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THE PERCEPTIONS OF PRE-SERVICE SCIENCE TEACHERS CONCERNING CONSTRUCTIVIST PERSPECTIVES TO TEACHING

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Abstract. *Preservice teachers begin their careers with their attitudes and perceptions about the profession. The purpose of this study is to identify how a four-semester teacher education program helps pre-service teachers' perceptions about constructivist teaching and learning to change as they progress through the program. The participants of the study included a total of 194 science preservice teachers in four different semesters of their teacher preparation program. The instrument used in this study was the Constructivist Learning Environment Survey (CLES). One way ANOVA was used to identify patterns within cohorts regarding preservice teachers' beliefs about constructivist strategies. Major findings indicated that although there were statistically different subscales of Shared Control and Critical Voice, in general preservice science teachers hold teacher centered beliefs. Based on these findings, it is possible to say that traditional teacher centered education have been carried on under the name of constructivism in Turkish teaching education programs.*

Key words: *constructivism, preservice science teacher, teacher education, teacher education program.*

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Introduction

Education undergoes continuous change in a continuously changing society. Especially, through National Science Education Standards (NSES), changes of science education are more rapid given the daily construction of new scientific knowledge. The NSES include standards for learning science content, learning to teach science, learning to learn, and program development; they state that teachers need the skills and ability to be lifelong learners, reflect on their own practice, and take responsibility for their own professional development (NRC, 1996); "Effective science teaching is more than knowing science content and some teaching strategies. Skilled teachers of science have special understandings and abilities that integrate their knowledge of science content, curriculum, learning, teaching and students." (p. 62). For this reason, a purpose of teacher education programs should be to create the best teachers possible for realizing the vision of the NSES. Teacher education programs should inform preservice teachers about current reforms, constructivist approaches, meaningful assessments, related research which relates to about effective teaching practices. And also The National Science Education Standard indicates the nature of current reforms that are based on constructivism which should make this theory teacher central to reform (NSES, 1996; MNE, 2004).

Constructivism is the cornerstone of the current reforms and has taken the center stage as the foundation for teaching and learning in science education programs in the recent past. Constructivism is a theory of learning when learners are seen to be actively engaged in the construction of knowledge in a socially motivated setting (Yager, 1991). Learners construct their knowledge and discuss their meanings in these social settings. The

most important factor in meaning negotiation and knowledge construction is the experience that each learner brings to the learning environment. Constructivism is central to the current reforms in science education and causes shifts in the focus of teaching and learning from how students learn science to how teachers learn to teach science in teacher education programs (Brooks and Brooks, 1993). Many research indicated that preservice teacher education programs that prepare new teachers will play a particularly important role regarding to use of constructivist teaching approaches. Through preservice teacher education programs, beginning teachers are often significantly influenced (Krajcik, 1986; Tobin & Fraser, 1992). Therefore, the importance of methods courses in teacher education programs was investigated in a variety of past studies (Goodman, 1986; Hewson, Zeichner, Tabachnick, Blomker & Tollin, 1992; Loughran, 1994).

However, the researcher should not forget about there is also a growing interest in studies of social and cultural dimensions of knowledge acquirement, for instance, by investigating the discourses between teachers and students in the classroom. Other trends are the growing interest in studies of laboratory work, especially (open-) inquiry, the implementation and use of problem solving strategies, and the use of internet, computer software, and interactive multimedia (De Jong, 2007).

There are likely connections between a better understanding of teacher beliefs and the design of quality programs of teacher education. According to National Science Education Standards (NRC, 1996), "The science methods course should cause students to reflect upon and reassess the values and beliefs they hold with respect to science learning and teaching". Through years of school experiences, preservice teachers have established a strong set of beliefs regarding the teaching of science. The goal of science educators is to challenge preservice teachers' views and work collectively to see them eventually hold new perspectives. "In shifting the way we prepare teachers for professional practice, we may enable our students to confront, shift, and/or refine the beliefs, knowledge, values and assumptions that form their personal theories about teaching and learning" (Bryan, Abel & Anderson, 1996, p. 3).

