PERCEPTIONS OF 4TH AND 5TH GRADE PRIMARY SCHOOL STUDENTS AND THEIR TEACHERS ABOUT CONSTRUCTIVIST LEARNING ENVIRONMENTS IN SCIENCE AND TECHNOLOGY COURSES

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Approval of the Graduate School of Social Sciences

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ABSTRACT

PERCEPTIONS OF 4TH AND 5TH GRADE PRIMARY SCHOOL STUDENTS AND THEIR TEACHERS ON CONSTRUCTIVIST LEARNING ENVIRONMENTS IN SCIENCE AND TECHNOLOGY COURSES

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The purpose of this study was to investigate the extent to which Constructivist Learning Environment (CLE) aspects exist in primary level 4th and 5th grade Science and Technology Courses in Turkey as perceived by students and their teachers. Secondly, the study aimed at finding out whether perceptions of students on CLE differ according to certain demographic variables. Finally, the study attempted to explore the extent to which the perceptions of teachers on administrative support have a relationship with their perceptions on CLE.

Subjects of the study involved 1143 primary level 4th and 5th grade students in Turkey during 2006-2007 school year from 6 socio-economic development groups as determined by State Planning Department and their 264 teachers.

Data were collected in 2006-2007 Spring semester through administration of two questionnaires to the students and the teachers. Data analysis was carried out

through both quantitative (repeated measures ANOVA, frequencies, means, standard deviations, MANOVA) and qualitative analysis techniques.

The results of the study indicated that students and teachers perceived the current learning environment to be often constructivist. In addition, the results revealed that perception of CLE differed according to socio economic status and technology use of students. Lastly, the results revealed that there is a significant but low correlation between teachers' perceptions on CLE and their perceptions on administrative support they received.

The results revealed that students should be provided with more facilities and teachers be provided with more in-service training opportunities.

Keywords: Constructivism, Constructivist Learning Environment, Constructivist Learning Environment aspects.

ÖZ

FEN VE TEKNOLOJİ DERSİNDEKİ YAPILANDIRMACI ÖĞRENME ORTAMLARINA İLİŞKİN 4 VE 5. SINIF ÖĞRENCİLERİ VE ÖĞRETMENLERİNİN ALGILARI

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Bu çalışmanın amacı, öğrenci ve öğretmenlerin algılarına göre ilköğretim düzeyinde Türkiye'deki 4. ve 5. sınıf Fen ve Teknoloji derslerinde Yapılandırmacı Öğrenme Ortamı (YÖO) özelliklerinin ne oranda bulunduğunu araştırmaktı. İkinci olarak, bu çalışma öğrencilerin YÖO'na ilişkin algılarının belli başlı demografik özelliklerine göre değişip değişmediğini bulmayı hedefledi. Son olarak, bu çalışma öğretmenlerin YÖO algıları ile yönetim desteği algıları arasında bir bağıntı olup olmadığını araştırdı.

Çalışmanın denekleri, Devlet Planlama Teşkilatı'nın belirlediği 6 sosyo-ekonomik gruptaki ilçelerden 2006-2007 öğrenim yılındaki 1143 4. ve 5. sınıf ilköğretim öğrencisi ile 264 öğretmendir.

Veriler 2006-2007bahar döneminde iki anketin öğrenci ve öğretmenlere uygulanması sonucu toplanmıştır. Verilerin analizi için hem nicel (Tekrarlı ölçümler için ANOVA, frekans, ortalama, standart sapma, MANOVA) hem de nitel analiz teknikleri kullanılmıştır.

Çalışmanın sonuçları öğrenci ve öğretmenlerin var olan öğrenme ortamını çoğunlukla yapılandırmacı bulduklarını göstermektedir. Ayrıca, öğrencilerin YÖO algılarının sosyo ekonomik statü ve teknoloji kullanımına göre değişkenlik gösterdiği sonucuna varılmıştır. Son olarak, öğretmenlerin YÖO algıları ile yönetim desteği algıları arasında düşük ama anlamlı bir korelasyon tespit edilmiştir.

Sonuçlar öğrencilerin daha fazla olanaklarla buluşturulması gerektiğini ve öğretmenlerin daha fazla hizmet-içi eğitim çalışmalarına katılabilmeleri gerektiğini göstermektedir.

Anahtar kelimeler: Yapılandırmacılık, Yapılandırmacı Öğrenme Ortamı, Yapılandırmacı Öğrenme Ortamı Boyutları.

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CHAPTER I

INTRODUCTION

In this chapter, first, the background to the present study is presented. Next, the purpose and significance of the study and definitions of the key terms are provided. In the second chapter, the relevant literature is reviewed. The third chapter is devoted to the method of the study. The results of the study are reported in the fourth chapter while conclusions and implications for practice and further research are presented in the last chapter.

1.1. Background to the Study

In today's world, one should develop himself regularly to accommodate the changes in various aspects of his environment, both in living and working. This trend requires that learners in formal and other educational institutions should be well trained in critical thinking skills, problem solving skills, and teamwork skills (Doolittle & Camp, 1999; Rice & Wilson, 1999); as well as continuously striving to remain lifelong learners. For example, Rice and Wilson (1999) state that capacities to learn, reason and solve problems, as well as collaborate and negotiate with others, have become the expectations of the society from individuals. Constructivism, a paradigm for the purpose of preparing students to be capable in socially expected skills, advocates that students construct knowledge by integrating their own and others' experience rather than receiving information from teachers. As an outcome of various studies and practical application of constructivist learning environments, teaching and learning

have shifted the focus from teacher-centered to learner-centered. According to this, educational institutions are supposed to set up a learner-centered learning environment by means of engaging students in activities, such as hands-on activities, small group projects, and self-directed inquiry. Doolitte and Camp (1999) claim that an educational program should provide higher-order skills, problem solving skills, and collaborative skills. They argue that traditional behaviorist approach fails to connect learning to these skills. Instead, the constructivist approach is a new direction toward educational reforms. The issue has come to educational reform proponents' attention with convincing evidence of learning outcomes (Lunenburg, 1998).

As a result of the reform efforts in education all over the world, the practice of constructivism is viewed as an effective paradigm, particularly when combined with collaborative teams in learning. Students involved in this new paradigm need to take more responsibility for their learning (Lunenburg, 1998). This manner of learning has been regarded as highly related to improving higher-order thinking, which is the core element of problem solving and the heart of self directed learning.

In this research study, to focus on students' share on implementing constructivism in learning environments, critical constructivist approach is mainly considered. Critical constructivist teaching goes beyond teaching of content knowledge and emphasizes the importance of students' independent critical thinking. As critical constructivism has its roots in critical pedagogy it can also be claimed that this approach is seen as an agent of social change since it has an emancipatory potential (Gilbert, 1994). According to Watts and Jofili (2007), critical constructivists also attach importance on change in institutional structures either for political concerns (Elliott, 1991) or in a specific learning setting (Baird and White, 1993).

Critical awareness is the key for critical constructivists. According to them, firstly, being aware of themselves and their perspectives is important in developing constructivist learning environments. Secondly, they have a stance regarding their perspectives and approaches to the construction of knowledge and ways in which their own consciousness has been shaped by the society and mainly in schools. They know the role the schools play in developing and also containing their awareness and in

socializing thinking. This counts for the learners too (Baird and White, 1993 as cited in Watts and Jofili, 2007). According to critical constructivists, they need to transfer this approach to their students too. Watts and Jofili (2007) cites Kincheloe (1993) who describes critical constructivism as the following:

> Critical constructivists … ask what are the forces which construct consciousness, the ways of seeing of the actors who live in it… Critical constructivism concerns the attempt to move beyond the formal style of thinking which emerges from empiricism and rationalism, a form of cognition that solves problems framed by the dominant paradigm, the conventional way of seeing (p. 118).

A critical constructivist view of teaching, then, looks to full learner empowerment through knowledge appropriation. The concept of empowerment encompasses the importance of making education meaningful so as to make it critical and, consequently, emancipatory. Such teaching implies a concern for independent thinking and common social welfare. As Watts and Jofili (1998) share, such concerns, suggests Freire (1972), must always be coherently present in teachers' analysis of classroom contexts and decision taking.

According to Watts and Jofili (1998), a synthesis of views on critical constructivism implies that the characteristics of critical constructivist teachers include:

1. Enabling learners to express their understanding, to appreciate their own and their peers' understanding, and to undertake negotiations of knowledge towards an emancipatory construction of consciousness. This entails learners being active subjects who question and transform, and that learning is a means to re-create the way learners see themselves, education and society;
2. Presenting problems for inquiry relating to key aspects of the learner's experience, not simply as theoretical exercises but as problems posed within learners' own experiences. Encouraging learners to pose problems and to ask questions is the key to stimulating the impatience and vivacity which characterize a search for creativity and invention. In problem posing, academic material is the integrated into learner life; learners face problems which relate to their lives and society;

3. Leading the class in democratic learning processes as well as with critical ideas. Teachers must affirm themselves without thereby disaffirming the learners. This means an awareness of the complexities of learning and learning situations, and an understanding of the dynamics of power in social settings, and its use towards democratic social and educational change (p. 177-178).

In short, in ideal case, it is advocated that inside a critical constructivist classroom, learners are supposed to reflect on their own lives, ask questions to discover meanings and values. Their learning experiences should include a self-reflective dimension around themes from daily life. In addition, with dialogic reflection among their peers, they are expected to gain critical distance from their conditions and consider how to transform them (McLaren and Leonard 1993 as cited in Watts and Jofili, 1998). As a result, they become active participants in shaping the economic, social and cultural environment in which they live. These learners also become actively and critically involved in controlling their own learning, and teachers need to work towards the 'liberation' of learners, instead of their 'domestication'.

The critical question at this point is how the so called constructivist learning environments would be assessed. Assessing the characteristics of learning environments has been an important aspect of educational research since the social, physical, psychological and pedagogical contexts in which learning occurs directly affect student achievement and attitudes. In the literature, the definition of learning environment and the characteristics of an ideal learning environment are provided thoroughly. Arends (1988) as cited in Kesal (1996) defined an ideal learning environment as a place where students display a high degree of achievement motivation and where they have positive attitudes towards learning and learning materials. At the same time, a powerful learning environment can be defined as an environment where effective, personally meaningful learning occurs (Kesal, 1996).

The Turkish Educational System is also being reconsidered with its strengths and weaknesses in parallel with the trends all over the world. The Ministry of National Education in Turkey has come up with certain rationales and is working on reforming the programs to achieve the national overall goals of the country in the field of

education. For instance, it had been widely discussed that the changes in the field of science and technology should somehow be reflected to the programs. In addition to this, it is a result of the societal motion that the new instructional approaches and learning styles are to be considered as part of a paradigm shift in the whole educational system. It was also thoroughly discussed that there was a need to increase the overall quality of the Turkish education to acquire more social equity and democracy. The Board of Education prepared a new program in 2004 as part of the educational reforms in Turkey and developed the new Science and Technology Courses for 4^{th} and 5^{th} grades in primary schools together with other programs in 5 major areas. These programs have been implemented all over Turkey since 2005-2006.

Although it is still being discussed in the Turkish academic world that the results of the international studies like PISA, TIMMS and PIRLS may not be in favor of constructivist understanding, the Ministry of Education has been pointing out these results together with the position of Turkey on the scale among other countries as a rationale or an indicator of a need for a rapid change in the field of education. This need of change eventually has its roots in the idea that the students should engage more in their learning processes and actively learn within a certain process. So, the educational philosophy underlying this idea, constructivism, formed the philosophical bases of the reform efforts in Turkey.

This study focuses on the effects of these reform efforts on the practice of constructivism in the Turkish national education within the context of Science and Technology Courses in 4^{th} and 5^{th} grades, which eventually sheds light to the future of constructivist practices in primary schools all over Turkey. For this purpose, five aspects of a constructivist learning environment which are highly emphasized in research on constructivism are focused on. These aspects are specifically listed as personal relevancy, uncertainty, critical voice, shared control and student negotiation.

1.2. Purpose of the Study

The main problem leading this study is the assessment of the learning environments in primary level 4th and 5th grade Science and Technology Courses in Turkey with a constructivist approach. The purpose of the study is mainly to investigate the extent to which constructivist learning environment aspects such as personal relevance, uncertainty, critical voice, shared control and student negotiation exist in 4th and 5th grade Science and Technology Courses in primary level in Turkey as perceived by both the students and their teachers. Secondly, the study aims at finding out whether perceptions of the students on constructivist learning environment differ according to certain demographic variables such as socio-economic status group of their district, their grade level, their number of siblings, their having a separate study room, their way of transportation to school, the education level of their mother, the education level of their father, their gender, existence of a computer laboratory with Internet connection at their school, existence of Internet connection at their home and usage of Internet during the science and technology classes. Finally, the study attempts to explore the extent to which the perceptions of teachers on administrative support have a relationship with their perceptions on constructivist learning environment.

There were three main themes guiding the research process and giving shape to the research questions provided below. These themes were 1) Constructivist Learning Environment (CLE) aspects and the perceptions of the students and the teachers concerning those aspects; 2) The demographic characteristics of students and the relationship between those and the perceptions of students on the CLE aspects; and 3) the relationship between the perceptions of teachers on the CLE aspects and their perceptions on administrative support they received regarding the implementation of those aspects. These three themes bred the following three research questions and their sub questions:

1. To what extent does the Science and Technology Course Learning Environment of 4th and 5th grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical

voice) of a preferred constructivist learning environment as perceived by the students and their teachers?

1.1. To what extent does the Science and Technology Course Learning Environment of 4th and 5th grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) of a preferred constructivist learning environment as perceived by students?

1.2. To what extent does the Science and Technology Course Learning Environment of 4th and 5th grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) of a preferred constructivist learning environment as perceived by teachers?

2. Do primary 4th and 5th grade students' perceptions of Constructivist Learning Environment (CLE) in Science and Technology Course in Turkey in five aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) differ according to their certain characteristics (the socio-economic status group of their district, grade, gender, socio economic status of students as indicated by their number of siblings, having a study room, way of transportation to school, the education level of their mother and the education level of their father; and their use of technology as indicated by existence of a computer laboratory with internet connection at school, existence of an internet connection at home and usage of internet during the science and technology classes)?

2.1. Do primary 4th and 5th grade students' perceptions of Constructivist Learning Environment (CLE) in Science and Technology course in Turkey differ according to the socio-economic status group of their district?

2.2. Do primary 4th and 5th grade students' perceptions of Constructivist Learning Environment (CLE) in Science and Technology course in Turkey differ according to their grade?

2.3. Do primary 4th and 5th grade students' perceptions of Constructivist Learning Environment (CLE) in Science and Technology course in Turkey differ according to their gender?

2.4. Do primary 4th and 5th grade students' perceptions of Constructivist Learning Environment (CLE) in Science and Technology course in Turkey differ according to their socio-economic status as indicated by their number of siblings, having a separate study room, their way of transportation to school, education level of their mother and education level of their father)?

2.5. Do primary 4th and 5th grade students' perceptions of Constructivist Learning Environment (CLE) in Science and Technology course in Turkey differ according to their use of technology as indicated by existence of a computer laboratory with internet connection at school, existence of an internet connection at home and usage of internet during the Science and Technology classes)?

3. Is there a significant relationship between teachers' perceptions on Constructivist Learning Environment (CLE) and their perceptions on administrative support they received?

1.3. Significance of the Study

The significance of this study comes from the importance of the new programs being utilized all over Turkey. As the Ministry of National Education announced, the new programs are being revised in line with the feedback provided through research conducted related with these new programs. Among these, Güzel and Alkan (2005)

conducted a study to evaluate the new primary level program pilot implementation. Çınar, Teyfur and Teyfur (2006) conducted a study on the primary school teachers and administrators' views about constructivist education approach and new programs. Bıkmaz (2006) aimed to establish some issues that are frequently repeated in the new primary school curricula which can lead to misunderstandings by teachers. This study, on the other hand, contributes to such efforts especially when the learning environments constructed in the new Science and Technology Courses are considered.

Recently, studies have been conducted on the new program specifically regarding the Science and Technology Courses but nearly all of them aimed to collect data specifically on the opinions and suggestions of the teachers and in some cases of the students related with the new program itself. These efforts were focused on how the new program was perceived rather than discussing the different aspects of a typical (preferred) constructivist learning environment and collecting data on specific characteristics of such environments. In this study, the researcher carefully avoided from general questions on the new program. Instead, the perceptions of the teachers and the students are being questioned through analysis of their approaches to specific characteristics of a typical constructivist learning environment. Another attribute of this study is the sample used. Nearly all studies recently conducted on the new Science and Technology Program had a purposeful sampling technique and the data were collected in a specific province level. In the case of this study, data was collected from different districts in different provinces selected according to the six socio-economic status development groups determined by State Planning Department; eventually representing the whole country. These districts and their provinces are listed in Appendix E. From a scientific perspective, this study contributes to the learning environment research through providing results that are generalized to Turkey.

Apart from this, the researcher would like to assess the extent to which the perceptions of the teachers are influenced from the administrative support they received at their schools. Through this way, it will be possible for the researcher to discuss the relationship between the implementation of such reform efforts and the administrative support the teachers have.

1.4. Definition of Important Terms

This part is devoted to the definitions of the key terms that require clarification.

1. Constructivist Learning Environment: A classroom (incorporates students, teacher, curriculum, teaching methods) based on constructivism as a paradigm of instruction. Aspects of this environment are Personal Relevance, Uncertainty, Critical Voice, Social Control and Student Negotiation. These aspects correlate with scales on the Constructivist Learning Environment Survey - CLES.
2. Personal Relevance: An aspect of a constructivist environment (used as a scale of the CLES) concerned with the use of students' everyday experiences as a basis for developing students' understanding of science concepts (Taylor, Fraser & White, 1994).
3. Scientific Uncertainty: A characteristic aspect (used as a scale of the CLES) of a constructivist environment in which the teachers provide opportunities for students to experience the inherent uncertainty, subjectivity and limitations of scientific knowledge (Taylor, Dawson, & Fraser, 1995, p. 5).
4. Critical Voice: An aspect of a constructivist environment (used as a scale in the CLES) in which the prevailing social climate encourages students to question and express concerns about the teacher's pedagogical plans and methods (Taylor, Fraser & White, 1994). This particular aspect incorporates the critical theory of Habermas.
5. Shared Control: An aspect of a constructivist environment (used as a scale on the CLES) in which students are involved with the teacher in the planning of the learning environment, "including the articulation of their own learning goals, the design and management of their learning activities, and determining and applying assessment criteria (Taylor, Dawson, & Fraser, 1995, p. 4).
6. Student Negotiation: An aspect of a constructivist environment (used as a scale on the CLES) in which student-student interactions of explaining, justifying, understanding and reflecting on the viability of scientific ideas are emphasized (Taylor, Dawson, & Fraser, 1995, p. 4).

In the following chapter, the review of the literature related to the implications of constructivism for learning environments and the relevant studies are presented.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter mainly covers a background on constructivist theories in general and highlights critical constructivism. In addition, the literature on the influence of constructivism on science education is also provided. Lastly, research in the field of learning environments and specifically constructivist learning environments are presented.

2.1. Constructivism

In the field of education, in many studies, efforts to describe constructivism mainly connects it directly with experience. When a student enters a classroom, s/he brings his/her own experiences into the environment and based on his/her prior experiences s/he already had developed a cognitive structure. It does not matter whether his/her already developed cognitive structure is valid, invalid or incomplete. In case new information or experiences are provided in connection with his/her prior knowledge, s/he reformulates his existing cognitive structures. It is actually the responsibility of the student himself/herself to draw inferences, elaborations and relationships between his/her old perceptions and new ideas so that the consequence could be integration of the new ideas and their becoming a useful part of the memory. Memorization is not encouraged simply because any new information which is not connected to the learner's prior experiences is quickly forgotten. This brings us to the

principle that the learners should actively construct new information based on their prior knowledge and existing cognitive structures so that to experience a meaningful learning. Putting experience as the core of the phenomena, while defining constructivism many researchers needed to specify its dimensions. For instance, Matthews (2002) asserts that especially in the case of science education, it would be more productive to specify the dimensions of constructivism in analyzing and debating different aspects. He comes up with 8 different dimensions defining constructivism as "a theory of learning", "a theory of teaching", "a theory of education", "a theory of cognition", "a theory of personal knowledge", "a theory of scientific knowledge", "a theory of educational ethics and politics" and "as a worldview" (p. 124).

Apart from these dimensions, some came up with some principles forming the basis for constructivist approaches. While discussing constructivist principles Oh (2003) argue that in case constructivism is considered as a theory of learning, three refined assumptions or principles could be used to define this theory. These are: 1) Learning is situated, 2) Learning is goal driven and 3) learning is social-dialogical (Duffy & Orrill, 2001 as cited in Oh, 2003). As Oh (2003) puts it, Duffy and Orrill (2001) argue that "learning takes place in the activity of the learner" (p. 1). According to Oh (2003), the researchers do not simply mean that learning is an active process but rather they provide that "one must concentrate on the activity in which the learner engages to understand learning together with the tools being used and the context itself that the activity takes place" (p.1). They cite that since learning is situated, a classroom environment should be authentic and by authentic they mean "environments that are consistent with the contexts we expect the student to be able to work in after the course is over" (Duffy & Orrill, 2001, p.2 as cited in Oh, 2003). The authenticity also depends on the qualitative degree to which the performance required in the learning environment represents that of the real context (Duffy & Cunningham, 1996). Second constructivist principle was that learning is goal-driven which means "learning is driven by an individual's need to understand and achieve some end" (p. 3). What is learned is significantly affected by the goal that the learner has. According to Oh (2003), Duffy and Orrill (2001) explain this principle through this example:

> Students come to different understanding of a text… depending on what type of examination they expect. It is not that they learn more or less, but rather they approach the text and classroom discussion differently depending on their exam expectation. Of course, if their goal was to use the information on a real project, then their learning would be very different (p.3 as cited in Oh, 2003).

In a way, students should engage in the inquiry of their own to become active and capable in their everyday lives and in the future work places. Oh (2003) points out that there are three components of this engagement: "1) Students to see the problem as important and personally relevant; 2) Students to feel that their action is of value and not just an exercise; and 3) students to have ownership and responsibility for their learning" (Duffy & Orrill, 2001, as cited in Oh, 2003, p. 4).

The third constructivist principle that Oh (2003) discuss is that "what we know and understand is based upon social negotiation and evolves through interaction with others" (Duffy & Orrill, 2001, p. 4 as cited in Oh, 2003). This can also be linked with the idea that learning is a process of making sense of the world (Duffy & Cunningham, 1996).

In addition to its dimensions and principles, any effort to explain constructivism should also involve definitions of how constructivists perceive concepts such as truth, reality, information, knowledge, understanding or learning. This helps creating a link between changing paradigms in social sciences and their reflections in the field of education. According to social constructivists, the human condition is based upon multiple realities because it is a function of behavior constructed through interaction (Williams, 2007). The world view is subjective regardless of whether it has a common or shared perspective. As Williams (2007) puts it, Kukla (2000) provides that individuals reflect a communal construct that projects a socially navigated understanding of occurrences. On the other hand, knowledge is defined as "the collective product of social and cultural machinations" (Ernest, 1999; Gredler, 1997; Prawat & Floden, 1994 as cited in Williams, 2007, p. 32). "Meaning is constructed in response to socially acceptable practices and interactions within an environment" (Williams, 2007, p. 32). Social constructivists advocate that learning is inherently

socially mediated. The subjectivities of learning are dynamic, interactive and are responsive to personal and social interactions (McMahon, 1997 as cited in Williams, 2007). Information, on the other hand, is not just provided and repeated, but is a discovered reality through the process of interaction and inquiry (Brooks and Brooks, 1993). However, constructivism means different things to different researchers according to Matthews (2000). Piaget and Vygotsky emphasized that cognitive change only take place when previous conceptions go through a process of disequilibria with the new information and their contribution had a major effect on constructivist theories (Slavin, 1994). It should be noted that cognitive development theories highlight the active role of learners in developing their own understanding of reality. Leinhardt (1992) stated that "the essence of constructivist theory is the idea that learners must individually discover and transform complex information if they are to make it their own" (p. 48). The constructivist theory in education rooted in neo-Piagetain thought is personal constructivism (Von Glaserfeld, 1989). Solomon (1987) and Millar (1989) have taken personal constructivism further to social constructivism that advocates that learners make use of their previous experience and culture in internalizing the new information. Spivey (1997) argued that the social constructivist have focused on the cognitive as well as the social. Cobb (1996) stated that although von Glaserfeld defined learning as self-organization, he acknowledges that this constructive activity occurs as the cognizing individual interacts with other members of a community (p.37) and the socio-cultural and cognitive constructivist perspectives each constitute the background for the other (Cobb, 1996, p.48).

Still, it is widely discussed that the meaning of constructivism goes far beyond a theory. As many researchers put it, the range of constructivist concerns may involve constructivist views of learning, constructivist views of teaching, constructivist views of curriculum and curriculum development. While doing this so, it is very common to compare the traditional approach and the constructivist approach in the literature. For instance, as cited in Önder (2006), Tobin and Tippins (1993) argue that traditional view assumes that there exists a knowable reality outside of human perceptions however constructivists acknowledge that there exists an external reality but value that people

can never know what that reality is actually like. Similarly, Selley (1999) compares the two approaches to argue that traditional teacher is responsible for effectiveness and extend of the learning whereas constructivist teachers, as the facilitator, must find ways to understand their students' viewpoints and their alternative conceptions so that they can develop classroom tasks which help student to construct their own knowledge.

Chin (1997) compares tradition and constructivist approaches in three dimensions which are epistemological perspective, teacher and teaching and learner and learning. Table 1 summarizes Chin's (1997) comparison.

Table 1

Traditional and Constructivist Views

Traditional	Constructivist
I. Epistemological Perspectives	
1. Truth is out there to be discovered	1. Reality / Truth is unknown
2. Learner is a blank slate. • Learner is viewed as cumulative accretion of knowledge • Learner has passive role as absorber of information	2. Learner has prior ideas. • Learning is a constructive process involving restructuring of ideas (conceptual change view) • Learner is actively engaged in constructing knowledge in social settings through social interaction with others so meanings can be negotiated.
3. Knowledge acquisition is straightforward, unproblematic. • Ready-made science	3. Knowledge construction is problematic. • Science-in-the-making

Table 1 *(continued)*

Traditional	Constructivist
II. Teacher and Teaching	
1. Sees curriculum as body of knowledge or skills.	1. Sees curriculum as program of activities from which students construct knowledge.
2. Teaching conceptualized as conduit metaphor. • Teacher is didactic, authoritative dispenser of knowledge. • Teacher sees role as transmitting science content, giving expositions. Subscribes to frequent drill and practice.	2. Teacher is facilitator of learning. • Teacher promotes interaction of students with materials and ideas. 3. Elicitation and assessment of prior ideas. • Teacher elicits students' prior ideas, encourage students to make prediction, ask questions, answer their own questions, explain their reasoning, and apply ideas. • Teacher asks guided questions and 4. suggest ideas, rather than tell students directly what to do. Teacher provides supportive learning environments. • Non-evaluative, sensitive to and respects students ideas.

Table 1 *(continued)*

III.	*Learning and Learner*		
1.	Students sit in rows and typically listen to teachers lecture, copy notes.	1.	Students are involved in hands-on activities, group work and discussion.
2.	Student is told ready-made knowledge; results of how other have made sense of the world. Passive.	2.	Minds-on learning, student is encouraged to make predictions about phenomena, ask questions, attempt to answer own questions and explain reasoning, apply ideas to new situations, evaluate alternative points of view.
3.	Laboratory activities recipe like which emphasize verification of know laws. Step-by-step procedures are given.	3.	Laboratory activities involve more open-ended investigations, exploration and experimentation.

Source: (Chin, 1997).

Despite efforts to define constructivism through discussions on its principles, assumptions or psychological and philosophical backgrounds, still one needs to provide an answer to a question like "Which constructivism?" Şimşek (2004) provides a list of different streams in the constructivist literature while discussing constructivist learning and instruction. Table 2 covers the list provided by Şimşek (2004).

Recalling Matthews (2000) citing "Constructivism means different things to different researchers", the question of "Which constructivism?" by Şimşek (2004) can be thoroughly discussed. Şimşek (2004) points out that, different streams in constructivism may have different approaches to certain phenomena. For example, on the question whether knowledge can be objective or not, he provides evidences that different approaches in constructivism may have different answers to such question. While some sharply rejects the claim that knowledge can be objective, some may have a softer stance on the issue. On the reality concept, Şimşek (2004) argues that even the radical constructivists have similar definitions on absolute reality as the objectivist

world views and again different theorists from different orientations may define absolute reality accordingly.

Table 2

Terms Defining Constructivist Orientations

1.	Information Processing	11.	Predicativism
2.	Social Constructivism	12.	Critical Constructivism
3.	Interactive Constructivism	13.	Contextual Constructivism
4.	Radical Constructivism	14.	Constructionism
5.	Piagetian / Personal Constructivism	15.	Cultural Constructivism
6.	Psychological Constructivism	16.	Progressivist Constructivism
7.	Russian / Markovian Constructivism	17.	Conservative Constructivism
8.	New Constructivism / Bishop Constructivists	18.	Reactionary Constructivism
9.	Intuitionism	19.	Golden Mean
10.	Finitism		

Source: Henriques, 1997; Bonnstetter, 2001; Matthews, 2000; Phillips, 1995, Von Galasersfeld, 1991 as cited in Şimşek, 2004

On the other hand, according to Williams (2007) there is a consensus among constructivist theorist on certain issues. Williams (2007) cites many well known researchers such as Dewey, Dede, Freire, Bruner, Vygotsky, Piaget, Gardner and Shunk to provide that all position of constructivism agree that teaching cannot be viewed as the transmission of knowledge to the unenlightened from the enlightened. According to Williams (2007) learning process cannot be teacher-centered where the student is a

receptacle of information; the learning process cannot be content-centered where reality is arrived at through an observable cause and effect relationship.

Ernest von Glaserfeld, on the other hand, distinguishes between Piagetian inspired and more trivial versions of constructivism (Davis and Sumara, 2002). Radical, cognitive, situated, social, cultural, socio-cultural and critical constructivism are frequently cited by Glaserfeld and he mentions John Dewey, Sigmund Freud, William James, Immanuel Kant, Karl Marx, Charles Pierce, Giambattista Vico together with Jean Piaget and Lev Vygotsky as the proponents. Also D.C Philips (1995) discusses the range of conceptual influences on constructivist discourses.

Influence of Constructivist Approaches on Teaching

Influence of constructivist approaches on teaching also needs to be thoroughly discussed as an important dimension of the literature on constructivism. So (2002) points that Fischler (1999) states, "teaching should not be regarded as an arrangement of instructional strategies", but more "a situation in which learning processes need to be recognized and supported" (p. 173). This important knowledge base of teaching creates demands on the teachers as they need to:

> … be sensitive to students' learning difficulties; be patient through the process of students' construction of new knowledge; take into account the students' existing knowledge; create a classroom climate in which students are willing to express and discuss their ideas; create situations in which students can present their own opinions; and, to accept a teaching role that is not so much that of a communicator and an examiner, but more as a person who advises and helps students to develop knowledge (Scott, Asoko and Driver, 1992 as cited in So, 2002).

Brooks and Brooks (1993) claim that becoming a constructivist teacher may require a difficult transformation since most instructors were prepared for teaching in the traditional, objectivist manner. It "requires a paradigm shift" and "requires the willing abandonment of familiar perspectives and practices and the adaptation of new ones" (p. 25). The following represent a summary of some suggested characteristics of a constructivist teacher:

1. Become one of many resources that the student may learn from, not the primary source of information.
2. Engage students in experiences that challenge previous conceptions of their existing knowledge.
3. Allow student response to drive lessons and seek elaboration of students' initial responses. Allow student some thinking time after posing questions.
4. Encourage the spirit of questioning by asking thoughtful, open-ended questions.
5. Encourage thoughtful discussion among students.
6. Use cognitive terminology such as "classify", "analyze", and "create" when framing tasks.
7. Encourage and accept student autonomy and initiative. Be willing to let go of classroom control.
8. Use raw data and primary sources, along with manipulative, interactive physical materials.
9. Don't separate knowing from the process of finding out.
10. Insist on clear expression from students. When students can communicate their understanding, then they have truly learned (Brooks and Brooks, 1993, p. 26).

Yager (1991), on the other hand, suggests the following procedures for teachers in the classroom environment to become constructivist teachers:

1. Seek out and use student questions and ideas to guide lessons and whole instructional units.
2. Accept and encourage student initiation of ideas.
3. Promote student leadership, collaboration, location of information and taking actions as a result of the learning process.
4. Use student thinking, experiences and interests to drive lessons.
5. Encourage the use of alternative sources for information both from written materials and experts.
6. Encourage students to suggest causes for event and situations and encourage them to predict consequences.
7. Seek out student ideas before presenting teacher ideas or before studying ideas from textbooks or other sources.
8. Encourage students to challenge each other's conceptualizations and ideas.
9. Encourage adequate time for reflection and analysis; respect and use all ideas that students generate.
10. Encourage self-analysis, collection of real evidence to support ideas and reformulation of ideas in light of new knowledge.

11. Use student identification of problems with local interest and impact as organizers for the course.
12. Use local resources (human and material) as original sources of information that can be used in problem resolution.
13. Involve students in seeking information that can be applied in solving real-life problems.
14. Extend learning beyond the class period, classroom and the school.
15. Focus on the impact of science on each individual student.
16. Refrain from viewing science content as something that merely exists for students to master on tests.
17. Emphasize career awareness--especially as related to science and technology (Yager, 1991, p. 89).

While discussing the roles of teachers in constructivist epistemology, Selley (1999) points out that student-centered approach does not mean that teachers do not have any functions; instead teachers have an important active role. Selley (1999) also shares the rationale that in learning some factual knowledge like the alphabet or symbols used in mathematics, direct transmission is necessary since such learning does not involve creative thinking or personal imagination. He also discusses what constructivist approach is not. For instance, Selley (1999) cites that constructivist approach is not just the provision of the tasks for students to engage in; a project in which predetermined information has to be found; a practical activity conducted according to a predetermined method even if this is called an investigation or a kind of lesson which leads students to an achievement which is exactly what the teacher expected.

Criticisms to Constructivism

Şimşek (2004) mentions experimental, theoretical, practical and Turkish terminology problems in constructivism. He underscores that the problems that constructivist approach face are as much as the problems that the traditional approaches are facing. For instance, he discusses that the research which inquire constructivist practices are not adequate in the sense that they cannot be generalized to specific

conditions and be implemented (Klein, 2002 as cited in Şimşek, 2004, p. 132). While discussing the theoretical problems Şimşek (2004) argues that radical constructivists reject objective knowledge which in the end results in a more than enough freedom environments and one cannot mention something like "instruction" in such an environment. Most importantly, Şimşek (2004) argues that most of the philosophical and psychological assumptions on human learning in constructivism are not simply new. Most of them show parallelism with famous old intellectuals such as Vico and Durkheim and the representatives of counter paradigms have already mentioned them in the literature. In that sense some argue that the originality of constructivism can be questioned. From a practicality perspective Şimşek (2004) warns the constructivists to get rid of the criticism which says it takes too much time to teach something with constructivist approaches. The freedom in constructivist learning environments may result in unexpected learning and this may result in lower achievement levels (Şimşek, 2004). On the "consensus" emphasis of social constructivists, Şimşek (2004) argues that in case some students may sound more in certain environments, this may result in the tyranny of the majority.

