service chemistry teachers and investigated Jordanian chemistry student teachers' and experienced teachers' beliefs about teaching and learning. In this study, the teacher-centeredness or student-centeredness of teachers' beliefs concerning science teaching was measured by using DASTT-C. The results indicated that each group of participants held quite traditional beliefs which were teacher-centred to teach and learn chemistry and student teachers' traditional beliefs were more pronounced than in-service teachers' beliefs.

Elmas, Demirdogen and Geban (2011) conducted a study with the aim of exploring pre-service chemistry teachers' images of science teaching in their future classrooms and association between instructional style, gender, and desire to be a teacher. They studied with 66 pre-service chemistry teachers from three public universities used a modified version of DASTT-C as a data collection tool. They found that 39.4% of 66 participants were among student-centred and teacher-centred, 37.9% of them were student-centred and 22.7% of them were teacher-centred. The results of the study showed that there was a significant difference between gender and instructional style and female pre-service teachers were more willing to use student-centred teaching style rather than male pre-service teachers.

Markic and Eilks (2010) conducted a study with 266 first-year science education students from four German universities. Participants' beliefs about science teaching and learning were measured by using DASTT-C. The results of this study showed that chemistry and physics students mostly had teacher-centred beliefs. On the other hand, they found that biology and primary science students had student-centred beliefs.

Minogue (2010) conducted a study with DASTT-C in order to investigate 50 pre-service elementary teachers' beliefs about science teaching and science methods course effectiveness. Participants were asked to complete the DASTT-C during the first and last meeting of the semester-long science methods course. The results indicated that participants' images of science teaching changed from teacher-centred instruction to student-centred instruction and participation in the methods course had an effect on pre-service teachers' images of themselves as a science teacher.

Yılmaz, Turkmen, Pedersen and Huyuguzel Cavas (2007) investigated 213 pre-service elementary teachers' images of science teaching and analyzed the gender differences in image of science teaching. They found that Turkish elementary pre-service teachers' teaching style was 20% student-centred, 41% teacher-centred, and 39% between student-centred and teacher-centred. Also, the results of this study showed that there was no significant difference between gender and teaching style.

El-Deghaidy (2006) investigated the impact of a science teaching methods course designed with a constructivist teaching and learning approaches on pre-service teachers' self-efficacy and perceptions of themselves as science teachers. This study was conducted with 36 pre-service science teachers (biology, chemistry and primary). Self-efficacy was measured using the Science Teaching Efficacy Belief Instrument (STEB-I) and DASTT-C was used to measure participants' perceptions of themselves as science teachers. The findings implied that the course had an impact on self-efficacy beliefs and increased personal was associated with increased student-centeredness in participants' drawings. The results of this study showed that there was a moderate correlation between pre-service teachers' perceptions of themselves as science teachers and their self-efficacy beliefs.

Finson, Pedersen and Thomas (2006) conducted a study with 9 teachers and 327 students with the aim of investigating the relationship between teachers' teaching styles and their students' perceptions of scientists. Teachers' teaching styles were assessed using DASTT-C and students' perceptions of scientists were evaluated using the Draw-a-Scientist-Test Checklist (DAST-C) in the study. The result of this study showed that there was no significant relationship between the teachers' teaching style and their students' perceptions of scientists.

Thomas, Pedersen and Finson (2001) organized the teaching styles of pre-service teachers into three distinct groups: Exploratory Teaching Style, Conceptual Teaching Style and Explicit Teaching Style. In the Exploratory Teaching Style, teacher is the guide for students' activities and students are the managers of their own learning. In the Conceptual Teaching Style, teacher organizes the connections of the content and processes of science and lessons include hands-on activities, group work, and discussion of ideas. In the Explicit Teaching Style, teacher is the knowledge transmitter and starts the classroom activities.



### *Sample of Research*

To be able to teach in secondary education in Turkey it is necessary to graduate from an education faculty or graduate from the department and additionally to complete the one year program including pedagogical formation after graduating from the department. In Turkey, field, field educational and educational courses are taught together for five years in an education faculty and only field courses are taught for four years in the department. This study was conducted with 130 pre-service secondary science teachers in the spring semester of 2011-2012 academic year. 106 of the participants were female and 24 of them were male. The participants were graduated from 26 different universities at the Faculty of Sciences from the departments of biology, chemistry and physics and enrolled at Pedagogical Formation Program in the department of secondary science education at a public university in Turkey. 30 of the participants were pre-service biology teachers, 57 of them were pre-service chemistry teachers and 43 of them were pre-service physics teachers. The participants were to be counted as graduates from the Pedagogical Formation Program.