Teacher education programs play a significant role in the development of teachers' beliefs about teaching and learning. The findings of educational research stated that changes in preservice teacher belief are generally not effected by reading (Kagan, 1992). Some studies stated that design of course to influence specific beliefs can be effective in a methods class setting (Briscoe & Stout, 1996) and that preservice teachers construct beliefs through teaching experiences (Connor & Scharmann, 1996). When preservice teachers do accept information from outside sources such as colleagues or university or teacher education program, they filter it through their own personal belief systems, translating and absorbing it into their pedagogies. They need time to incorporate new skills and abilities into their existing frameworks of what teaching should to be, and to become more reflective about their learning. A number of research findings have led to some changes in methods courses such as increasing the number of field experience hours in classrooms. Tobin's (1993) research stated that "learning about teaching science is best accomplished by direct experience of the teacher–learner in conjunction with opportunities to reflect critically on the experience and emergent problems" (p. 242). Active reflection on the development of beliefs in preservice teachers is also seen as an important means of resolving conflicts between practice and theory (Korthagen & Kessels, 1999).

However, there are not many research studies available which are focused on effect of teacher education program on preservice teachers in Turkey. Considering these concerns the present research focuses on changing preservice science teachers' beliefs about constructivist teaching and learning through a four year teacher education program. The examination of preservice teachers' beliefs could provide definition for potential teacher education programs and understanding the effects of methods courses on preservice teachers will be useful as models for other teacher educators. Moving from this point of view, this study is designed to investigate the development and change in constructivist perceptions of preservice science teachers of the Pamukkale University Primary Science Teacher Education Program (PSTEP) over the four semester sequence. The following main question was presented:

How do pre-service science teacher perceptions of their use of constructivist practices change during their preparatory program? (Constructivist practices are examined by considering the following subscales: I. Personal Relevance -PR, II. Scientific Uncertainty-SU, III. Critical Voice -CV, IV. Shared Control -SC, and V. Student Negotiation-SN).

Methodology of Research

This research has simple descriptive survey approach. The simple descriptive survey approach is one-shot survey for the purpose of describing the characteristics of a sample at one point in time apart from the other approaches of survey research namely cross-sectional and longitudinal (Mertens, 1998, p.108). In this research simple descriptive survey is conducted for the purpose of describing how a four-semester sequence teacher education program helps change pre-service teachers' perceptions about constructivist teaching and learning.

Sample of Research

Participants are preservice science teachers of a faculty of education from a state university in one of the cities located on the west of Turkey. Purposive sampling is used to select the participants. In purposive sampling procedure, it is assumed that the persons chosen possess the necessary information about the target population (Frankel & Wallen, 1996). 192 of 372 preservice science teachers (average age of 21.8) were volunteered to participate in the study Fourty-nine first year preservice science teachers have enrolled in basic science courses (Physics I-II, Chemistry I-II and Mathematics I-II). At this level, they have taken the courses introduction to educational science and educational psychology. Fifty second year preservice science teachers have enrolled in basic science courses (Physics III-IV, Chemistry III-IV and Biology I-II) and besides started to have courses about science teaching Science-Technology Programme and Planning. Thirty-five juniors who are a third year preservice science teacher. The researcher assumed that 3rd year has an important role in science teacher education as preservice science teachers have completed the sets of basic science courses (Physics I-II-III-IV, Chemistry I-II-III-IV, Mathematics I-II and Biology I-II) and besides start to have courses about science teaching science (such as Special Methods of Science Teaching I), science laboratory practices (Science Teaching Laboratory Practices I-II) and nature of science (Nature and History of Science). Seniors who are at their last year of preservice teacher have completed courses about science teaching (such as Special Methods of Science Teaching II) School Experience, Teaching Practice, Turkish Educational System and School Management.