Akar (2003) also provides criticisms to constructivism emerging in the literature. As the first criticism she mentions the fact that teachers are likely to leave the curriculum behind to follow the desires of their constructivist students for the sake of becoming goal-directed learners. She also shares that "constructivist approaches to education lack strictness, and cause insecurity of what is being done" (Brooks and Brooks, 1999 as cited in Akar, 2003). According to Akar (2003) there are also criticisms to constructivism focusing on the need of students to receive factual knowledge in certain cases:

> Baines and Stanley (2000) highlight that teaching is one of the most demanding and dynamic occupations on earth. It requires eclecticity, spontaneity, and highly adaptability. The authors state that classrooms are hunger for knowledge and complain that the constructivist approach to teaching takes away from the learner not being able to receive sophisticated knowledge by just working in small groups with peers. The complaints they maintain is that the teacher as a facilitator is not required to know any of the answers, or if there is it should not be communicated to the learner. They do

> not see any relevance in not communicating with the learners about factual knowledge. They assert that lecture and discussion are powerful educational tools, especially if they are in the hands of charismatic, demanding, and knowledgeable teachers. (Akar, 2003, p. 75)

Akar (2003), on the other hand, criticizes Baines and Stanley (2000) for not making any distinction among the constructivist approaches in the literature and for underestimating the role depicted on the constructivist teacher without providing proper evidence from the literature.

2.1.1. Critical Constructivism

Williams (2007) discusses that in simple terms, according to Taylor (1996) critical constructivism represents realities contained by a social and cultural context for the purpose of taking care of inequalities through the teaching and learning environment. It deals with the implications of language and knowledge in order to provoke reform (Taylor, 1996 as cited in Williams, 2007). According to this definition, construction itself means the potential that teachers have to effect change through the processes of reflection, critical inquiry and dialogue. The dynamics of the teaching and learning environment changes as a result of acknowledging critical constructivism. The language of instruction turns into a democratic, emancipatory discourse that shares the importance of the student in society. According to Williams (2007), Taylor (1996) also provides that critical constructivism presents a reflective construct that significantly directs the different structures of a student-centered environment to a global understanding.

In a way, it can be argued that critical constructivism aims to synthesize constructivist views on "the nature of knowledge with Habermas' scheme of human interests" (Taylor, 1994; and Taylor & Campbell-Williams, 1993 as cited in Geelan, 1996). Geelan (1996) calls this "a challenge to repress cultural myths, such as cold reason and hard control, which restricts the discourse between the students and teachers" (p. 32). As Özerbaş (2007) puts it, Loving (1997) while commenting on

different perspectives concerning constructivism provides that in time constructivism had faced some changes from individualistic which is identified with Ausbel to radical which is identified with Piaget and Von Glaserfeld, from radical to social (Vygotsky) and from social to critical which is identified with Habermas.

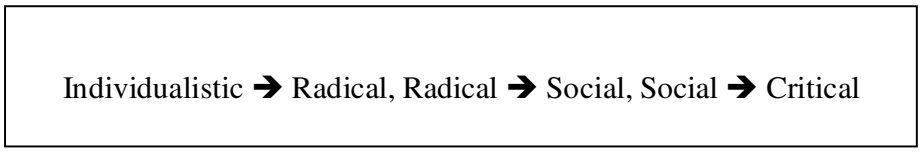

Figure 1 *Changes in Constructivism in Time (Özerbaş, 2007)*

Taylor (1994) describes hard control as one example of repressive myths as "a repressive myth that renders as natural the teacher's classroom role of teacher as controller and that locks teachers and students into grossly asymmetrical power relationships designed to reproduce (rather than challenge) the established culture" (p. 18). Geelan (1996) comments on this definition as the following:

> To put it another way, these myths are invisible assumptions we have about what is 'natural' in education. They make it very difficult to question unfair and unsupportive practices, simply because we don't see that it's possible to ask those questions. Emancipatory rationality provides us with the tools to look critically at school culture, and to imagine ways to make schooling more free, fair and equitable for students and teachers (Gillen, 1996, p. 5).

Back to Taylor, critical constructivism is seen as a "social epistemology" (Taylor, 1994, p. 11) which stresses that, "the cultures of schooling are socially constructed by communities of teachers, students and administrators and desirable changes to such cultures need to be negotiated by empowered groups of teachers and practitioners, rather than by isolated individuals" (p. 11). "Critical constructivism is a social epistemology that is concerned with the ethics of discursive practices: it addresses the socio-cultural context of knowledge construction and serves as a referent for cultural reform" (Taylor, 1994, p. 11).

In the literature, as introduced above, critical theory is said to be a major background for constructivism. It can be argued that there are many parallels between the literature on the development of critical pedagogy and the literature on constructivist learning. Critical theorists tend to question the value of such concepts as individualism, efficiency, rationality and objectivity, and the forms of curriculum and pedagogy that have developed from these concepts.

As cited in Watts and Jofili (1998), Gilbert (1994) underscores the emancipatory potential in critical constructivist approaches in education and sees this as an agent of social change since it does not deal with teaching the content knowledge but also focuses on students' independent critical thinking.

According to Geelan (1996), since critical constructivists are inspired from Habermas and his critical theory, one finds it natural that while criticizing usage of technical approaches in learning environments, practical and emancipatory modes of knowing emerges through references to Habermas (1972). Mezirow (1981) made use of Habermas's ideas to conduct action research in the field of education. For him, critical theory of Habermas is "based on empirical knowledge and is governed by technical rules" (Mezirow, 1981, p. 144). Geelan (1996) claims that while technical rationality is concerned with the discovery of predictable, generalizable relationships of cause and effect, with cost benefit ratios and with the efficiency and effectives of the means used to attain ends which themselves remain unexamined (Gore & Zeichner, 1991, p. 122-123 as cited in Geelan, 1996), Habermas deals with human relationships and communication, with the building of consensus and mutual understanding (Geelan, 1996). Mezirow (1981) points out that this understanding does not focus on technical control and manipulation but rather on the clarification of conditions for communication and inter-subjectivity. "It is not the method of the empirical-analytic sciences which are appropriate to this task but systematic inquiry which seeks the understanding of meaning rather than to establish causality" as Mezirow (1981, p.144) puts it.

The practical reflection of Habermas's critical theory to education can be overviewed as the following: The task is one of explaining and clarifying the

assumptions and predispositions underlying teaching activity and in assessing the adequacy of the educational goals toward which the activity leads (Gore & Zeichner, 1991, p. 122-123 as cited in Geelan, 1996).

Geelan (1996), while discussing Habermas's critical theory develops an understanding that people are complex. He provides that human beings are not simple, predictable and standardized enough to understand them through only technical approaches. He insists that people are much more complex than that and to understand them and in addition to be able to communicate with them, a practical concern with meaning and understanding is necessary.

On discussions concerning critical constructivism, Lowe's (1982) definition of social or educational reality is also put as a base for pro-critical constructivist arguments: There are two levels by which one makes sense of social reality. First level focuses on individual learning and the second one deal with social scientists interpretation of first level constructs. Critical constructivism deals with the first level rather than the second one. For example Kincheloe's (1991) description of critical constructivism involves such a notion:

> Critical constructivists [...] ask what are the forces which construct the consciousness, the ways of seeing of the actors who live in it. [...] Critical constructivism concerns the attempt to move beyond the formal style of thinking which emerges from empiricism and rationalism, a form of cognition that solves problems framed by the dominant paradigm, the conventional way of seeing. (p. 88)

Kincheloe (2005) thoroughly discusses critical constructivism in many ways in his book which provides the premises and definitions of the critical constructivist approach. While defining reality, he points out that the world is socially constructed which means there is a knower if someone talks about what is known and even which is to be known. How the knower constructs the known constitutes what we think of as reality. This premise sheds light on the fact that all knowers are historical and social subjects. As Kincheloe (2005) puts it, we all come from a "somewhere" which is located in a particular historical time frame and these spatial and temporal settings

always give shape to the nature of our constructions of the world. In addition, it can be concluded that not only is the world socially and historically constructed, but so are people and the knowledge people hold. We create ourselves with the cultural tools that we have. We operate and construct the world and our lives on a particular social, cultural and historical context. According to Kincheloe (2005) a key aspect of education in this context involves understanding the nature of these constructions therefore it would be a naive approach to simply study random outcomes of the construction process. This is why constructivists are concerned with the processes through which certain information becomes validated knowledge. Also, it can be noted that the critical constructivists do not attempt to reduce variables but to maximize them when they produce knowledge (Knoble, 1999 as cited in Kincheloe, 2005). This of course results in a more detailed, more complex understanding of the social, political, economical, cultural, psychological and pedagogical world. In this respect, the purpose of education should not be to transmit a body of validated truths to students for learning by heart. Critical constructivists believe that central role of schooling is to allow students to go through a knowledge production process. Teacher, therefore, is engaging students in analyzing, interpreting and constructing different knowledge rising from different sources. It is also underscored by Kincheloe (2005) that critical constructivists deal with the over-emphasized role of power in the construction and validation processes. They are specifically interested in the ways these processes help some people benefit from this fact whilst some other are marginalized. Inspired from Freire (1972 as cited in Kincheloe, 2005), they recall the idea that knowledge is not a substance that can be deposited like money in a bank neither can be taken out when right time comes. Kincheloe (2005) cites that information is transferred from the teacher to the students' mind in this transmissive theory of knowledge and in critical constructivist formulation knowledge is constructed in the minds of students keeping in mind that minds are also constructed by the society around the students (Tobin, 1993; Tobin and Tippins, 1993; Greeland, 1996 as cited in Kincheloe, 2005). As the knowledge of the classroom is constructed where students' personal experience intersects with academic knowledges, a key role of the teachers is to take care of this synthesis of personal experience and

academic knowledge. Kincheloe (2005) defines this as a very complex pedagogical act and teachers should be able to bring different perspectives together while actualizing this act. Teachers should understand how their own perspectives came to be constructed and how the social values, ideologies and information they encounter shape their pedagogies and worldviews. Lastly, Kincheloe (2005) concludes that critical constructivists become detectives of new ways of seeing and constructing the world while searching for ways to produce democratic and reminiscent knowledges; consequently they come to value knowledges and forms of meaning making traditionally ignored by dominant culture and conventional academics and to construct "blue knowledge" as they call it inspired from African American blues idiom.

2.1.2. Implications of Constructivism in Science Education

While discussing the trends in science curricula and science education research, Jong (2007) provides insights concerning the developments in science education and research in science education especially in the Western world. He mentions three reform waves in science education and cites that the first wave can be located in the middle of the Cold War era, in 1957; that year, the former Soviet Union launched the first satellite into an orbit around the world. The new curricula in those years in the leading western countries allowed students to use special student data books so that they can understand basic concepts and processes instead of knowing a large number of facts. The new curricula also focused on stimulating the development of basic scientific skills and classrooms were adapted or added for conducting laboratory work by students. According to Jong (2007) the results of these reforms were disappointing because the focus was more on the body of knowledge from the expert perspective rather than from the student perspective. In the 1980s reform which was the second wave according to Jong (2007), the design of most courses was much more focusing on active learning of students. However the results were again disappointing. The students could not see the relevance of the given contexts for understanding the related concepts and rules. Lately, innovative science education projects came up. Jong (2007) points out

that it is too early to make a judgment on the success of the third wave of reforms in science education. It should also be noted that the involvement of computer assisted instruction and learning came up between the second and third wave of reform and growing use of Internet in science education followed this.

The influential theories are also important in analyzing the reform efforts in the field of science education. Table 3 provides details on this aspect for each wave of reform.

Table 3

Science Education Reforms and Influential Psychological Theories

Wave of reform	Influential theory that shapes curricula and courses	Issue of growing interest
• 1960s	• Descriptive behaviorism • Stages of cognitive development	• Programmed instruction • Sequence of science topics
• 1980s	• Guided discovery learning • Information-processing perspectives	• Lab work for school students • Learning cycle
• 2000s	• Social constructivism • Socio-cultural perspectives	• Students' ways of reasoning • Role of context and language

Source: (Jong, 2007, p. 17).

The first wave of reform was mainly influenced by descriptive behaviorism and stages of cognitive development. Descriptive behaviorism focuses on the idea of a stimulus-response mechanism that shapes behavior by operant conditioning (Skinner, 1953 as cited in Jong, 2007). In this case learning is considered as something that occurs through conditioning which is provided as an input and the learning outcomes is

the output. Cognitive development on the other hand focuses on the idea of the development of cognitive stages in learners (Piaget, 1954 as cited in Jong, 2007).

The second wave of reform was a reaction to descriptive behaviorism and a follow-up of the cognitive development perspective. In that era, the focus was on the learning process itself. Discovery learning (Bruner, 1975 as cited in Jong, 2007) and information-processing mechanism of learning (Gagne, 1977 as cited in Jong, 2007) had an impact on cognitive psychology trends. Active learning was the focus and this was being actualized through laboratory work at schools. The instructional strategy of the learning cycle was highly considered this time (Karplus, 1977 as cited in Jong, 2007).

The last wave of reform was influenced from social constructivist and socio-cultural perspectives. According to these perspectives, learning is a dynamic and social process in which learners actively construct meanings from their experiences in the context of their prior understanding and the social setting (Driver, 1989 as cited in Jong, 2007). Vygotsky (1986 as cited in Jong, 2007) focuses on the fact that education is an enculturation process and learning can be considered as a change from one socio-cultural environment, usual everyday life experiences and knowledge, to a new, scientific environment, including a change of languages.

In the literature on teaching science, some principles have evolved for an effective teaching. These are:

- Dealing with students' existing ideas and conceptions,
- Encouraging students to apply new concepts or skills into different contexts,
- Encouraging student participation in lessons,
- Encouraging student inquiry,
- Encouraging cooperative learning among students, and
- Offering continuous assessment and providing corrective feedback. (Çimer, 2007, p. 21).

As Çimer (2006) puts it as his conclusion, after outlining effective teaching in science education from the perspective of various studies in the literature it should also be considered that an international perceptive makes sense to develop the Turkish context.

Good et al. (1993) mentions Piaget as the great pioneer of constructivism and gives example of one of his books with the title "To understand is to Invent" (1973). As Good et al. (1993) put it, there, "Piaget identifies empirical associationism (e.g. Skinner's work), innateness (e.g., Chomsky's work) and constructivism as the trends in education" (p. 81-82). They share that Piaget (1973) applies constructivist ideas to science teaching and says:

> It is obvious that the teacher as organizer remains indispensable in order to create the situations and construct the initial devices which present useful problems to the child. Secondly, he is needed to provide counter-examples that compel reflection and reconsideration of over-hasty solutions. What is desired is that the teacher ceases being a lecturer, satisfied with transmitting ready-made solutions; his role should rather be that of a mentor stimulating initiative and research. Considering that it took centuries to arrive at the so-called new mathematics and modern, even macroscopic, physics, it would be ridiculous to think that without guidance toward awareness of the central problems the child could ever succeeded in formulating them himself. But, conversely, the teacher-organizer should know not only his own science, but also be well versed in the details of the development of the child's or adolescent's mind (p. 16-17 as cited in Good et al. 1993).

"Piaget goes on to underline the importance of experimentation in science with considerable freedom of initiative on the part of students" cite Good et al. (1993, p. 82). In short, the basic principle of active methods will have to draw its inspiration from the history of science and may be expressed as follows: to understand is to discover, or reconstruct by rediscovery, and such conditions must be complied with if in the future individuals are to be formed who are capable of production and creativity and not simply repetition (p. 20).

So (2002) has conducted a thorough literature review on constructivist teaching in science. He provides that according to Fensham (1992), the most conspicuous psychological influence on curriculum thinking in science since 1980 has been the constructivist view of learning (p. 801). He also shares that Tobin (1993) provides constructivism has become increasingly popular in the past ten years and it represents a

paradigm change in science education (p. ix) and Yeany (1991) on the other hand argues that "a unification of thinking, research, curriculum development, and teacher education appears to now be occurring under the theme of constructivism" (p.1). As So (2002) puts it, these views were echoed by the words of Scoot, Asoko, Driver and Emberton (1994) who cite, "Science learning, viewed from a constructivist perspective, involves epistemological as well as conceptual development" (p. 219). According to So (2002), constructivist views emphasize inquiry strategies, generative learning and questioning (Slavin, 1994 as cited in So, 2002). In addition, hands-on inquiry oriented instruction is advocated to promote children's conceptual knowledge by building on prior knowledge, active engagement with the subject content and application to real world situations is also promoted in science lessons (Stofflett & Stoddart, 1994 as cited in So, 2002). According to So (2002) constructivist approaches in science education focus on discovery, open ended problems and experimentation (Neale & Smith, 1990) and Wildy and Wallce (1995) advocate that good science teachers are those that teach for the sake of deep understanding. They cite, "They use students' ideas about science to guide lessons, providing experiences to test and challenge those ideas to help students arrive at more sophisticated understanding. The classrooms of such teachers are learner-centered places where group discussion, exploration and problem solving are common place" (p.143 as cited in So, 2003).

In various resources learning as a conceptual change is mentioned while discussing the implications of constructivism in science education (Driver & Oldham, 1986). Hodson & Hodson (1998) provide some teaching strategies that may help students in conceptual reconstruction: Identifying students' views and ideas; creating opportunities for students to explore their ideas and to test their robustness in explaining phenomena, accounting for events and making prediction; providing stimuli for students to develop, modify and where necessary, change their ideas and views; and, supporting their attempts to re-think and reconstruct their ideas and views.

In science education, it is believed that there are certain teaching methods based on constructivist approaches which help students' learning. There are some practices emerging from cognitive psychology which help students understand, recall and apply

essential skills, concepts and information. These are applied in order for making lessons relevant, help students to elaborate and organize information, activate their prior knowledge and promote asking question in the learning environment. As So (2002) shares, Slavin (1994) lists those practices as the following:

1. Advanced organizers: general statements given before instruction that relate new information to existing knowledge to help students process new information by activating background knowledge, suggesting relevance, and encouraging accommodation;
2. Analogies: pointing out the similarities between things that are otherwise unlike, to help students learn new information by relating it to concepts they already have; and
3. Elaboration: the process of thinking about new material in a way that helps to connect it with existing knowledge (p. 237-239 as cited in So, 2002).

On the other hand, So (2002) points out that Wilson (2000) suggests science educators should look beyond the limits of cognitive psychology in developing students' understanding of scientific concepts. The four immediate accessible points provides for practicing teachers to consider in teaching concepts to students also rooted with constructivist teaching are such:

1. Recognizing what pupils already know;
2. Teach fewer concepts;
3. Improve continuity across key stages and progression of the development of concepts. Pupils are exposed to scientific concepts at a much earlier stage in their education; and,
4. Acknowledge the diversity of learners.

As a criticism to constructivism in science education, a proponent of natural sciences, Matthews (2002), argue that although constructivism has introduced some new words and meanings in science education, it is not clear that new realities have been identified or old realities are better explained. He also claims that long standing problems of epistemology have not been avoided, transcended or solved. To support his argument, he makes use of some translations made from constructivist language to Standard English and orthodox philosophy of science. Table 4 provides a list of translations made from constructivist new speak to orthodox old speak.

Table 4

A List of Translations from Constructivist New Speak to Orthodox Old Speak

Constructivist new speak	Orthodox old speak
Perturbation	Anomaly
Viability	Confirmation
Construction of knowledge	Learning
Facilitating cognitive transformation	Teaching
Scheme	Theory
Conceptual ecology	Ideas
Accommodation	Theory change
Negotiation of meaning	Student discussion
Dialogical interactive processes	Talking with each other
Student engagement	Paying attention
Off-task behavior	Not paying attention
Community of discourse	Group
Distinctive discoursive communities	Different groups
Personal construction of meaning	Understanding
Discourse	Writing
Verbal discourse	Speaking
Discoursive resources	Concepts
Habitus	Cultural environment
Mediational tools	Graphs

Table 4 *(continued)*

Constructivist new speak	Orthodox old speak
Conversational artifacts	Diagrams
Symbolic violence	Learning something different
Inscription devices	Drawings, diagrams, graphs
Cognitive apprenticeship	Education

Source: (Matthews, 2002, p. 131).

Matthews (2002) makes use of this list of translations as a manual to rewrite some constructivist passages in simple everyday terms. The passages and the corresponding translated statements are provided in Table 5.

Table 5

Constructivist Passages Translated into Simple Everyday Terms

Constructivist speak	Plain speak
Since co-participation involves the negotiation of a shared language, the focus is on sustaining a dynamic system in which discursive resources are evolving in a direction that is constrained by the values of the majority culture while demonstrating respect for the habitus of participants from minority cultures, all the time guarding against the debilitation of symbolic violence. (Tobin, 1998, p. 212)	Teach in a way that is sensitive to cultural values
… through our presence as facilitators and mentors, we can provide settings that are constrained and have minimal complexity so that students can construct conceptual and procedural knowledge with low risks of failure. (Roth, 1993, p. 168)	If students are taught simple things first, they are more likely to learn

Table 5 *(continued)*

Constructivist speak	Plain speak
The discursive practices in science classrooms differ substantially from the practices of scientific argument and enquiry that take place within various communities of professional scientists. (Driver et al., 1994, p. 9)	Student learning differs from scientific research
Making meaning is thus a dialogic process involving persons-in-conversation, and learning is seen as the process by which individuals are introduced to a culture by more skilled members. As this happens they "appropriate" the cultural tools through their involvement in the activities of this culture. (Driver et al., 1994, p. 7)	Students need the assistance of teachers when learning new concepts
If students are to learn science as a form of discourse, then it is necessary for them to adapt their language resources as they practice science in settings in which those who know science assist them to learn by engaging activities of coparticipation occurs. (Tobin et al., 1997, p. 493)	Students need new concepts and vocabulary in order to learn science
Our micro-analytical view of the learning processes in one group showed how much the evolution of students" activities depended on features of the physical context, discourse contributions from individual group members, material actions on and with instructional artefacts, contingent interpretations, and the past history of the activity itself. (Duit et al., 1998, p. 1070)	Our small study students showed that their learning is affected by peers and by the availability of educational resources

Source: (Matthews, 2002, p. 131).

Matthews (2002) discusses that he has no problem with specialized vocabularies and theoretical terms however he claims that while natural science uses such terms to

simplify complex matters, social science, at least in the examples that he provides, uses theoretical terms to make simple matters more complex.

2.2. Learning Environment Research

The classroom learning environment or the educational environment or the classroom climate, is the social atmosphere in which learning takes place. Fraser (1994) acknowledges these learning environments as the social-psychological contexts or determinants of learning. Learning environment research has been in a progress in the last 30 years and in the literature there are many studies on how the learning environments have been conceptualized, assessed or investigated (Fraser, 1986, 1994, 1998; Fraser & Walberg, 1991). Herbert Walberg and Rudolf Moos are said to be the first researchers who initiated studies in the field of learning environments long ago. Fraser (1998) provides that Learning Environment Inventory (LEI) was developed by Walberg as part of the research and evaluation activities of Harvard Project Physics and then widely used by other researchers too (Walberg & Anderson, 1968 as cited in Fraser, 1998). Classroom Environment Scale (CES) was then developed by Moos which evolved from his efforts to develop social climate scales (Moos, 1979; Moos & Trickett, 1987 as cited in Fraser, 1998). Works of Walberg and Moos were followed by many major studies (Fraser 1986; Fraser & Walberg 1991; Moos 1979; Walberg 1979 as cited in Fraser, 1998), literature reviews (Fraser 1994; MacAuley 1990; von Saldern 1992) and monographs sponsored by the American Educational Research Association's Special Interest Group (SIG) on the Study of Learning Environments (Fisher 1994). According to Fraser (1998) there are many studies in the literature revealing that classroom learning environment is a strong factor in determining and predicting students' attitudes toward science in all grades.

In classroom environment studies some major practices have evolved in time. Firstly, the use of qualitative methods in learning environment research has become popular research (Tobin, Kahle & Fraser, 1990) and mixed methods which include combination of quantitative and qualitative research have been widely used (Fraser &

Tobin, 1991). Secondly, preferred forms of instruments have been developed which allow investigation of differences between actual and preferred classroom environments (Fraser & Fisher, 1983). Observations of classroom teaching and learning and interviews with classroom teachers may provide valuable insights into the classroom learning environment however it should also be noted that student perceptions of the classroom learning environment are important, should be of interest to classroom teachers, and can be fairly easily measured with classroom environment perception instruments. Thirdly, teachers started to conduct action researches to improve their classrooms through assessments of actual and preferred classroom environment (Fraser & Fisher, 1986). Lastly, the results of the studies on learning environments have been incorporated into teacher education (Fraser, 1993) and school psychology (Burden & Fraser, 1993). In addition, it should be noted that the emphasis on social and / or critical constructivist perspectives on teaching and learning resulted in development of constructs such as involvement, satisfaction, participation, relevance, autonomy, independence and critical voice to measure and describe learning environment.

As mentioned before, in the history of instruments for assessing classroom environments, Learning Environment Inventory (LEI) and Classroom Environment Scale (CES) are the first two important instruments. Individualized Classroom Environment Questionnaire (ICEQ); My Class Inventory (MCI); College and University Classroom Environment Inventory (CUCEI); Questionnaire on Teacher Interaction (QTI); Science Laboratory Environment Inventory (SLEI); Constructivist Learning Environment Survey (CLES); and What Is Happening In This Class (WIHIC) questionnaire follow LEI and CES. Fraser (1998) tabulated these instruments according to scales they have, the student level that they most suit, the number of items contained in each scale and the classification of each scale according to Moos's (1974) scheme for classifying human environments. The first dimension mentioned by Moos (1974) is relationship dimensions identify the nature and intensity of personal relationships within the environment and assess the extent to which people are involved in the environment and support and help each other. Secondly, Moos (1974) mentions personal development dimensions which is focused on assessing basic directions along

which personal growth and self-enhancement tend to occur. Last classification of Moos (1974) is the system change dimensions and this involve the extent to which the environment is orderly, clear in expectations, maintains control and is responsive to change. Table 6 demonstrates overview of 9 classroom environment instruments as developed by Fraser (1998).

Among these instruments, Constructivist Learning Environment Survey (CLES) which was also adapted and used in this study was developed with a psychological view of learning that highlights the fact that students construct their own knowledge (Taylor, Fraser & Fisher, 1997).

As cited in Önder (2006), Honebein (1996) discusses that constructivist learning environments are designed to satisfy seven pedagogical goals:

1. Provide experience with the knowledge construction process: students take primary responsibility in selecting topics and methods of how to learn.
2. Provide experience in and appreciation for multiple perspectives: students must engage in activities which enables them to think about several ways for solution since the real life problems rarely have one correct solution.
3. Embed learning in realistic and relevant context: learning activities are designed so that they reflect all the complexity that surrounds them outside the classroom.
4. Encourage ownership and voice in the learning process: illustrates the student centeredness of constructivist learning.
5. Embed learning in social experience: learning should reflect collaboration between student and teacher and student and student.
6. Encourage the use of multiple modes of representation: a variety of activities and instructional strategies coupled with variety of media provides richer experiences.
7. Encourage self-awareness of the knowledge construction process: it is important students to know how they know (p. 17).

Nix, Fraser and Ledbetter (2005) provides a detailed background on evaluating an integrated science learning environment using the constructivist learning environment survey. According to them, CLES characterizes specific dimensions of a preferred constructivist learning environment and has been used in many studies in a variety of countries. Taylor et al. (1997) conducted a study in Western Australia with a

sample of 494 13 year old students in 41 science classrooms in 13 schools to establish the factorial validity and reliability of CLES. CLES was also cross validated through a study with a sample of 1081 science students in 50 schools in Australia by Aldridge, Fraser, Taylor and Chen (2000). Lee and Taylor (2001) provide that cultural adaptability of the instrument was also considered. The CLES was also validated in Korea and Taiwan by Kim, Fisher and Fraser (1999), Lee and Taylor (2001) and Aldridge et al. (2000). The survey was translated into Korean language by Kim et al. (1999) and administered to 1083 science students in 24 classrooms in 12 schools. Lee (2001) also conducted a study in Korea with 440 science students in 13 classrooms. Aldridge et al. (2000) made use of its Chinese version in Taiwan to conduct a study with 1879 science students in 50 classrooms. Wilks (2000) made use of the CLES in Singapore and administered it to students studying English with some modifications. He called the instrument GPCLES (General Paper Constructivist Learning Environment Survey) and included two additional scales which are political awareness and ethic of care. Political awareness scale was reflecting Habermas' notion of emancipatory interest and assessing the extent to which students advocate political reform and analyze causes of social injustice. Ethic of care scale on the other hand was assessing the degree of emotional warmth in the classroom. The results of Wilks' study (2000) with 1046 students in 48 classrooms provided evidence that survey has a good factorial validity and internal consistency reliability. Sebela, Fraser, and Aldridge (2003) administered the survey in South Africa to 1864 students in 43 grade 4-9 classrooms and the results again supported the reliability and factorial validity of the survey. The literature provides enough evidences that the CLES has been widely implemented in many countries and established validity and it is a valuable tool for assessing the degree to which a learning environment is consistent with the constructivist epistemology. It also helps teachers in becoming reflective teachers based on the results obtained through the administration of the survey.

Table 6

Overview of Nine Classroom Environment Instruments

Instrument	Level	Items per scale	Scales Classified According to Moos's Scheme		
			Relationship dimensions	Personal development dimensions	System maintenance and change dimensions
Learning Environment Inventory (LEI)	Secondary	7	Cohesiveness Friction Favoritism Cliqueness Satisfaction Apathy	Speed Difficulty Competitiveness	Diversity Formality Material Environment Goal Direction Disorganization Democracy
Classroom Environment Scale (CES)	Secondary	10	Involvement Affiliation Teacher Support	Task Orientation Competition	Order and Organization Rule Clarity Teacher Control Innovation

Table 6 *(continued)*

Instrument	Level	Items per scale	Scales Classified According to Moos's Scheme: Relationship dimensions	Personal development dimensions	System maintenance and change dimensions
Individualized Classroom Environment Questionnaire (ICEQ)	Secondary	10	Personalization Participation	Independence Investigation	Differentiation
College and University Classroom Environment Inventory (CUCEI)	Higher Education	7	Personalization Involvement Student Cohesiveness Satisfaction	Task Orientation	Innovation Individualization
My Class Inventory (MCI)	Elementary	6-9	Cohesiveness Friction Satisfaction	Difficulty Competitiveness	

Table 6 *(continued)*

Instrument	Level	Items per scale	Scales Classified According to Moos's Scheme		
			Relationship dimensions	Personal development dimensions	System maintenance and change dimensions
Questionnaire on Teacher Interaction (QTI)	Secondary / Primary	8-10	Helpful / Friendly Understanding Dissatisfied Admonishing		Leadership Student Responsibility and Freedom Uncertain Strict
Science Laboratory Environment Inventory (SLEI)	Upper Secondary / Higher Education	7	Student Cohesiveness	Open-Endedness Integration	Rule Clarity Material Environment
Constructivist Learning Environmen Survey (CLES)	Secondary	7	Personal Relevance Uncertainty	Critical Voice Shared Control	Student Negotiation
What Is Happening In This Classroom (WIHIC)	Secondary	8	Student Cohesiveness Teacher Support Involvement	Investigation Task Orientation Cooperation	Equity

Source: (Fraser, 1998)

Wallace, Venville and Chou (2001) digested the criticisms to the current learning environment research: One criticism to the current learning environment research is on the universality of learning environment constructs (Roth, 1999). It is argued that the members of a classroom do not share the same environment and do not get the same meaning from the constructs used to measure the environment. According to Kondo (1990), the participants of a research study may construct and reconstruct their own meanings based on their experiences of the world and their self conceptualization. Eisner (1993) contributes to this discussion through citing that meaning comes in multiple forms because each individual's experience is different and constantly in a state of change. Lemke (1995) adds that meaning is created as individuals work within and act upon their social and cultural circumstances. Based on these arguments it can be discussed that the learning environment is not separate from but integral to the learner (Roth, 1999). It is created and perceived in the moment (Kondo, 1990). Even more, it is argued by some researchers that learning environment is multifaceted and dynamic and it reflects a subject-position rather than a subject-object view of the world (Bianchini, Cavazos & Helms, 2000). In the last 10 years or so, such criticism to learning environment research and the constructs being used resulted in a search for satisfying the alternative views of social reality which emphasize the importance of the subjective experience of individuals. Interpretive methods have emerged lately to investigate the roles of teachers and learners. Nowadays interviews in classroom environment research are widely used as an optional extra to questionnaires (She & Fisher, 2000; Waldrip & Fisher, 2000). Interviews allowed the researchers to make individual experience of the classroom environment clearer but it is still highly connected to the assumption of shared meaning of learning environment constructs. Some researchers aim to investigate the variety of ways in which students understand and describe their learning environment through use of interpretive methods – interviews, journals and classroom observations (McRobbie & Tobin, 1997; Richie, Tobin & Hook, 1995; Wallace & Chou, 2001).

2.3. Research Related to Learning Environment and Constructivist Learning Environment

Some recent studies investigating learning environments in science and technology classes and in other various contexts are mentioned below.

Mucherah (2008) examined classroom climate and student goal structures in high-school biology classrooms in Kenya. 891 10^{th} and 11^{th} grade students from two boarding schools constituted the sample of the study. School differences were found on all classroom climate aspects except teacher support and competition. Relative to 10^{th} graders, 11^{th} graders perceived their classrooms to be higher in teacher support, task focus, competition, rule strictness, and innovation. There were school and grade differences in students' goal structures, with School 1 students, relative to School 2 students, perceiving more personal performance-approach goals and their teachers as encouraging performance-approach goals. 11^{th} graders reported more performance-approach goals at both the personal and teacher levels. Teachers perceived their classroom climates more positively than their students.

Teacher-student interaction and students' attitudes towards project work in secondary schools in Singapore were investigated by Quek et al. (2007). The researchers investigated quantitatively how a group of 270 secondary-school students (aged 14 years) perceived their seven project work teacher-facilitators' face-to-face interactions with students based on the Questionnaire on Teacher Interaction (QTI), and whether their perceptions of teacher–student interaction during project work classrooms were related with their attitudes towards project work learning as a whole. The authors discussed the findings in terms of how teachers who function as facilitators can translate their interpersonal behaviors into effective teaching strategies for communicating with students and facilitating students' learning in project work classrooms.

Bowker and Tearle (2007) conducted a research study on the impact of the early stages of an international project namely Gardens of Life (GfL) on children's perceptions of school gardening and on their learning. The project involved 67 schools in England, Kenya and India and focused on the growing of crops, recognizing the

importance of both the process and product of this activity in different countries. The theoretical framework was derived from consideration of informal learning and more specifically experiential learning, drawing on prior research undertaken in the context of school gardening. The study showed a positive impact on learning and on the perceptions of children towards school gardening in all three countries. It also highlighted the different perceptions, interpretations and understanding of school gardening in the different cultures and environments, as well as the various aspects of it which the children themselves highlighted.