### *Instrument and Procedures*

In this research, Draw-a-Science-Teacher-Test Checklist (DASTT-C), which was developed by Thomas, Pedersen and Finson in 2001, was used to measure pre-service secondary science teachers' images of themselves as science teachers. In this research, participants were suggested to "Draw a picture of yourself as a science teacher at work." and to write a brief description their drawings and specifically answer the questions, "What is the teacher doing?" and "What are the students doing?" regarding their drawings via DASTT-C. In this study participants were provided with the DASTT-C drawing page and 20-30 minutes to complete the test. It is explained to the participants that the quality of drawings was not important; the individuals could be drawn as stickman and the content of drawings was important for this study. Pre-service science teachers were asked to "Draw a picture of yourself as a science teacher at work." and to write "What is the teacher doing?" and "What are the students doing?" in their drawing pages. The drawings of pre-service teachers were scored according to the 13-item checklist. The checklist consists of three sections: Teacher, Students and Environment. Total checklist scores can range from 0 to 13. The lowest score (0) shows the most student-centred image and the highest score (13) shows the most teacher-centred image. The scores of 0-4 represents student-centred image, 5-9 represents between student-centred and teacher-centred and 10-13 represents teacher-centred image. The scores were organized into three distinct groups: Exploratory (0-4 points), Conceptual (5-9 points) and Explicit (10-13 points) Teaching Styles.

The drawings of the participants were analyzed by the researcher. 10% of the participants' drawings were randomly selected and two evaluators who were outside this study evaluated these drawings independently to determine the inter-rater reliability. Consistency for the evaluation of participants' drawings was 95% agreement between the evaluators and the researcher. The evaluators and researcher resolved all disagreements by discussion until 100% agreement was reached. DASTT-C produces dichotomous data, for this reason internal reliability was calculated for the data set by using the Kuder-Richardson 20 (KR20). The internal reliability coefficient for the DASTT-C was .765.

### *Data Analysis*

The data obtained from participants were evaluated separately according to the participants' domains. The findings were presented with examples of participants' drawings. The results were given as percentages. According to the participants' DASTT-C scores, Kruskal-Wallis H-Test and Mann-Whitney U-Test were used in order to investigate the significant difference between participants' domains. Also to investigate the participants' images about themselves as science teachers according to their gender Mann-Whitney U-Test was used.



## Results of Research

In order to investigate the participants' DASTT-C scores according to the domain of them Kruskal-Wallis H-Test was used. The results showed that there were significant differences between the pre-service secondary teachers' images about themselves as science teachers and their domains ( $\chi^2(2) = 10.732$ ,  $p < 0.05$ ). When looking at the significance of the difference between groups using Mann-Whitney U-Test, the results showed that there was no significant difference between biology and physics pre-service teachers ( $U = 564.50$ ,  $p = 0.363$ ,  $p < 0.05$ ); but there were significant differences between biology and chemistry pre-service teachers ( $U = 613.00$ ,  $p = 0.030$ ,  $p < 0.05$ ) and between physics and chemistry pre-service teachers ( $U = 791.50$ ,  $p = 0.002$ ,  $p < 0.05$ ). See Table 1.

**Table 1. The Kruskal-Wallis H-test results of pre-service science teachers' DASTT-C scores according to the domain.**

Domain	n	Mean Rank	df	Mean Square	p
Biology	30	70,88	2	10.732	0.005
Physics	43	77,47			
Chemistry	57	53,64			