Instrument and Procedures

The original name of the instrument utilized in this study is Constructivist Learning Environmental Survey (CLES), developed by Taylor, Fraser and White in 1994. It was designed to measure teachers' beliefs about what constitutes good learning environments which they create in their classrooms. The CLES has a five point Likert-Scale from 1-5. Strong agreements with favorable items are given a score of 5 and strong disagreements with unfavorable items are given a score of 1. To translate the scores into "teacher-centered" vs. "student-centered" type responses, the higher the score on each subscale, the more student-centered the classroom is perceived to be by the participant.

The CLES was found to be valid and reliable in its statistical characteristics through two large-scale quantitative surveys of classroom learning environments in Thailand (Puacharearn and Fisher, 2004). The Kruder-Richardson alpha reliability coefficient to determine the reliability of the subscales was used by the authors of the instrument and reported reliability coefficients ranging from .54 to .85 (Taylor, Fraser & White, 1994).

CLES was translated into Turkish by Bukova-Guzel and Alkan and double check translation techniques used to check the quality of translation in 2005, controlled and approved by five other experts in the field of science and mathematics educators. A pilot study with 500 preservice teachers was also carried out to get the final version of the measurement. Then the item scale correlations were calculated to determine the suitability of the items. Thus, the remaining item scale correlations ranged from .713 to .919 and all of the items constituted the new form of the scale. Their reported reliability coefficients ranging from .64 to .70.

The CLES was designed to measure teacher development of constructivist approaches in teach-

ing science with the following five subscales that relate to constructivist practices (Aldridge, Fraser & Taylor, 2000).

- Personal Relevance (PR) refers to teachers' perceived relevance of science outside of the classroom.
- Scientific Uncertainty (SU) refers to how the nature of science is reflected in the classroom.
- Critical Voice (CV) refers to the degree to which students feel comfortable in questioning pedagogical decisions made by the teacher.
- Student Negotiations (SN) refers to student to student interactions and determines if opportunities are perceived to be present for students to work collaboratively in arriving at answers to a problem.
- Shared Control (SC) relates to how well students feel they are able to determine and contribute to the activities within the classroom.

Data Analysis

The Statistical Package for Social Sciences (SPSS) software (version 12.00) was used in statistical analysis of the data of this study. To identify patterns in the scores obtained on the CLES for each cohort, a one- way analysis of variance (ANOVA) was conducted. In this research simple descriptive survey was conducted for the purpose of describing how a four-semester sequence teacher education program helped to change the pre-service teachers' perceptions about constructivist teaching and learning. The ANOVA analysis was chosen because while the analysis of variance deals with differences between or among sample means; it imposes no restriction on the number of means.

In this study the level of teacher expertise regarding constructivist behavior is defined as indicated in Table 1. The categories were further collapsed into patterns that best described the preservice teachers' constructivist expertise level (Salish Project, 1997). These patterns were classified as teacher-centered, transitional, and student-centered conceptions (Table 1).

Table 1. Criteria for defining level of teacher expertise regarding constructivist behavior.

Teacher Performances	Teacher Centered		Transitional	Student Centered	
	Novice	Beginner	Transitional	Early Const.	Expert Const.
Mean Scores	1.00-1.49	1.50-2.49	2.50-3.49	3.50-4.49	4.50-5.00

This definition stated that "Novice and Beginners" in constructivist practices are also described as being teacher-centered in their approaches to teaching, "Transitional" in constructivist practices are also described as between teacher-centered and student-centered, and "Early and Expert Constructivists" are also described as mainly student-centered. The patterns that emerged from the categories were defined (Salish Project, 1997; Simons et al, 1999)

Teacher-centered teaching conceptions/actions: These are defined as conceptions or actions that put the teacher at the forefront of teaching and learning. The teacher espouses conceptions or takes actions that portray learning to be teacher directed. These conceptions or actions exclude the students from active participation of their learning. Learning is perceived to occur through direct presentation of information to the students, reading textbooks, and other sources that do not help the learner to generate their own knowledge.