Another recent study which made use of Constructivist Learning Environment survey was conducted by Ogbuehi and Fraser (2007). This study of middle-school students in California focused on the effectiveness of using innovative teaching strategies for enhancing the classroom environment, students' attitudes and conceptual development. A sample of 661 students from 22 classrooms in four inner city schools completed modified forms of the Constructivist Learning Environment Survey (CLES), What Is Happening In this Class? (WIHIC) questionnaire and Test of Mathematics Related Attitudes (TOMRA). The researchers evaluated the effectiveness of the innovative instructional strategy in terms of classroom environment and attitudes to mathematics for the whole sample, as well as for mathematics achievement for a subgroup of 101 students. A comparison of an experimental group which experienced the innovative strategy with a control group supported the efficacy of the innovative teaching methods in terms of learning environment, attitudes and mathematics concept development. Also the authors found associations between perceptions of classroom learning environment and students' attitudes to mathematics and conceptual development.

Another study concerning learning environments was conducted by Telli, den Brok and Çakıroğlu (2007) to investigate the reliability and validity of a Turkish adaptation of an existing instrument for measuring teacher interpersonal behavior. The authors asserted that the Questionnaire on Teacher Interaction (QTI) mapped teacher behavior in terms of two dimensions which are Influence (Dominance–Submission) and Proximity (Cooperation–Opposition). A sample of 674 students from 24 classes in

grades 9 to 11 that have experienced teachers in two Turkish secondary schools participated in the study. Several steps were taken to develop the instrument: 1) translation and back translation by teacher educators; 2) piloting of different versions while refining the items; 3) interviews with students and teachers to establish the importance of teacher interpersonal behavior in the Turkish context; and 4) final administration of the questionnaire to the sample. Interview data and statistical analyses supported the reliability and validity of the instrument. As the authors cite, "Turkish teachers were perceived by their students as very cooperative and moderately dominant" (Telli, den Brok & Çakıroğlu, 2007).

Another instrument was developed by Handelzalts, Berg, Slochteren and Verdonschot (2007) to assess perceptions of pre-service teachers in an ICT rich learning environment that encourages pre-service teachers to direct their own learning to build a two-way relationship between theory and teaching practice. The study consisted of a qualitative and a quantitative part. Six factors derived from interviews with users formed the basis of the instrument: (1) Support of Learners' Initiatives; (2) Support of Interaction; (3) Support of Information Searches; (4) Relationship with Fellow Students; (5) Relationship with other learning environment staff; and (6) Relationship with Teacher Educators. The authors reported that 186 students responded the questionnaire and analysis of the data supported five out of six factors.

Ellis et al. (2007) published an article on convergence of observer ratings and student perceptions of reform practices in 6th grade mathematics classrooms in USA. As part of a research project examining relationships between instructional practices and student cognitive and social outcomes in middle-school mathematics classes, external observers and students reported perceptions of teachers' instructional practices. A 25-item observation protocol aligned with the reform practices called for in the Standards of the National Council of Teachers of Mathematics (NCTM) was used to develop a quantitative profile of instructional practices across two lessons in each of 28 classes of 15 participating teachers. Students in each of the observed classes completed a 49-item survey of their perceptions of instructional practices. The items for both the observation protocol and Student Survey were designed to measure alignment with the

same dimensions of reform practice, so the convergence of these two data sets was examined as a tool to confirm the observation ratings. The authors reported that the findings show moderately strong correlations between ratings of external observers and perceptions of sixth-grade students across three dimensions (pedagogy, tasks and mathematical interactions) of reform-oriented teacher practice in mathematics classrooms.

Allen and Fraser (2007) conducted a research study on the perceptions of parents and students concerning classroom learning environment and its association with student outcomes. They assert, "This research is distinctive in that parents' perceptions were utilized in conjunction with students' perceptions in investigating science classroom learning environments among Grade 4 and 5 students in South Florida (Allen & Fraser, 2007). The What Is Happening In this Class? (WIHIC) questionnaire was modified for young students and their parents and was administered to 520 students and 120 parents. Data analyses supported the WIHIC's factorial validity, internal consistency reliability and ability to differentiate between the perceptions of students in different classrooms. Both students and parents preferred a more positive classroom environment than the one perceived to be actually present, but effect sizes for actual-preferred differences were larger for parents than for students. Associations were found between some learning environment dimensions (particularly task orientation) and student outcomes (particularly attitudes). Qualitative methods suggested that students and parents were generally satisfied with the classroom environment, but that students would prefer more investigation while parents would prefer more teacher support. As the authors put it, "The study provides a pioneering look at how parents and students perceive the science learning environment and opens the way for further learning environment studies involving both parents and students" (Allen & Fraser, 2007).

Multilevel issues in research using students' perceptions of learning environments were investigated by Brok, Brekelmans and Wubbels (2006). According to the authors, frequently the design of learning environment studies investigating students' perceptions is multilevel in nature. This multilevel nature of studies can

appear in the purpose of research (for example, teacher behavior towards the individual student or towards the class), the level of perception (personalized perceptions or group perceptions) and the sampling of data (usually clustered: students are sampled with their classmates, classes are sampled with other classes taught by the same teacher, etc.). In their study, the authors focused on the impact of decisions about level using students' perceptions of the teacher–student relationship as assessed with the Questionnaire on Teacher Interaction (QTI). Data were gathered in one school (59 classes of 29 teachers) with two versions of the questionnaire: a personalized version and a class version. For reasons of comparison, additional data on the class version were analyzed from 44,415 students from 1,913 teachers in 207 schools. Results from multilevel and single-level analyses of the class and personal versions of the QTI indicated that multilevel analyses are to be preferred over single-level analyses and that different conceptual structures could apply depending on the purpose of study and the level of perception.

The role of student characteristics in studying micro teaching-learning environments was investigated by Seidel (2006). The hypothesis was that teachers teach differently to micro environments in their classrooms. The author shares that her study is the first of a series exploring the following four questions: (1) What student profiles are identified at the beginning of a school year with respect to cognitive and motivational-affective factors?; (2) How do students with different profiles perceive conditions in their learning environment?; (3) To what degree do classrooms differ in the composition of student profiles?; and (4) What are possible consequences for examining micro teaching–learning environments? The study investigated 82 randomly selected high school science classrooms. Student characteristics were assessed at the beginning of the school year. After a video taped teaching unit, students were asked to rate the degree to which they experienced learning conditions as supportive. The author provides that Latent class analysis (LCA) showed five distinct student profiles that varied along cognitive and motivational-affective dimensions. Multilevel analyses showed effects of student profiles assessed at the beginning of the school year on the students' perception of learning conditions in a teaching unit 4 months later. Student

profiles were linked to video examples in order for demonstrating consequences for examining micro teaching–learning environments. The author asserted that the examples showed the special value of LCA in studying micro teaching – learning environments since they make it possible to focus on the individual student and to investigate the interactions of student characteristics and the learning environment.

Doppelt (2006) conducted a research study in which an intervention program was implemented in the learning environment of science and technology classes at the junior high school level (grades 7-9, 12-15 years old) in Israel. The author explains that the intervention included a three-year workshop involving 224 hours each year and the teachers (N = 22) were required to reflect on their experiences using a portfolio describing their actual teaching experiences for relevant discussions at the workshop they attended. Quantitative and qualitative tools were used to examine the teachers' implementation of new teaching / learning and assessment methods or new subject matter, that were addressed by the workshop in their classes, and to identify learning environment characteristics and learning outcomes according to teachers' perceptions. The author provides that differences were found between teachers' and pupils' perceptions of the impact of learning environment characteristics on learning outcomes.

Thomas and Mee (2005) conducted a research study on the impact of a 2-month classroom intervention that aimed to change the learning environment of two Hong Kong primary schools. The authors provide that a mixed methodology, employing quantitative and qualitative data-gathering strategies, was used to investigate changes to the learning environments, including changes to the teachers' language and ultimately the students' meta-cognition. The quantitative aspect of the research involved the development of a 15-item learning environments instrument, the General Studies Metacognitive Orientation Scale (GSMOS) that evaluated elements of the meta-cognitive orientation of the classrooms' learning environments. Concerning the findings, the authors asserted that while the data from the administration of the GSMOS suggested no statistical differences between the pre and post-intervention environments of the classrooms, student interviews and classroom observations provided supportive data for some changes, which resulted in students developing meta-cognitive

knowledge of teacher-selected thinking and learning strategies, as well as some awareness and limited control of their use of such strategies in their classrooms.

Kemper and Leung (2005) investigated the influence of the teaching and learning environment on the development of generic capabilities needed for knowledge based society in Hong Kong. They examined this with a survey administered to 1756 undergraduate students at a university. The authors provide that the survey assessed students' perceptions of the development of the six capabilities of critical thinking, self-managed learning, adaptability, problem solving, communication skills, and interpersonal skills and group work. They also cited that students were also asked to rate the quality of nine aspects of the teaching and learning environment. They used structural equation modeling to test a model of the influence of teaching on the development of the six capabilities. Concerning the findings, the authors provided that the model grouped the nine aspects of teaching and learning under the three higher-order latent variables of teaching, teacher–student relationship, and student–student relationship and showed a good fit to the data, indicating that the teaching and learning environment had a significant impact on the development of the generic capabilities while the students were taking their degree. According to the authors the teaching latent variable had the strongest effect on the development of all six of the capabilities and a suitable teaching environment was characterized by a focus on understanding, the active participation of students in learning activities, a rational curriculum, and assessment which focused on analytical skills and self-learning capability. They reported that strong student–student relationships nurtured communication and interpersonal skills. They also added that there was a mutually reinforcing effect between the type of teaching, teacher–student relationships and student–student relationships.

Within two Flemish institutes of pre-service and in-service teacher education, Petegem, Donche and Vanhoof (2005) examined the relationship between the learning styles and preferences for learning environments of pre-service teachers. As the authors reported, the results of the study indicated that some components of pre-service teachers' learning approaches (learning conceptions, learning strategies and learning

orientations) are predictors for preferences for constructivist learning environments. They also added that the differences in learning approaches and preferences for learning environments are also related to the type of teacher education that pre-service teachers followed.

Nix, Fraser and Ledbetter (2005) made use of the constructivist learning environment survey to evaluate an integrated science learning environment. They developed a comparative student version (CLES-CS) to evaluate the impact of an innovative teacher development program (based on the Integrated Science Learning Environment ISLE model) in school classrooms. Using data collected from 1079 students in 59 classes in north Texas, the authors reported that principal components factor analysis with varimax rotation and Kaiser normalization confirmed the a priori structure of the CLES-CS. According to the authors, the factor structure, internal consistency reliability, discriminant validity, and the ability to distinguish between different classes and groups were supported for the CLES-CS. Students whose science teachers had attended the ISLE program perceived higher levels of Personal Relevance and Uncertainty of Science in their classrooms relative to the classrooms of other science and non-science teachers in the same schools. Similar results were found by the authors when comparing the classroom environment perceptions of students whose science teachers had attended the ISLE program with the perceptions of students whose science teacher had attended alternative field trip programs.

Koul and Fisher (2005) studied the cultural background and students' perceptions of science classroom learning environment and teacher interpersonal behavior in India. A sample of 1021 students from 31 classes in seven private schools completed a survey including the Questionnaire on Teacher Interaction (QTI), the What Is Happening In this Class? (WIHIC) and a question relating to cultural background. The authors reported that the statistical analyses showed the Kashmiri group of students perceived their classrooms and teacher interaction more positively than those from the other cultural groups identified in the study.

Doppelt (2004) focused on the impact of science and technology learning environment characteristics on learning outcomes in Israel. As he reported, the research

study included three stages: field research, pilot research and expanded research. In the field research, an intervention program was planned and implemented. The intervention program included a three-year in-service training workshop consisting of 224 hours each year. Quantitative and qualitative tools were used by the researcher to assess teachers' implementation of the intervention program. As the author provided, the findings revealed the characteristics of the science-technology learning environment and various learning outcomes. The pilot research allowed the researcher to develop and validate a questionnaire called the Science-Technology Learning Environment Questionnaire (STLEQ). As the author explains, the STLEQ was aimed at assessing teachers' and pupils' perceptions of learning environment. The author also reported that the conclusions from the pilot research showed differences between teachers' and pupils' perceptions towards the impact of learning environment characteristics on learning outcomes. In the expanded research, two cohorts of pupils participated, namely, the 2002 cohort (N= 207) and the 2003 cohort (N= 159). These cohorts had studied science-technology in junior-high school. The findings of the expanded research partly match the findings from the pilot research, leading to insight into the pupils' perspective of the science-technology learning environment. No gender differences were found in pupils' scoring of learning outcomes. On the other hand, boys scored higher than girls on Computer Usage.

The status of science classroom learning environment in Indonesian lower secondary schools was investigated by Wahyudi and Treagust (2004). In their article they share the cross-validation results for an Indonesian-language version of a modified form of the What Is Happening In this Class? (WIHIC) questionnaire and its use in investigating the nature of science classroom learning environments in Indonesian lower secondary schools. Following administration of the WIHIC to nearly 1400 students and their teachers in 16 schools, the study led to five assertions. These are reported by the authors as such: 1) The study confirmed that the Indonesian version of the modified WIHIC is a valid and reliable instrument for measuring the classroom learning environment in the Indonesian educational context; 2) There were significant differences between students' perceptions of the actual and preferred learning

environment, with students tending to prefer a more favorable classroom learning environment than the one which they actually experienced; 3) Female students generally held slightly more positive perceptions of both actual and preferred learning environments; 4) Students held less favorable perceptions of both actual and preferred learning environments than did their teachers; and 5) There were significant differences in students' perceptions of the actual classroom learning environment depending on the schools' locality, with students in rural schools holding less favorable perceptions than students in urban and suburban schools for all seven WIHIC scales. In conjunction with the last assertion, the authors also reported that the students in urban and suburban schools perceived their classroom environments similarly with the exception that students in urban schools perceived greater cooperation and less teacher support than did students in suburban schools.

Sharma et al. (2008) studied the student learning outcomes in technology enhanced constructivist learning environment and tried to integrate constructivist designs to empower student learning. They reported that the use of constructivist learning environment resulted in positive perceptions of the content. As they reported, the other factors identified by students included authentic contexts and the provision of pedagogical scaffolds to meet authentic problems.

Waldrip and Fisher (2007) investigated the student perceptions of teacher-student interpersonal behavior and cultural factors of learning environment in metropolitan and country schools in Australia. They reported the findings from a study of 2,176 students in 103 science classrooms in Western Australia and Queensland. Two questionnaires, the Questionnaire of Teacher Interaction and the Cultural Learning Environment Questionnaire were used with attitudinal and concept understanding measures were used to collect data from schools from geographically diverse locations, namely, metropolitan, rural and remote areas. They also provide information on the differences that occur between these locations, for example, in their understanding of science concepts, metropolitan students scored less than rural students who scored less than provincial students; and associations between students' culturally sensitive learning environment and their attitudes and student understanding of science concepts

were found in that more positive student attitudes were associated with more equitable treatment, competition and congruence between school and home.

Asbell-Clerke and Rowe (2007) conducted a descriptive study on online science courses for teachers. Using a sample of 40 online science courses for teachers offered during the 2004-2005 academic year, the Learning Science Online (LSO) study examined the nature and variety of instructional methods and activities as well as communication, and students' perceptions of supports within the course. As they cite, "This research is unique in that it is the first aggregate study of online science courses offered by a wide variety of educational programs" (Asbell-Clerke & Rowe, 2007). They also reported that the descriptive analyses suggested the instructional methods employed in online science courses for teachers include frequent use of online discussions and students participated in minds-on activities, including articulation and reflection on their scientific ideas, posing questions, analyzing data, and drawing conclusions from evidence. They shared that hands-on instructional activities were rarely used, and pen-and-paper and collaborative instructional activities were occasionally used. Technology was used primarily for communications such as discussion boards, email, and chat, but there were very few other computer-based tools used within the courses. Concerning the findings of the study, the authors provided that the students felt supported by instructors, other students, and the course design.

Rosen and Salomon (2007) conducted a meta-analysis on the differential learning achievements of constructivist technology-intensive learning environments as compared with traditional ones. The authors hypothesized that constructivist learning environments lead to the attainment of achievements that are consistent with the experiences that such settings provide and that more traditional settings lead to the attainments of other kinds of achievement in accordance with the experiences they provide. A meta-analytic study was carried out on 32 methodologically-appropriate experiments in which these 2 settings were compared. Results supported that overall constructivist learning environments are more effective than traditional ones (ES = .460) and that their superiority increases when tested against constructivist-appropriate measures (ES = .902). However, as the authors reported, contrary to expectations,

traditional settings did not differ from constructivist ones when traditionally-appropriate measures were used. A number of possible interpretations are offered among them the possibility that traditional settings have come to incorporate some constructivist elements. This possibility is supported by other findings of the authors such as smaller effect sizes for more recent studies and for longer lasting periods of instruction.

Köse, Bağ and Gezer (2007) analyzed journals, books and unpublished dissertations in the field of learning environments to come up with a learning environment bibliography in which 212 articles and book reviews and 83 unpublished dissertations are listed.

2.4. Curriculum Reform and Science and Technology Programs in Turkey

Bulut (2007) argues that in the last ten years some development and improvement efforts had been attempted in the Turkish educational system however Turkish students are reported to perform below the international average in international assessment tests such as Third International Mathematics and Science Study Repeat TIMSS-R (1999), The Progress in International Reading Literacy Study PIRLS (2001) and Programme for International Student Assessment PISA (2003) (Berberoğlu, Çelebi, Özdemir, Uysal & Yayan, 2003; İş, 2003 as cited in Bulut, 2007). Based on this fact, new curricula have been developed and are being implemented for primary schools since 2004. Board of Education in Ministry of National Education in Turkey developed the new primary level programs and these programs were piloted in 9 provinces and 120 schools during the 2004-2005 school year. The programs were put into implementation all through the country in the next school year which was 2005-2006. It was announced by the Ministry that this was a revolution in the Turkish educational system and it was also argued that the philosophy of the system had gone through a radical change. As İnal (2008) mentioned, Board of Education and Discipline pointed out four main rationales for this radical change in the system. These rationales were classified as 1) socio-economical (globalization); 2) political (European Union

process of Turkey); 3) Philosophical (constructivism); and 4) Instructional (student centered instruction).

Koç, Işıksal and Bulut (2007) made use of primary resources of Ministry of National Education in Turkey to digest the fundamentals of the new curriculum which has been in practice since 2005. According to this, social, individual, economical and historical and cultural fundamentals of the new curriculum are tabulated in Table 7.

Gömleksiz (2005) evaluated the effectiveness of new Turkish primary school curriculum in practice. The data collection instrument was a questionnaire consisting of subscales such as learning environment, knowing the curriculum, adapting the curriculum and implementing the curriculum and it was administered to 982 teachers in 8 provinces where the new curriculum was conducted. As the author reported, the findings of the study indicated that the opinions of teachers significantly differed in the context of learning environment in terms of province, the number of students in the classroom and gender. The researcher found out that the teachers in Van, Samsun and Bolu accepted the learning environment of the new primary school curriculum more positively than those in Istanbul, Ankara, Izmir, Kocaeli and Hatay. Another finding of the researcher was that the views of the teachers showed significant differences in knowing and adapting the new curriculum in terms of province and gender. In addition, the author reported that the views of the teachers on the implementation of the new primary school curriculum did not differ significantly in terms of gender and the number of students in the classroom. Two years later, Gömleksiz (2007) conducted another research study this time to evaluate teachers' perceptions of the new primary school curriculum in terms of some variables. He reported that no significant differences were found between the opinions of teachers on learning environment, knowing, adapting and implementing the curriculum and on the whole curriculum in terms of class and education level variables. He added that there was a significant difference between the opinions of the teachers on knowing the curriculum in terms of teaching experience variable but no significant difference was found on learning environment, adapting and implementing the curriculum and on the whole curriculum.

Table 7

Fundamentals of the New Curriculum

Social Fundamentals	Individual Fundamentals
The new curriculum, in particular, aims at:	*The objectives for the improvement of the individual fundamentals are as follows:*
▪ improving students' psychological, social, moral, and cultural development within their own socio-cultural contexts; ▪ reminding students of their rights and responsibilities and raising individuals who are in harmony with the society's internal institutions such as family, school and government; ▪ raising awareness on social, economical and political issues surrounding the society and the outside world such as economic crises, natural disasters, international conflicts and environmental pollution; ▪ raising awareness on education of gifted and handicapped students; ▪ raising awareness on democratic values and human rights within the society; ▪ placing considerable emphasis on character education for individual and social happiness; and ▪ placing considerable importance on recreational and physical activities as part of students' cognitive, psychomotor and affective development.	▪ acknowledging each student as a separate human being with his or her own personal characteristics; ▪ providing opportunities for life-long success in academic, professional and personal development; ▪ allowing experiences to enhance personal satisfaction and professional achievement through intrinsic motivation reinforcement; ▪ creating environments that promote life-long skills such as creativity, entrepreneurship, and scientific, analytic and critical thinking; ▪ raising awareness on psychological and physical health; ▪ placing considerable emphasis on meta-cognitive skills; and ▪ providing learning experiences to support multiple perspectives. ▪

Table 7 *(continued)*

Economical Fundamentals	Historical and Cultural Fundamentals
The new curriculum aims at: ▪ allowing experiences to enhance economic development around the nation; ▪ taking measures to decrease the economic gaps across the geographical regions; ▪ taking measures to supply the manpower required that are based on economic demands; ▪ encouraging students' entrepreneurship; and ▪ encouraging product-oriented activities.	*Education is a social activity that needs always to consider cultural and historical characteristics of the society through:* ▪ basing the philosophy of the education system on Ataturk's principles: Republicanism, Nationalism, Populism, Etatism, Reformism, and Secularism; ▪ raising awareness and supporting cultural, national and social norms; ▪ considering the national history as a guide for the future; and ▪ acknowledging cultural and fine arts as the mediums for individual development and socialization.

Source: (Koç, Işıksal & Bulut, 2007)

In 2005, Güzel and Alkan conducted a research study to evaluate the new primary level program pilot implementation. Their study aimed to determine the extent to which a change occurred and what the difficulties faced were. They administered the Constructivist Learning Environment Survey (CLES) to 600 students and held face to face interviews with 10 teachers. The authors reported that the teachers faced difficulties in managing the classrooms and in finding activities in teaching certain topics. The teachers were also reported that they were hesitant in sharing the responsibility. According to the researchers, the students were more positive towards constructivist approaches however when the aspects of the approach were considered, it was also found out that the students too faced difficulties in many aspects. The students were reported that they were hesitant in taking responsibility in their own learning. Similarly, the students were reported to face some difficulties in establishing relation between their school learning with their daily lives and in linking science and real life.

Çınar, Teyfur and Teyfur (2006) conducted a study on the primary school teachers and administrators' views about constructivist education approach and new programs. They developed a questionnaire to gather data from randomly selected 195 primary school teachers and administrators in the province of Ağrı in 2005. As they reported, the findings of the study indicated that teachers and administrators generally had a positive view about constructivist education approach and they thought that the most important handicap for the new constructivist program was the problems of infrastructure in their schools.

Bıkmaz (2006) aimed to establish some issues that are frequently repeated in the new primary school curricula which can lead to misunderstandings by teachers. She claimed that the teachers were not informed properly during the process of change and added that the teachers need to well grasp the conceptual infrastructure of the change. For instance, she underscored that taking into account individual differences not only means employing different methods, techniques or strategies during the teaching-learning process or to carry out different but also to differ in the expectations from the students. She also discussed that active learning is not only to carry out activities but also to consider the fact that the activities should aim to improve understanding of the

theme or the concept. In addition, according to her, active learning does not mean that the students are active only in the physical environment or just socially active during the teaching-learning process. She also pointed out that the teachers would require strong subject knowledge as the facilitator within the learning process. She added that traditional measurement and evaluation techniques may be employed in addition to the new techniques for measurement and evaluation in the new programs. Lastly, she highlights the fact that planning a learning process in line with the new curriculum approach and to implement this would further increase the work load of the teachers.

Yavuz (2007) evaluated the new programs through investigating opinions and suggestions of 41 teachers in 4 schools in Buca, İzmir. He reported that 49% of the teachers perceived the new programs positively, 34% had negative perceptions and 17% were undecided. He provided that the teachers had some positive opinions on the new programs since the contents in the programs were updated and more relevant to daily lives of students, they were more student-centered, allowing student participation and there were more activities in them. On the other hand, the author reported that the teachers had some negative opinions such as they face timing difficulties in implementing the new programs and the infrastructure did not permit a quality implementation of the programs. The teachers also asserted that the classrooms are over crowded, the topics are so messy and they lack necessary equipment that the new programs require. The researcher also reported that the teachers thought their work load has increased with the new programs (59%). The teachers complaint that they lose too much time in putting everything in folders and measurement and evaluation had become so difficulty since each course needed a different method of measurement and evaluation. 93% of the teachers who participated in Yavuz's (2007) study provided that the in-service trainings are insufficient. 85% of them reported that they didn't participate in the development phase of the new programs.

İnal (2008) criticizes the new program under three sub headings which are 1) the problematic issues concerning the pedagogical philosophy of the new programs, 2) criticism of the philosophy lying beneath the new programs and 3) problems faced

during the implementation of the programs. Among those criticisms the problems faced during the implementation phase of the programs are such:

According to İnal (2008), as far as the entrance examinations to certain schools are not abolished, memorization issue would not be resolved. He also points out that there is a measurement and evaluation problem in the new programs. Although the process rather than the product was declared to be assessed in the new programs, he claimed that it is not clear how the process would be measured. He discusses that the goal of the Ministry to develop good individuals, good persons and good citizens is problematic since being good is relative in many ways. Another argument by İnal (2008) is that the new programs lean upon certain infrastructure and services to be provided by the schools. This results in continuation of the equality problems in the Turkish educational system. He also warns that the new teaching methods and principles, approaches and the philosophies, purposes and the outputs contradict with the knowledge, values and the way how the current teachers were developed. Lastly, he claimed that the expectations from the primary level students in the new programs such as being entrepreneurs, being conscious consumers, carrier planners or taking risk are higher than their developmental levels.

2.4.1. Science and Technology Program

Board of Education developed the new Science and Technology Program with a team consisting of various academics from different universities and students, parents, teachers, inspectors and various civil society organizations commented on the new programs (BoE, 2005). In the literature, the attainment of the Science and Technology Course objectives is highly connected to the success of the students in their whole school life. For example, Howe (2002) argues that the teachers, who attain the objectives such as promoting curiosity towards the environment the students live in, observing and exploring their environment to enable them to transform their experiences into regular knowledge, enabling them to develop techniques and mental skills for the prospective scientific studies they would conduct, making it possible for them to

conduct practical studies in order for them to grasp the importance of science in life, enabling them to associate what they learn in schools with their own lives and enabling them to get the pleasure from science and develop positive attitudes towards school; help them to become successful students throughout their educational lives.

The overall objectives of science and technology program that has been put into practice in Turkey are defined as:

- Enabling students to learn and understand the natural world, and live the mental richness and excitement of it,
- Encouraging students to develop curiosity for scientific and technologic advances and events at every grade level,
- Enabling students to understand the nature of the science and technology; the interaction between science, technology, society and environment,
- Enabling students to gain the skills of constructing new knowledge through investigation, reading and discussion,
- In terms of their further education and occupation choice, forming the background that will help them develop knowledge, experience, and interest regarding the occupations based on science and technology,
- Enabling students to learn learning and therefore to develop the capacity that will keep in step with the changing nature of the occupations,
- Enabling students to use science and technology in obtaining information and problem solving in unfamiliar situations that they may likely encounter,
- Enabling students to recognize the social, economic, ethic, personal, health and environmental issues related to science and technology,
- Enabling students to be willing to know and understand, inquire, value to the natural environment, value to logic, have scientific values such as thinking the consequences of the actions, act in line with there values in interacting with the society and environment,
- Increasing students' productivity by using knowledge, understanding, and skills in their professional lives (MEB, 2004, p. 12-13 as cited in Yaşar & Duban, 2007).

The main topics, units and their learning outcomes of the new Science and Technology Courses are in Table 8.

Kırıkkaya and Tanrıverdi (2006) conducted a study on the level of importance and the degree of achievement of learning outcomes related to skill, understanding,

attitude and values in the science and technology program. The sample of the study was the 4th and 5th grade teachers in Kocaeli province and the 3rd year Faculty of Education students at Kocaeli University. The researchers found out that both in-service and pre-service perceived the learning outcomes as very important and highly achieved. Partly achieved learning outcomes were generally in the theme "Developing Life Style". The researchers reported that those partly achieved learning outcomes were difficult to develop according to the teachers in a short time and they found it difficult to observe because of the fact that they took place not only in classroom environment but also outside of the classroom. The teachers were also reported to comment that the crowded classrooms, lack of materials and equipment necessary for the activities and insufficient in-service training about the program are the reasons for not being able to actualize all the learning outcomes.

Table 8

4th and 5th Grade Science and Technology Course Contents

Main topics	4th Grade		5th Grade	
	Units	No. of outcomes	Units	No. of Outcomes
Living things and Life	1. Let's solve the riddle of our body	23	1. Let's solve the riddle of our body	22
	6. Let's explore the world of living things	16	6. Let's explore the world of living things	33
Substance and change	2. Let's recognize substance	46	2. Change of substance and its recognition	46
Physical facts	3. Power and movement	13	3. Power and movement	21
	4. Light and sound	43	4. Electricity in our lives	16
	7. Electricity in our lives	20	7. Light and sound	39
World and Universe	5. Our universe and the world	17	5. World, sun and moon	19
Total		178	Total	196

Erdoğan (2007) conducted a qualitative case study to analyze the new 4th and 5th grade science and technology program according to the steps suggested by Posner

(1995). He interviewed an expert who took part in the curriculum development process and 5 teachers from 2 pilot schools and their 56 students. The author reported that the roles of teachers and students have been redefined in the new program. Teachers are expected to facilitate the learning process of the students who are encouraged to construct their own knowledge by doing, living, searching and reasoning. According to Erdoğan (2007), spiral curriculum suggested by Bruner was taken into account when designing the content of the new Science and Technology Courses. He has 5 suggestions to improve the program during the implementation:

> 1) Since the curriculum development is a never ending process (Ornstein & Hunkins, 1988), the continuous analysis and evaluation studies associated with new curriculum should be done not only by teachers but also by Board of Education. 2) Continuous in-service training should be planned and actualized so as to share new changes, philosophy of the curriculum and the problems of teachers faced during the implementation. 3) The primary school teachers might collaborate with other groups of teachers to effectively implement the curriculum in their classrooms. 4) OKS and LGS exams for entrance to high school in Turkey should be redesigned in line with new changes in the curriculum. 5) Adequate materials and equipments should be provided to the schools to effectively and efficiently implement the curriculum. (Erdoğan, 2007).

Gömleksiz and Bulut (2006) conducted a study to determine the views of teachers on the new science and technology program. 383 classroom teachers from 64 schools in 8 different provinces responded to a 32 item science and technology curriculum scale developed by the researchers. They reported that the learning attainments, content, teaching-learning activities and evaluation were found to be effective by the teachers at much level. They also reported that there was no significant difference among the views of the teachers in terms of classroom, gender, teaching experience and education level variables.

Yangın and Dindar (2007) investigated teachers' perceptions about goals of the new science and technology program and course activities. 75 teachers from Ankara province responded to a questionnaire. The authors reported that the most favorable item was the fourth item in the questionnaire which was "to gain scientific values" and the least favorable item was "the recognition of the role of science and technology in

society". They also concluded that the perceptions of teachers concerning the course changed in a negative way and this is an indicator of a need to reconsider the goals of the program in the education system, changes in the implementation and more integration of science-technology-society themes in the program.

2.5. Summary of the Review of the Literature

As an outcome of the review of literature, it can be concluded that the constructivist views in education has highly influenced the teaching practice, the roles of both the teachers and the students. Critical constructivists on the other hand discuss that communities of administrators, teachers and students contribute to the development of the school cultures and any change in this culture needs to be participative in the sense that empowered groups of teachers and other groups put something in it. As part of the third wave of reforms in science education in western countries, social constructivism and socio-cultural perspectives have loomed large. Based on that, science educators started to recognize what their students already know, teach fewer concepts, acknowledge the diversity of learners and improve continuity across key stages and progression of the development of concepts.

Review of the literature on learning environment research provided that in the last 30 years the field has considerably developed and many instruments have been developed to assess or investigate learning environments. Constructivist Learning Environment Survey (CLES) is one of these instruments and it involves 5 scales which are personal relevance, uncertainty, critical voice, shared control and student negotiation. A psychological view of learning leads the development of the CLES and it highlights the fact that the students construct their own knowledge. Research related to learning environments mainly assess the learning environments and investigates associations between the learning environments and certain variables.

Studies on the new programs in Turkey and especially the new primary level science and technology program mainly discuss that despite some problems such as lack of equipment, crowded classrooms or inadequate infrastructure, the teachers and

students welcomed the new programs since they have many advantages in terms of learning outcomes when compared with the old programs.

CHAPTER III

METHOD

This chapter elaborates on the method used to conduct the present study that deals with understanding the extent to which constructivist learning environment aspects such as personal relevance, scientific uncertainty, critical voice, shared control and student negotiation exist in 4th and 5th grade Science and Technology Courses in primary level in Turkey as perceived by the students and the teachers. The study also aims to understand if the demographic information concerning students' socio-economic development group of the district, grade level, number of siblings, having a study room, way of transportation to school, the education of mother, the education of father, gender, existence of a computer laboratory with Internet connection at school, existence of Internet connection at home and usage of Internet during the science and technology classes affect the perceptions of the students on constructivist learning environment and its aspects. The study lastly focuses on the correlation between the perceptions of teachers on constructivist learning environment and administrative support they receive in developing constructivist learning environments in their classrooms. The chapter begins with the presentation of the overall research design. Then, the chapter proceeds with a brief description of the course and documents the constructivist learning environment compared with the traditional one. Next, the subjects, characteristics of the students who participated in the study, educational background of the teachers who participated in the study, data collection instruments, data collection procedures and data analysis are explained. The chapter ends with the limitations of the study.

3.1. Overall Research Design

Throughout the study, a cross sectional survey research design was followed in order to investigate whether constructivist learning environment aspects existed in Science and Technology courses in 4th and 5th grades and a causal-comparative research design was followed to determine whether the perceptions of students change according to certain variables. Lastly a correlation survey research design was followed to determine whether there is a relationship between the perceptions of teachers on constructivist learning environment and their perceptions on administrative support they received. The research design mainly involved five steps, namely, planning, development of a sampling plan, data collection, data analysis and reporting and interpreting the conclusions. These steps were summarized in a flowchart in Figure 2 adapted from Wiersma (1991). Two questionnaires were used to collect data from students and teachers. The student questionnaire consisted of questions concerning the demographic insides of students and their perceptions on the constructivist learning environment. The teacher questionnaire consisted of questions concerning their perceptions on constructivist learning environment, their perceptions on administrative support they received and open ended questions to gather more information on the opinions of the teachers concerning the personal relevance, uncertainty and critical voice aspects of the constructivist learning environment in addition to the open-ended question concerning the difficulties in utilizing the new programs which has something to do with the administrative support they received.