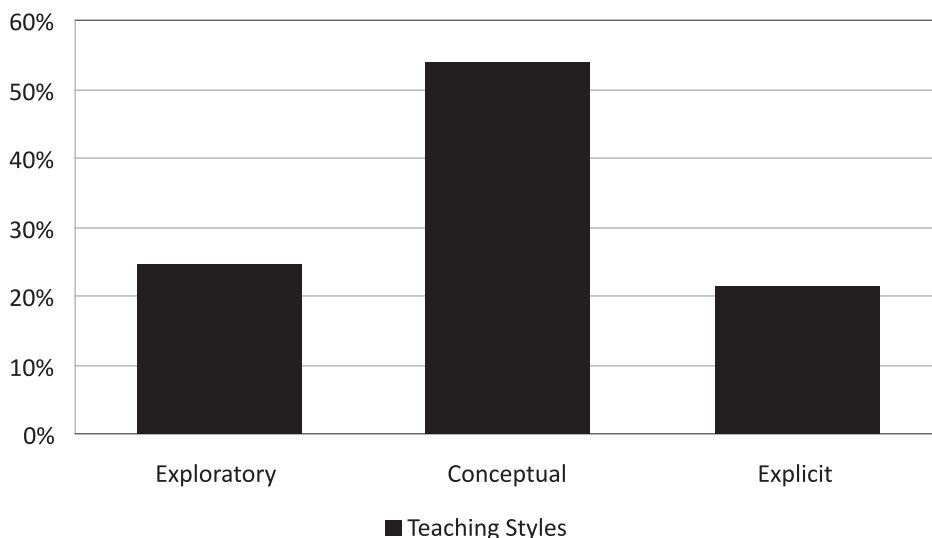
In order to investigate the relationship between pre-service science teachers' gender and images about themselves as science teachers, Mann-Whitney U-Test was used. As seen in Table 2, there is no significant difference between gender and images about themselves as science teachers ( $U = 1157.00$ ,  $p > 0.05$ ).

**Table 2. The results of Mann-Whitney U-test of participants' DASTT-C scores according to the gender.**

Gender	N	Mean Rank	Sum of Ranks	U	p
Female	24	70.29	1687.00	1157.00	0.487
Male	106	64.42	6828.00		

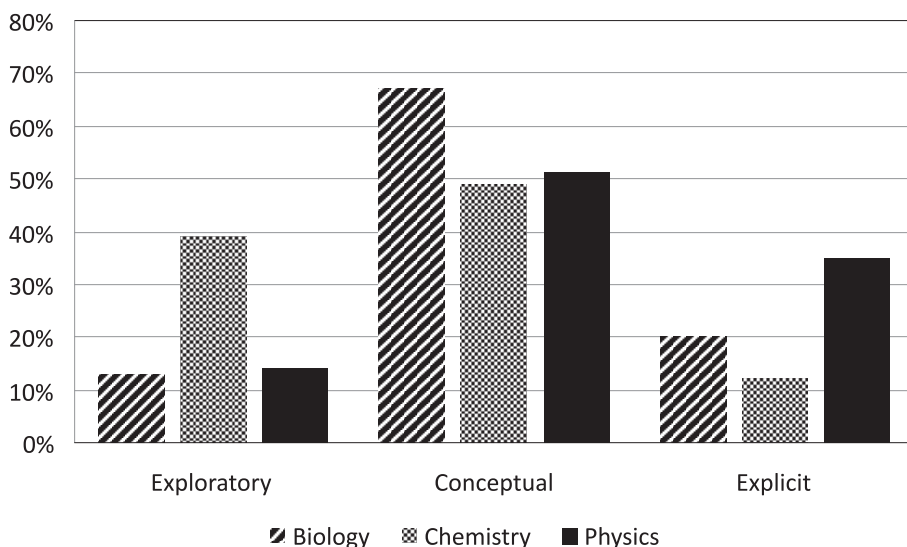
The total DASTT-C scores of participants ranged from 1 to 13. The mean of total DASTT-C score of pre-service secondary science teachers was 6.9. This score showed that the participants had both student-centred and teacher-centred teaching style. Data obtained from DASTT-C indicated that participants mostly had conceptual teaching style with the proportion of 54%. Also, results showed that 25% of pre-service chemistry teachers saw themselves as exploratory teachers. The proportion of explicit teachers was 22% in this study. In other words, 25% of participants were rated as student-centred, 22% of participants were rated as teacher-centred and 54% of participants were rated as between student-centred and teacher-centred. The distribution of pre-service secondary science teachers' teaching styles is presented in Figure 1.





**Figure 1: Teaching styles for pre-service secondary science teachers.**

When examining the total DASTT-C scores of participants according to their domains, results showed that the proportions of the conceptual teaching style were 67% for pre-service biology teachers, 49% for pre-service chemistry teachers and 51% for pre-service physics teachers. It is indicated that the proportions of the exploratory teaching style were 13% for pre-service biology teachers, 39% for pre-service chemistry teachers and 14% for pre-service physics teachers. Also the results showed that the proportions of the explicit teaching style were 20% for pre-service biology teachers, 12% for pre-service chemistry teachers and 35% for pre-service physics teachers. The distribution of pre-service secondary science teachers' teaching styles according to their domains is presented in Figure 2.