Transitional: These are defined as conceptions or actions when the teacher is seen to dominate the teaching and learning process, though on certain occasions uses strategies that focus on students

taking charge of their learning. According to the espoused conceptions or observed actions, the teacher focuses on discrete concepts and would occasionally involve students to the extent that they can explain concepts to one another. Their conceptions of teaching and learning tend to be focused on teacher-centered strategies though other teaching strategies such as hands-on activities, group work, and explanation of concepts to others may be mentioned or observed.

Student-centered teaching conceptions/action: These are defined as conception or action of pedagogy that focuses on the learner as the generator of knowledge. These conceptions or actions focus on the student understanding by actively engaging students in the inquiry process. The teacher's role is perceived to be that of a facilitator (Salish Project, 1997; Simons et al, 1999).

Results of Research

Turkish version of the CLES was conducted to the 194 preservice teachers, who were enrolled in methods courses and school experience in 2009- 2010 spring semester. The change in the preservice science teachers' beliefs of their use of constructivist practices during their preparatory program were presented at Table 2.

Table 2. Mean scores of preservice teachers by cohort(s) and CLES subscales.

Cohort	N	PR		SU		CV		SN		SC	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Freshmen	49	1.442	.203	1.412	.197	1.548	.259	1.589	.398	1.367	.285
Sophomore	50	1.444	.199	1.373	.227	1.393	.279	1.728	.507	1.355	.249
Junior	35	1.406	.203	1.412	.199	1.571	.255	1.542	.379	1.307	.239
Senior	60	1.459	.242	1.363	.254	1.505	.361	1.648	.553	1.235	.236

The mean scores for freshmen, sophomore, junior and senior were close to 1.5 on the subscales of Personal Relevance, Scientific Uncertainty, and Shared Control of CLES. This result indicates that the dimensions measured on these subscales with respected constructivist practices were perceived to occur "never" in their classrooms.

Another result is that the mean scores of these cohorts were scale of 1.50- 2.49 on the subscales of Critical Voice and Student Negotiation towards Science, indicating that each one of these dimensions as measured by the CLES occurred "very seldom" in the classroom of these cohorts.

The Tukey HSD test was utilized to determine which cohort mean scores differed on the subscale where significant differences existed. The results are shown in Table 3.

Table 3. Comparison of observed cohort mean differences as measured on CLES.

Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.
PR	1.00	2.00	-.00227	.04330	1.000
		3.00	-.01814	.04768	.981
		4.00	-.01708	.04148	.976
	2.00	1.00	.00227	.04330	1.000

Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.
		3.00	-.01587	.04748	.987
		4.00	-.01481	.04125	.984
	3.00	1.00	.01814	.04768	.981
		2.00	.01587	.04748	.987
		4.00	.00106	.04582	1.000
	4.00	1.00	.01708	.04148	.976
		2.00	.01481	.04125	.984
		3.00	-.00106	.04582	1.000
SU	1.00	2.00	.03937	.04515	.819
		3.00	.00000	.04971	1.000
		4.00	.04974	.04325	.659
	2.00	1.00	-.03937	.04515	.819
		3.00	-.03937	.04950	.857
		4.00	.01037	.04301	.995
	3.00	1.00	.00000	.04971	1.000
		2.00	.03937	.04950	.857
		4.00	.04974	.04777	.726
	4.00	1.00	-.04974	.04325	.659
		2.00	-.01037	.04301	.995
		3.00	-.04974	.04777	.726
CV	1.00	2.00	.15542	.06012	.051
		3.00	-.02268	.06618	.986
		4.00	.04320	.05758	.876
	2.00	1.00	-.15542	.06012	.051
		3.00	-.17810(*)	.06591	.037
		4.00	-.11222	.05726	.207
	3.00	1.00	.02268	.06618	.986
		2.00	.17810(*)	.06591	.037
		4.00	.06587	.06361	.729
	4.00	1.00	-.04320	.05758	.876
		2.00	.11222	.05726	.207
		3.00	-.06587	.06361	.729
SN	1.00	2.00	-.13932	.09584	.468
		3.00	.04671	.10552	.971
		4.00	-.05858	.09181	.920
	2.00	1.00	.13932	.09584	.468

Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.
		3.00	.18603	.10508	.291
		4.00	.08074	.09130	.813
	3.00	1.00	-.04671	.10552	.971
		2.00	-.18603	.10508	.291
		4.00	-.10529	.10141	.727
	4.00	1.00	.05858	.09181	.920
		2.00	-.08074	.09130	.813
		3.00	.10529	.10141	.727
SC	1.00	2.00	.01179	.05095	.996
		3.00	.05941	.05610	.715
		4.00	.13216(*)	.04881	.037
	2.00	1.00	-.01179	.05095	.996
		3.00	.04762	.05586	.829
		4.00	.12037	.04854	.066
	3.00	1.00	-.05941	.05610	.715
		2.00	-.04762	.05586	.829
		4.00	.07275	.05391	.533
	4.00	1.00	-.13216(*)	.04881	.037
		2.00	-.12037	.04854	.066
		3.00	-.07275	.05391	.533

** The mean difference is significant at the .05 level.*

As seen in Table 3, statistically significant differences were found between preservice teachers in sophomore and junior teacher candidates. Mean scores on the Critical Voice subscale increased through second year to third year. With regard to the Shared Control subscale, the mean score for the freshman preservice teachers was significantly higher than it was for the senior preservice teachers. There was no significant difference found between preservice teachers regarding Personal Relavance, Scientific Uncertainty and Student Negotiation. The mean scores of Personal Relevance, Scientific Uncertainty for preservice science teachers were close to 1.5; the mean scores of Student Negotaiation were close to 1.5-2.49. Although there is some increase on the mean scores for cohorts, they are still ranged on the teacher centered scale (Table 1). These results stated that these preservice teachers have teacher centered beliefs.

Discussion

It is not easy to become a constructivist teacher, particularly as a beginning teacher who is not sufficiently prepared specifically in terms of constructivist philosophies.

The purpose of this study was to determine the effects of the Pamukkale University (PSTEP) four semester sequences on the preservice teachers' perceptions regarding constructivist teaching strategies. The results of the Constructivist Learning Environment Survey were used to determine patterns of changes for preservice teachers' perceptions within each cohort and among the four cohorts. Evidence from the data shows that there are statistically significant changes in preservice teachers' perceptions

as reported with the CLES subscales of Critical Voice (CV) and Shared Control (SC).

When the researcher look at the results, they may indicate that the perception of the preservice teachers regarding the importance of Shared Control (SC) significantly increased over time. This subscale is concerned with students' being invited to share control of the learning environment, including the articulation of learning goals, the design and management of learning activities, and the determination and application of assessment criteria with the teacher. In general, this subscale was scored as the lowest compared to other subscales concerning constructivist teaching. Yutakom (1997) studied the most successful twelve teachers who were experienced on the use of constructivist practices; these teachers obtained a mean score of 2.6 for Shared Control subscale. This mean score was classified as "transitional constructivist" (between student-centered and teacher-centered) with regards to definition of expertise level pertaining to constructivist teaching in this study.

It is also interesting that perceptions of the importance of Critical Voice (CV) among the preservice science teachers increases significantly. However, the range still beginner level of teacher centered. This subscale of CLES examines the extent to which a social climate has been established in which students feel that it is legitimate and beneficial to question the teacher's pedagogical plans and methods, and to express concerns about any impediments to their learning. This finding shows that preservice teachers had positive perceptions about providing opportunities for students to explain and justify their newly developing ideas to other students. Overall, preservice teacher responses indicate that through open-ended questioning strategies, teachers encourage students to speak-up. In this way they can explain their ideas or ask their questions.