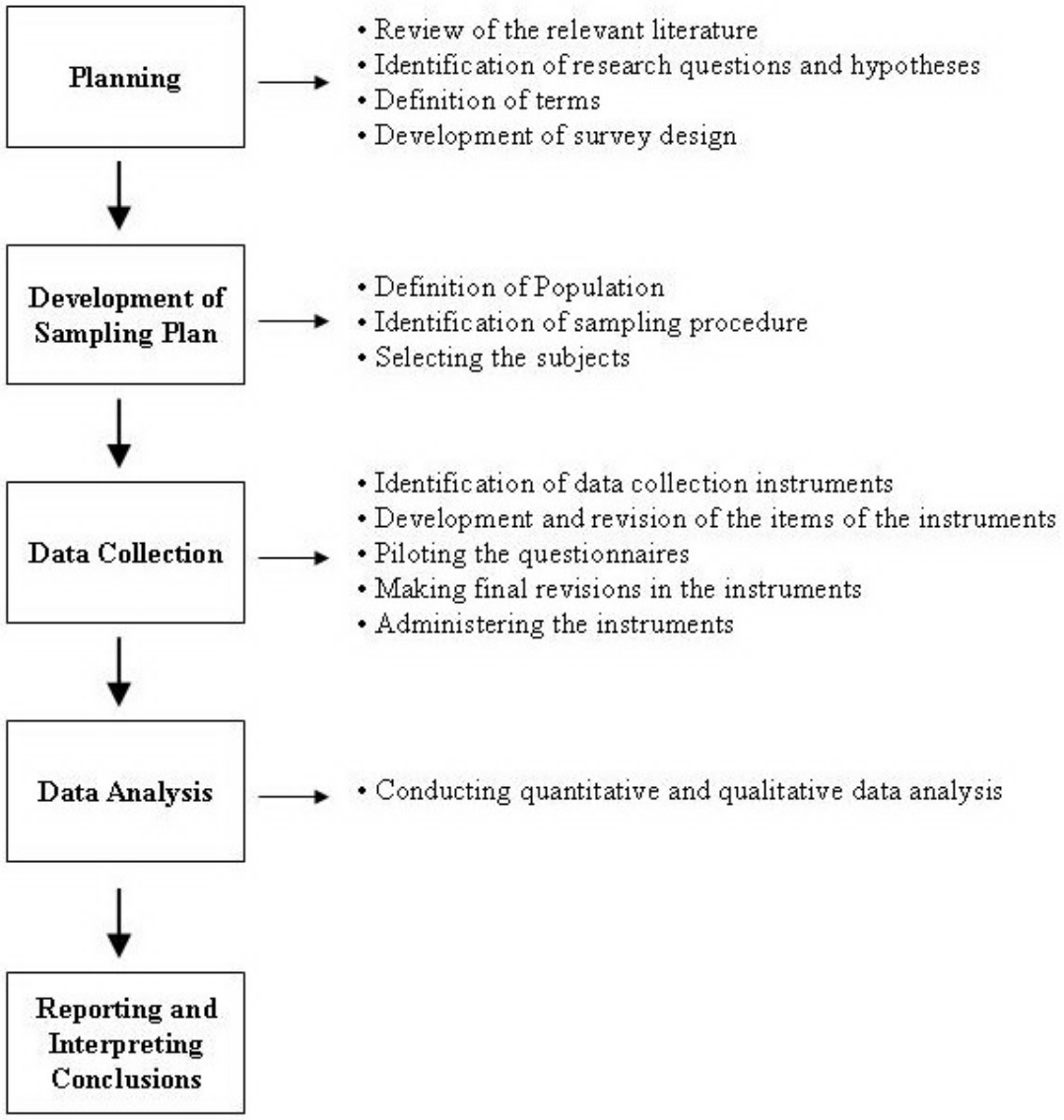

Figure 2 *Flowchart of the Design of the Study adapted from Wiersma (1991)*

3.2. Description of Science and Technology Course Program

The basic aspects of the Science and Technology Course program have been changed in 2004 and piloted in 120 schools in 9 provinces in the same school year (2004-2005). As stated in the new program, the vision is to educate all the citizens as science and technology literates. As Board of Education (2005) argues, the basic

understandings in the program of Science and Technology Course regarding the teaching and assessment processes changed significantly in comparison to the previous program. These basic changes are presented in Appendix F. Although there are controversies among different groups of educational scientists in Turkey regarding the correctness of Ministry of National Education's comparison of the program developed in 2000 and the new program, Appendix G provides an overall comparison of the two programs as provided by the ministry.

The new program has been implemented in all primary schools all over Turkey starting in 2005-2006 school year. The differences between the old and the new programs have been widely discussed in the academic circles in Turkey. The objectives of the new program are focusing on students' preparation for the future. The students are more informed about the job opportunities in the field of science and technology, they get more chance to experience some aspects of the field; the program aims to increase the motivation and interest of the students concerning science and technology. As a result of all these, it is aimed to prepare students to be capable of adapting themselves to the changing work environments in the future, developing their questioning skills, valuing the nature and the environment, being motivated to learn more, reasoning, making good use of information, different paradigms and skills to increase economic effectiveness. Some of the selected objectives relevant to this study that the Ministry of National Education pointed out can be listed as the following:

At the end of the course, the children will be able to:

- Interpret the nature of science and technology, the relationship between the two, the interaction of science and technology with the society and the environment.
- Utilize the tools, processes and strategies on issues related to science and technology.
- Develop necessary knowledge capacity and skills to take responsible and critical positions in the case of innovations.
- Interpret the development of science in various individual and social contexts, technological changes, changes in the knowledge and understanding of people in time.
- Respect different values, paradigms and decisions on science and technology related issues and act responsively.
- Investigates scientific processes and technological solutions through questioning. (MEB, 2004)

In this study, only the five aspects of a preferred constructivist learning environment were explored because of the necessity of limiting the focus of the study. Moreover, Science and Technology Course is a good case to investigate the extent of paradigm shift in students, teachers and even administrators at schools since the topics are highly appropriate to develop a constructivist learning environment in which both behaviorist approaches and constructivist approaches shall be demonstrated together. In this sense, this course could be considered as a bridge between the old and new paradigms of the programs in primary schools in Turkey.

3.3. Subjects

The population of this study is the 4th and 5th grade students in the MONE primary schools in Turkey and their teachers. A stratified sampling technique was used in this study combined with random sampling and convenient sampling techniques whenever appropriate. The sample was selected based on the State Planning Department list of districts grouped according to their socio-economic development status. All the districts in all provinces in Turkey have been grouped into six categories by the State Planning Department and accordingly this study made use of those six categories (Group 1 is the richest SES group whereas Group 6 is the poorest) (Dincer & Özaslan, 2004).

At the very first place, the whole population of 4th and 5th grade students in all provinces in Turkey has been determined through Ministry of National Education records including each and every province and district in Turkey. According to MEB (2006), number of students in primary education was 10,346,509. Number of 4th grade students was 1,332,770 and the number of 5th grade students was 1,285,862. In total, number of 4th and 5th grade students was 2,618,632. With a 95% confidence level and a 3.1% confidence interval, the sample size needed was calculated as 1000. Then, the proportions for each of the 6 socio-economic status groups were calculated through calculating the total population of the districts in each group and then dividing that sum

with the share of each specific group. For example, 13% of the whole population of Turkey lives in districts which are in Socio-Economic Status Group 1 and 26% of the whole population lives in districts which are in Group 2. Directly reflecting these proportions to the case of 4th and 5th grade students, the percentage of 4th and 5th grade students in each socio-economic status group was calculated. According to this, 13% of the 4th and 5th grade students in Turkey are in the first socio-economic status group. The percentages of 4th and 5th grade students belonging to groups 2, 3, 4, 5 and 6 are 26%, 20%,8%, 4% and 6%, respectively. Based on these proportions, the number of districts in each group to be reached in the study was determined. This led the specification of number of districts to be used in this study for each group: 3 districts in Socio-Economic Status Group 1, 7 in Group 2, 5 in Group 3, 2 in Group 4, 1 in Group 5 and 2 in Group 6. The districts have been chosen randomly from a list of districts for each of the six socio-economic status groups. In Socio-Economic Status Group 1, central district of Eskişehir, Çorlu in Tekirdağ and Gebze in Kocaeli had been chosen. In Group 2, Alanya in Antalya, central district of Şanlıurfa, Iskenderun in Hatay, central district of Yalova, Didim in Aydın, Seferhisar in İzmir and central district of Bolu were chosen. In Group 3, Kızılcahamam in Ankara, central districts of Bartın, Şırnak, Bitlis and Bingöl had been chosen. In Group 4, central district of Ardahan and Bala in Ankara were chosen. In Group 5, the only district chosen for this study was Araban in Gaziantep. Lastly, two districts were chosen in Group 6 which are Siverek in Şanlıurfa and Başkale in Van. As the last step in completing the selection of the subjects of the study, the number of students and teachers were determined for each district in each of the groups to involve 500 4th grade students in total, 500 5th grade students in total and 300 teachers in total. Table 12 represents the proportion of 4th and 5th grade students according to the student population all over the country, the number of 4th and 5th grade students and the number of teachers in each group, the districts and the number of students and teachers in each district. While selecting the schools and students in each district, a convenient sampling technique was used.

Table 9

Number of Samples Selected in each District with respect to SES Groups

SES Group	% of 4th and 5th Grades in the Population (Country)	Number of Districts According to Population Ratios	No. of 4th & 5th Grades According to Population Ratios	No. of Teachers According to Population Ratios	District	No. of 4th Grades	No. of 5th Grades	No. of Teachers
1	13	3	150	45	Eskişehir (Center)	25	25	15
					Tekirdağ (Çorlu)	25	25	15
					Kocaeli (Gebze)	25	25	15
2	26	7	350	105	Antalya (Alanya)	25	25	15
					Şanlıurfa (Center)	25	25	15
					Hatay (Iskenderun)	25	25	15
					Yalova (Center)	25	25	15
					Aydın (Didim)	25	25	15
					İzmir (Seferhisar)	25	25	15
					Bolu (Center)	25	25	15

Table 9 *(continued)*

SES Group	% of 4th and 5th Grades in the Population (Country)	Number of Districts According to Population Ratios	No. of 4th & 5th Grades According to Population Ratios	No. of Teachers According to Population Ratios	District	No. of 4th Grades	No. of 5th Grades	No. of Teachers
3	20	5	250	75	Ankara (Kızılcahamam)	25	25	15
					Bartın (Center)	25	25	15
					Şırnak (Center)	25	25	15
					Bitlis (Center)	25	25	15
					Bingöl (Center)	25	25	15
4	8	2	100	30	Ardahan (Center)	25	25	15
					Ankara (Bala)	25	25	15
5	4	1	50	15	Gaziantep (Araban)	25	25	15
6	6	2	100	30	Şanlurfa (Siverek)	25	25	15
					Van (Başkale)	25	25	15
					Total	500	500	300

3.3.1. Characteristics of the Students Participated in the Study

In this part, characteristics of the students participated in the study including the socio-economic development status group, their grade levels and their number of siblings, whether they have a study room or not, their way of transportation to school and whether they have an Internet connection at home or not are summarized. The number of students who responded the questionnaire was 1143 however total number of students may vary while reporting their certain characteristics since the number of students providing information on specific variables varied. In addition, the education levels of mothers and fathers are also reported. Table 10 summarizes the socio-economic development status groups of the students and their gender.

Table 10

Socio-Economic Development Status Groups of Students

SES Group	Gender		
	Female	Male	Total
1	87 (7.7%)	75 (6.6%)	162 (14.3%)
2	209 (18.4%)	137 (12.1%)	346 (30.5%)
3	129 (11.4%)	125 (11%)	254 (22.4%)
4	130 (11.5%)	126 (11.1%)	256 (22.6%)
5	30 (2.6%)	34 (3%)	64 (5.6%)
6	23 (2%)	28 (2.5%)	51 (4.5%)
Total	608 (53.7%)	525 (46.3%)	1133 (100%)

As seen in Table 10, about half of the students (53.7%) are female and the remaining 46.3% students are male. The distribution of the numbers in groups

represents the whole population of 4th and 5th grade students in Turkey. Although the number of students in Group 4 exceeded the expected numbers, all of them were included in the study. Next, the grade level of students according to their gender is summarized in Table 14.

As Table 11 indicates, 540 (47.7%) of the students were attending grade 4 during the 2006-2007 spring semester when this study was conducted. On the other hand, 592 (52.3%) of them were attending the 5th grade during the same period.

Table 11

Grade Level of Students

	Gender		
Grade Level	Female	Male	Total
4	296 (26.1%)	244 (21.6%)	540 (47.7%)
5	311 (27.5%)	281 (24.8%)	592 (52.3%)
Total	607 (53.6%)	525 (46.4%)	1132 (100%)

Next, number of siblings of students (including the student) in each socio-economic status group is summarized in Table 12.

As seen in Table 12, number of siblings of the students increases as the socio-economic status decreases. While only 1.9% of the students have 5 or more siblings in Group 1, 50% of the students in Group 6 have 5 or more siblings. In groups 1, 2 and 3, the students mostly have 2 siblings (54.7%, 50.1% and 31.4%, respectively). In groups 4 and 5, the students mostly have 3 siblings (37.7% and 33.8%). As mentioned above, in Group 6, half of the students have 5 or more siblings. Only 1.9% of them have 1 sibling. Next, whether the students have a separate study room or not is summarized in Table 13.

Table 12

Number of Siblings of Students

SES Group		Number of Siblings					Total
		1	2	3	4	5 +	
1	Count	26	88	26	18	3	161
	% Within Group	16.1%	54.7%	16.1%	11.2%	1.9%	100%
2	Count	49	173	79	24	20	345
	% Within Group	14.2%	50.1%	22.9%	7%	5.8%	100%
3	Count	17	80	62	31	65	255
	% Within Group	6.7%	31.4%	24.3%	12.2%	25.5%	100%
4	Count	18	70	98	40	34	260
	% Within Group	6.9%	26.9%	37.7%	15.4%	13.1%	100%
5	Count	2	6	22	16	19	65
	% Within Group	3.1%	9.2%	33.8%	24.6%	29.2%	100%
6	Count	1	5	8	12	26	52
	% Within Group	1.9%	9.6%	15.4%	23.1%	50%	100%
TOTAL	Count	113	422	295	141	167	1138
	% Within Group	9.9%	37.1%	25.9%	12.4%	14.7%	100%

As seen in Table 13, 55.6% of the students provided that they have a separate study room whilst the remaining 44.4% provided that they do not own a separate study room at home. In Table 14, way of transportation to school is summarized.

Table 13

Students' Owning a Separate Study Room

Study Room	Gender		Total
	Female	Male	
Yes	348 (31%)	276 (24.6%)	624 (55.6%)
No	255 (22.7%)	244 (21.7%)	499 (44.4%)
Total	603 (53.7%)	520 (46.3%)	1123 (100%)

Table 14

Students' Way of Transportation to School

Way of Transportation to School	Gender		Total
	Female	Male	
Taken by Family	61 (5.4%)	39 (3.5%)	100 (8.9%)
By Bus	169 (15%)	145 (12.9%)	314 (27.9%)
On Foot	373 (33.2%)	337 (30%)	710 (63.2%)
Total	603 (53.6%)	521 (46.4%)	1124 (100%)

Table 14 indicates that 8.9% of the students are taken to school by their families, 27.9% goes to school by bus and more than half of them (63.2%) go to school on foot. Next, the availability of an Internet connection at students' home is investigated in Table 15.

Table 15

Availability of Internet Connection at Students' Home

SES Group		Internet Connection at Home		Total
		No	Yes	
1	Count	70	74	144
	% Within Group	48.6%	51.4%	100%
2	Count	140	178	318
	% Within Group	44%	56%	100%
3	Count	137	59	196
	% Within Group	69.9%	30.1%	100%
4	Count	128	29	157
	% Within Group	81.5%	18.5%	100%
5	Count	58	1	59
	% Within Group	98.3%	1.7%	100%
6	Count	31	12	43
	% Within Group	72.1%	27.9%	100%
Total	Count	564	353	917
	% Within Group	61.5%	38.5%	100%

In Table 15, it is indicated that students in higher socio-economic status groups have more Internet connection at their homes. While in groups 1 and 2 more than half of the students have Internet connection at home (51.4% and 56%, respectively), in groups 3, 4, 5 and 6, most of the students do not have an Internet connection at home. 69.9% of the students in Group 3 provided that they do not have an Internet connection while 81.5% in Group 4, 98.3% in Group 5 and 72.1% in Group 6 provided that they do not have an Internet connection at home. Next, education level of students' mothers (ELoM) is summarized according to the socio-economic status groups.

Table 16

Education Level of Mothers in 6 Socio-Economic Status Groups

SES Group	%	ELoM					
		Never Attended to School	Primary School	Secondary School	High School	University	Total
1	Count	2	83	23	34	20	162
	Within Group	1.2%	51.2%	14.2%	21.0%	12.3%	100.0%
	Within ELoM	1.3%	15.5%	20.0%	17.7%	14.7%	14.4%
	% of Total	.2%	7.4%	2.0%	3.0%	1.8%	14.4%
2	Count	23	111	36	89	83	342
	Within Group	6.7%	32.5%	10.5%	26.0%	24.3%	100.0%
	Within ELoM	15.3%	20.7%	31.3%	46.4%	61.0%	30.3%
	% of Total	2.0%	9.8%	3.2%	7.9%	7.4%	30.3%
3	Count	65	112	15	41	21	254
	Within Group	25.6%	44.1%	5.9%	16.1%	8.3%	100.0%
	Within ELoM	43.3%	20.9%	13.0%	21.4%	15.4%	22.5%
	% of Total	5.8%	9.9%	1.3%	3.6%	1.9%	22.5%
4	Count	21	174	29	19	11	254
	Within Group	8.3%	68.5%	11.4%	7.5%	4.3%	100.0%
	Within ELoM	14.0%	32.5%	25.2%	9.9%	8.1%	22.5%
	% of Total	1.9%	15.4%	2.6%	1.7%	1.0%	22.5%
5	Count	18	36	4	6	0	64
	Within Group	28.1%	56.3%	6.3%	9.4%	.0%	100.0%
	Within ELoM	12.0%	6.7%	3.5%	3.1%	.0%	5.7%
	% of Total	1.6%	3.2%	.4%	.5%	.0%	5.7%
6	Count	21	19	8	3	1	52
	Within Group	40.4%	36.5%	15.4%	5.8%	1.9%	100.0%
	Within ELoM	14.0%	3.6%	7.0%	1.6%	.7%	4.6%
	% of Total	1.9%	1.7%	.7%	.3%	.1%	4.6%
Total	Count	150	535	115	192	136	1128
	Within Group	13.3%	47.4%	10.2%	17.0%	12.1%	100.0%
	Within ELoM	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	13.3%	47.4%	10.2%	17.0%	12.1%	100.0%

As seen in Table 16, only 1.2% of the mothers in Group 1 did not attend a school at all. As the socio-economic status decreases, the percentage of mothers who did not attend a school at all increases. In Group 2 and 3, 23.5% and 44.1% of

the mothers graduated from a primary school. In Group 4, more than half of the students provided that their mother graduated from a primary school (68.5%). In Group 5, 28.1% of the students provided that their mothers never went to a school and 56.3% provided that their mothers graduated from a primary school. In Group 6, 40.4% of them never attended a school and 36.5% of them graduated from primary school. 1.9% of the students in Group 6 provided that their mothers graduated from a university. In Group 5, none of the students provided that their mother graduated from a university. 4.3% of students in Group 4, 8.3% of them in Group 3, 24.3% of them in Group 2 and 12.3% in Group 1 provided that their mothers graduated from a university. Next, education level of fathers (ELoF) in 6 socio-economic status groups is summarized in Table 17.

As indicated in Table 17, in Group 1, none of the students provided that their father did not go to a school (0%). However in Group 6, 7.7% of the students provided that their father never went to a school. 33.3% of the students in Group 1 provided that their father graduated from a high school. 38.5% of them in Group 2 provided that their father graduated from a university. In Group 3, 31.6% of the students provided that their father graduated from a high school. In Group 4 more than half of the students and in groups 5 and 6 nearly one third of the students provided that their fathers graduated from a primary school (54.8%, 34.9% and 38.5%, respectively).

Table 17

Education Level of Fathers in 6 Socio-Economic Status Groups

SES Group	%	ELoF					
		Never Attended to School	Primary School	Secondary School	High School	University	Total
1	Count	0	37	27	54	44	162
	Within Group	.0%	22.8%	16.7%	33.3%	27.2%	100.0%
	Within ELoF	.0%	10.4%	16.3%	18.9%	16.2%	14.4%
	% of Total	.0%	3.3%	2.4%	4.8%	3.9%	14.4%
2	Count	7	69	49	86	132	343
	Within Group	2.0%	20.1%	14.3%	25.1%	38.5%	100.0%
	Within ELoF	15.9%	19.3%	29.5%	30.2%	48.7%	30.5%
	% of Total	.6%	6.1%	4.4%	7.7%	11.8%	30.5%
3	Count	26	72	25	80	50	253
	Within Group	10.3%	28.5%	9.9%	31.6%	19.8%	100.0%
	Within ELoF	59.1%	20.2%	15.1%	28.1%	18.5%	22.5%
	% of Total	2.3%	6.4%	2.2%	7.1%	4.5%	22.5%
4	Count	6	137	43	35	29	250
	Within Group	2.4%	54.8%	17.2%	14.0%	11.6%	100.0%
	Within ELoF	13.6%	38.4%	25.9%	12.3%	10.7%	22.3%
	% of Total	.5%	12.2%	3.8%	3.1%	2.6%	22.3%
5	Count	1	22	13	21	6	63
	Within Group	1.6%	34.9%	20.6%	33.3%	9.5%	100.0%
	Within ELoF	2.3%	6.2%	7.8%	7.4%	2.2%	5.6%
	% of Total	.1%	2.0%	1.2%	1.9%	.5%	5.6%
6	Count	4	20	9	9	10	52
	Within Group	7.7%	38.5%	17.3%	17.3%	19.2%	100.0%
	Within ELoF	9.1%	5.6%	5.4%	3.2%	3.7%	4.6%
	% of Total	.4%	1.8%	.8%	.8%	.9%	4.6%
Total	Count	44	357	166	285	271	1123
	Within Group	3.9%	31.8%	14.8%	25.4%	24.1%	100.0%
	Within ELoF	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	3.9%	31.8%	14.8%	25.4%	24.1%	100.0%

3.3.2. Educational Background of the Teachers Participated in the Study

In order to provide quality information on the educational background of the teachers participated in the study, very shortly the teacher education in Turkey is given so that the system that these teachers were educated in is shared. The establishment of the Council of Higher Education is a turning point in higher education in Turkey. All the higher education institutions were reorganized the same year when the new higher education law was passed in the parliament in 1981; the same year when the Council of Higher Education was established. Teachers' colleges became parts of universities. In short, the Higher Education Reform in 1981 resulted in transfer of all teacher training institutions of Ministry of National Education to the university system (Simsek & Yıldırım, 2001). Lately, compulsory education was increased from 5 to 8 all over Turkey and this also created trouble in finding teachers to take responsibility in primary schools in Turkey. This resulted in the need for universities to increase their capacities so that they train more primary school teachers. The government changed the programs of the education faculties to increase the length of methodology courses, to add more pedagogical courses and to spend more time on developing the teaching skills of the students to educate effective instructors at the end of the programs. The Ministry of National Education and the Council of Higher Education, the two important institutions leading the education sector in Turkey, cooperated to implement these reforms in teacher trainings (Simsek & Yıldırım, 2001).

In the reformed teacher training programs, field experiences were attached importance and the teacher candidates had to spend more time on classroom observation and teaching practice before they graduated. Although some of them graduated from teachers' colleges or from other teacher education institutions before the mentioned reforms, the science and technology teachers who took part in this study have either assimilated their experience to relate them to the work being done at the faculty and to discuss them with staff and other students when they were pre-service teachers or they have been teachers for more than 10 years which allowed them accumulate enough experience in teaching science and technology and adapt themselves to the new course program. Below is a summary of the courses related to

science, education and teaching profession that pre-service teachers required completing in Turkey right after the mentioned reforms at the end of 1990s (see Table 18).

Table 18

Courses that Pre-Service Teachers Take before They Graduate from University

Courses	Total Credit
Biology	16
Physics	14
Chemistry	14
Introduction to teaching profession	3
Learning and Development	3
Instructional Planning and Evaluation	4
Methods of Science Teaching	6
School Experience	6
Practice Teaching	5

Science teachers complete the four year undergraduate programs in Turkey and these programs in different universities are more or less the same as they follow very similar coursework that the Council of Higher Education suggests. As an example for these programs; the purpose of the Department of Elementary Science Education at Middle East Technical University, as the head of department provides in official homepage of the department, is "to educate science teachers with a good self-image, an outgoing personality, a sense of humor and an interest in helping their students to understand science in a meaningful way. The program also aims to develop teachers with a sound understanding of how children learn science; confident in using technology; capable in problem-solving; attentive to human

rights, democracy, and ethics. The program emphasizes critical thinking, personal reflection, and professional development of pre-service science teachers".

3.4. Data Collection Instruments

Over the past two decades, considerable interest has been shown internationally in the conceptualization, measurement and investigation of perceptions of psychosocial characteristics of the learning environment of primary and secondary schools (Taylor, Fraser, & Fisher, 1997). Several instruments have been developed to assess classroom environment. The Learning Environment Inventory (Fraser, Anderson & Walberg, 1982), the Classroom Environment Scale (Moos & Trickett, 1974) and the Individualized Classroom Environment Questionnaire have been used extensively to assess classroom environment at the secondary level. The My Class Inventory (Fisher & Fraser, 1981; Fraser, Anderson & Walberg, 1982) and the College and University Classroom Environment Inventory (Fraser & Treagust, 1986) were developed for use at the primary and university levels, respectively. Because of the importance and uniqueness of laboratory settings in science education, the Science Laboratory Environment Inventory was developed to assess the environment of science laboratory classes (Fraser, Giddings & McRobbie, 1995). Also in order to provide a questionnaire for the study of the science outdoor learning environment, the Science Outdoor Learning Environment Inventory was developed (Orion, Hofstein, Tamir & Giddings, 1997). Although most classroom environment research has focused on the assessment and improvement of learning and teaching, it has done so largely within the context of traditional epistemology underpinning the established classroom environment (Taylor, Fraser & Fisher, 1997). However, the traditional teacher-centered, didactic approach to teaching has been extensively criticized and there is a better understanding of the nature of knowledge development. Therefore, the Constructivist Learning Environment Survey (CLES) was developed with a psychological view of learning that focused on students as co-constructors of their own knowledge (Taylor & Fraser, 1991). Originally, the CLES was found to be valid (Taylor & Fraser, 1991; Taylor, Fraser & Fisher, 1997) and to contribute insightful understanding of classroom learning environment (Roth & Roychoudury,

1993; 1994). As mentioned above, critical constructivism brings together critical theory and constructivist theory to provide a powerful social epistemology that values discourse aimed at generating critical self-reflective thinking (Taylor, 1996). This framework has been made accessible to teachers of science by the development of the Constructivist Learning Environment Survey (CLES) which has been designed to assist teacher researchers to monitor the development of learning environments in school science in accordance with the referent of critical constructivism (Taylor, Fraser, & Fisher, 1997). In this study, the data collection instruments were two questionnaires; one for students and one for teachers. In the following sections, further information on the instruments is provided.

3.4.1. Student and Teacher Questionnaires

This part is devoted to the description of the two questionnaires and the procedures followed for developing them.

The student questionnaire consists of questions on grade level, gender, school name, province and district, number of siblings, availability of a separate study room at home, way of transportation to school, education level of mother, education level of father in section A as personal information; likert-scale type 26 questions in section B investigating perceptions of students on 5 different aspects of a preferred constructivist learning environment; and in section C, questions on Internet usage such as existence of a computer laboratory with Internet connection at school, existence of Internet connection at home and usage of Internet during the science and technology classes. Section B which is on the perceptions of the student concerning the constructivist learning environment in their classrooms was adapted from the Constructivist Learning Environment Survey (CLES) by Taylor and Fraser (1997). CLES consists of five scales to collect data on the perceptions of students about five aspects of a constructivist learning environment. These scales are: 1) Personal Relevance, 2) Scientific Uncertainty, 3) Critical Voice, 4) Shared Control and 5) Student Negotiation. The reflection of these scales on the questionnaires are 1) Learning About Life, 2) Learning About Science and Technology, 3) Expressing Oneself, 4) Learning How to Learn, and 5) Interaction Among Students. First scale which is learning about life is a reflection of the aspect namely personal relevance,

which is concerned with the use of students' everyday experiences as a basis for developing students' understanding of science concepts (Taylor, Fraser & White, 1994). The second scale, learning about science and technology, is focused on scientific uncertainty aspect of the constructivist learning environment in which the teachers provide opportunities for students to experience the "inherent uncertainty, subjectivity and limitations of scientific knowledge (Taylor, Dawson, & Fraser, 1995). The third scale, expressing oneself represents critical voice aspect in which the prevailing social climate encourages students to question and express concerns about the teacher's pedagogical plans and methods (Taylor, Fraser & White, 1994). This particular aspect incorporates the critical theory of Habermas. Fourth scale, learning how to learn is a reflection of shared control aspect of a constructivist environment in which students are involved with the teacher in the planning of the learning environment, "including the articulation of their own learning goals, the design and management of their learning activities, and determining and applying assessment criteria" (Taylor, Dawson, & Fraser, 1995). Lastly, interaction among students scale is a reflection of the student negotiation aspect of a constructivist learning environment in which student-student interactions of explaining, justifying, understanding and reflecting on the viability of scientific ideas are emphasized (Taylor, Dawson, & Fraser, 1995). To measure these aspects, a survey which consists of sections in parallel with the mentioned aspects is used. The sections of the survey are "Learning about life", "Learning about science and technology", "Learning to speak out", "Learning to learn" and "Learning to communicate". Table 19 provides a summary of the five scales in section B of the student questionnaire which involves 26 questions to gather data on the perceptions of the students regarding constructivist learning environment in their classrooms.

The second data collection instrument which is teacher questionnaire is also mainly adapted from CLES and in addition there are four open ended questions to collect qualitative data from the teachers concerning different aspects of the study such as personal relevance, shared control, student negotiation and school support they have while implementing the new science and technology program in their courses. Section A of teacher questionnaire consists of 26 questions on CLE, section B has 12 questions on administrative support and section C consists of 4 open ended questions.

Constructivist Learning Environment Survey (CLES) by Taylor and Fraser (Taylor, 1997) is on the Internet free of charge for the usage of teachers to get information from their students. There is a link in Taylor's personal homepage to the web site where the instrument shall be downloaded. The researcher has got into communication with Taylor via e-mail and received his approval for the usage of the instrument in this research study (see Appendix C).

Table 19

Sub-Scales of Constructivist Learning Environment Survey (CLES)

Scale Name	Description	Reflection of the Scale on the Questionnaire	Sample Item
Personal Relevance	Relevance of learning to students' lives	Learning about life	I have learnt that science and technology may be a part of my life outside school
Uncertainty	Provisional status of scientific knowledge	Learning about science and Technology	I have learnt that technology may change in time
Critical Voice	Legitimacy of expressing a critical opinion	Learning to speak out	I can express myself about anything which hinders my learning
Shared Control	Participation in planning, conducting and assessing of learning	Learning to learn	I inform my teacher about the period of time I need for activities
Student Negotiation	Involvement with other students in assessing viability of new ideas.	Learning to communicate	I share my opinions about the course with my friends

The instruments were applied after the protocol was signed with EARGED from 4th grade and 5th grade students in the schools of the mentioned districts above. Their teachers also responded the questionnaires.

3.4.2. Development of the Questionnaires

The following steps were taken in order for strengthening the tools in respect to validity and reliability concerns:

The Constructivist Learning Environment Survey (CLES) by Taylor (1997) has been translated into Turkish through the application of translation / back translation method. Four English Language teachers from Eastern Mediterranean University Preparatory School translated all the items in the scales into Turkish. Later, four different teachers at same level selected the best out of four translated items. Once the assessment of four teachers was completed; this eventually led the selection of best translated Turkish statements for each of the items in the scales. The main difficulties faced during this process were to try to provide feedback and explain Eight different people what the original statements focus on based on the approaches in the field of educational sciences and the constructivist approach whenever needed. At the end, the Turkish versions of the CLES were developed both for students and the teachers.

After translation of survey items into Turkish, they were digested and looked over by specialists for some aspects. The thesis advisor helped in assessing each item for many aspects. Then, two professors from the department of educational sciences at METU provided feedback on the items. An expert who holds master's degree in the field of Human Resources Management went through the items to provide his opinions and suggestions. Another expert, who has a Ph. D. from Department of Secondary Science and Mathematics Education, Faculty of Education METU and conducting work in the field of measurement and evaluation, contributed to the development of the tools with his valuable feedback and the instruments were revised accordingly. Additionally, two primary teachers who are experienced in their fields for many years in different schools, have gone through the instruments to identify the items that are not clear enough and those items were revised. The teachers' survey was conducted in Gazeteci Hasan Tahsin Primary School in Ankara and 5 teachers provided their feedback on the items which needed to be revised. Later, 30 more teachers filled in the survey to assess the reliability of the survey with the involvement of at least 35 teachers in total. In the same school, equally distributed female and male 40 students from 4^{th} and 5^{th} grades have filled in

the students' survey and their feedback was received on each item. In cases that items were not clear to students, they were rephrased and took part in the instrument accordingly. The Cronbach's Alpha reliability coefficients of 5 different aspects and the whole questionnaires are provided in Table 20.

Table 20

Reliability Coefficients of Questionnaires

	Student Questionnaire	Teacher Questionnaire
N	40	35
Personal Relevance (α)	.70	.67
Scientific Uncertainty (α)	.60	.68
Critical Voice (α)	.69	.78
Shared Control (α)	.73	.77
Student Negotiation (α)	.71	.82
Whole Questionnaire (α)	.88	.91

In addition to the pilot study conducted to determine the Cronbach's Alpha reliability coefficients of the two questionnaires used in this study, to provide supportive information, a thorough literature review was conducted concerning the internal validity (alpha reliability) of the original CLES and Table 21 involves information collected on this aspect.

Table 21

Research Providing Alpha Reliability for CLES

Title of the study	Researcher(s)	N	Personal Relevance (α)	Scientific Uncertainty (α)	Critical Voice (α)	Shared Control (α)	Student Negotiation (α)
Science Learning Environments: Assessment, Effects and Determinants	Barry J. Fraser	1081	.88	.76	.85	.91	.89
Monitoring Constructivist Classroom Learning Environments	Peter C. Taylor, Barry J. Fraser and Darrell L. Fisher	Between 1574 and 1626	.70	.61	.82	.89	.89
Constructivist Learning Environments in a Cross-National Study in Taiwan and Australia	Jill M. Aldridge, Barry J. Fraser, Peter C. Taylor and Chung-Chi Chen	RC: 1879 AUS: 1081	RC: .87 AUS: .88	RC: .83 AUS: .76	RC: .73 AUS: .85	RC: .92 AUS: .91	RC: .85 AUS: .89
Assessment and Investigation of Constructivist Science Learning Environments in Korea	Heui-Baik Kim, Darrell L. Fisher and Barry J. Fraser	1107	.79	.64	.84	.86	.87

Table 21 *(continued)*

Title of the study	Researcher(s)	N	Personal Relevance (α)	Scientific Uncertainty (α)	Critical Voice (α)	Shared Control (α)	Student Negotiation (α)
CLES: An instrument for monitoring the development of constructivist learning environments	Peter C Taylor, Barry J Fraser and Loren R White	34	.81	.54	.79	.85	.68
ow Are Our Graduates Teaching? Looking at the Learning Environments in Our Graduates' Classrooms	Bruce Johnson and Robert McClure	476	.80	.81	.83	.85	.91

3.5. Data Collection Procedures

The significance of this study comes from the fact that the results can be generalized to the whole population of 4th and 5th grades in primary schools in Turkey. Directorate of Educational Research and Development (EARGED) in Ministry of National Education (MONE) contributed to the data collection phase of this study. The process of receiving this support was such:

1. The researcher applied EARGED with a proposal to get their support. The proposal consisted of the problem statements, the purpose and the significance of the study, the limitations, and the definitions of terms, the method section and the data collection instruments.
2. The proposal was assessed by EARGED.
3. EARGED suggested some changes in the proposal and those changes were reflected to the proposal and consecutively to the study. The suggestions were focusing on the validity and reliability of the study. This was a long process in which the researcher visited EARGED for plenty of times to discuss the suggestions and possible changes to overcome validity and reliability threats.
4. The proposal was accepted by EARGED and a protocol was signed between EARGED, the thesis advisor and the researcher.
5. EARGED took responsibility to copy and send the data collection instruments to the relevant Provincial MONE Directorates.
6. Provincial MONE directorates distributed the instruments to schools and collected them through official writings.
7. Provincial MONE directorates expected the school administrators to consider ethical issues while collecting the data and allowed them to complete the whole process within a week. The students filled in the questionnaires in the classrooms in 30 minutes and the teachers filled in the questionnaires in teachers' room in again 30 minutes.