**Figure 2: Teaching styles for pre-service science teachers according to their domains.**

As seen Table 3, according to the DASTT-C response frequency distributions of the participants, in Teacher Section; pre-service chemistry teachers were less likely to draw themselves lecturing or giving directions with the proportion of 46%, pre-service biology teachers with the proportion of 83% and



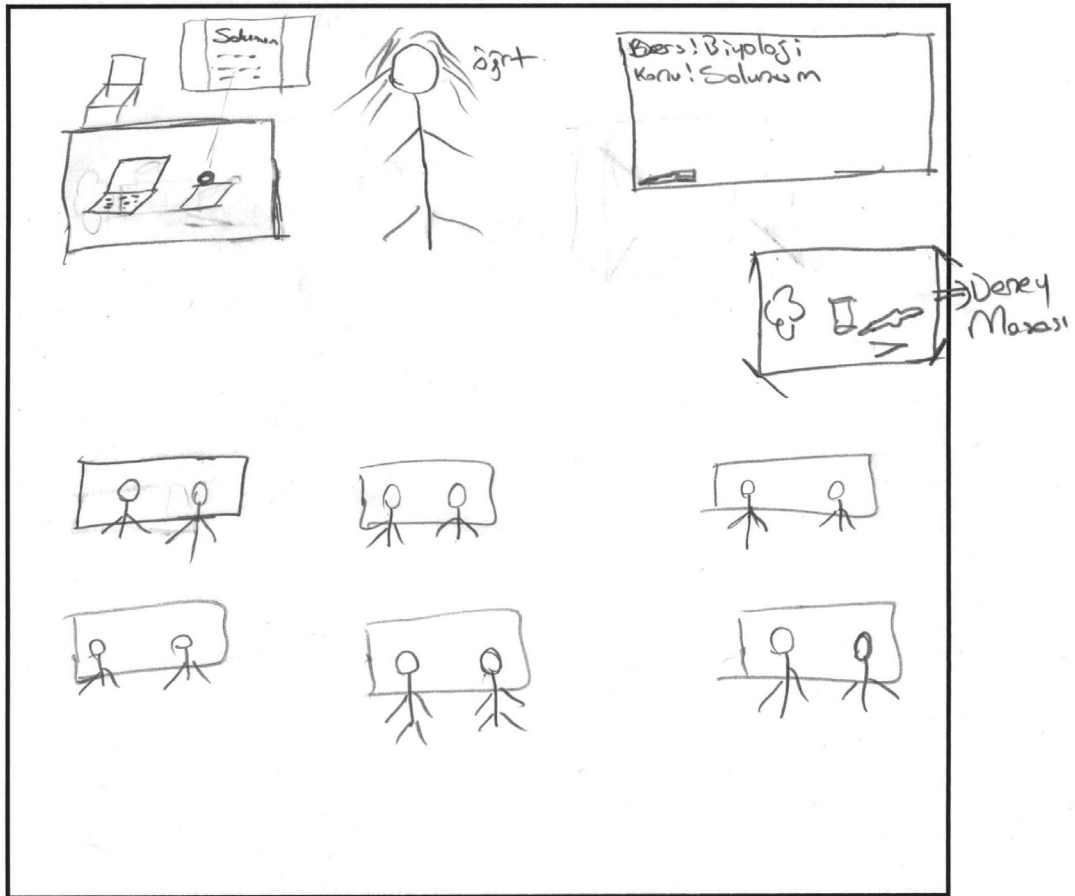
pre-service physics teachers with the proportion of 74% were more likely to draw themselves lecturing or giving directions. 77% of the pre-service biology teachers, 42% of the pre-service chemistry teachers and 77% of the pre-service physics teachers drew themselves centrally located. Moreover, 40% of the pre-service biology teachers, 37% of the pre-service chemistry teachers and 51% of the pre-service physics teachers drew themselves demonstrating experiment or activity. In Student Section; pre-service biology teachers and pre-service physics teachers were more likely to draw their students watching and listening with the proportion of 67% for both of them and pre-service chemistry teachers with the proportion of 46% were less likely to draw themselves lecturing or giving directions. 63% of the pre-service biology teachers, 40% of the pre-service chemistry teachers and 72% of the pre-service physics teachers drew their students seated. In Environment Section; 43% of the pre-service biology teachers, 32% of the pre-service chemistry teachers and 51% of the pre-service physics teachers drew desks arranged in rows. Also 53% of the pre-service biology teachers, 58% of the pre-service chemistry teachers and 56% of the pre-service physics teachers drew teacher table located at the front of the room.