It is also seen that perservice teachers' beliefs during the four semester sequence became more teacher-centered. Because of this fact, they experienced fewer practicum hours during the 4 years teacher education program. The preservice teachers in these education program was exceptionally knowledge-able concerning science, the most important reason of that in these levels, preservice teachers work with instructors and they affected their instructors teaching strategies and instructors teaching philosophies. Actually, through practicum hours precervice teachers have a chance to see what they learned from the instructors in their teaching education programs. However, in this program there are not enough practicum hours. Northfield (1998) illustrated the student teaching experience as a powerful influence on beliefs and actions. Some studies stated that design of course to influence specific beliefs can be effective in a methods class setting (Briscoe & Stout, 1996) and that preservice teachers construct beliefs through teaching experiences (Connor & Scharmann, 1996).

Conclusions

The pre-service teachers' perceptions about constructivisit profile drawn by this study is not hearte-ning. This research results revealed that, it is not easy to become a constructivist teacher, particularly as a beginning teacher who is not sufficiently prepared specifically in terms of constructivist philosophies. The findings from this study strengthen and widen previous studies to show the success of teacher education programs at the universities in Turkey regarding preparation of new science teachers who are going to use constructivist teaching in their science classrooms.

Even though evidence from the data shows that there are statistically significant changes in pre-service teacher' beliefs as reported with the CLES subscales of Critical Voice and Student Negotiation, in general, preservice science teachers held teacher centered belief during.

The reasons of this result may be grouped under three main headings and recommendations may be proposed accordingly. Firstly, the constructivist approach in science education is a new concept for preservice science teachers in Turkey. Science teacher education program in Turkey was restructured between 2005–2006 according to the constructivist approach. This program has been applied at all the faculties of education in Turkey in 2006–2007.

Secondly, the actual practice time is very limited at science teacher education program. Preservice science teacher hasn't got any chance on actual practice in the classroom till the last semester of the senior class. At the program, preservice science teachers have to complete four method courses in three semesters of junior and senior classes. They have to enroll in the course, Special Teaching Method- I,

which is a strictly theoretical course, at the spring term of junior class; Special Teaching Method- II, during which students make some micro-teaching practice using the elementary science curriculum, and Scool Experience, during which preservice teachers just do classroom observation in elementary science classrooms, at the fall term of senior class and Student Teaching course, during which students do 1 or 2 actual practices in an elementary science classroom, at spring of senior class. As it seen, except Student Teaching courses, the preservice teachers do not have any practice. That is a big disadvantage in terms of the improvement of preservice science teachers' believes. The researcher know that when preservice teachers do accept information from outside sources (such as colleagues or university or teacher education programs), they filter it through their own personal belief systems, translating and absorbing it into their pedagogies. They need time to incorporate new skills and abilities into their existing frameworks of what teaching should be, and to become more reflective about their learning. And many research states that the student teaching experience has a powerful influence on beliefs and actions. These research mentioned about design of course may influence specific beliefs and can be effective in a methods class setting and that preservice teachers construct beliefs through teaching experiences. However, science teacher education programs at universities in Turkey offer a fewer practicum hours with method courses to preservice science teachers in terms of actual practice. Unfortunately, because of these reasons, precervise science teachers may held a teacher centered belief.

The last reason, although instructors have enough knowledge about constructivist approach, they still may have difficulties in administering the new curriculum in classroom settings. Because they themselves may have never been taught and they may have had no chance to see the constructivist approach being used in a classroom setting. Naturally, it is possible to say that this situation affects beliefs of preservice science teachers regarding constructivist approach. They most probably may have met applications of constructivist approach at the teacher education program for the first time.

Through this study, the researcher reached several potentially important results about classroom learning environment research. However, there are limited studies about this topic in Turkey. It is possible to assess preservice teachers' perceptions of their own classroom environments through Turkish version of the CLES. It is recommended that this study be replicated with a larger sample group so that it will provide enough power for statistical analysis of the quantitative data. Another recommendation is that preservice teachers' perceptions about teaching and learning be determined prior to instruction and then be monitored continuously. This study did not consider the philosophies and actual practices of the instructional staff for each of the four semesters. Future studies should focus on the effects of different philosophical and pedagogical views held by different faculty members with whom they interact through courses concerning their own beliefs and practices during the four-semester program.

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