8. MONE Provincial directorates sent the filled in questionnaires back to EARGED through official ways and EARGED shared this data and the official letters coming from the schools, districts and the provinces with the researcher. This process was finalized within 2006-2007 spring period.

3.6. Data Analysis

The following methods were used for the analysis of the data: The qualitative data obtained from the open ended questions in the teacher questionnaires were analyzed through writing them down on a word document which was formatted by leaving a wide space in the right margin in order to facilitate reading it and to write comments next to the answers provided by the teachers for each of the four open ended questions. Then, the meaningful opinions were selected among the whole set of answers and repeated ones were eliminated. Lastly, the opinions of teachers were categorized according to their relevancy with the research questions and their sub questions. They were also reported in results chapter of this study.

Since the perceptions of students and teachers on constructivist learning environment is being investigated in the first research question, the mean, standard deviation and frequencies for each of the 5 scales in the instruments were calculated. To find answers to the second research question and its sub questions, whether there is a difference in the perceptions of students or not was investigated according to certain categorical variables which are the socio-economic status group of the district, grade level, number of siblings, having a study room, way of transportation to school, the education of mother, the education of father, gender, existence of a computer laboratory with Internet connection at school, existence of Internet connection at home and usage of Internet during the science and technology classes. For this purpose, MANOVA was used. In the case of the third research question, the relationship between the perceptions of teachers on the administrative support they received while trying to implement the new science and technology program in their classrooms and their perceptions on the 5 major aspects of constructivist learning environment was investigated. For this purpose,

the mean values for each of the 5 CLE aspects were calculated and the Pearson R correlation coefficient was investigated with the mean of the perceptions of teachers on administrative support they received.

The following tables (see Table 22, 23 and 24) provide a summary of variables relevant to each research question and the statistical analysis used to answer each research question.

Table 22

Variables and Statistical Analysis Used to Answer Research Question 1

Research Question 1
To what extent does the Science and Technology Course Learning Environment of 4th and 5th grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) of a preferred constructivist learning environment as perceived by the students and their teachers?
Variables
• Student perceptions on CLE (26 items in student survey) • Student perceptions on personal relevance (6 items in student survey) • Student perceptions on uncertainty (4 items in student survey) • Student perceptions on shared control (5 items in student survey) • Student perceptions on student negotiation (5 items in student survey) • Student perceptions on critical voice (6 items in student survey) • Teacher perceptions on CLE (26 items in teacher survey) • Teacher perceptions on personal relevance (6 items in teacher survey) • Teacher perceptions on uncertainty (4 items in teacher survey) • Teacher perceptions on shared control (5 items in teacher survey)

Table 22 *(continued)*

• Teacher perceptions on student negotiation (5 items in teacher survey) • Teacher perceptions on critical voice (6 items in teacher survey)
Statistical Analysis
Repeated Measures ANOVA, mean, standard deviation and frequencies of all variables

Table 23

Variables and Statistical Analysis Used to Answer Research Question 2

Research Question 2
Do primary 4th and 5th grade students' perceptions of Constructivist Learning Environment (CLE) in Science and Technology Course in Turkey in five aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) differ according to their certain characteristics (the socio-economic status group of their district, grade, gender, socio economic status of students as indicated by their number of siblings, having a study room, way of transportation to school, the education level of their mother and the education level of their father; and their use of technology as indicated by existence of a computer laboratory with internet connection at school, existence of an internet connection at home and usage of internet during the science and technology classes)?

Table 23 *(continued)*

Variables
1. Student perceptions on constructivist learning environment (26 items in student survey)
2. Student perceptions on personal relevance (6 items in student survey)
3. Student perceptions on uncertainty (4 items in student survey)
4. Student perceptions on shared control (5 items in student survey)
5. Student perceptions on student negotiation (5 items in student survey)
6. Student perceptions on critical voice (6 items in student survey)
7. The socio-economic status group of the district
8. Grade level
9. Number of siblings
10. Having a study room
11. Way of transportation to school
12. The education of mother
13. The education of father
14. Gender
15. Existence of a computer laboratory with Internet connection at school
16. Existence of Internet connection at home
17. Usage of Internet during the science and technology classes
Statistical Analysis
MANOVA to investigate difference in variables 1-6 according to SES (variables 9, 10, 11, 12 and 13), Technology Use (variables 15, 16 and 17), variables 7, 8 and 14.

Table 24

Variables and Statistical Analysis Used to Answer Research Question 3

Research Question 3
Is there a significant relationship between teachers' perceptions on Constructivist Learning Environment (CLE) and their perceptions on administrative support they received?
Variables
1. Teacher perceptions on constructivist learning environment (26 items in teacher survey) 2. Teacher perceptions on personal relevance (6 items in teacher survey) 3. Teacher perceptions on uncertainty (4 items in teacher survey) 4. Teacher perceptions on shared control (5 items in teacher survey) 5. Teacher perceptions on student negotiation (5 items in teacher survey) 6. Teacher perceptions on critical voice (6 items in teacher survey) 7. Teacher perceptions on school support they have (12 items in teacher survey)
Statistical Analysis
Pearson R correlation to investigate the relationships between the means of 1-6 and 7, respectively.

3.7. Limitations

The results obtained in this study did not involve comparison of students' and teachers' perceptions which is a limitation of the study. Perceptions of students and teachers are personal reporting scales which mean it is not possible to hundred percent be sure that their responses were really their own ideas and perceptions.

In addition, the validity of the study is limited to the reliability of the instruments used in the study. While assessing the proposal, EARGED suggested shortening the

teacher questionnaire and this resulted in lack of demographic information on teachers such as their experience and age; and this limited the study in further discussing the determining factors of the perceptions of the teachers.

CHAPTER IV

RESULTS

This chapter presents the results related to the research questions of the study. As it was stated before, the purpose of this study was mainly to investigate the perceptions of students and their teachers on constructivist classroom environment and its aspects (personal relevance, uncertainty, critical voice, shared control and student negotiation) in 4th and 5th grades Science and Technology courses in Turkish primary schools and to find out whether perceptions of students on constructivist learning environment and its aspects differed according to certain variables or not. Another purpose was to investigate the correlation between the perceptions of teachers on constructivist learning environment including all its aspects and school support they received.

The overall results of the data analysis related to each research question in the study are presented in the following parts. While reporting the open ended questions, the opinions and suggestions that were mentioned by a considerable number of teachers (at least 10) were considered.

4.1. Perceptions of Students on Constructivist Learning Environment

In order to give an answer to research question 1, "To what extent does the Science and Technology Course Learning Environment of 4th and 5th grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) of a preferred constructivist learning

environment as perceived by the students and their teachers?", firstly, the student questionnaire was administered to 1143 students in grades 4 and 5 in Science and Technology Course (160 from Socio-Economic Development Status Group 1, 343 from Group 2, 251 from Group 3, 246 from Group 4, 62 from Group 5 and 51 from Group 6, respectively). The items were scored in the following way: Always is 3.26-4.0, often is 2.51-3.25, sometimes is 1.76-2.50 and never is 1-1.75.

First, the total scores obtained from the whole student questionnaire and its mean and standard deviation were presented. Additionally, repeated measures ANOVA was conducted to determine whether the mean differences among the aspects of CLE are significant as perceived by students. The sixth item of the personal relevance aspect of constructivist learning environment in student questionnaire, "I face difficulties in making connections between what I learn at school and my life out of school" and the first item of the uncertainty aspect which is "I can solve all of the problems in life through science and technology" were reversed before the assessment because higher scores on those items represent negative perceptions. The questionnaire had 26 questions on constructivist learning environment and its five aspects. The mean of the total score of the questionnaire was 78.01 (M = 3.00 out of 4 / close to often) while its standard deviation was 11.51 (Sd = .44). The results suggested that the students perceived the constructivist learning environment and its aspects to be often constructivist. The lowest score obtained was 40 (M = 1.54 out of 4) while the highest score was 101 (M = 3.88 out of 4).

As seen in Table 28 more than half of the students (68 %) perceived the learning environment and its aspects to be often constructivist while only 16 % of them perceived them to be sometimes constructivist. 15% of the students perceived the constructivist learning environment and its aspects to be always constructivist. On the other hand, nearly none of the students perceived the learning environment to be never constructivist (0.3%). Next, the means, standard deviations, frequencies and percentages of the aspects of the constructivist learning environment including personal relevance, uncertainty, critical voice, shared control and student negotiation were calculated.

In order to find an answer for research question 1.1, "To what extent does the Science and Technology Course Learning Environment of 4th and 5th grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) of a preferred constructivist learning environment as perceived by students?", the questionnaires administered to the students were analyzed.

Table 25

Total Scores of Students as Obtained Through Student Questionnaire

Total Score	Frequencies	Percentages (%)
Always	175	15
Often	777	68
Sometimes	183	16
Never	4	0.3
Total	1143	100

As seen in Table 29, analysis of the mean scores revealed that all the aspects of the learning environment were perceived to be often constructivist by the students. (M = 3.1, M = 3.21, M = 2.9, M = 3.02 and M = 2.64, respectively). Most of the students perceived the personal relevance, uncertainty, critical voice and shared control aspects of the learning environment either always or often constructivist (42.3%, 43%, 31.3% and 37%, respectively perceived always and 39.8 %, 45.9%, 39.4% and 39.8%, respectively perceived often). Nearly half of the students perceived the student negotiation aspect to be often constructivist (40.8%) and 34.6% perceived this aspect sometimes constructivist. On the other hand, when the percentages of Always and Often

were added up, it was found out that in all aspects the students perceived the learning environment mostly constructivist.

Table 26

Responses of Students Concerning 5 Different Aspects of CLE in the Questionnaire

Aspect of CLE	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
Personal Relevance (N=1137)	3.1	.54	42.3	39.8	17.2	.7
Uncertainty (N=1136)	3.21	.46	43	45.9	9.9	1.2
Critical Voice (N=1124)	2.9	.59	31.3	39.4	26.1	3.2
Shared Control (N=1119)	3.02	.64	37	39.8	21.1	2.1
Student Negotiation (N=1120)	2.64	.63	16.6	40.8	34.6	7.9
Total (N=1143)	2.97	.44	30.8	53.4	15.4	.4

Additionally, repeated measures ANOVA was conducted to determine whether the mean differences among the aspects of CLE are significant as perceived by students. The result indicated that mean differences among the aspects are significant, $F(4, 1090) = 229.903$, $p < .05$. To further analyze this result, paired sampled test was applied as summarized in Table 27 below.

There are enough evidences to conclude that there are significant mean differences between the means of the perceptions of students about personal relevance aspect of CLE and uncertainty aspect of CLE; between the means of the perceptions of

students about personal relevance aspect of CLE and critical voice aspect of CLE; between the means of the perceptions of students about personal relevance aspect of CLE and shared control aspect of CLE; between the means of the perceptions of students about personal relevance aspect of CLE and student negotiation aspect of CLE; between the means of the perceptions of students about uncertainty aspect of CLE and critical voice aspect of CLE; between the means of the perceptions of students about uncertainty aspect of CLE and shared control aspect of CLE; between the means of the perceptions of students about uncertainty aspect of CLE and student negotiation aspect of CLE; between the means of the perceptions of students about critical voice aspect of CLE and shared control aspect of CLE; between the means of the perceptions of students about critical voice aspect of CLE and student negotiation aspect of CLE; and lastly, between the means of the perceptions of students about shared control aspect of CLE and student negotiation aspect of CLE.

Table 27

Paired Samples Test for Students

Paired Samples	*M*	*Sd*	*t*	*df*	*p*
Personal Relevance – Uncertainty	-1.09	.56	-6.53	1134	.00
Personal Relevance – Critical Voice	.20	.52	12.99	1117	.00
Personal Relevance – Shared Control	.09	.53	5.47	1112	.00
Personal Relevance – Student Negotiation	.46	.60	25.74	1114	.00
Uncertainty – Critical Voice	.31	.61	16.99	1117	.00
Uncertainty – Shared Control	.19	.66	9.76	1112	.00
Uncertainty – Student Negotiation	.57	.7	27.36	1114	.00
Critical Voice – Shared Control	-.16	.5	-7.73	1118	.00

Table 27 *(continued)*

Paired Samples	*M*	*Sd*	*t*	*df*	*p*
Critical Voice – Student Negotiation	.27	.59	15.05	1101	.00
Shared Control- Student Negotiation	.38	.60	21.03	1099	.00

In the following parts, perceptions of students concerning the aspects of constructivist learning environment obtained through the analysis of the questionnaires administered to the students are presented.

4.1.1. Personal Relevance Aspect

In order to determine the extent to which the Science and Technology Course environment of 4th and 5th grades in primary schools in Turkey represent personal relevance aspect of a preferred constructivist learning environment according to students, the questionnaires administered to the students were analyzed.

Table 28

Students' Responses Related to Personal Relevance as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. I make analogies about things outside of school life. (n=1117)	2.63	.9	21.3	27.3	44.1	7.1
2. I have realized that we can fix some daily life problems through science and technology. (n=1126)	3.02	.9	36.9	32.8	25.6	4.7

Table 28 *(continued)*

Item	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
3. I can explain life better now. (n=1123)	3.38	.8	56.3	27.2	14.7	1.8
4. I can establish a connection between life out of school and science and technology. (n=1118)	3	.92	36.9	31.5	26.5	5.2
5. I can give daily life examples about science and technology (n=1124)	3.26	.86	50.8	25.8	21.5	1.9
6. I experience hardship in establishing a relationship between the things I learn at class and life out of school. (n=1118)	3.34	.74	47.4	43	6.2	3.4
Total	3.1	.54	42.3	39.8	17.2	.7

As seen in Table 28, analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the personal relevance aspect were either always or often perceived by the students to exist in their classrooms, while making analogies about things outside of school as part of their Science and Technology Course mainly often come true.

4.1.2. Uncertainty Aspect

In order to determine the extent to which the Science and Technology Course environment of 4^{th} and 5^{th} grades in primary schools in Turkey represent uncertainty aspect of a preferred constructivist learning environment according to students, data obtained from the related section of student questionnaire were analyzed.

As seen in Table 29, analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the uncertainty aspect were either always perceived by the students to exist in their classrooms, while solving all of the problems in life through science and technology which was a reversed item was perceived to sometimes come true.

Table 29

Students' Responses Related to Uncertainty as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. I can solve all of the problems in life through science and technology. (n=1125)	2.35	.86	6.8	39.6	35.1	18.4
2. I am aware of the fact that technology changes in time. (n=1130)	3.61	.74	74.2	14.1	9.7	1.9
3. I believe technology can improve our school. (n=1128)	3.43	.82	61.8	22.6	12.7	2.9
4. I can make a distinction between internet technology and old technologies. (n=1133)	3.45	.85	65.8	18.1	12	4.1
Total	3.21	.46	43	45.9	9.9	1.2

4.1.3. Critical Voice Aspect

In order to determine the extent to which the Science and Technology Course environment of 4th and 5th grades in primary schools in Turkey represent critical voice

aspect of a preferred constructivist learning environment according to students, data obtained from the related section of student questionnaire were analyzed.

As seen in Table 30, analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the critical voice aspect were either often or sometimes perceived by the students to exist in their classrooms. On the other hand, nearly all of the students do not think that if necessary they can ask their teachers why they have to learning a topic (M = 1.76). 53.5% of the students never perceived this characteristic of a preferred constructivist learning environment in their classrooms. 54.7% of them always perceived the characteristic which is "I ask about things that I do not understand about activities" (M = 3.29). At the same time, 59.8 % of them think that they can defend their rights with courage if necessary (M = 3.38).

Table 30

Students' Responses Related to Critical Voice as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. If necessary I can ask my teacher "Why I have to learn this?" (n=1113)	1.76	.99	9.7	10.2	26.6	53.5
2. I make comments about class for my teacher. (n=1115)	2.87	.97	33.1	28.8	30	8.1
3. I ask about things that I do not understand about activities. (n=1116)	3.29	.88	54.7	22.1	20.6	2.5
4. If there are things preventing me from learning I share these with my teacher. (n=1106)	3.14	.95	47.6	24.7	21.9	5.8

Table 30 *(continued)*

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
5. I can easily tell what I think. (n=1116)	2.98	.97	39.1	26.8	27.4	6.7
6. If I see necessary I can defend my rights with courage. (n=1116)	3.38	.87	59.8	22	14.4	3.8
Total	2.9	.59	31.3	39.4	26.1	3.2

4.1.4. Shared Control Aspect

In order to determine the extent to which the Science and Technology Course environment of 4th and 5th grades in primary schools in Turkey represent shared control aspect of a preferred constructivist learning environment according to students, data obtained from the related section of student questionnaire were analyzed.

As seen in Table 31, analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the shared control aspect were either always or often perceived by the students to exist in their classrooms. On the other hand, 31.1% of the students sometimes express to their teacher how much time they need for the activities and 11.7% of them never do that (*M*=2.74). As the students perceive it, 64% of them always think that they give answers to their teachers while he/she is inquiring to find out how good they learnt things (*M*=3.51).

Table 31

Students' Responses Related to Shared Control as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. I think, at the stage of planning the course, my opinions (ideas) are important for better learning. (n=1109)	3.04	.92	39.5	29.5	26.1	4.9
2. I tell my teacher if I learned a thing or not. (n=1110)	3.01	.96	40.5	25.6	28.1	5.9
3. I express my idea to my teacher regarding the decision of which activities are good for me at the stage of deciding activities. (n=1107)	2.82	.99	31.4	29.2	29.2	10.2
4. I express to my teacher how much time I need for the activities. (n=1110)	2.74	1	28.3	28.9	31.1	11.7
5. I give answers to my teacher while he/she is inquiring to find out how good I learnt things. (n=1108)	3.51	.73	64	23.6	11.5	1
Total	3.02	.64	37	39.8	21.1	2.1

4.1.5. Student Negotiation Aspect

In order to determine the extent to which the Science and Technology Course environment of 4th and 5th grades in primary schools in Turkey represent student negotiation aspect of a preferred constructivist learning environment according to students, data obtained from the related section of student questionnaire were analyzed.

Table 32

Students' Responses Related to Student Negotiation as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. I have the opportunity to discuss course related issues with my friends. (n=1119)	2.58	.91	20.6	25.2	46	8.2
2. I talk to my friends regarding how problems can be solved. (n=1115)	2.97	.92	35.3	31.1	28.3	5.2
3. I tell my friends about the things I learned at class. (n=1117)	2.88	.94	32.3	29.2	32.3	6.2
4. Other students ask me to explain what I think about the courses. (n=1107)	2.34	.94	14.5	23	44.4	18.2
5. Other students tell me about what they learnt in class. (n=1109)	2.45	.97	18.5	23.4	42.4	15.7
Total	2.64	.63	16.6	40.8	34.6	7.9

As seen in Table 32, analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the student negotiation aspect were either often or sometimes perceived by the students to exist in their classrooms. On the other hand, 46% of the students perceived that sometimes they have the opportunity to discuss with their friends course related issues and sometimes (44.4%) other students ask them to explain what they think about the courses (M = 2.58 and M = 2.34, respectively). 35.3% of the students expressed that they always talk to their friends regarding how problems can be solved and 31.1% of them often think that way (M = 2.97).

4.2. Perceptions of Teachers on Constructivist Learning Environment

In order to give an answer to research question 1, "To what extent does the Science and Technology Course Learning Environment of 4th and 5th grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) of a preferred constructivist learning environment as perceived by the students and their teachers?", in addition to data received from the students, another questionnaire was administered to their teachers. Teacher questionnaire was administered to 264 teachers who offer Science and Technology Course in primary schools in Turkey. The items were scored in the following way: Always is 3.26-4.0, often is 2.51-3.25, sometimes is 1.76-2.50 and never is 1-1.75.

First, the total scores obtained from the whole teacher questionnaire and its mean and standard deviation was presented. Additionally, repeated measures ANOVA was conducted to determine whether the mean differences among the aspects of CLE are significant as perceived by teachers. The sixth item of the personal relevance aspect of constructivist learning environment in teacher questionnaire, "I face difficulties in making connections between what I learn at school and my life out of school" was reversed before the assessment because higher scores on those items represent negative perceptions. The questionnaire had 26 questions on constructivist learning environment and its five aspects. The mean of the total score of the questionnaire was 75.16 (M = 2.89 out of 4 / close to Often) while its standard deviation was 9.82 (Sd = .38). The results suggested that the teachers perceived the constructivist learning environment and its aspects to be often constructivist. The lowest score obtained was 49 (M = 1.88 out of 4) while the highest score was 96 (M = 3.69 out of 4).

Table 33

Total Scores of Teachers as Obtained Through Teacher Questionnaires

Total Score	Frequencies	Percentages (%)
Always	11	4.2
Often	214	81.1
Sometimes	39	14.8
Never	-	-
Total	264	100

As seen in Table 33, more than half of the teachers (81.1 %) perceived the learning environment and its aspects to be often constructivist while only 14.8 % of them perceived them to be sometimes constructivist. 4.2% of the teachers perceived the constructivist learning environment and its aspects to be always constructivist. On the other hand, none of the teachers perceived the learning environment to be never constructivist (0%). Next, the means, standard deviations, frequencies and percentages of the aspects of the constructivist learning environment including personal relevance, uncertainty, critical voice, shared control and student negotiation were calculated.

In order to find an answer for research question 1.2, "To what extent does the Science and Technology Course Learning Environment of 4^{th} and 5^{th} grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) of a preferred constructivist learning environment as perceived by teachers?", the questionnaires administered to the teachers were analyzed.

As seen in Table 34, analysis of the mean scores revealed that all the aspects of the learning environment were perceived to be often constructivist by the teachers. (M = 2.88, M = 3.06, M = 2.78, M = 2.81 and M = 2.94, respectively). More than half of the

teachers perceived the personal relevance, uncertainty, shared control and student negotiation aspects of the learning environment often constructivist (64.3 %, 57.3%, 58.3% and 53.8%, respectively). Nearly one third of the teachers perceived the critical voice aspect to be sometimes constructivist (33.7%). On the other hand, when the percentages of Always and Often were added up, it was found out that in all the aspects the teachers perceived the learning environment highly constructivist.

Table 34

Responses of Teachers Concerning 5 Different Aspects of CLE in the Questionnaire

			Percentages			
Aspects of CLE	*M*	*Sd*	Always %	Often %	Sometimes %	Never %
Personal Relevance (N=263)	2.88	.4	14.8	64.3	20.9	0
Uncertainty (N=255)	3.06	.46	27.5	57.3	14.1	1.2
Critical Voice (N=255)	2.78	.49	18.4	46.3	33.7	1.6
Shared Control (N=264)	2.81	.51	15.2	58.3	25	1.5
Student Negotiation (N=264)	2.94	.52	25.4	53.8	20.1	.8
Total (N=264)	2.9	.37	19.3	67.8	12.9	0

Additionally, repeated measures ANOVA was conducted to determine whether the mean differences among the aspects of CLE are significant as perceived by teachers. The result indicated that mean differences among the aspects are significant, $F(4, 251) = 16.35$, $p < 0.05$. To further analyze this result, paired sampled test was applied as summarized in Table 35 below.

There are enough evidences to conclude that there are significant mean differences between the means of the perceptions of teachers about personal relevance

aspect of CLE and uncertainty aspect of CLE; between the means of the perceptions of teachers about personal relevance aspect of CLE and critical voice aspect of CLE; between the means of the perceptions of teachers about personal relevance aspect of CLE and student negotiation aspect of CLE; between the means of the perceptions of teachers about uncertainty aspect of CLE and critical voice aspect of CLE; between the means of the perceptions of teachers about uncertainty aspect of CLE and shared control aspect of CLE; between the means of the perceptions of teachers about critical voice aspect of CLE and shared control aspect of CLE; between the means of the perceptions of teachers about critical voice aspect of CLE and student negotiation aspect of CLE; and lastly, between the means of the perceptions of teachers about shared control aspect of CLE and student negotiation aspect of CLE. On the other hand, it can be concluded that there are no significant mean differences between the means of the perceptions of teachers about personal relevance aspect of CLE and shared control aspect of CLE; and between the means of the perceptions of teachers about uncertainty aspect of CLE and student negotiation aspect of CLE.

Table 35

Paired Samples Test for Teachers

Paired Samples	*M*	*Sd*	*t*	*df*	*p*
Personal Relevance – Uncertainty	-.13	.57	-3.53	254	.000
Personal Relevance – Critical Voice	.16	.61	4.21	254	.000
Personal Relevance – Shared Control	.03	.61	.71	262	.478
Personal Relevance – Student Negotiation	-.10	.63	-2.64	262	.009
Uncertainty – Critical Voice	.29	.64	7.14	254	.000
Uncertainty – Shared Control	.16	.66	3.78	254	.000
Uncertainty – Student Negotiation	.02	.63	.4	254	.690

Table 35 *(continued)*

Paired Samples	*M*	*Sd*	*t*	*df*	*p*
Critical Voice – Shared Control	-.13	.58	-3.54	254	.000
Critical Voice – Student Negotiation	-.27	,6285	-6.88	254	.000
Shared Control- Student Negotiation	-.13	,6573	-3.18	263	.002

In the following parts, perceptions of teachers concerning the aspects of constructivist learning environment obtained through the analysis of the questionnaires administered to the teachers are presented. In addition, the responses of the teachers to the open ended questions in the teacher questionnaire were also used to support some of the analysis in the following parts.

4.2.1. Personal Relevance Aspect

In order to determine the extent to which the Science and Technology Course environment of 4^{th} and 5^{th} grades in primary schools in Turkey represent personal relevance aspect of a preferred constructivist learning environment according to teachers, the questionnaires administered to the teachers were analyzed.

As seen in Table 36, analysis of the mean scores revealed that all of the characteristics that a preferred constructivist learning environment may cover in the personal relevance aspect were either always or often perceived by the teachers to exist in their classrooms.

Table 36

Teachers' Responses Related to Personal Relevance as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. Students make deductions about the life outside of school. (n=262)	2.68	.58	5.7	57.3	36.6	.4
2. Students learn new things about life outside of the school. (n=260)	2.67	.63	7.2	53.8	37.7	1.2
3. Students establish link between life and science and technology. (n=262)	2.92	.62	15.3	61.8	22.5	.4
4. Students can better explain life. (n=259)	2.71	.7	12.4	47.9	38.2	1.5
5. Due to things that they have learned in class students can give interesting daily life examples. (n=262)	2.79	.69	14.1	51.9	32.8	1.1
6. Students learn that things they have learnt have no relationship with the things in life outside of the school. (n=258)	3.54	.67	62.4	30.6	5.4	1.6
Total	2.88	.4	14.8	64.3	20.9	0

The first open ended question that the teachers answered was, "Has the fact that new program has been linked to the daily lives of children resulted in any changes in their learning process? If yes, what are these changes?" Analysis of the responses of teachers provided in depth information on example cases which can be acknowledged as

evidences for the existence of personal relevance aspect of the constructivist learning environment in the science and technology classes together with the problems encountered within this aspect. Some of the important statements were as the following:

Program Related Statements

- Since the program is new, the students could not adapt to it yet. We could not save students from the influence of the old program yet. The courses are too loaded. Students had to be guided from the 4th grade onwards. If this can be done students could be involved in class more and this will result in more daily life influence on student's life.
- The program gives emphasis to technology and turns students to be more active about technological elements which develop their researcher side.
- The new program helped to eliminate the belief in students that the school life is only about the school. They started to enjoy things they learn more since they can establish link with the daily life.
- With this new program learning is not hanging in abstract anymore. It has become a part of the life. The value of the necessity of learning acquired importance in the eyes of the students.
- The new program has not been fully understood. This is obvious in the change of books every year.

Learning and Learning Environment Related Statements

- While we were thinking that we got rid of memorization we realized that successful students turn out to be the locomotive of the class while unsuccessful students started to develop an attitude such as "someone in class will do these activities in class so why bother?" and they tend to come to class unprepared.
- Getting ready sections at the beginning of chapters helps students to establish link with their daily lives. The examples of the book are from daily lives.

- The very fact that students can establish a link with their daily lives and class (especially in science and technology class) resulted in increasing student participation. Student concentration and attention increased since they started to find answers to the question of "why I am learning this?"
- Students developed knowledge about their environment. They are not throwing garbage around. Also they have developed the capacity of categorizing things. This can be observed from their school bags which are more organized now. They started to view plants as living things now. They can express which organ of them is aching.
- It became easier for students to understand and establish links. We got rid of abstract learning.
- They developed a capacity on how to reach the knowledge. They have learned from where they can get help when they encounter a problem.
- Linking what they have learned in class with their daily life is done through teacher guidance.
- Students are very much attracted by the environmental problems topic of the science and technology class. They have started to ask questions, suggest solutions and even warn the interested groups regarding the subject.
- They started to examine nature more carefully. They started to use the question of why in their daily lives.
- Since they can establish link with their daily lives they started to enjoy classes more. They become more successful since they enjoy working and conduct activities voluntarily. They started to observe their environment more carefully and they have learned to discuss.
- Students started to become interested in issues that are not possible for them to see in their daily lives. They have started to ask very interesting questions. They have enjoyed science and technology class very much. They have learned to learn while having fun. They have learned to make research.
- They develop the ability to attach what they have learned in Science and Technology Course to their lives. They learn that the things that they use and see in their daily

lives such as plants, animals and technological tools have a historical evolution process.

- It has been easier for students to understand subjects since they have managed to establish link with their environment. They have understood that there is a scientific explanation of the things they see around. Especially regarding the subjects such as environment, our planet, power etc.
- They have managed to establish a link between their daily lives and for example while conducting the chapter on discovering our body and the role of vitamins in our body that is available in vegetables and fruits. They have learned the function of the body parts. In air and power chapters they managed to give daily life examples regarding gravity, air and water pressure. They managed to learn about the function of the electric circuits and how it is used.

Infrastructure and SES Related Statements

- Due to the social environment that they live in, it is hard for students to establish a link between what they have learned and their daily lives.
- This program is very good for those schools which have facilities; however I do not think that it is convenient to the living conditions of the village kids. It is hard for them to establish a link between things that they have never seen in their lives and in the class. While we lecture we lower the levels of the courses. However in addition to all they can easily establish a link between the classes and things available in their daily lives. This makes learning more effective.

As seen in the statements of the teachers, personal relevance aspect of the constructivist learning environment partially actualized in the science and technology classroom in parallel to the strength of the infrastructure of the schools. Next, perceptions of teachers on the uncertainty aspect of the constructivist learning environment are discussed.

4.2.2. Uncertainty Aspect

In order to determine the extent to which the Science and Technology Course environment of 4th and 5th grades in primary schools in Turkey represent uncertainty aspect of a preferred constructivist learning environment according to teachers, the questionnaires administered to the teachers were analyzed.

As seen in Table 37, analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the uncertainty aspect were often or always perceived by the teachers to exist in their classrooms.

Table 37

Teachers' Responses Related to Uncertainty as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. Students think that they can solve problems in life by using technology. (n=254)	2.67	.65	8.3	52.4	37.8	1.6
2. Students realize that technology changes in time. (n=255)	3.33	.62	40.8	51.4	7.8	0
3. Students make the deduction that technology can change the learning environment. (n=255)	2.94	.64	16.5	62	20.4	1.2
4. Students make the distinction that Internet technology is different from the technology used long years ago. (n=253)	3.34	.71	45.5	45.1	7.5	2
Total	3.06	.46	27.5	57.3	14.1	1.2

4.2.3. Critical Voice Aspect

In order to determine the extent to which the Science and Technology Course environment of 4th and 5th grades in primary schools in Turkey represent critical voice aspect of a preferred constructivist learning environment according to teachers, the questionnaires administered to the teachers were analyzed.

As seen in Table 38 analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the critical voice aspect were either often or sometimes perceived by the teachers to exist in their classrooms. It should be noted that more than half of the teachers (53.6%) think that students sometimes ask the question of "why I have to learn this?" whenever they feel the need. Only 7.1% of the teachers perceived this case as always (M = 2.38). According to teachers, students show the courage of defending their rights (M = 3.12) and they express their thoughts freely (M = 3.12) however they sometimes question how the teaching is being conducted (M = 2.42).

Table 38

Teachers' Responses Related to Critical Voice as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. When they see need students ask the question of "why I have to learn this?" (n=252)	2.38	.73	7.1	31.7	53.6	7.5
2. Students question how the teaching is being conducted. (n=253)	2.42	.66	4.7	37.2	53.4	4.7
3. Students express their opinions if they did not understand the activities done. (n=254)	2.79	.75	19.3	48.8	29.9	2

Table 38 *(continued)*

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
4. Students do not refrain from questioning things preventing them from learning. (n=254)	2.79	.75	15.7	50.8	29.9	3.5
5. Students express their thoughts freely. (n=254)	3.12	.65	27.2	58.3	14.2	.4
6. Students show the courage of defending their rights. (n=254)	3.12	.68	29.5	53.1	16.9	.4
Total	2.78	.49	18.4	46.3	33.7	1.6

4.2.4. Shared Control Aspect

In order to determine the extent to which the Science and Technology Course environment of 4th and 5th grades in primary schools in Turkey represent shared control aspect of a preferred constructivist learning environment according to teachers, the questionnaires administered to the teachers were analyzed.

As seen in Table 39analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the shared control aspect were often perceived by the teachers to exist in their classrooms (M = 2.81). On the other hand, 50% of the teachers think that attention is often being paid at the stage of course planning in order to assure the best learning for the students (M = 3.21). 58.4% of them often perceived that students help them in deciding how good they are learning (M = 2.85). Lastly, while 39.1% of teachers sometimes perceived the characteristic, 42.1% of the teachers' perception is that often before deciding how much time is required for activities students help them (M = 2.57).