**Table 3. Biology, chemistry and physics pre-service teachers' DASTT-C response frequency distributions.**

DASTT item	Biology		Chemistry		Physics	
	f	%	f	%	f	%
Teacher Activity						
Demonstrating Experiment/Activity	12	(40)	21	(37)	22	(51)
Lecturing/Giving Directions (teacher talking)	25	(83)	26	(46)	32	(74)
Using Visual Aids (chalkboard, overhead, and charts)	23	(77)	24	(42)	32	(74)
Teacher Position						
Centrally located (head of class)	23	(77)	24	(42)	33	(77)
Erect Posture (not sitting or bending down)	28	(93)	23	(40)	35	(81)
Student Activity						
Watching and Listening (or so suggested by teacher behavior)	20	(67)	26	(46)	29	(67)
Responding to Teacher/Text Questions	5	(17)	13	(23)	7	(16)
Student Position						
Seated (or so suggested by classroom furniture)	19	(63)	23	(40)	31	(72)
Environment						
Desks are arranged in rows (more than one row)	13	(43)	18	(32)	22	(51)
Teacher desk/table is located at the front of the room	16	(53)	33	(58)	24	(56)
Laboratory organization (equipment on teacher desk or table)	3	(10)	21	(37)	13	(30)
Symbols of Teaching (ABC's, chalkboard, bulletin boards, etc.)	27	(90)	38	(67)	37	(86)
Symbols of Science Knowledge (science equipment, lab instruments, wall charts, etc.)	14	(47)	43	(75)	22	(51)

When examining the participants' drawings, it is indicated that in teacher-centered drawings the teacher is usually in front of a blackboard, lecturing and demonstrating an experiment. The students are listening to their teacher, answering the questions and sitting on the desks which are arranged in traditional rows. An example of a teacher-centered drawing can be seen in Figure 3. The participant whose drawing is presented in Figure 3 explained "What is the teacher doing?" and "What are the students doing?" section as "The teacher is lecturing by demonstrating and using chalkboard. When necessary, teacher is doing an experiment. The students are watching and participating in the experiment."

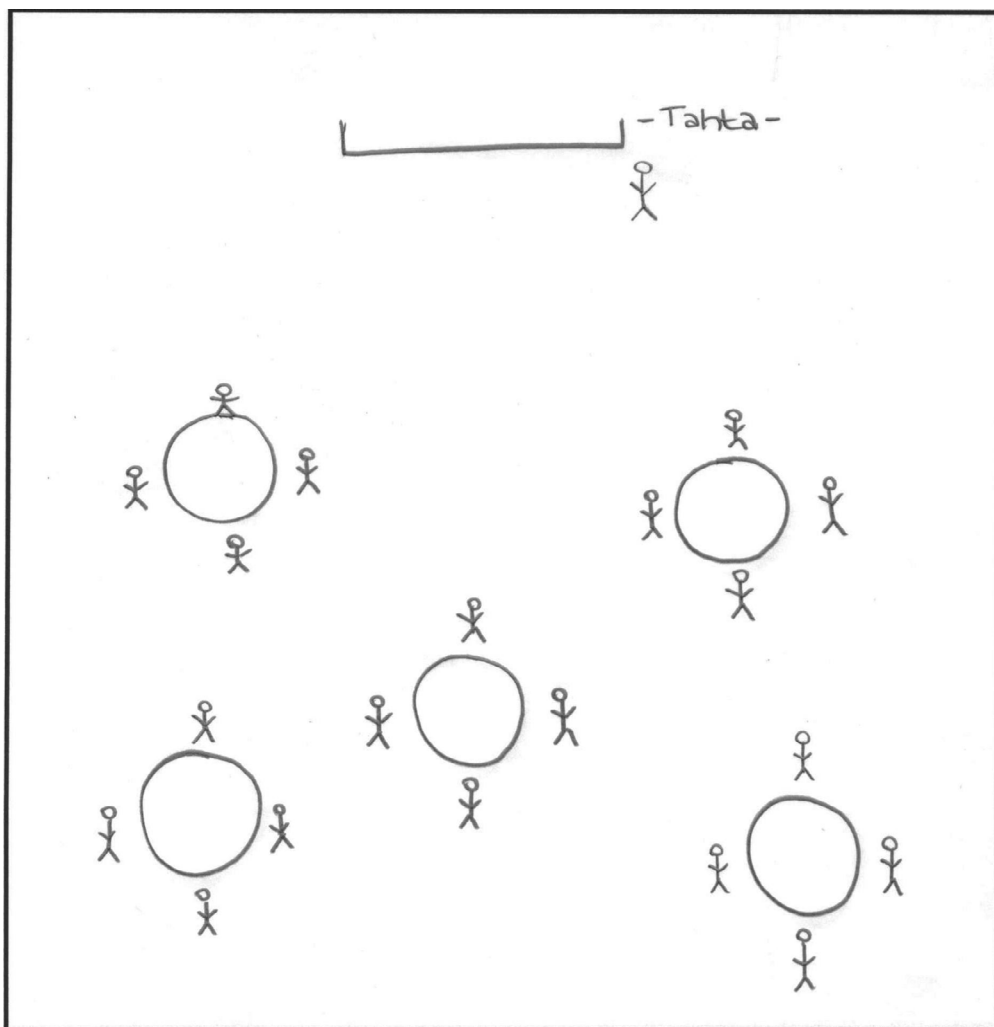




**Figure 3:** An example of teacher-centered drawing.

When examining the participants' drawings, it is indicated that in student-centred drawings the teacher is not usually in front of a blackboard and looks like a guide for students' activities. The students are working with groups and discussing with their classmates. The desks are not arranged in traditional rows. An example of a student-centred drawing can be seen in Figure 4. The participant whose drawing is presented in Figure 4 explained "What is the teacher doing?" and "What are the students doing?" section as "The teacher is giving the basic knowledge about the topic which the students will discuss. Then the teacher is visiting groups to check how the process works and giving feedback to the students to correct the mistakes. The teacher doesn't want the students to sit on desks which are arranged traditionally. The teacher wants them to be interacting with each other. Because the teacher thinks that one of the best ways of learning is learning from peers and cooperative learning. The students are discussing the topic in detail within the framework of basic knowledge given by their teacher. The lesson isn't boring for students. Students' argumentation skills are developing."





**Figure 4:** An example of student-centered drawing.

### Discussion

The results of this study showed that pre-service secondary science teachers mostly had conceptual teaching style. They saw themselves both student-centred and teacher-centred teachers. The findings of this study are in agreement with the findings that are found in this field (Ambusaidi & Al-Balushi, 2012; Boz & Uzuntiryaki, 2006; Demirdogen & Elmas 2009; Elmas, Demirdöğen & Geban, 2011; Uner, Akkus & Turan, 2012; Yılmaz, Turkmen, Pedersen & Huyuguzel Cavas, 2007).

In this study, it was found out that pre-service chemistry teachers' images about themselves as teachers were more exploratory than pre-service biology and physics teachers' images about themselves. Also, the results showed that pre-service physics teachers' images about themselves were more explicit than pre-service biology and chemistry teachers' images about themselves. When looking at the distribution of DASTT-C response frequency distributions, it is concluded that teachers in the drawings of pre-service biology and physics teachers were appeared to lecture more than teachers in pre-service chemistry teachers' drawings and students were more passive in the



learning process in pre-service biology and physics teachers' drawings. One possible reason of this situation may be the courses that participants take during their education programs. Pre-service teachers' images about themselves may be affected by their prior school experiences and their previous teachers (Ambusaidi & Al-Balushi, 2012; Al-Amosuh, Markic, Abu-Hola & Eilks, 2011; Demirdögen & Elmas, 2009; Eilks, Al-Amoush & Markic, 2011; Elmas, Demirdögen & Geban, 2011; Markic & Eilks, 2008; Markic, Eilks & Valanides, 2008; Thomas & Pedersen, 2003; Thomas, Pedersen & Finson, 2001; Yılmaz, Turkmen, Pedersen & Huyuguzel Cavas, 2007). The reasons of pre-service teachers' images about themselves were not investigated in this study; these reasons should be examined through interviews in further studies.