Table 39

Teachers' Responses Related to Shared Control as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. Attention is being paid at the stage of course planning in order to assure the best learning for the students. (n=262)	3.21	.7	36.3	50	12.6	1.1
2. Students help me in deciding how good they have learnt. (n=262)	2.85	.66	14.1	58.4	26.3	1.1
3. Students help me in deciding which activity is good for them. (n=262)	2.78	.71	14.9	50.4	32.8	1.9
4. Before deciding how much time is required for activities students help me. (n=261)	2.57	.79	11.1	42.1	39.1	7.7
5. Students help me in evaluating their learning levels. (n=262)	2.66	.7	8.8	52.7	34	4.6
Total	2.81	.51	15.2	58.3	25	1.5

The second open ended question that the teachers answered was, "What were the inputs of the students to the learning environment all through the classes?" Analysis of the responses of teachers provided in depth information on example cases which can be acknowledged as evidences for the existence of shared control aspect of the constructivist learning environment in the science and technology classes together with the problems encountered within this aspect. Some of the important statements were as the following:

Program Related Statement

- Since the program can not be fully understood I do not believe students had any real contribution.

Learning and Learning Environment Related Statements

- If the student is prepared in advance they have good contributions to class if not there is no contribution at all. You end up doing class with 3-5 students.
- 1. Students contributed through giving more examples about their daily life experiences; 2. They have made learning environment more enjoyable; 3. They have encouraged other students to participate in class as well.
- The students' questions direct the process in class. Sometimes it ends up in a place that has never been thought before the class.
- They brought equipment to the class and they have made class more active by asking questions in class.
- Students became more active in class. The teacher became the facilitator but the class is being conducted more by the students which makes learning environment more compatible with their levels.
- "Students usually prefer to keep silent. I can say that the low performance of the students in the learning environment negatively affected the learning process"
- Students are active and motivated for class. It is possible to observe transfer and use of knowledge in their life. The learning becomes more permanent. It is possible to observe knowledge transfer between courses.
- While learning the subjects, students enjoy conducting experiments, seeing materials, and touching. That is why they were very enthusiastic about brining things to class outside of the school.
- They become more active in class. They show effort in more participating, discussing and reaching to knowledge in class. They present their research findings to class, and make other students benefit from their knowledge as well.

- Only some students had contributions for learning in class; not all of them.
- The students have conducted the courses on their own so they have learned how to learn. They have enriched the class through the preparations they have made before coming to class.
- Students can participate in class through their research projects. They bring in necessary materials for conducting experiments. With some very interesting questions of some students classes become more interesting and attractive.
- Through the participation of students from different intelligence levels it has been possible to increase learning and sharing.
- Students participate in the learning environment through playing drama, doing experiments on their own, preparing songs on some issues, preparing posters and etc.
- The very fact that students are coming to class by doing research and getting prepared changed the course of the classes. Due to diversity of materials they have brought into class the classes became fluent and fun. This has raised interest of students in class.
- Their participation in class has been increased. They have started to bring in very different interesting new ideas and products. I have been able to observe that the things that they have learned in class do not stay only there but they can use these in their daily lives. I feel that we become happy mutually. My teaching and their learning load have been diminished. Because their lives and classes are overlapping.
- They have learned to come up with different and good ideas regarding problem solving. They like to use brainstorming method more than any other method.
- Students support the learning environment through their questions during the class. They enrich the activities through resources they bring in class that they find from the Internet, their environment as well as library.
- They have contributed to class through their research, and the questions that they have asked which guided the class. They are constantly active in class. They can describe the function of electric circle by using drama.

- Students became more active. The questions available at the "let's think" sections help them to concentrate their attention to the class.
- Students are enthusiastic about the activities. However, while conducting the activities, since they do not know what they should do, sometimes it gets out of control.
- Most of the students come to class without bringing in the necessary materials for the course. This results in decreasing efficiency. They only perceive activities as fun and this prevents them from being able to make necessary deductions from the activity.

Infrastructure and SES Related Statement

- There is not much contribution on behalf of families in establishing the environment they have at school. That is why they can not practice things they learn at school while they are at home. This breaks continuity. Even if students sometimes want to do some of the activities because of the financial constraints they can not do.

The statements of the teachers support the analysis of their perceptions on shared control aspect of the constructivist learning environment. Next, perceptions of teachers on the student negotiation aspect of the constructivist learning environment are discussed.

4.2.5. Student Negotiation Aspect

In order to determine the extent to which the Science and Technology Course environment of 4^{th} and 5^{th} grades in primary schools in Turkey represent student negotiation aspect of a preferred constructivist learning environment according to teachers, the questionnaires administered to the teachers were analyzed.

As seen in Table 40, analysis of the mean scores revealed that majority of the characteristics that a preferred constructivist learning environment may cover in the

student negotiation aspect were often perceived by the teachers to exist in their classrooms. According to 58.8% of the teachers, often students find the opportunity to communicated with other students (M = 3.06). 56.8% of the teachers perceived that often students exchange their views on solving problems. While 15.2% of the teachers always perceived the case, 45.2% of the teachers often perceived that students want other students to share their views (M = 2.73).

Table 40

Teachers' Responses Related to Student Negotiation as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. Students find the opportunity to communicate with other students. (n=262)	3.06	.67	24.4	58.8	15.6	1.1
2. Students can exchange their views on solving problems. (n=264)	2.92	.67	17.8	56.8	24.6	.8
3. Students get the opportunity to express their ideas to other students. (n=264)	3	.64	20.5	59.1	20.5	0
4. Students want other students to share views. (n=263)	2.73	.74	15.2	45.2	37.3	2.3
5. Students can express themselves to their friends. (n=264)	2.98	.69	22.7	53.4	23.5	.4
Total	2.94	.52	25.4	53.8	20.1	.8

The third open ended question that the teachers answered was, "What were the contributions of the quality of the interaction among the students to the learning

process?" Analysis of the responses of teachers provided in depth information on example cases which can be acknowledged as evidences for the existence of student negotiation aspect of the constructivist learning environment in the science and technology classes together with the problems encountered within this aspect. Some of the important statements were as the following:

Program Related Statement

- There is no contribution of the program since there is not enough resource and families are not informed adequately. There is too much complaint from families regarding the projects and term paper.

Learning and Learning Environment Related Statements

- What ever activity you do in class (whether group work, project or term homework) you can only receive the results from the same small group of students (5-10 students). The remaining students group is usually not active, inadequate and not motivated.
- It is easy to work with the interested students, but since the majority of the students are not interested it is not possible to reach the expected results. Since students can constantly pass to a higher class there is no meaning of the term paper and project.
- Good students are working well but the bad students are left behind in class.
- Since the research is done in groups, this enables students to discover what is missing in them.
- In group work they do share knowledge but unfortunately I can not see much development in research. Usually they prepare homework with the help of adults just by printing out the material and without even reading them.
- Student interaction has been effective through the group exercises and cooperation among them.

- Students could not find the opportunity for exchanging their views. Usually they have done individual research projects and performance studies. They have participated in class activities such as experiments, observations and provided materials for these activities. They have also made in class presentations.
- Since students are working more in groups, the problems of establishing friendship and communication have been eliminated. They can push for their tights and act more independent.
- Students are engaged with the effort of proving themselves and started to move with the motivation of "I can do better". This resulted in increase in success levels.
- The possibility of learning by doing and learning through role modeling has been increased. The hidden competition between groups influenced learning environment positively.
- I have realized that some of the projects and homework are done by the students but majority of them are done by parents.
- They have experienced hardships in doing research and collecting information for preparing homework. They have got extensive support from their elders.
- There is exchange of information. Their self confidence has been increased. They have developed their abilities in speaking in front of public and expressing their views. Visual presentations attract them more and increase their attention. They develop their abilities to help and share the knowledge. This enables them to learn more in a shorter time.
- Having group work is a positive aspect; however the high number of projects, homework and other activities destructs the attention of the students. The high number of research above their levels can be tiring for students.
- Project and performance homework are having major contribution in constructing the knowledge. The students who are doing research influence other students as well. When compared to the first semester now more research is being done.
- The students participate in group work voluntarily. They reach knowledge through research. The cooperation about the subjects increases the helping sense in the students. The materials used for activities are economic.

- I can not manage to have the involvement of all of the students to classes.
- Students learned to act together, and come to a shared decision through bringing in their different opinions. Being aware of their responsibilities made them to develop a capacity to share and develop group identity.
- It has not been possible for me to effectively utilize group work. Students experience hardships in sharing their knowledge. They usually prefer to work with same team mates.
- Project activities helped students to develop responsibility and sharing. Students have learned how to behave in society. Through projects they have managed to take class outside of school. They have developed self confidence. Knowledge acquired permanence through observing and learning by doing.
- Students have learned that in life they can not be alone and it is important to cooperate and help each other. They have learned the importance of sharing responsibilities, and what kind of results can be faced if they fail to meet their responsibilities.
- Students do not do homework on their own but they just take it from the Internet or they make their parents do their homework.
- Knowledge becomes permanent since they learn in through the project and performance methods and furthermore the very fact that they shared what they have learned with their friends also contributed to the permanency of knowledge.
- While doing research they get influenced from each other (go to library, conduct questionnaires etc). They share their resources while doing homework.
- Activities had a positive impact on learning and students. Students learned to value the responsibilities they got; they started to cooperate and help each other in a democratic environment.
- Mostly the exchange of opinion is beneficial for the students but it is hard to balance the duration of these discussions in class and runs the risk of distancing from the core.
- They have learned that every idea is valuable and activities such as brain storming helped them to bring in very different ideas to class. They have learned the value of

sharing their views and they have started to look at world with more questioning eyes.

- Experiments are simplified. If there was a CD it would be much better. The activities conducted by the motivated students make less motivated ones participate in class as well. Students conduct research and they think that using technology is obligatory for conducting research.
- Democracy perception of students has been increased as a result of group works.

Infrastructure and SES Related Statements

- Required success can not be reached due to impossibility of coming together of students outside of the class due to reasons such as lack of confidence among families in sending their kids to others' houses or the lack of adequate environment at school for such activities. That is why project and performance home works are much more successful.
- It is a reality hard to say that it had contributed. However there is no study being conducted regarding the problems that students have encountered while conducting the activities. We are sending students' to Internet café's which are full of smoking people. The information technology classes at schools became tools of money making. In addition to monetary contributions acquired from parents the stationary expenses required for the activities such as projects also became a financial burden.
- In these issues the family conditions of the students are important as well. Each student does not have the opportunity to conduct each activity. Socio-economic status is an important problem. Individual studies are more successful.
- The experiments and projects which have been conducted with groups produced very good results. But members of the group experienced problems in coming together outside of the school. Students who are coming to school with services experienced problem in being active in group work. Especially the students who are coming from villages experienced problems in doing research with Internet or finding materials for experiment.

- My students can not be active in research because we do not have library and Internet access in our school. The conditions of the region that they live in are not convenient for conducting research. Through the group work they have managed to develop good relations with each other. They have better understood the value of helping and sharing.

The statements of the teachers support the analysis of their perceptions on student negotiation aspect of the constructivist learning environment. Next, perceptions of students according to certain categorical variables are discussed.

4.3. Perceptions of Students According to Their Demographic Characteristics

In order to answer research question 2, "Do primary 4th and 5th grade students' perceptions of CLE in Science and Technology Course in Turkey in five aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) differ according to their certain characteristics (the socio-economic status group of their district, grade, gender, socio economic status of students as indicated by their number of siblings, having a study room, way of transportation to school, the education level of their mother and the education level of their father; and their use of technology as indicated by existence of a computer laboratory with internet connection at school, existence of an internet connection at home and usage of internet during the science and technology classes)?", the following analysis were conducted.

4.3.1. Students' Socio-Economic Status

In this part of the study, socio-economic status of students is generated as a new variable through combination of variables such as number of siblings, having a separate study room, way of transportation to school, education level of mother and education level of father. The responses of students to those five independent variables were coded as low, medium and high socio-economic status indicators and then combined into a single SES variable. This process was guided by a measurement and evaluation expert.

To determine whether the primary 4th and 5th grade students' perceptions of CLE in Science and Technology course differ according to their socio-economic status, one-way MANOVA was run where the SES was the independent variable and perceptions of students on personal relevance, uncertainty, critical voice, shared control and student negotiation aspects were dependent variables. Descriptive statistics for the dependent variables across the socio economic status (low = 487, medium = 291, high = 316) are displayed in Table 41.

Table 41 shows that students with high socio economic status had the highest mean score on each dependent measure. Moreover, skewness and kurtosis values displayed in the table indicated univariate normality for the individual dependent variables across independent variable. This finding can be considered as a sign of meeting multivariate normality assumption of MANOVA. Nonsignificant Box's Test result, further suggested that multivariate normality assumption was met as well as homogeneity of variance and covariance matrices assumption F (30, 2770177) = 3,55, p = .00. Results of Levene's Test performed to check whether each dependent variable has the same variance across groups were presented in Table 42.

Table 41

Levene's Test of Equality of Error Variances (Students' Socio-Economic Status)

Aspects	*F*	*df1*	*df2*	*p*
Personal Relevance	.81	2	1091	.45
Uncertainty	32.81	2	1091	.00
Critical Voice	1.46	2	1091	.23
Shared Control	1.14	2	1091	.32
Student Negotiation	.84	2	1091	.43
Total	1.14	2	1091	.32

Table 42

Descriptive Statistics with respect to CLE Aspects

	M			*Sd*			Skewness			Kurtosis		
Aspects	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Personal Relevance	2.93	3.13	3.37	.52	.52	.49	-.07	-.31	-.63	-.24	-.5	-.28
Uncertainty	3.09	3.28	3.35	.50	.44	.33	-.61	-1.24	-1.27	-1.2	2.14	2.21
Critical Voice	2.75	2.96	3.11	.56	.6	.54	-1.24	-.51	-.62	-.39	-.29	.2
Shared Control	2.86	3.05	3.25	.60	.64	.61	-.1	-.41	-.71	-.62	-.5	-1.12
Student Negotiation	2.54	2.69	2.76	.60	.64	.66	.09	-.09	-.19	-.57	-.39	-.52
Total	2.84	3.02	3.17	.41	.43	.4	.00	-.47	-.6	-.4	-.06	-.09

The results revealed that there was violation of homogeneity of variance assumption for the dependent measures of variables except uncertainty. However, it should be notified that Box' Test allowing to test the assumption of homogeneity of variances and covariances among the dependent variables across socio economic status groups of students did not yield a significant result indicating homogeneity of variance and covariance matrices. After checking the assumptions, one-way MANOVA was conducted. Results of the analysis were shown in Table 43.

Table 43

MANOVA results with respect to collective dependent variables of CLE Aspects

Source	Wilks' Lambda	Hypothesis df	Error df	Multivariate F	Sig. (p)	Eta-Squared	Observed Power
SES	.86	10	2174	17.55	.000	.08	1

The findings showed that there was a significant mean difference between the socio economic status groups with respect to aspect of CLE. The multivariate $\eta 2$ based on Wilk's Λ was not strong, 0.86, implying that the magnitude of the difference between the groups was small. In fact, this value indicated 86 % of multivariate variance of the dependent variables was associated with the SES groups. What is more, power, which is the probability of detecting a significant effect when the effect truly does exist in nature, was found to be very high, 1.00.

In order to determine the effect of SES on each CLE aspect univariate ANOVA's were run. Table 44 displays the results of univariate ANOVAs. As it can be inferred from the table, concerning the socio-economic status of students there was a significant mean different between low, medium and high SES students with respect to perceived CLE and its aspects which are personal relevance, uncertainty, critical voice, shared control and student negotiation. The mean scores given in Table 41 were examined to determine that high SES students tend to perceive CLE and its aspects as more constructivist. In addition, results revealed that medium SES students' perceptions

were higher than low SES students' perceptions in all aspects. Concerning SES groups, the univariate ANOVAs for the dependent variables which are the aspects of CLE, are significant ($p < 0.05$) indicating that there was a statistically significant mean difference between the groups with respect to aspects of CLE.

Table 44

Follow-Up Multiple Comparisons

Source	Dependent Variable	*df*	*F*	*p*	Eta-Squared	Observed Power
SES	Personal Relevance	2	72.63	.00	.12	1.00
	Uncertainty	2	34.07	.00	.06	1.00
	Critical Voice	2	40.81	.00	.07	1.00
	Shared Control	2	38.97	.00	.07	1.00
	Student Negotiation	2	12.25	.00	.02	.996
	Total	2	63.48	.00	.10	1.00

In the following sub-sections, the MANOVA results for specific variables constituting the SES variable as reported above (number of siblings, having a separate study room, way of transportation to school, education level of mother and education level of father) and also the socio-economic status group of students' districts which yields supportive parallel results are provided.

4.3.1.1. The Socio-Economic Status Group of Students' District

MANOVA was used to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to the socio-economic status group of their district or not. The MANOVA results are presented in Table 45.

Table 45

Perception of Constructivist Learning Environment Aspects According to Socio-Economic Status Groups of Districts

Aspects	Socio-Economic Status Groups															
	1 (n=160)		2 (n=343)		3 (n=251)		4 (n=246)		5 (n=62)		6 (n=51)					
	M	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	3.19	.51	3.30	.53	3.13	.51	2.86	.49	2.8	.47	3.10	.56	5	23.25	.15	.000
Uncertainty	3.4	.46	3.46	.49	3.33	.46	3.03	.6	2.88	.63	3.21	.48	5	24.86	.00	.000
Critical Voice	3.10	.52	2.99	.6	2.94	.56	2.71	.57	2.54	.55	3.02	.53	5	17.13	.14	.000
Shared Control	3.14	.56	3.13	.67	3.06	.63	2.8	.63	2.87	.49	2.96	.59	5	10.72	.00	.000
Student Negotiation	2.76	.61	2.69	.65	2.64	.64	2.61	.64	2.38	.49	2.55	.61	5	3.77	.2	.002
Total	3.13	.40	3.12	.48	3.04	.44	2.82	.46	2.69	.40	2.97	.43	5	21.57	.12	.000

Analysis of the whole questionnaire revealed that students' perception of constructivist learning environment (CLE) differed according to socio-economic status group of their districts, $F(5, 1088) = 21.57$, $p < .05$, $\eta = .12$. Tukey test for multiple comparisons indicated no significant difference between the mean scores of the students in socio-economic status groups 1 and 2 and 6 while there were significant differences among the mean scores of the other groups. The students from groups 1 and 2 perceived the CLE to be more constructivist (M=3.13 and M=3.12, respectively) compared to the students in groups 3, 4, 5 and 6 (M=3.04, M=2.82, M=2.69 and M=2.97). Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the CLE according to socio-economic status groups of districts. As seen in Table 45, there was a significant difference in all aspects ($p < .05$).

Multivariate analysis of variance (MANOVA) was run to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in personal relevance aspect differ according to the socio-economic status group of their district or not (see Table 45). The results indicated that there was a significant mean difference between perceptions of students with respect to their socio-economic status groups, $F(5, 1088) = 23.25$, $p < 0.05$, $\eta = .15$. Mean score of students in Group 2 was 3.30 and mean score of students in Group 5 was 2.86.

Multivariate analysis of variance (MANOVA) was run to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in uncertainty aspect differ according to the socio-economic status group of their district or not (see Table 45). The results indicated that there was a significant mean difference between perceptions of students with respect to their socio-economic status groups, $F(5, 1088) = 24.86$, $p < 0.05$, $\eta = .00$. Mean score of students in Group 2 was 3.46 and mean score of students in Group 5 was 2.88.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ according to the socio-economic status group of their district, MANOVA was used. The results (see Table 45) revealed that there was a difference, $F(5, 1088) = 17.13$, $p < 0.05$, $\eta = .14$. Mean score of students in Group 1 was 3.10 and mean score of students in Group 5 was 2.87.

In order to analyze whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to the socio-economic status group of their district or not, multivariate analysis of variance (MANOVA) was run (see Table 45). The results indicated that there was a significant mean difference between perceptions of students with respect to their socio-economic status groups, $F(5, 1088) = 10.72$, $p < 0.05$, $\eta = .00$. Mean score of students in Group 1 was 3.14 and mean score of students in Group 4 was 2.8.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ or not according to the socio-economic status group of their district, MANOVA was run. The results (see Table 45) revealed that there was a difference, $F(5, 1088) = 3.77$, $p < 0.05$, $\eta = .2$. Mean score of students in Group 1 was 3.13 and mean score of students in Group 5 was 2.69.

4.3.1.2. Students' Number of Siblings

MANOVA was used to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ or not according to their number of siblings. The MANOVA results are presented in Table 46.

Analysis of the whole questionnaire revealed that students' perception of CLE differed according to their number of siblings, $F(4, 1085) = 19.93$, $p < .05$, $\eta = .13$. Regardless of number of siblings, the students perceived the learning environment and all of its aspects inquired to be constructivist but at different levels. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the CLE according to number of siblings of students. As seen in Table 46, there was a significant difference in all aspects ($p < .05$). Tukey test for multiple comparisons indicated no significant difference between the mean scores of the students who have 1 and 2 siblings while there were significant differences among the means scores of the other students. In the case of students who have 5 or more siblings, there was a significant difference between the means scores of the students who have 1 and 2

siblings however there was no difference when compared with students who have 3 and 4 siblings.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in personal relevance aspect differ or not according to their number of siblings, multivariate analysis of variance (MANOVA) was conducted (see Table 46). The results indicated that there was a significance mean difference between perceptions of students with respect to their number of siblings, $F (4, 1085) = 21.79$, $p < 0.05$, $\eta = .05$.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in uncertainty aspect differ or not according to their number of siblings, multivariate analysis of variance (MANOVA) was run (see Table 46). The results indicated that there was a significant mean difference between perceptions of students with respect to their number of siblings, $F (4, 1085) = 7.69$, $p < 0.05$, $\eta = .00$. Mean score of students who have 1 sibling was 3.27 whereas mean scores of students who have 2, 3, 4, 5 and more were 3.29, 3.17, 3.1 and 3.14, respectively.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ or not according to their number of siblings MANOVA was used. The results in Table 46 revealed that there was a difference, $F (4, 1085) = 10.67$, $p < 0.05$, $\eta = .42$. Mean score of students who have 1 sibling was 3.02 whereas mean scores of students who have 2, 3, 4, 5 and more were 3.02, 2.83, 2.78 and 2.76, respectively.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to their number of siblings or not, multivariate analysis of variance (MANOVA) was run (see Table 46). The results indicated that there was a significant mean difference between perceptions of students with respect to their number of siblings, $F (4, 1085) = 13.29$, $p < 0.05$, $\eta = .27$. Mean score of students who have 1 sibling was 3.08 whereas mean scores of students who have 2, 3, 4, 5 and more were 3.18, 2.92, 2.82 and 2.91, respectively.

Table 46

Perception of Constructivist Classroom Aspects According To Their Number of Siblings

Aspects	Number Of Siblings													
	1 (n=113)		2 (n=422)		3 (n=295)		4 (n=141)		5 and more (n=167)					
	M	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	3.23	.54	3.26	.50	3.02	.57	2.9	.50	2.92	.50	4	21.79	.05	.000
Uncertainty	3.27	.41	3.29	.39	3.17	.48	3.1	.54	3.14	.48	4	7.69	.00	.000
Critical Voice	3.02	.62	3.02	.57	2.83	.57	2.78	.62	2.76	.56	4	10.67	.42	.000
Shared Control	3.08	.65	3.18	.62	2.92	.66	2.82	.57	2.91	.6	4	13.29	.27	.000
Student Negotiation	2.73	.65	2.76	.63	2.58	.61	2.54	.61	2.49	.64	4	7.43	.90	.000
Total	3.07	.45	3.1	.4	2.9	.45	2.83	.43	2.84	.42	4	19.93	.13	.000

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to their number of siblings or not MANOVA was used. The results (see Table 46) revealed that there was a difference, F (4, 1085) = 7.43, p < 0. 05, η = .90. Mean score of students who have 1 and 2 siblings were 2.73 and 2.76 whereas mean scores of students who have 3, 4, 5 and more were 2.58, 2.54 and 2.49, respectively.

4.3.1.3. Having a Separate Study Room

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to having a study room or not MANOVA was used. The MANOVA results are presented below in Table 47.

Table 47

Perception of Constructivist Classroom Aspects According to Having a Study Room

Aspects	Having A Study Room							
	NO (n=503)		YES (n=629)					
	M	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	2.94	.52	3.23	.52	1	78.09	.84	.000
Uncertainty	3.11	.49	3.29	.41	1	47.98	.00	.000
Critical Voice	2.77	.58	3.01	.58	1	49.35	.75	.000
Shared Control	2.86	.60	3.15	.63	1	62.33	.21	.000
Student Negotiation	2.54	.61	2.72	.64	1	20.77	.51	.000
Total	2.84	.42	3.08	.43	1	85.25	.68	.000

Analysis of the whole questionnaire revealed that students' perception of Constructivist Learning Environment differed according to having a study room, $F(1, 1082) = 85.25$, $p < .05$, $\eta = .68$. The mean scores of perceptions of students who do not own a separate study room was 2.84 whereas those who have a separate study room had a 3.08 mean score. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the classrooms according to having a study room.

In order to determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in personal relevance aspect differ according to having a study room or not, multivariate analysis of variance (MANOVA) was run (see Table 47). The results indicated that there was a significant mean difference between perceptions of students with respect to their owning a study room, $F(1, 1082) = 78.09$, $p < 0.05$, $\eta = .84$. Mean score of students who do not have a study room was 2.94 and mean score of students who have a study room was 3.23.

In order to determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in uncertainty aspect differ according to having a study room or not, multivariate analysis of variance (MANOVA) was run (see Table 47). The results indicated that there was a significant mean difference between perceptions of students with respect to their having a study room or not, $F(1, 1082) = 47.98$, $p < 0.05$, $\eta = .00$. Mean score of students who do not have a study room was 3.11 and mean score of students who have a study room was 3.29.

To determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in critical voice aspect differ according to having a study room or not, MANOVA was used. The results (see Table 47) revealed that there was a difference, $F(1, 1082) = 49.35$, $p < 0.05$, $\eta = .75$. Mean score of students who do not have a study room was 2.77 and mean score of students who have a study room was 3.01. In order to determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in shared control aspect differ according to having a study room or not, multivariate analysis of variance (MANOVA) was run (see Table 47). The results indicated that there was a significant mean difference between

perceptions of students with respect to their owning a study room or not, $F(1, 1082) = 62.33$, $p < 0.05$, $\eta = .21$. Mean score of students who do not have a study room was 2.86 and mean score of students who have a study room was 3.15. To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to owning a study room or not, MANOVA was used. The results (see Table 47) revealed that there was a difference, $F(1, 1082) = 20.77$, $p < 0.05$, $\eta = .51$. Mean score of students who do not have a study room was 2.54 and mean score of students who have a study room was 2.72.

4.3.1.4. Students' Way of Transportation to School

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to way of transportation to school or not, MANOVA was used. The MANOVA results are presented below in Table 48.

Analysis of the whole questionnaire revealed that students' perception of CLE differed according to their way of transportation to school, $F(2, 1081) = 5.44$, $p < .05$, $\eta = .14$. Regardless of way of transportation to school, the students perceived the learning environment and all of its aspects inquired to be constructivist but at different levels. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the CLE according to way of transportation to school of students. As seen in Table 48, there was a significant difference in personal relevance, uncertainty, critical voice and shared control aspects ($p < .05$) but not in student negotiation aspect ($p > .05$). Tukey test for multiple comparisons indicated a significant difference between the mean scores of the students who are taken to school by the family and students who go to school by bus or on foot. In the case of students who go to school by bus, there was no significant difference between the mean score of the students who go to school on foot but there was a significant difference when compared with those who are taken to school by their families.

Table 48

Perception of Constructivist Classroom Aspects According to Way of Transportation to School

Aspects	Transportation To School									
	Family (n=100)		By Bus (n=317)		On Foot (n=716)					
	M	*Sd*	*M*	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	3.31	0.52	3.11	0.55	3.08	0.54	2	8.32	.67	.000
Uncertainty	3.35	0.34	3.14	0.50	3.22	0.44	2	10.03	.00	.000
Critical Voice	3.02	0.61	2.93	0.57	2.88	0.59	2	3.40	.51	.034
Shared Control	3.15	0.67	3.02	0.64	3.01	0.63	2	3.26	.94	.039
Student Negotiation	2.69	0.59	2.70	0.63	2.62	0.63	2	2.03	.5	.131
Total	3.10	0.40	2.98	0.44	2.96	0.44	2	5.44	.14	.004

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in personal relevance aspect differ according to their way of transportation to school or not, multivariate analysis of variance (MANOVA) was conducted (see Table 48). The results indicated that there was a significance mean difference between perceptions of students with respect to their way of transportation to school, $F(2, 1081) = 8.32$, $p < 0.05$, $\eta = .67$. Mean score of students who were taken to school by their families was 3.31 whereas mean scores of students who go to school by bus and on foot were 3.11 and 3.08, respectively.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in uncertainty aspect differ according to their way of transportation to school or not, multivariate analysis of variance (MANOVA) was run (see Table 48). The results indicated that there was a significant mean difference between perceptions of students with respect to their way of transportation to school, F

(2, 1081) = 10.03, p < 0. 05, η = .00. Mean score of students who were taken to school by their families was 3.35 whereas mean scores of students who go to school by bus and on foot were 3.14 and 3.22, respectively.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ according to their way of transportation to school or not, MANOVA was conducted. The results (see Table 48) revealed that there was a difference, F (2, 1081) = 3.4, p < 0. 05, η = .51.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ or not according to their way of transportation to school, multivariate analysis of variance (MANOVA) was run (see Table 48). The results indicated that there was a significant mean difference between perceptions of students with respect to their way of transportation to school, F (2, 1081) = 3.26, p < 0. 05, η = .5.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to their way of transportation to school or not, MANOVA was used. The results (see Table 48) revealed that there was no difference, F (2, 1081) = 5.44, p > 0. 05, η = .14.

4.3.1.5. Education Level of Students' Mother

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to education level of their mother or not, MANOVA was used. The MANOVA results are presented below in Table 49.

Analysis of the whole questionnaire revealed that students' perception of CLE differed according to education level of their mother, F (4, 1077) = 24.69, p < .05, η = .21. Regardless of education level of their mother, the students perceived the learning environment and all of its aspects inquired to be constructivist but at different levels. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the CLE according to education level of students' mother. As seen in Table 49, there was a significant difference in all aspects (p < .05). Tukey test for

multiple comparisons indicated significant difference between the mean scores of the students whose mother did not attend school at all and whose mother attended to school. While there is no significant difference between the mean scores of the students whose mother graduated from a primary school and whose mother graduated from a secondary school, similarly, there is no significant difference between the mean scores of the students whose mother graduated from a high school and whose mother graduated from a university.

In order to determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in personal relevance aspect differ according to education level of their mother or not, multivariate analysis of variance (MANOVA) was conducted (see Table 49). The results indicated that there was a significance mean difference between perceptions of students with respect to education level of their mothers, $F(4, 1077) = 33.78$, $p < 0.05$, $\eta = .01$.

In order to determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in uncertainty aspect differ according to education level of their mother or not, multivariate analysis of variance (MANOVA) was run (see Table 49). The results indicated that there was a significant mean difference between perceptions of students with respect to education level of their mothers, $F(4, 1077) = 10.8$, $p < 0.05$, $\eta = .00$. Mean score of students whose mother did not attend a school was 3.15 whilst mean scores of students whose mother graduated from a primary school, a secondary school, a high school and a university were 3.16, 3.18, 3.31 and 3.39, respectively.

To determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in critical voice aspect differ according to education level of their mother or not, MANOVA was used. The results (see Table 49) revealed that there was a difference, $F(4, 1077) = 13.34$, $p < 0.05$, $\eta = .99$. Mean score of students whose mother did not attend a school was 2.68 whilst mean scores of students whose mother graduated from a primary school, a secondary school, a high school and a university were 2.86, 2.94, 3.06 and 3.07, respectively.

Table 49

Perception of Constructivist Classroom Aspects According to Education Level of Mother

Aspects	Education Level of Mother													
	Never Attended to School (n=150)		Primary Education (n=535)		Secondary Education (n=115)		High Education (n=192)		University Education (n=136)					
	M	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	2.88	.48	3.02	.53	3.07	.51	3.29	.54	3.47	.42	4	33.78	.01	.000
Uncertainty	3.15	.46	3.16	.50	3.18	.42	3.31	.35	3.39	.32	4	10.8	.00	.000
Critical Voice	2.68	.56	2.86	.58	2.94	.57	3.06	.58	3.07	.60	4	13.34	.99	.000
Shared Control	2.83	.62	2.95	.64	3.04	.60	3.20	.59	3.27	.65	4	16.06	.90	.000
Student Negotiation	2.43	.60	2.62	.61	2.67	.61	2.77	.69	2.76	.63	4	7.52	.13	.000
Total	2.79	.40	2.92	.43	2.98	.43	3.13	.43	3.19	.38	4	24.69	.21	.000

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to education level of their mother or not, multivariate analysis of variance (MANOVA) was run (see Table 49). The results indicated that there was a significant mean difference between perceptions of students with respect to education level of their mothers, $F(4, 1077) = 16.06$, $p < 0.05$, $\eta = .90$. Mean score of students whose mother did not attend a school was 2.83 whilst mean scores of students whose mother graduated from a primary school, a secondary school, a high school and a university were 2.95, 3.04, 3.20 and 3.27, respectively.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to education level of their mother or not, MANOVA was conducted. The results (see Table 49) revealed that there was a difference, $F(4, 1077) = 7.52$, $p < 0.05$, $\eta = .13$. Mean score of students whose mother did not attend a school was 2.43 whilst mean scores of students whose mother graduated from a primary school, a secondary school, a high school and a university were 2.62, 2.67, 2.77 and 2.76, respectively.

4.3.1.6. Education Level of Students' Father

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to education level of their father or not, MANOVA was used. The MANOVA results are presented below in Table 50.

Analysis of the whole questionnaire revealed that students' perception of CLE differed according to education level of their father, $F(4, 1070) = 17.23$, $p < .05$, $\eta = .88$. Regardless of education level of their father, the students perceived the learning environment and all of its aspects inquired to be constructivist but at different levels. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the CLE according to education level of students' father. As seen in Table 50, there was a significant difference in all aspects ($p < .05$). Tukey test for multiple comparisons indicated no significant difference between the mean scores of the students whose father did not attend school at all and whose father graduated from a

primary school or a secondary school. While there is a significant difference between the mean scores of the students whose father did not attend to a school and whose father graduated from a high school or a university, a similar case is observed for students whose father graduated from a primary school; which is, there is a significant difference between the mean scores of the students whose father graduated from a primary school and whose father graduated from a high school or a university.

In the case of students whose father graduated from a high school, there is a significant mean difference when compared with the students whose father did not attend to a school or whose father graduated from a primary school or a secondary school. There is no significant difference between the mean scores of students whose father graduated from a high school and whose father graduated from a university.

In order to determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in personal relevance aspect differ according to education level of their father or not, multivariate analysis of variance (MANOVA) was conducted (see Table 50). The results indicated that there was a significance mean difference between perceptions of students with respect to education level of their fathers, $F(4, 1070) = 19.24$, $p < 0.05$, $\eta = .78$. Mean score of students whose father did not attend a school was 2.92 whilst mean scores of students whose father graduated from a primary school, a secondary school, a high school and a university were 2.97, 3.01, 3.18 and 3.3, respectively.

In order to determine whether the students' perceptions of CLE in 4^{th} and 5^{th} grades in primary schools in Turkey in uncertainty aspect differ according to education level of their father or not, multivariate analysis of variance (MANOVA) was run (see Table 50). The results indicated that there was a significant mean difference between perceptions of students with respect to education level of their fathers, $F(4, 1070) = 13.34$, $p < 0.05$, $\eta = .00$. Mean score of students whose father did not attend a school was 3.15 whilst mean scores of students whose father graduated from a primary school, a secondary school, a high school and a university were 3.12, 3.11, 3.31 and 3.31, respectively.

Table 50

Perception of Constructivist Classroom Characteristics According to Education Level of Father

Aspects	Education Level of Father													
	Never Attended to School (n=44)		Primary Education (n=357)		Secondary Education (n=166)		High Education (n=285)		University Education (n=271)					
	M	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	2.92	.44	2.97	.53	3.01	.51	3.18	.52	3.30	.53	4	19.24	.78	.000
Uncertainty	3.15	.41	3.12	.53	3.11	.48	3.31	.37	3.31	.37	4	13.34	.00	.000
Critical Voice	2.71	.51	2.79	.60	2.82	.59	3.00	.55	3.03	.58	4	11.33	.58	.000
Shared Control	2.94	.58	2.90	.64	2.93	.64	3.10	.62	3.17	.63	4	9.9	.91	.000
Student Negotiation	2.48	.64	2.60	.60	2.59	.61	2.67	.66	2.74	.64	4	3.32	.45	.010
TOTAL	2.84	.39	2.87	.44	2.90	.43	3.05	.40	3.11	.44	4	17.23	.88	.000

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ according to education level of their father or not, MANOVA was used. The results (see Table 50) revealed that there was a difference, $F(4, 1070) = 11.33$, $p < 0.05$, $\eta = .58$. Mean score of students whose father did not attend a school was 2.71 whilst mean scores of students whose father graduated from a primary school, a secondary school, a high school and a university were 2.79, 2.82, 3 and 3.03, respectively.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to education level of their father or not, multivariate analysis of variance (MANOVA) was run (see Table 50). The results indicated that there was a significant mean difference between perceptions of students with respect to education level of their fathers, $F(4, 1070) = 9.9$, $p < 0.05$, $\eta = .91$. Mean score of students whose father did not attend a school was 2.94 whilst mean scores of students whose father graduated from a primary school, a secondary school, a high school and a university were 2.90, 2.93, 3.1 and 3.17, respectively.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to education level of their father or not, MANOVA was used. The results (see Table 50) revealed that there was a difference, $F(4, 1070) = 3.32$, $p < 0.05$, $\eta = .45$. Mean score of students whose father did not attend a school was 2.48 whilst mean scores of students whose mother graduated from a primary school, a secondary school, a high school and a university were 2.6, 2.59, 2.67 and 2.74, respectively.

4.3.2. Students' Technology Use

In this part of the study, technology use of students is determined as a new variable through combination of variables such as existence of computer laboratory with internet connection at students' school, existence of internet connection at students' home and usage of internet during the Science and Technology classes. Those three independent variables were coded as do not use, low, medium and high technology use

indicators and then combined into a single technology variable. This process was guided by a measurement and evaluation expert.

To determine whether the primary 4th and 5th grade students' perceptions of CLE in Science and Technology course differ according to their technology use, one-way MANOVA was run where the technology use was independent variable and perceptions of students on personal relevance, uncertainty, critical voice, shared control and student negotiation aspects were dependent variables. Descriptive statistics for the dependent variables across the technology use (do not use = 362, low = 309, medium = 267, high = 156) are displayed in Table 51.

Table 51

Levene's Test of Equality of Error Variances (Students' Technology Use)

Aspects	*F*	*df1*	*df2*	*p*
Personal Relevance	1.13	3	1090	.34
Uncertainty	17.47	3	1090	.00
Critical Voice	.81	3	1090	.49
Shared Control	.82	3	1090	.48
Student Negotiation	1.13	3	1090	.34
Total	2.95	3	1090	.03

Table 52

Descriptive Statistics with respect to CLE Aspects

Aspects	*M*				*Sd*				Skewness				Kurtosis			
	Do Not Use	Low	Medium	High	Do Not Use	Low	Medium	High	Do Not Use	Low	Medium	High	Do Not Use	Low	Medium	High
Personal Relevance	2.99	3.02	3.2	3.4	.55	.52	.51	.48	-.15	-.12	-.31	-.69	-.35	-.54	-.53	-.33
Uncertainty	3.1	3.19	3.31	3.37	.50	.46	.4	.31	-.7	-.9	-1.18	-1.08	.1	.54	2.07	1.5
Critical Voice	2.83	2.83	2.99	3.12	.58	.59	.57	.54	-.26	-.23	-.45	-.48	-.45	-.43	-.21	-.17
Shared Control	2.93	2.9	3.16	3.29	.63	.62	.62	.58	-.1	-.17	-.59	-.78	-.67	-.58	-.23	-.06
Student Negotiation	2.61	2.55	2.66	2.88	.62	.63	.64	.59	.00	.24	.00	-.57	-.54	-.31	-.6	-.54
TOTAL	2.89	2.9	3.06	3.21	.44	.43	.41	.37	-.1	.00	-.51	-.62	-.49	-.57	-.1	-.48

Table 51 shows that students who use technology most had the highest mean score on each dependent measure. Moreover, skewness and kurtosis values displayed in the table indicated univariate normality for the individual dependent variables across independent variable. This finding can be considered as a sign of meeting multivariate normality assumption of MANOVA. Nonsignificant Box's Test result, further suggested that multivariate normality assumption was met as well as homogeneity of variance and covariance matrices assumption F (45, 155066) = 2,12, p = .000. Results of Levene's Test performed to check whether each dependent variable has the same variance across groups were presented in Table 52.

The results revealed that there was violation of homogeneity of variance assumption for the dependent measures of variables except uncertainty. However, it should be notified that Box' Test allowing to test the assumption of homogeneity of variances and covariances among the dependent variables across technology use groups of students did not yield a significant result indicating homogeneity of variance and covariance matrices. After checking the assumptions, one-way MANOVA was conducted. Results of the analysis are shown in Table 53.

Table 53

MANOVA results with respect to collective dependent variables of CLE Aspects

Source	Wilks' Lambda	Hypothesis df	Error df	Multivariate F	Sig. (p)	Eta-Squared	Observed Power
Technology Use	.89	15	2998	8.37	.000	.04	1

The findings showed that there was a significant mean difference between the technology use groups with respect to aspects of CLE. The multivariate $\eta 2$ based on Wilk's Λ was not strong, 0.89, implying that the magnitude of the difference between the groups was small. In fact, this value indicated 89 % of multivariate variance of the dependent variables was associated with the technology use groups. What is more, power, which is the probability of detecting a significant effect when the effect truly does exist in nature, was found to be very high, 1.00.

In order to determine the effect of technology use on each CLE aspect univariate ANOVA's were run. Table 54 displays the results of univariate ANOVAs.

Table 54

Follow-Up Multiple Comparisons

Source	Dependent Variable	*df*	*F*	*p*	Eta-Squared	Observed Power
Technology Use	Personal Relevance	3	27.61	.00	.07	1.00
	Uncertainty	3	19.27	.00	.05	1.00
	Critical Voice	3	13.08	.00	.04	1.00
	Shared Control	3	21.23	.00	.06	1.00
	Student Negotiation	3	10.33	.00	.03	.999
	Total	3	28.77	.00	.07	1.00

As it can be inferred from the table, concerning the technology use of students there was a significant mean different between do not use, low, medium and high technology use of students with respect to perceived CLE and its aspects which are personal relevance, uncertainty, critical voice, shared control and student negotiation. The mean scores given in Table 51 were examined to determine that high technology user students tend to perceive CLE and its aspects as more constructivist. In addition, results revealed that medium technology user students' perceptions were higher than low technology user students' perceptions in all aspects. The same case is observed when the low technology user students and students who do not use technology at all are considered. Concerning technology use groups, the univariate ANOVAs for the dependent variables which are the aspects of CLE, are significant ($p < 0.05$) indicating that there was a statistically significant mean difference between the groups with respect to aspects of CLE.

In the following sub-sections of this part, the MANOVA results for specific variables constituting the technology use variable as reported above (existence of computer laboratory with Internet connection at students' school, existences of

internet connection at students' home and usage of the Internet during the Science and Technology classes) are provided.

4.3.2.1. Existence of Computer Laboratory with Internet Connection at Students' School

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to existence of a computer laboratory with Internet connection at school or not, MANOVA was used. The MANOVA results are presented in Table 55.

Analysis of the whole questionnaire revealed that students' perception of Constructivist Learning Environment differed according to existence of a computer laboratory with Internet connection at school, $F(1, 917) = 7$, $p < .05$, $\eta = .13$. The mean scores of perceptions of students who go to a school with a computer laboratory with Internet connection was 3.02 whereas students who go to a school without a computer laboratory with internet connection had a 2.91 mean score. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the classrooms according to existence of a computer laboratory with Internet connection at school.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in personal relevance aspect differ according to existence of a computer laboratory with Internet connection at school or not, multivariate analysis of variance (MANOVA) was run (see Table 55). The results indicated that there was a significant mean difference between perceptions of students with respect to existence of a computer laboratory with Internet connection at their schools, $F(1, 917) = 4.81$, $p < 0.05$, $\eta = .13$. The mean score of perceptions of students who go to a school with a computer laboratory with Internet connection was 3.16 whereas students who go to a school without a computer laboratory with internet connection had a 3.05 mean score.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in uncertainty aspect differ according to existence of a computer laboratory with Internet connection at school or not, multivariate analysis of variance (MANOVA) was run (see Table 55). The results

indicated that there was a significant mean difference between perceptions of students with respect to existence of a computer laboratory with Internet connection at school, $F(1, 917) = 7.83$, $p < 0.05$, $\eta = .00$. The mean score of perceptions of students who go to a school with a computer laboratory with Internet connection was 3.26 whereas students who go to a school without a computer laboratory with internet connection had a 3.15 mean score.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ according to existence of a computer laboratory with Internet connection at school or not, MANOVA was used. The results (see Table 55) revealed that there was a difference, $F(1, 917) = 8$, $p < 0.05$, $\eta = .02$. The mean score of perceptions of students who go to a school with a computer laboratory with Internet connection was 2.95 whereas students who go to a school without a computer laboratory with internet connection had a 2.79 mean score.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to existence of a computer laboratory with Internet connection at school or not, multivariate analysis of variance (MANOVA) was run (see Table 55). The results indicated that there was no significant mean difference between perceptions of students with respect to existence of a computer laboratory with Internet connection at school, $F(1, 917) = 2.58$, $p > 0.05$, $\eta 2 = .33$. The mean score of perceptions of students who go to a school with a computer laboratory with Internet connection was 3.07 whereas students who go to a school without a computer laboratory with internet connection had a 2.97 mean score.

Table 55

Perception of CLE Aspects According to Existence of Computer Laboratory with Internet Connection at School

Aspects	Existence of Computer Lab with Internet Connection at School							
	NO (n=174)		YES (n=766)					
	M	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	3.05	.59	3.16	.54	1	4.81	.13	.029
Uncertainty	3.15	.52	3.26	.42	1	7.83	.00	.005
Critical Voice	2.79	.66	2.95	.57	1	8	.02	.005
Shared Control	2.97	.68	3.07	.63	1	2.58	.33	.109
Student Negotiation	2.59	.66	2.66	.63	1	1.08	.35	.298
Total	2.91	.48	3.02	.43	1	7.00	.13	.008

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to existence of a computer laboratory with Internet connection at school or not, MANOVA was used. The results (see Table 55) revealed that there was no difference, $F(1, 917) = 1.08$, $p > 0.05$, $\eta = .13$. The mean score of perceptions of students who go to a school with a computer laboratory with Internet connection was 2.66 whereas students who go to a school without a computer laboratory with internet connection had a 2.59 mean score.

4.3.2.2. Existence of Internet Connection at Students' Home

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to existence of Internet connection at home or not, MANOVA was conducted. The MANOVA results are presented below in Table 56.

Analysis of the whole questionnaire revealed that students' perception of Constructivist Learning Environment differed according to existence of an Internet connection at home, $F(1, 896) = 56.49$, $p < .05$, $\eta = .15$. The mean scores of perceptions of students who have an Internet connection at home was 3.14 whereas students do not have an Internet connection at home had a 2.92 mean score. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the classrooms according to existence of an Internet connection at home.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in personal relevance aspect differ according to existence of an Internet connection at home or not, multivariate analysis of variance (MANOVA) was run (see Table 56). The results indicated that there was a significant mean difference between perceptions of students with respect to existence of an Internet connection at home, $F(1, 896) = 68.50$, $p < 0.05$, $\eta = .01$. The mean score of perceptions of students who had an Internet connection at home was 3.33 whereas students who did not have an Internet connection at home had a 3.04 mean score.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in uncertainty aspect differ according to existence of an Internet connection at home or not, multivariate analysis of variance (MANOVA) was run (see Table 56). The results indicated that there was a significant mean difference between perceptions of students with respect to existence of an Internet connection at home, $F(1, 896) = 24.96$, $p < 0.05$, $\eta = .00$. The mean score of perceptions of students who had an Internet connection at home was 3.34 whereas students who did not have an Internet connection at home had a 3.20 mean score.

Table 56

Perception of CLE Aspects According to Existence of Internet Connection at Home

Aspects	Existence of Internet Connection At Home							
	NO (n=564)		YES (n=353)					
	M	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	3.04	.54	3.33	.49	1	68.50	.01	.000
Uncertainty	3.20	.47	3.34	.36	1	24.96	.00	.000
Critical Voice	2.86	.57	3.05	.58	1	21.78	.61	.000
Shared Control	2.96	.62	3.21	.62	1	33.52	.83	.000
Student Negotiation	2.57	.62	2.78	.64	1	23.41	.76	.000
Total	2.92	.43	3.14	.41	1	56.49	.15	.000

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ according to existence of an Internet connection at home or not, MANOVA was used. The results (see Table 56) revealed that there was a difference, $F (1, 896) = 21.78$, $p < 0.05$, $\eta = .61$. The mean score of perceptions of students who had an Internet connection at home was 3.05 whereas students who did not have an Internet connection at home had a 2.86 mean score.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to existence of an Internet connection at home or not, multivariate analysis of variance (MANOVA) was run (see Table 56). The results indicated that there was a significant mean difference between perceptions of students with respect to existence of an Internet connection at home, $F (1, 896) = 33.52$, $p < 0. 05$, $\eta = .83$. The mean score of perceptions of students who had an Internet connection at home

was 3.21 whereas students who did not have an Internet connection at home had a 2.96 mean score.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to existence of an Internet connection at home or not, MANOVA was conducted. The results (see Table 56) revealed that there was a difference, $F(1, 896) = 23.51$, $p < 0.05$, $\eta = .76$. The mean score of perceptions of students who had an Internet connection at home was 2.78 whereas students who did not have an Internet connection at home had a 2.57 mean score.

4.3.2.3. Usage of the Internet during the Science and Technology Classes

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to usage of Internet during the Science and Technology classes or not, MANOVA was used. The MANOVA results are presented below in Table 57.

Analysis of the whole questionnaire revealed that students' perception of Constructivist Learning Environment differed according to usage of Internet during the science and technology classes, $F(1, 804) = 43.47$, $p < .05$, $\eta = .11$. The mean scores of perceptions of students who declare that Internet is used in their science and technology classes was 3.12 whereas students who declare that Internet is not used in their science and technology classes had a 2.92 mean score. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the classrooms according to usage of Internet during the Science and Technology course.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in personal relevance aspect differ according to usage of Internet during the Science and Technology classes or not, multivariate analysis of variance (MANOVA) was run (see Table 57). The results indicated that there was a significant mean difference between perceptions of students with respect to usage of Internet during the Science and Technology classes, $F(1, 804) = 25.95$, $p < 0.05$, $\eta = .39$. The mean score of perceptions of students who declare that Internet is used in their science and technology classes was 3.26 whereas students

who declare that Internet is not used in their science and technology classes had a 3.06 mean score.

Table 57

Perception of CLE Aspects According to Usage of Internet during Science and Technology Classes

Aspects	Usage of Internet during Science and Technology Classes							
	NO (n=456)		YES (n=366)					
	M	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	3.06	.54	3.26	.52	1	25.95	.39	.000
Uncertainty	3.18	.47	3.34	.36	1	32.99	.00	.000
Critical Voice	2.85	.59	3.04	.56	1	19.45	.13	.000
Shared Control	2.96	.63	3.20	.60	1	30.04	.52	.000
Student Negotiation	2.56	.61	2.76	.64	1	19.79	.37	.000
Total	2.92	.43	3.12	.41	1	43.47	.11	.000

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in uncertainty aspect differ according to usage of Internet during the science and technology classes or not, multivariate analysis of variance (MANOVA) was run (see Table 57). The results indicated that there was a significant mean difference between perceptions of students with respect to usage of Internet during the science and technology classes, $F(1, 804) = 32.99$, $p < 0.05$, $\eta = .00$. The mean score of perceptions of students who declare that Internet is used in their science and technology classes was 3.34 whereas students who declare that Internet is not used in their science and technology classes had a 3.18 mean score.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ according to usage of

Internet during the science and technology classes or not, MANOVA was used. The results (see Table 57) revealed that there was a difference, $F(1, 804) = 19.45$, $p < 0.05$, $\eta = .13$. The mean score of perceptions of students who declare that Internet is used in their science and technology classes was 3.04 whereas students who declare that Internet is not used in their science and technology classes had a 2.85 mean score.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to usage of Internet during the science and technology classes or not, multivariate analysis of variance (MANOVA) was run (see Table 57). The results indicated that there was a significant mean difference between perceptions of students with respect to usage of Internet during the science and technology classes, $F(1, 804) = 30.04$, $p < 0.05$, $\eta = .52$. The mean score of perceptions of students who declare that Internet is used in their science and technology classes was 3.20 whereas students who declare that Internet is not used in their science and technology classes had a 2.96 mean score.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to usage of Internet during the science and technology classes or not, MANOVA was used. The results (see Table 57) revealed that there was a difference, $F(1, 804) = 19.79$, $p < 0.05$, $\eta = .37$. The mean score of perceptions of students who declare that Internet is used in their science and technology classes was 2.76 whereas students who declare that Internet is not used in their science and technology classes had a 2.56 mean score.

In the following two sections, the MANOVA results for two other variables which are students' grade level and students' gender are reported.

4.3.3. Students' Grade Level

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to their grade or not, MANOVA was used. The MANOVA results are presented below in Table 58.

Analysis of the whole questionnaire revealed that students' perception of CLE did not differ according to their grade levels, $F(1, 1091) = 2.95$, $p > .05$, $\eta = .76$. Both 4th grade and 5th grade students perceived the learning environment and all of its aspects inquired to be constructivist. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the CLE according to grade level of students. As seen in Table 58, there was a significant difference in student negotiation aspect ($p < .05$). In other aspects such as personal relevance, uncertainty, critical voice and shared control, it was relieved that there was no significant difference according to the grade levels of the students ($p > .05$).

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in personal relevance aspect differ according to their grade levels or not, multivariate analysis of variance (MANOVA) was run (see Table 58). The results indicated that there was no significant mean difference between perceptions of students with respect to their grade levels, $F(1, 1091) = .7$, $p > 0.05$, $\eta = .32$. Mean score of students in the 4th grade was 3.1 and mean score of students in the 5th grade was 3.13.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in uncertainty aspect differ according to the their grade level or not, multivariate analysis of variance (MANOVA) was run (see Table 58). The results indicated that there was no significant mean difference between perceptions of students with respect to their grade level, $F(1, 1091) = .42$, $p > 0.05$, $\eta = .02$. Mean score of students in the 4th grade was 3.27 and mean score of students in the 5th grade was 3.32.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ according to their grade

level or not, MANOVA was used. The results (see Table 58) revealed that there was no difference, F (1, 1091) = 3.01, p > 0. 05, η = .77. Mean score of students in the 4th grade was 2.88 and mean score of students in the 5th grade was 2.95.

Table 58

Perception of CLE Aspects According to Grade Levels

Aspects	Grade Levels							
	4th (n=534)		5th (n=577)					
	M	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	3.1	.55	3.13	.53	1	.7	.32	.404
Uncertainty	3.27	.55	3.32	.54	1	.42	.02	.518
Critical Voice	2.88	.59	2.95	.58	1	3.01	.77	.083
Shared Control	3.01	.63	3.03	.65	1	.23	.33	.631
Student Negotiation	2.59	.61	2.69	.65	1	7.06	.13	.008
Total	2.99	.46	3.04	.48	1	2.95	.76	.086

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to their grade level or not, multivariate analysis of variance (MANOVA) was run (see Table 58). The results indicated that there was no significant mean difference between perceptions of students with respect to their grade level, F (1, 1091) = .23, p > 0. 05, η = .33. Mean score of students in the 4th grade was 3.01 and mean score of students in the 5th grade was 3.03.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to the grade level of students or not, MANOVA was used. The results (see Table 58)

revealed that there was a difference, F (1, 1091) = 6.98, $p < 0.05$, $\eta = .76$. Mean score of students in the 4th grade was 2.59 and mean score of students in the 5th grade was 2.99.

4.3.4. Students' Gender

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey differ according to their gender or not, MANOVA was used. The MANOVA results are presented below in Table 59.

Analysis of the whole questionnaire revealed that students' perception of CLE differed according to their gender, F (1, 1083) =5.85, $p < .05$, $\eta = .29$. The mean score of perceptions of female students was 3.01 whereas male students had a 2.94 mean score. Further analysis of data was carried out in order to analyze the difference in perception of each aspect of the classrooms according to gender.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in personal relevance aspect differ according to their gender or not, multivariate analysis of variance (MANOVA) was run (see Table 59). The results indicated that there was no significant mean difference between perceptions of students with respect to their gender, F (1, 1083) = 1.53, $p > 0.05$, $\eta = .03$. Mean score of female students was 3.13 and mean score of male students was 3.08.

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in uncertainty aspect differ according to gender or not, multivariate analysis of variance (MANOVA) was run (see Table 59). The results indicated that there was no significant mean difference between perceptions of students with respect to their gender, F (1, 1083) = .68, $p > 0.05$, $\eta = .74$. Mean score of female students was 3.22 and mean score of male students was 3.2.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in critical voice aspect differ according to their gender or not, MANOVA was used. The results (see Table 59) revealed that there was no difference, F (1, 1083) = .79, $p > 0.05$, $\eta = .4$. Mean score of female students was 2.92 and mean score of male students was 2.88.

Table 59

Perception of CLE Aspects According to Gender

Aspects	Gender							
	Female (n=608)		Male (n=525)					
	M	*Sd*	*M*	*Sd*	*df*	*F*	η	*p*
Personal Relevance	3.1	.55	3.13	.53	1	1.53	.03	.216
Uncertainty	3.27	.55	3.32	.54	1	.68	.74	.411
Critical Voice	2.88	.59	2.95	.58	1	.79	.4	.376
Shared Control	3.01	.63	3.03	.65	1	7.11	.75	.008
Student Negotiation	2.59	.61	2.69	.65	1	10.31	.77	.001
Total	2.99	.46	3.04	.48	1	5.85	.29	.016

In order to determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in shared control aspect differ according to their gender or not, multivariate analysis of variance (MANOVA) was run (see Table 59). The results indicated that there was a significant mean difference between perceptions of students with respect to their gender, $F (1, 1083) = 7.11$, $p < 0.05$, $\eta = .75$. Mean score of female students was 3.07 and mean score of male students was 2.96.

To determine whether the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in student negotiation aspect differ according to their gender or not, MANOVA was used. The results (see Table 59) revealed that there was a difference, $F (1, 1108) = 10.31$, $p < 0.05$, $\eta = .77$. Mean score of female students was 2.70 and mean score of male students was 2.57.

Table 60 summarizes the results related to students' perception of constructivist learning environment. The results revealed that students' perception

differed according to socio-economic status of their district, their number of siblings, their owning a study room, their way of transportation to school, education level of their mother, education level of their father, their gender, existence of a computer laboratory with Internet connection at their school, existence of Internet connection at their home and usage of internet during the science and technology classes. However, students' perception did not differ according to their grade level. Students in socio economic status groups 1 and 2, students who have 1 or 2 siblings, students who have a study room, students who are taken to school by their family, students whose mother graduated from a university, students who mother is a nurse, students whose father graduated from a university, students whose father is a policeman or a soldier, students who are female, students who declared that there is a computer laboratory with Internet connection in their schools, students who declared that there is Internet connection at their home and students who declared that they use the Internet during the science and technology classes perceived the learning environment to be more constructivist compared to the other students.

Table 60

Summary of the Results Related to Difference in Students' Perceptions of CLE Aspects

	Variables	*p*	More Constructivist Perception	Less Constructivist Perception
1.	Socio-Economic Status Group of Students' District	.000	Students in groups 1, 2 and 3	Students in groups 4, 5 and 6
2.	Students' Grade Level	.086	No difference	No difference

Table 60 *(continued)*

	Variables	*p*	More Constructivist Perception	Less Constructivist Perception
1.	Socio-Economic Status Group of Students' District	.000	Students in groups 1, 2 and 3	Students in groups 4, 5 and 6
2.	Students' Grade Level	.086	No difference	No difference
3.	Students' Number of Siblings	.000	Students who have 1 or 2 siblings	Students who have 4, 5 or more siblings
4.	Students' Having a Study Room	.000	Students who have a study room	Students who do not have a study room
5.	Students' Way of Transportation to School	.004	Students who are taken to school by their family	Students who go to school on foot
6.	Education Level of Students' Mother	.000	Students whose mother graduated from a university	Students whose mother never attended to school
7.	Education Level of Students' Father	.000	Students whose father graduated from a university	Students whose father never attended to school
8.	Students' Gender	.016	Students who are female	Students who are male
9.	Existence of a Computer Laboratory with Internet Connection at Students' School	.008	Students who declared that there is a computer laboratory with Internet connection in their school	Students who declared that there is no computer laboratory with Internet connection in their school
10.	Existence of Internet connection at Students' Home	.000	Students who have Internet connection at their home	Students who have no Internet connection at their home
11.	Usage of Internet During the Science and Technology	.000	Students who declared that they use the Internet during the science and technology classes	Students who declared that they do not use the Internet during the science and technology classes

4.4. Relationship between Teachers' Perceptions on CLE and Administrative Support They Received

As the perceptions of teachers on CLE and its aspects have been thoroughly analyzed while trying to give an answer to research question 1.2, briefly the perceptions of teachers on administrative support they received is reported in this section before analyzing the relationship between the two variables.

Table 61

Teachers' Responses Related to Administrative support they received as Obtained through Questionnaires

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
1. I feel that I belong to a wide group of professional educators which also covers the environment outside of the school. (n=256)	2.59	.82	12.9	41.8	36.7	8.6
2. Administrators support teachers to use new methods. (n=261)	2.95	.81	27.2	43.3	26.4	3.1
3. Teachers in my school work together in order to increase the quality in education. (n=262)	2.96	.78	25.6	47.7	23.7	3.1
4. My school provides a positive environment for learning. (n=261)	3	.82	29.1	45.2	21.8	3.8
5. My administrators support me for participating in professional meetings. (n=260)	2.89	.88	27.3	41.2	25	6.5

Table 61 *(continued)*

Items	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
6. My administrators provide me with the opportunity to use the teaching equipment necessary for Science and Technology Course. (n=258)	2.96	.86	27.9	46.9	18.2	7
7. We are constantly encouraged to share our views with other teachers for improving the Science and Technology Course. (n=261)	2.84	.86	23.4	43.7	26.4	6.5
8. In conducting Science and Technology Course I have the facilities such as library, field work and guest speakers. (n=260)	2.17	.9	8.5	25.4	41.2	25
9. The opportunities of in service training provided by the Ministry of education are enough. (n=260)	2	.8	3.1	22.7	45	29.2
10. Up until now I have participated in at least one in service training regarding the new program. (n=243)	2.57	1.05	24.3	27.2	30	18.5
11. Ministry gives new decisions in application of the new program by consulting with the teachers. (n=257)	1.88	.8	3.9	14.8	46.7	34.6

Table 61 *(continued)*

Item	*M*	*Sd*	Percentages			
			Always %	Often %	Sometimes %	Never %
12. The problems and questions that we have encountered regarding the new program have been overcome by the school administration or ministry of education. (n=258)	2.14	.8	4.7	25.6	48.8	20.9
Total (n=262)	2.52	.6	2.3	50.8	43.5	3.4

As seen in Table 61, analysis of the mean scores revealed that majority of the characteristics that an ideal administrative support for the science and technology teachers in order for utilizing the new course program in their classrooms were either often or sometimes perceived by the teachers (50.8% and 43.5%, respectively). The teachers think that often they cooperate with each other to increase the quality of education (47.7% and $M = 2.96$). Similarly they think that their administrators provide them with the opportunity to use the teaching equipment necessary for Science and Technology Course ($M = 2.96$). However the ministry sometimes give decisions in application of the new program by consulting with the teachers (46.7% and $M = 1.88$). 34.6 % of the teachers declared that the ministry never gave decisions in application of the new program by consulting with them. 29.2 % of them never think that the opportunities of in service training provided by the Ministry are enough ($M = 2$).

The fourth open ended question that the teachers answered was, "What are the difficulties that you face during the implementation of the new program?" Analysis of the responses of teachers provided in depth information on example cases which can be acknowledged as opinions and suggestions in regard to the administrative support that the teachers have to develop the constructivist learning environment in the science and technology classes together with the problems

encountered within this aspect. Some of the important statements were as the following:

Program Related Statements

- I did not fully understand the new program. There has to be in service training given by the experts. There are not enough infrastructures in the schools. Families are not fully informed about the program.
- 1. The curriculum has been developed by force; 2. No clear information has been given regarding the implementation of the program; 3. Parents are not informed about the program adequately that is why they can not know how they can help to students.
- Fast and constant change of the program brings problems with itself.
- The program is heavy. There should be more opportunity for activities if the component of the course could be narrowed down.
- The only problem is that the program is too much focused on activities. There is a need to establish a link between the region and environment and these activities.
- While conducting the new science and technology program the experiments in labs should be adequate. Most of the schools have only one such room. The student work books are not found attractive by the students.
- The program has a complex structure. If we can simplify, it is easy to make the activities. It takes too much effort to explain students how they can do things. Moreover this new program requires quality schools, quality students and financial possibilities. It is very hard for the rural areas and poor students who are very far from implementing this program.
- It is hard to get rid of the habits stemming from the old (teacher centered) program.
- There are problems regarding the contents of the course books. Content wise they should be more clear and informative.
- We had encountered problems regarding the timing of activities and lectures provided in the new program. In the workbooks there were exercises that it was not possible for students to complete them on their own.

- I believe that books are inadequate for the application of the program. Due to time limitations we can not dwell on subjects requiring learning through activities and games.
- It was hard form me to conduct the new program last year which we were using it for the first time. I have managed to conduct it better this year. But I do not want to see a new program every year.
- It has been said that through this program students will be more active. This has happened to some extent but the ability to express through writing is diminished. I have realized that while becoming more active students are loosing their respect to the teacher.
- The major missing element regarding the new program is the lack of information in the books. Students experience problems in reaching information adequate to their level. They get lost when they use the Internet.
- Science and technology course is the most enjoyable course of the new program.
- Teachers are not prepared adequately for the new program.
- The major problem that I have encountered with the new program is the small size of the letters in teacher guide. I also find project and performance evaluation criteria conflicting. I believe they will become better in the future.
- The subjects in Science and Technology Course are better prepared than other courses.
- The trial exams are conflicting with the method that we follow in the new program. This results in confusions.

Teaching and Learning Environment Related Statements

- Our teaching and management methods are limited. There is no room given to different activities in our book. The themes given are very superficial.
- The program is too loaded. It should not be very loaded as such with very widespread subjects and planning since it is such an idealized program which requires student involvements. There has to be planning covering much narrow issues.

- The very fact that activities are time consuming and the level of the books is not compatible with the levels of the students created problems while conducting the course.
- Guide books should have more detail and examples.
- The new program has the potential to make learning easier but both students and I experience problems in getting used to conducting this program.
- It is good that the program is research based but sometimes it becomes tiring for students to learn every subject through research.
- Sometimes we encounter problems regarding timing. We can not conduct some of the activities since we do not have laboratories. We can benefit more if the drill and practice sections are expanded.
- When activities are too much it is hard for us to finalize teaching about the subjects. The activities are time consuming. There is not enough equipment and material in the laboratory. In crowded classes usually time is not enough for group, home work and project presentations.
- Since experiments, finding materials and research can not be done by all of the students it is not possible to conduct classes in a complementary way.
- Having homework and projects for every course is tiring for the teacher. We are drowning in photocopies. The number has to be lowered. The important thing is to make students love research otherwise they just bring their research findings without even reading.
- Low number of student participation in class.
- It is hard to conduct activities in class.
- We could not still get adapted to student centered environment.
- It is possible to observe that during conducting activities the students started to misbehave.
- In the new program it is hard to find answers to some questions directed by students.
- I loose time since I want each presentation to be done. I have hard time in completing the chapters on time. I do not shift to the next unit if the students could not fully understand the previous unit and this makes me loose time. The books for the Science and Technology Course are much better when compared

to the books of other courses and we really have fun when we are doing this course.

- Sometimes the high number of examples in order to materialize the subjects results in destruction and distancing from the original subject.
- I do experience problems in conducting the experiments and explaining some of the subjects.
- Students experience hardships in understanding due to lack of their prior knowledge. Sometimes concepts become harder to understand because of the regional differences (i.e. şeker eridi = şeker çözündü in Turkish)
- Activities take too much time. Sometimes I feel the necessity of explaining the subjects to students in order to make them understand better. The activities in the book have to be reconsidered by taking the environment the school exists in into consideration.
- I believe that the teacher course book and the guide book are inadequate. We can not make students develop skills without the resource or complementary books.
- While conducting the activities class management becomes very hard.
- Limited knowledge on how to conduct research creates hardship for the application of the program. This most of the time results in shifting to old method.
- The lack of opportunities or the lack of understanding technology on behalf of the people of eastern Turkey creates hardships in conducting the new program. The content of the program is very nice. However while preparing this new program emphasis would have been given to the regional and socio-cultural and economic differences. This could have been resulted in a more productive learning environment.

Infrastructure and SES Related Statements

- The main hardship that I experience is about the photocopy issue. It is really hard for me to collect money from students. I can not get any support from school in that sense. This limits the activities that I can select. Instead I prefer to do activities on the class work book.

- The activities on the book are not compatible with the levels of the students. The activities and course subjects are research oriented but students do not have these opportunities (Internet, encyclopedias, libraries etc.).
- Classes are crowded and the families are not used to such a program. That is why they think that students do not learn anything and they react to that.
- The lack of tools is too much. The Ministry should cooperate with TRT and prepare educational CDs and distribute them to schools. This kind of a method is not expensive but at the same time will be very beneficial for both the natural and social sciences courses.
- We encounter the problem of convincing the families, lack of equipment, and the Ministry making new arrangements in the middle of the education year. The lack of adequate publicity about the program is another problem.
- Lack of resources is the major problem. The resource books have problems such as their knowledge base and use.
- The high number of students. The extensive time spend on the measurement and evaluation activities.
- The general problem that we have encountered is the inadequacy of the physical structure of the school and the failure of the science and technology laboratory to meet the requirements of the new program.
- The program can be more productive in classes with lower number of students. Our opportunities at school are very limited. Moreover the possibilities of students themselves are very limited. That is why we can not assign much research homework to our students since they do not have opportunities for that. In addition to economic limitations the awareness level of families is low which makes it impossible for them to understand the necessity of such homework.
- The infrastructure is not convenient. There is no convenient environment for experiments. The classes are crowded and there is no money. It is being said that the number of subjects are lowered however we still have time problem in conducting the activities. Rather than sending the students to unknown environments outside of school for doing research we need adequate environment to be developed at schools.
- The homework are research based but since most of the students do not have internet access at home they create the homework excuse to spent most of their

time at internet cafes. They just take printouts and bring them to school. Students became distanced from books.