Analysis of the effect of gender on pre-service science teachers' images about themselves as science teachers revealed that there is no significant difference between gender and participants' images about themselves as science teachers. In the literature, there are some supportive researches which concluded gender did not affect the teaching style (Yılmaz, Turkmen, Pedersen & Huyuguzel Cavas, 2007). On the other hand, there are some researches which concluded gender affected the teaching style (Chudgar & Sankar, 2008; Elmas, Demirdögen & Geban, 2011). Gender may be one of the reasons that influence pre-service teachers' images about themselves as science teachers. For this reason, the effect of gender should be investigated deeply in future studies.

Teachers' and teacher candidates' beliefs about teaching and learning are very important for establishing appropriate actions in classrooms. An evaluation of pre-service teachers' beliefs should be a part of their university training (Markic & Eilks, 2012). Teacher education programs should lead and help pre-service science teachers to think and talk about themselves and science teaching (Boz & Uzuntiryaki, 2006; Thomas & Pedersen, 2003). Teacher educators should provide opportunities for pre-service teachers to examine their beliefs about themselves, teaching and learning during teacher education programs. If pre-service teachers understand the nature of teaching and learning and be aware of themselves as a teacher, the problems faced by them in their future classrooms can be solved easily (Thomas & Pedersen, 2003). Pre-service science teachers will become science teachers in the future, the perspective of them towards themselves should be examined before they start training (Uner, Akkus & Turan, 2012). DASTT-C should make pre-service teachers to think about their mental models and beliefs of teaching (Thomas & Pedersen, 2003). DASTT-C can be used to focus self-reflection of pre-service teachers and to make them aware of their beliefs about themselves (Markic & Eilks, 2008).

Drawings can be used to assess the development of pre-service teachers' beliefs (Talsma, 2007). Revealing pre-service teachers' beliefs on teaching and learning and making them aware of their beliefs may be the first step for self-reflection and changing these beliefs (Markic & Eilks, 2008; Markic, Eilks & Valanides, 2008). Investigating the images of pre-service teachers via DASTT-C allows pre-service teachers to think about themselves as teachers (Thomas & Pedersen, 2003). Moreover, the DASTT-C can be used as an instrument to evaluate the teacher education programs (Louca, Rigas & Valanides, 2003). Also, the changes of pre-service teachers' images from being a novice teacher to experienced teacher should be investigated via DASTT-C after their graduation (Ambusaidi & Al-Balushi, 2012). In future studies, the change in images of pre-service teachers should be examined via DASTT-C at different steps of their trainings.

## Conclusions

This study provides the data of pre-service secondary science teachers' images of themselves as a science teacher and their teaching styles. Pre-service science teachers will be science teachers and play important roles in educational changes in their future classrooms. It is important for pre-service teachers to think about their teaching style, since they can cope up with possible problems in their future classrooms more easily. A pre-service science teacher's image of himself or herself is a light guiding about his or her future class.

The images of pre-service teachers about themselves should be examined in order to make them



aware of their beliefs. Also, by this way, pre-service teachers' images may provide teacher educators data about the effectiveness of teacher education programs. DASTT-C is a useful instrument to assess the pre-service teachers' images about themselves and their teaching styles. Therefore, in this study, pre-service science teachers' images about themselves were examined in order to provide awareness for them via DASTT-C. It is believed that more studies investigating the images and beliefs of pre-service teachers about their teaching are needed. It is expected that future studies about pre-service teachers' images of themselves and teaching styles will shed light on the factors that influence these images, the effect of teacher education programs on these images and the change of these images over time.

## References

- Al-Amoush, S. A., Markic, S., Abu-Hola, I., & Eilks, I. (2011). Jordanian prospective and experienced chemistry teachers' beliefs about teaching and learning and their potential role for educational reform. *Science Education International*, 22 (3), 185-201.
- Ambusaidi, A. K., & Al-Balushi, S. M. (2012). A longitudinal study to identify prospective science teachers' beliefs about science teaching using the draw-a-science-teacher-test checklist. *International Journal of Environmental & Science Education*, 7 (2), 291-311.
- Boz, Y., & Uzuntiryaki, E. (2006). Turkish prospective chemistry teachers' beliefs about chemistry teaching. *International Journal of Science Education*, 28 (14), 1647-1667.
- Chudgar, A., & Sankar, V. (2008). The relationship between teacher gender and student achievement: evidence from five Indian states. *Compare: A Journal of Comparative and International Education*, 38 (5), 627-642.
- Demirdögen, B., & Elmas, R. (2009). Investigating preservice chemistry teachers' mental images about science teaching. *The European Conference on Educational Research (ECER)*. Vienna, Austria.
- Eilks, I., Al-Amoush, S. A., & Markic, S. (2011). Jordanian chemistry student teachers' and experienced teachers' beliefs about teaching and learning. *IX. European Science Education Research Association (ESERA)*. Lyon, France.
- El-Deghaidy, H. (2006). An investigation of pre-service teachers' self-efficacy and self-image as a science teacher in Egypt. *Asia Pacific Forum on Science Learning and Teaching*, 7 (2), 1-22.
- Elmas, R., Demirdögen, B., & Geban, Ö. (2011). Preservice chemistry teachers' images about science teaching in their future classrooms. *Hacettepe University Journal of Education*, 40, 164-175.
- Finson, K. D., Pedersen, J., & Thomas, J. (2006). Comparing science teaching styles to students' perceptions of scientists. *School Science and Mathematics*, 106 (1), 8-15.
- Louca, P., Rigas, P., & Valanides, N. (2003). Primary student teachers' conceptions of science teaching. *IV. European Science Education Research Association (ESERA)*. Noordwijkerhout, The Netherlands.
- Markic, S., & Eilks, I. (2012). A comparison of student teachers' beliefs from four different science teaching domains using a mixed methods design. *International Journal of Science Education*, 34 (4), 589-608.
- Markic, S., & Eilks, I. (2010). First-year science education student teachers' beliefs about student- and teacher-centeredness: parallels and differences between chemistry and other science teaching domains. *Journal of Chemical Education*, 87 (3), 335-339.
- Markic, S., & Eilks, I. (2008). A case study on German first year chemistry student teachers' beliefs about chemistry teaching, and their comparison with student teachers from other science teaching domains. *Chemistry Education Research and Practice*, 9, 25-34.
- Markic, S., Eilks, I., & Valanides, N. (2008). Developing a tool to evaluate differences in beliefs about science teaching and learning among freshman science student teachers from different science teaching domains: A case study. *Eurasia Journal of Mathematics, Science & Technology Education*, 4 (2), 109-120.
- Markic, S., Valanides, N., & Eilks, I. (2006). Freshman student teachers' beliefs about science teaching – A mixed methods study. In I. Eilks, B. Ralle (Eds.): *Towards research-based science teacher education* (pp. 29-40). Aachen: Shaker.
- Minogue, J. (2010) What is the teacher doing? What are the students doing? An application of the Draw-a-Science-Teacher-Test. *Journal of Science Teacher Education*, 21 (7), 767-781.
- Namsone, D. (2002). The science teacher in the situation of changing educational paradigm. *Journal of Baltic Science Education*, 2, 31-39.
- Talsma, V. L. (2007). Children learning science: Analysis of drawings from the science methods classroom. *North-Central Association for Science Teacher Educators (NASTE)*. Madison, WI.
- Thomas, J. A., & Pedersen, J. E. (2003). Reforming elementary science teacher preparation: What about extant teaching beliefs? *School Science and Mathematics*, 103 (7), 319-330.
- Thomas, J. A., Pedersen, J. E., & Finson, K. (2001). Validating the draw-a-science-teacher-test checklist (DASTT-C): exploring mental models and teacher beliefs. *Journal of Science Teacher Education*. 12 (3), 295-310.



- Uner, S., Akkus, H., & Turan, N. (2012). Image yourself as a chemistry teacher. *Procedia - Social and Behavioral Sciences*, 47, 417-421.
- Weber, S., & Mitchell, C. (1996). Drawing ourselves into teaching: studying the images that shape and distort teacher education. *Teaching & Teacher Education*, 12 (3), 303-313.
- Whyte, A., & Ellis, N. (2003). Graphic representation as a bridge to conceptual teaching. *The Arts and Learning Research Journal*, 19 (1), 167-194.
- Yilmaz, H., Turkmen, H., Pedersen, J. E., & Huyuguzel Cavas, P. (2007). Evaluation of pre-service teachers' images of science teaching in Turkey. *Asia-Pacific Forum on Science Learning and Teaching*, 8 (1), Article 2.

Received: December 22, 2012

Accepted: April 15, 2013

**Huseyin Akkus**

Assistant Professor at the Department of Secondary Science and Mathematics Education, Faculty of Education, Gazi University, 06500 Ankara, Turkey.  
E-mail: akkus@gazi.edu.tr & akkus72@gmail.com  
Website: <http://www.websitem.gazi.edu.tr/site/akkus>