- I think course books do not have adequate knowledge. I now that the reason behind this is to motivate students to conduct research. But some of my students do not have the opportunities for research.
- The opportunities for reaching information for students are almost non existent. There is not a clear approach regarding the exams. Still knowledge is being asked in the exams. But there is very little information in the books. The borders of the information are not clear.
- Since the program of the laboratory is too loaded we usually conduct the courses in class. If there was opportunity for each student to work individually it could have been possible to reach more visual material. Since the population of our school is too much we usually only do demonstration activities.
- While conducting the program since the level of students is not all the same, differences in their socioeconomic, cultural and other peculiarities it is not possible to reach required outcomes. The differences in the level of families' educational background are also influential.
- Due to economic and bureaucratic reasons we have experienced limitations in trip-observation and investigation activities.
- Evaluation measures are too much. In addition to stationary expenses it also creates extra burden and hardship for teachers.
- Although I enjoy conducting the new program, I experience problems with the bureaucracy necessary for organizing trips.
- Lack of information in books pacifies the students who have no opportunity to conduct research.
- It has been observed that in the hard performance homework students are experiencing problems. The ones who have capable and interested families get help from their families to overcome their problems but the ones with not interested families had hardships in those subjects. Families experience financial hardships due to extensive use of stationary. It is time consuming to do all of the forms required for evaluation.
- In some courses there are too many activities which are not possible to conduct them in village schools.

- The new program makes it obligatory for us to use technology more however the technological inadequacies that we are experiencing prevent us from conducting those activities.
- The books are not convenient for the conditions of the students. They can not conduct activities requiring research because they have no facilities for that. It is very hard and time consuming to find the materials necessary for the activities. Since we do not have a laboratory at school we have to do those activities by brining equipment in class and establish security conditions in class which is very hard. That is why most of the time I can not conduct activities.
- Students experience hardship in conducting research. The only source that they can depend on is the encyclopedia at the school library. This results in repetitive mono type home work.
- Most of the students do not have Internet connection at home and this creates hardships for us.
- Frequency of performance homework creates financial burden for students and also it has been observed that home works create boredom in students.
- We do experience problems since our school is not compatible with the new program. 1. We do not have a science and technology laboratory; 2. We do not have adequate equipment. Very limited computer access and no printer.
- Lack of equipment is a big problem. The school has very limited possibilities. Usually students can not break the boundaries of standardized knowledge. It is hard for them to make comments. Some of them might not like to work in groups.

As seen in the statements of the teachers, there are many difficulties that the teachers have to deal with while implementing the new program. The difficulties have their roots mainly in economic and social background of the students and the schools they attend. The relationship between the perceptions of teachers on administrative support the teachers have and their perceptions on constructivist learning environment and its aspects follows.

In order to determine whether there is a significant relationship between teachers' perceptions on CLE and their perceptions on administrative support they

received, correlation analysis was conducted. The results of the analysis can be seen in Table 62.

Table 62

Correlation between Teachers' Perceptions on CLE and Administrative support they received

Variables	N	Correlation Coefficient	*p*
Perceptions on CLE	262	.52	.00
Perceptions on School Support	262		

The results indicated that there was a significant correlation between teachers' perceptions on CLE and their perceptions on administrative support they received ($p < 0.05$). The interpretation of the size of the correlation provides that the correlation between the two variables is low.

4.4.1. Personal Relevance Aspect

In order to determine whether there is a significant relationship between teachers' perceptions on CLE in personal relevance aspect and their perceptions on administrative support they received, correlation analysis was conducted. The results of the analysis can be seen in Table 63.

The results indicated that there was a significant correlation between teachers' perceptions on CLE in personal relevance aspect and their perceptions on administrative support they received ($p < 0.05$). The interpretation of the size of the correlation provides that the correlation between the two variables is very low.

Table 63

Correlation between Teachers' Perceptions on CLE in Personal Relevance Aspect and Administrative support they received

Variables	N	Correlation Coefficient	*p*
Perceptions on CLE in Personal Relevance Aspect	261	.41	.00
Perceptions on School Support	262		

4.4.2. Uncertainty Aspect

In order to determine whether there is a significant relationship between teachers' perceptions on CLE in uncertainty aspect and their perceptions on administrative support they received, correlation analysis was conducted. The results of the analysis can be seen in Table 64.

Table 64

Correlation between Teachers' Perceptions on CLE in Uncertainty Aspect and Administrative support they received

Variables	N	Correlation Coefficient	*p*
Perceptions on CLE in Uncertainty Aspect	254	.38	.00
Perceptions on School Support	262		

The results indicated that there was a significant correlation between teachers' perceptions on CLE in uncertainty aspect and their perceptions on administrative support they received ($p < 0.05$). The interpretation of the size of the correlation provides that the correlation between the two variables is very low.

4.4.3. Critical Voice Aspect

In order to determine whether there is a significant relationship between teachers' perceptions on CLE in critical voice aspect and their perceptions on administrative support they received, correlation analysis was conducted. The results of the analysis can be seen in Table 65.

Table 65

Correlation between Teachers' Perceptions on CLE in Critical Voice Aspect and Administrative support they received

Variables	N	Correlation Coefficient	*p*
Perceptions on CLE in Critical Voice Aspect	254	.42	.00
Perceptions on School Support	262		

The results indicated that there was a significant correlation between teachers' perceptions on CLE in critical voice aspect and their perceptions on administrative support they received ($p < 0.05$). The interpretation of the size of the correlation provides that the correlation between the two variables is very low.

4.4.4. Shared Control Aspect

In order to determine whether there is a significant relationship between teachers' perceptions on CLE in shared control aspect and their perceptions on administrative support they received, correlation analysis was conducted. The results of the analysis can be seen in Table 66.

The results indicated that there was a significant correlation between teachers' perceptions on CLE in shared control aspect and their perceptions on administrative support they received ($p < 0.05$). The interpretation of the size of the correlation provides that the correlation between the two variables is very low.

Table 66

Correlation between Teachers' Perceptions on CLE in Shared Control Aspect and Administrative support they received

Variables	N	Correlation Coefficient	*p*
Perceptions on CLE in Shared Control Aspect	262	.45	.00
Perceptions on School Support	262		

4.4.5. Student Negotiation Aspect

In order to determine whether there is a significant relationship between teachers' perceptions on CLE in student negotiation aspect and their perceptions on administrative support they received, correlation analysis was conducted. The results of the analysis can be seen in Table 67.

Table 67

Correlation between Teachers' Perceptions on CLE in Student Negotiation Aspect and Administrative support they received

Variables	N	Correlation Coefficient	*p*
Perceptions on CLE in Student Negotiation Aspect	262	.38	.00
Perceptions on School Support	262		

The results indicated that there was a significant correlation between teachers' perceptions on CLE in student negotiation aspect and their perceptions on administrative support they received ($p < 0.05$). The interpretation of the size of the correlation provides that the correlation between the two variables is very low.

4.5. Summary of the Results

The results of the study as a whole are summarized below:

1. For investigating to what extent constructivist learning environment aspects existed in Science and Technology courses in 4th and 5th grades in primary education schools in Turkey, questionnaires were administered to the students taking the course and their teachers. The teachers also provided answers to 4 open ended questions which helped in learning more about the opinions of teachers on specific aspects of the constructivist learning environment and the administrative support they received at their schools. Analysis of the student questionnaires revealed that the students perceived the current learning environment to be often constructivist. Analysis of the sub-dimensions of the questionnaire indicated that the students perceived the personal relevance, uncertainty, critical voice, shared control and student negotiation aspects of a preferred constructivist learning environment to be often constructivist. Similar to the students, the analysis of the teacher questionnaire and its sub-dimensions indicated that the teachers perceived the learning environment and all of its aspects to be often constructivist. In the personal relevance aspect, the students had the highest mean score in responding the fourth item on the scale which was "I can explain life better now". On the other hand, in regard to the same aspect, they had the lowest mean score in responding the first item which was, "I make analogies about things outside of school life". In contrary, the items which the teachers achieved the highest and lowest mean scores in the teacher questionnaire in personal relevance aspect were, "Students learn that things they have learnt have no relationship with the things in life outside of the school" which was a reversed item while calculating the mean scores and "Students learn new things about life outside of the school". In the uncertainty aspect, the students had the highest mean score in responding the item which was "I am aware of the fact that technology changes in time". On the other hand, in regard to the same aspect, they had the lowest mean score in responding the item which was, "I can solve all of the problems in life through science and technology". In the case of the teachers, the items which they achieved the highest and lowest

mean scores in teacher questionnaire in uncertainty aspect were, “Students make the distinction that Internet technology is different from the technology used long years ago” and “Students think that they can solve problems in life by using technology”. In the critical voice aspect, the students had the highest mean score in responding the item which was “If I see necessary I can defend my rights with courage”. On the other hand, in regard to the same aspect, they had the lowest mean score in responding the item which was, “If necessary I can ask my teacher ‘Why I have to learn this?’”. In the case of the teachers, the items which they achieved the highest and lowest mean scores in the teacher questionnaire in critical voice aspect were, “Students express their thoughts freely” and “When they see need students ask the question of ‘Why I have to learn this?’”. In the shared control aspect, the students had the highest mean score in responding the item which was “I give answers to my teacher while he/she is inquiring to find out how good I learnt things”. On the other hand, in regard to the same aspect, they had the lowest mean score in responding the item which was, “I express to my teacher how much time I need for the activities”. In the case of the teachers, the items which the they achieved the highest and lowest mean scores in the teacher questionnaire in shared control aspect were, “Attention is being paid at the stage of course planning in order to assure the best learning for the students” and “Before deciding how much time is required for activities students help me”. In the student negotiation aspect, the students had the highest mean score in responding the item which was “I talk to my friends regarding how problems can be solved”. On the other hand, in regard to the same aspect, they had the lowest mean score in responding the item which was, “Other students ask me to explain what I think about the courses”. In the case of the teachers, the items which they achieved the highest and lowest mean scores in teacher questionnaire in student negotiation aspect were, “Students find the opportunity to communicate with other students” and “Students want other students to share views”.

2. For analyzing whether students’ perception of constructivist learning environment and its aspects differed according to certain variables, the students were administered questionnaires and MANOVA was carried out. The results revealed that perception of constructivist learning environment and its aspects differed according to socio-economic status group of students’ district in favor of

richest groups which are groups 1, 2 and 3, according to students' number of siblings in favor of students who have one or two siblings, according to students' having a study room in favor of those who have a study room, according to their way of transportation to school in favor of those who are taken to school by their families, according to education level of their mother in favor of those whose mother graduated from a university, according to education level of students' fathers in favor of those whose father graduated from a university, according to students' gender in favor of females, according to existence of a computer laboratory with internet connection at students' school in favor of those who continue such schools, according to existence of Internet connection at students' home in favor of those who have internet connection at home and lastly according to usage of Internet during the science and technology classes in favor of those who use Internet during the courses. On the other hand, perception of constructivist learning environment and its aspects did not differ according to the grade level of the students.

3. For analyzing whether there is a significant relationship between the perceptions of teachers on CLE and their perceptions on administrative support they received, SPSS was used to calculate the correlation coefficient and its significance. Before that, the analysis of the perceptions of teachers on administrative support they received was conducted to find out that the mean score of teachers' responses was 2.52 which is very close to sometimes range (1.51-2.5) but still in the often range (2.51-3.5). There is a significant but low correlation between teachers' perceptions on CLE and their perceptions on administrative support they received. Similarly, there is a significant but very low correlation between teachers' perceptions on 5 different aspects of CLE (personal relevance, uncertainty, critical voice, shared control and student negotiation) and their perceptions on administrative support they received.

In the following chapter, conclusions and implications of the present study is discussed.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

This chapter presents the conclusions and discussion of the findings, and implications for improving science and technology program in 4th and 5th grades and provides suggestions for further research.

5.1. Conclusions

The conclusions and discussion related to the findings of the study are presented under three main headings: Constructivist learning environment and its aspects; difference in students' perception of constructivist learning environment; and its aspects according to certain variables and relationship between the perceptions of teachers on administrative support they received and their perceptions on constructivist learning environment and its aspects. The results of the two questionnaires were reported in terms of means out of 4 (Always is 3.26-4, Often is 2.51-3.25, Sometimes is 1.76-2.5 and Never is 1-1.75) while the results of the open ended 4 questions in the teacher questionnaires were reported as bulleted lists in relevant sections of Chapter 4. In addition, 1143 students were administered the student questionnaire while 264 teachers were administered the teacher questionnaire and the 4 open ended questions in the questionnaire.

5.1.1. Conclusions Related to Constructivist Learning Environment and its Aspects

In order to answer research question 1, "To what extent does the Science and Technology Course Learning Environment of 4th and 5th grades in primary schools in Turkey represent five major aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) of a preferred constructivist learning environment as perceived by the students and their teachers?", the data were collected through two questionnaires administered to the students taking Science and Technology Course in 4th and 5th grades in primary schools in Turkey and to their teachers. Data was collected from 20 districts in 6 socio-economic development groups determined by State Planning Department and the results can be generalized to whole 4th and 5th grade primary education in the country in that sense. The number of students who responded the questionnaires was 1143 and the number of teachers who responded the teacher questionnaire was 264. In simple terms, the scores of students and teachers on this scale reflected the degree to which classrooms represent a critical constructivist learning environment. Higher scores represent a more student-centered and constructivist environment and lower scores represent classrooms that are less student centered and less constructivist.

Analysis of the data obtained via questionnaires administered to the students revealed that the students perceived the current learning environment in Science and Technology Course to be often constructivist. (M = 2.97). This can be interpreted as the 4th and 5th grade students in Turkey are satisfied with the constructivist learning environment that they engage in Science and Technology Courses. In the case of analysis of data obtained via teacher questionnaires, it can be concluded that the perceptions of teachers is also often constructivist (M = 2.9). This means the teachers are also thinking that learning environment in Science and Technology Courses in 4th and 5th grades in Turkey is constructivist. The students and the teachers perceived all aspects of the learning environment to be often constructivist but with different mean scores in different aspects. This was consistent with the literature emphasizing that degree of perceptions of teachers and students are similar or degree of teachers' perceptions is slightly higher (Fraser, 1994). Within all of the

aspects, scientific uncertainty had the highest mean score (M = 3.21 and M = 3.06) indicating that the students perceived the learning environment to include opportunities for them to experience scientific knowledge involving their experiences and the teachers perceived that the learning environment provides opportunity for that purpose. In the following parts, the results related to the aspects of the constructivist learning environments which are personal relevance, uncertainty, critical voice, shared control and student negotiation are discussed. A similar discussion can be found in the work of Güzel and Alkan (2005) who have also made use of the Constructivist Learning Environment Survey to assess the student and teacher perceptions on the learning environment in Mathematics education among those who are in one of the pilot schools in Izmir aging 10-12. They also found out that the views of the students and the teachers were generally compatible (Güzel & Alkan, 2005). Another finding of Güzel and Alkan (2005) in the same study was that there was a positive correlation among the five different aspects of the constructivist learning environment.

5.1.1.1. Conclusions Related to Constructivist Learning Environment Personal Relevance Aspect

The first six items in the section on perceptions of students and teachers on constructivist learning environment were on personal relevance which focuses on the connectedness of school science to students' out-of-school experiences and with making use of students' everyday experiences as meaningful contexts for the development of their scientific knowledge. Hamid (2006) discussed that relevancy has become a key word in today's instructional practices (Lorsbach & Tobin 1992; Yager, 1996). The constructivists argue that learning should take place in authentic and real world environments. As Hamid (2006) puts it, this idea was mainly discussed by Von Galasersfeld (1984) who cited "Our knowledge is useful, relevant, and viable if it stands up to experience and enables use to make predictions and bring about or avoid certain phenomena" (p.38). With respect to the personal relevance, analysis of the two questionnaires administered to the students and the teachers revealed that majority of the items pointing out personal relevance aspect of a constructivist learning environment were often present in the classroom (M = 3.1

for students and $M = 2.84$ for teachers). This can be interpreted as both the teachers and the students think that the Science and Technology Course learning environment in 4th and 5th grades in Turkey allows students to link what they learn in the classroom with their real life experiences.

Some of the teachers in answering open ended question in the teacher survey provided that, "The new program helped to eliminate the belief in students that the school life is only about the school. They started to enjoy things they learn more, since they can establish link with the daily life". They also argued that "With this new program learning is not hanging in abstract anymore. It has become a part of the life. The value of the necessity of learning attracted some importance in the eyes of the students" and "It became easier for students to understand and establish links. We got rid of abstract learning" they say.

National Science Education Standards (NSES) in the United States documents that scientific literacy is, "the knowledge and understanding of scientific conceptions and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Research Council, 1996, p.22 as cited in Hamid, 2006). In addition, Hamid (2006) provides that NSES described a scientifically literate person as one who "can ask, find, or determine answers to questions derived from curiosity about everyday experiences" (p. 22). Erdoğan (2006) cites that whatever the individual differences are, the vision is to develop all the children to become science and technology literates. In this respect, he argues that the purpose of the new science and technology programs in Turkey in 4th and 5th grades goes beyond providing students with academic information and expecting them to learn all the given information by heart. This is why the use of students' experiences as meaningful contexts for learning is important in assuring learning. Some teachers argued that "The students developed a capacity on how to reach information. They have learned from where they can get help when they encounter a problem". This was consistent with the suggestion of engagement theory that students learn in authentic focuses and would be highly motivated and satisfied (Kearsley & Shneiderman, 1999 as cited in Lin, 2003).

As Lin (2003) shares, numerous studies also asserted that authentic learning is one focus of constructivism (Kearsley & Shneiderman, 1999). Güzel and Alkan (2005) pointed out that the students could not understand the relation between the

school learning and real world except some topics in the case of Mathematics education in a pilot school in Izmir. They rationalized this with the fact that the activities used by the teachers in teaching Mathematics were not contributing to the situation. However, in the case of Science and Technology Courses, the teachers may work on alternative methods to create a link between the content of the course and the real life experiences of the students. One of the teachers argued that "They (the students) have managed to establish a link between their daily lives and for example while conducting the chapter on discovering our body and the role of vitamins in our body that is available in vegetables and fruits. They have learned the function of the body parts. In air and power chapters they managed to give daily life examples regarding gravity, air and water pressure. They managed to learn about the function of the electric circuits and how it is used".

As Aldridge et al. (2000) points out in their study "Constructivist learning environments in a cross national study in Taiwan and Australia", one of the most important factors enhancing learning in the learning environment is that teachers take time to bring everyday lives of students and the course content together. For example, in Taiwan, students give example of teachers who walk in mountains during weekends to help students learn biology or have students help them to collect specimens from around the school after class (Aldridge et al, 2000). In the answers given to the open ended questions some of the teachers in this study complaint that it was not easy for them to get permission to take students somewhere outside of school even during the school hours.

5.1.1.2. Conclusions Related to Constructivist Learning Environment Scientific Uncertainty Aspect

The second scale in the "Questions related to the Science and Technology Course" sections of the two questionnaires assessing the students' and teachers' perceptions on constructivist learning environment was related to scientific uncertainty. In short, this sub scale assesses the extent to which opportunities are provided for students to experience scientific knowledge arising from theory dependent inquiries involving human experience and values. According to Taylor et al. (1994), such opportunities should be seen as evolving, non foundational, and

culturally and socially determined. In constructivist science classrooms, the students learn to be skeptical and critical about the nature of science. This sub-scale is concerned with students learning that scientific knowledge is evolving and temporary which is conditioned by social and cultural influences, and arises from human interest and values (Aldridge, Fraser & Taylor, 2000). With respect to scientific uncertainty, analysis of the two questionnaires administered to the students and the teachers revealed that majority of the items pointing out scientific uncertainty aspect of a constructivist learning environment were **often** present in the classrooms (M = 3.22 for students and M = 2.97 for teachers). This means that both the teachers and the students think that the learning environment of 4th and 5th grade Science and Technology Courses allow students to develop an understanding of science which involves the idea that the solutions to real life problems provided by the field of science may vary in certain circumstances and may change in time according to the needs of human beings.

5.1.1.3. Conclusions Related to Constructivist Learning Environment Critical Voice Aspect

Items 10 to 15 in both the student and teacher questionnaires were concerned with the critical voice aspect of the learning environments in science and technology classrooms in grades 4 and 5 in Turkish primary schools. This aspect of constructivist learning environment is related with the relationship between the teachers and the students. In a way, it measures whether the social climate is appropriately developed to allow students feel that it is legitimate and beneficial to question teacher pedagogy and to express their concerns regarding the barriers in front of their learning. In other words, this part is mainly concerned with student autonomy. Brooks and Brooks (1993) cite that constructivist teaching and learning attach importance on students' point of view but in most cases student thinking is devalued in classrooms. On the other hand, Noddings (1992) suggest that students should be encouraged to respect the opinions and ideas of others.

With respect to critical voice, analysis of the two questionnaires administered to the students and the teachers revealed that majority of the items pointing out critical voice aspect of a constructivist learning environment were often

present in the classrooms (M = 2.9 for students and M = 2.68 for teachers). This can be interpreted as both the students and the teachers think that the learning environment of Science and Technology Course in 4th and 5th grades in Turkey allows students to express themselves freely especially in case they have a word to say on the instructional methods used by the teacher or in case they face difficulties in understanding a certain topic. Similarly, Güzel and Alkan (2005) reported in their study conducted in Turkey that the students scored high score about learning to speak out. In the literature, there are many studies on the role of students' question in teaching science. As Chin and Osborne (2008) cite, some argue that student questions help diagnose their understanding in formative assessment (Elstgeest, 1985; White & Gunstone, 1992; Watts & Alsop, 1995; Maskill & Pedrosa de Jesus, 1997). According to Chin and Osborne (2008), Dori and Hersovitz (1999) point out that students questions help in evaluating their higher order thinking. According to Chin and Osborne (2008), while Watts, Alsop, Gould & Walsh (1997) cites that student questions provoke critical reflection on classroom practice, some other scholars in the literature argue that student questions stimulate further inquiry into the topic via open investigations, problem based learning and project work (Gallas, 1995; Keys, 1998; Chin & Chia, 2004; Crawford, Kelly & Brown, 2000; Pedrosa de Jesus, Neri de Souza, Teixeria-Dias & Watts, 2005 as cited in Chin and Osborne, 2008). However, in the Turkish culture, the teacher may face difficulties in actualizing this aspect of the constructivist learning environment since they mostly tend to acknowledge the question coming from students on their way of teaching as rude statements or misbehaviors. For instance, some of the teachers in this study argued that "It is possible to observe that during conducting activities the students started to misbehave".

5.1.1.4. Conclusions Related to Constructivist Learning Environment Shared Control Aspect

The items in the questionnaires which constitute the sub scales focusing on the shared control aspect of the learning environment were concerned with the extent to which students share the control of the processes in the classrooms. This includes the articulation of learning goals, the design and management of learning activities and the determination of assessment criteria. The literature on shared control is rich. For the proponents of constructivism, students should be involved significantly in developing their own learning environments (Wilson, 1995; Reigeluth, 1999; Willis, 2000; Wills & Wright, 2000 as cited in Oh, 2003). Oh (2003) also argues that some researchers advocate that this should not be identified with assisting the teacher's role which involves transmitting factual information in an efficient way (McRobbie & Tobin, 1997). For example, according to Oh (2003) helping teachers with tasks such as collecting papers and arranging materials is not sufficient to meet this principle (Lee & Fraser, 2000). This principle goes beyond making use of students' ideas to support teachers' repertories for planning a lesson; it suggests that students should collaborate with the teacher to share control of all aspects of developing a learning environment (Aldridge, Fraser & Taylor, 2000; Taylor, Fraser & Fisher, 1997). In this respect, analysis of the two questionnaires administered to the students and the teachers revealed that majority of the items pointing out shared control aspect of a constructivist learning environment were often present in the classrooms (M = 3.02 for students and M = 2.81 for teachers). This means both the students and the teachers think that the learning environment of 4^{th} and 5^{th} grade Science and Technology Courses allows students to sound on how they learn and this contributes to their learning on how they learn. However, it should be noted that the student-teacher power relationships within the classroom are unequal in nature.

According to Chamberlain (1999) as the program addresses issues in a collaborative manner, students can experience a caring community where they have responsibility (Noddings, 1992; Smith, 1995). The answers provided by teachers on this issue provide evidence that the approach of students directly influences this aspect of the learning environment. While some teachers say, Students are active

and motivated for class. It is possible to observe transfer and use of knowledge in their life. The learning becomes more permanent. It is possible to observe knowledge transfer between courses"; "Students became more active in class. The teacher became the facilitator but the class is being conducted more by the students which makes learning environment more compatible with their levels" and "They have learned to come up with different and good ideas regarding problem solving. They like to use brainstorming method more than any other method", some others may say, "Most of the students come to class without bringing in the necessary materials for the course. This results in decreasing efficiency. They only perceive activities as fun and this prevents them from being able to make necessary deductions from the activity", "Students usually prefer to keep silent. I can say that the low performance of the students in the learning environment negatively affected the learning process" or "Since the program can not be fully understood I do not believe students had any real contribution". According to Chamberlain (1999), in the literature it has been provided that teachers sometimes are afraid of allowing students to participate in discussions (Gersch, 1996; Smith, 1995 as cited in Chamberlain, 1999) and as a result, teacher-student collaboration becomes vulnerable. However, literature provides some insights on the initial difficulties in implementing constructivism in the learning environments (Dawson & Taylor, 1998). Dawson and Taylor (1998) suggest that:

> It is important to emphasize the need for transformative teachers to be aware that critical discourse can be a two edged sword, one that can serve disruptive and divisive purposes. Some students are likely to need encouragement to be critical and others are likely to need to be restrained. In both cases, the teacher would be well advised to ensure that the legitimacy of critical discourse is understood to depend on mutually agreed social norms that govern its use; the 'bottom line' is to maintain a sharing and caring environment of mutual respect (p. 334).

Constructivist theory also suggests that students and teachers should be partners in learning. In other words, knowledge is produced by the learner not delivered to the learner (Brooks & Brooks, 1993). Some of the teachers provided that in their classrooms, "Students became more active in class; the teacher became the facilitator but the class is being conducted more by the students which makes

learning environment more compatible with their levels". As Chamberlain (1999) puts it, community and systems theories also suggest that both students and teachers should be partners in learning (Sergiovanni, 1994; Banathy, 1996 as cited in Chamberlain, 1999). According to teachers, "They (students) have learned to come up with different and good ideas regarding problem solving. They like to use brainstorming method more than any other method" which is consistent with the literature emphasizing that teachers should change the way classrooms are structured or program is organized; units of study may be developed around student needs and interests (Noddings, 1992; Beane, 1993 as cited in Chamberlain, 1999).

5.1.1.5. Conclusions Related to Constructivist Learning Environment Student Negotiation Aspect

The last sub-scales in the student and teacher questionnaires focused on the student negotiation aspect of the learning environments. These scales assess the extent to which collaboration and communication exist among the students. In a way these scales examine to what extent students explain and justify their answers. According to Oh (2003), the literature provides that in parallel to increase in constructivist views of learning, there is an increasing interest in group learning (Webb & Palincsar, 1996). He also adds that learning is sometimes defined as an inherently social-dialogical activity (Duffy & Cunningham, 1996; Savery & Duffy, 1996; Duffy & Orrill, 2001). According to this definition, "knowledge evolves through social negotiation and through the evaluation of the viability of individual understanding" (Savery & Duffy, 1996, p. 136 as cited in Oh, 2003).

Based on this principle, a learning environment should be created in ways that involves opportunities for students to explain and justify their ideas to others, to listen and reflect on the viability of other students' ideas and to reflect self critically on the viability of their own ideas (Taylor, Fraser & Fisher, 1997; Aldridge, Fraser & Taylor, 2000). In this respect, analysis of the two questionnaires administered to the students and the teachers revealed that majority of the items pointing out student negotiation aspect of a constructivist learning environment were either sometimes or often present in the classrooms (M = 2.64 for students and M = 2.94 for teachers). This can be interpreted as students and teachers think the students have an

interaction among themselves in the 4th and 5th grade Science and Technology Course learning environment and this enhances their learning.

Teacher responses to open-ended question on this aspect supported the idea in literature that working in groups has positive influence on developing a constructivist learning environment. For instance, some teachers said, "Since the research is done in groups, this enables students to discover what is missing in themselves". At the same time, teachers provided that "Student interaction has been effective through the group exercises and cooperation among them" and "Since students are working more in groups, the problems of establishing friendship and communication have been eliminated. They can push for their tights and act more independent" and more importantly "The possibility of learning by doing and learning through role modeling has been increased. The hidden competition between groups influenced learning environment positively". In addition, most of the teachers highlighted the following issue: "There is exchange of information. Their self confidence has been increased. They have developed their abilities in speaking in front of public and expressing their views. Visual presentations attract them more and increase their attention. They develop their abilities to help and share the knowledge. This enables them to learn more in a shorter time". On the other hand, this brought in some negative practices as teachers pointed out through saying that "Having group work is a positive aspect, however the high number of projects, homework and other activities destructs the attention of the students. The high number of research above their levels can be tiring for students" and "I can not manage to have the involvement of all of the students to classes".

The fact that teachers highlighted the group work implies that the learning environment allows implementing cooperative learning which involves students' working together and helping each other during the learning process (Jacobsen, Eggen and Kauchak, 2002, p. 231 as cited in Gültekin, Karadağ and Yılmaz, 2007). As Loyens, Rikers and Schmidt (2007) put it; cooperative learning is one of the most important assumptions of constructivism. Social interactions with fellow students contribute to the construction of knowledge (Steffe & Gale, 1995 as cited in Loyens et al, 2007). Loyens et al. (2007) also discusses that constructivist theories mostly share the idea that social negotiation and interaction is an important factor in the process of learning (Greeno, Collins & Resnick, 1996). The teachers also

complained that, “It has not been possible for me (them) to effectively utilize group work. Students experience hardships in sharing their knowledge. They usually prefer to work with same team mates”.

Yıldırım, et al. (2006), while reporting on the teacher opinions on the new program provided that the students find opportunities to hold discussions among themselves in the learning environment. In the literature, there are many studies on the role of students’ questions in learning science. As Chin and Osborne (2008) argue, student questions direct learning and drive knowledge construction (Chin & Brown, 2000). Chin, Brown and Bruce (2002) argue that student questions foster discussion and debate in classroom discourse. In addition, it is provided in the literature that student questions help them to monitor and self-evaluate their understanding (Wong, 1985; King, 1989; Graesser, Person & Huber, 1992; Chin, 2006 as cited in Chin & Osborne, 2008). As Chin and Kayalvizhi (2005) cite, student questions also increase their motivation and interest in a topic.

In parallel with the literature some teachers in this study argued that “Students are very much attracted by the environmental problems topic of the science and technology class. They have started to ask questions, suggest solutions and even warn the interested groups regarding the subject” and even “Students started to become interested in issues that is not possible for them to see in their daily lives. They have started to ask very interesting questions. They have enjoyed science and technology class very much. They have learned to learn while having fun. They have learned to make research”.

5.1.2. Conclusions Related to Difference in Students’ Perception of Constructivist Learning Environment and its Aspects According to Certain Variables

So far the importance of student background characteristics and characteristics of their family on academic achievement has been thoroughly discussed in the literature. For example as Boreck et al. (2005) share, Coleman et al. (1996) and several other studies mentioned the relation between home and the achievement of students. Some studies provide evidence for the importance of socio-economic status (SES) of the family. (Jenks et al., 1972; Dekkers, Bosker &

Driessen, 2000; Opdennaker & Van Damme, 2001; Opdennaker et al., 2002 as cited in Boreck et al., 2005). Parental education as one indicator of SES is found to correlate positively with achievement of students (Beaton et al., 1996; Husen, 1967; Opdenakker & Van Damme, 2001 as cited in Boreck, et al., 2005). However this study focuses on the difference of students' perception of learning environment rather than the achievement level which rarely take part in the current literature.

In order to answer research question two, "Do the students' perceptions of CLE in 4th and 5th grades in primary schools in Turkey in five aspects (personal relevance, uncertainty, shared control, student negotiation and critical voice) differ according to their demographic characteristics (the socio-economic status group of the district, grade level, number of siblings, having a study room, way of transportation to school, the education of mother, the education of father, gender, existence of a computer laboratory with Internet connection at school, existence of Internet connection at home and usage of Internet during the science and technology classes)?", the data collected through questionnaires administered to the students attending Science and Technology Course in 4th and 5th grades in Turkey was analyzed using MANOVA. The results revealed that students' perception of constructivist learning environment and its aspects differed significantly from each other ($p < .05$). The students in socio-economic status Group 1 ($M = 3.13$) and Group 2 ($M = 3.12$) perceived the learning environment and its aspects to be more constructivist than the students in groups 3, 4, 5 and 6 ($M = 3.04$, $M = 2.82$, $M = 2.69$ and $M = 2.97$, respectively). Further analysis of the aspects of the learning environment revealed that there was a significant difference in all aspects. In 4 of 5 aspects, the highest mean scores belonged to students in groups 1 and 2 while in all aspects the lowest mean scores belonged to the students in Group 5.

The analysis of variables such as number of siblings, having a separate study room, way of transportation to school, the level of education of the mother and the level of education of the father revealed parallel results with socio-economic status groups. In other words, as the number of siblings increases, mean scores of students on the perception of constructivist learning environment and its aspects decreases ($M = 3.07$ for students who have one sibling and $M = 2.84$ for students who have 5 or more siblings) ($p < .05$).

In a parallel vein to the results provided above, there is a significant difference between the perceptions of students who have a study room (M = 3.08) and those who do not have a separate room (M = 2.84) ($p < .05$). Similarly, there was a significant difference between the perceptions of students who are taken to school by their parents (M = 3.1) and those who go to school by bus (M = 2.98) or on foot (M = 2.96) ($p < .05$). In the case of the level of education of the mothers, again there was a significant difference in the perceptions of students ($p < .05$). Students whose mothers never attended to a school (M = 2.79) or whose mothers graduated from a primary school (M = 2.92) or a secondary school (M = 2.98) had lower mean scores when compared with students whose mothers graduated from a high school (M = 3.13) or from a university (M = 3.19). Similarly, perceptions of students on constructivist learning environment differed according to the education level of their fathers ($p < .05$). Students whose fathers never attended to a school (M = 2.84) or whose fathers graduated from a primary school (M = 2.87) or a secondary school (M = 2.9) had lower mean scores when compared with students whose fathers graduated from a high school (M = 3.05) or from a university (M = 3.11).

In the case of having a separate study room, further analysis of the aspects of the learning environment revealed that there was a significant difference in all aspects. In the case of way of transportation to school, further analysis of the aspects of the learning environment revealed that there was a significant difference in personal relevance and scientific uncertainty aspects but not in other three aspects which are critical voice, shared control and student negotiation. In the case of education level of mothers and education level of fathers, further analysis of the aspects of the learning environment revealed that there was a significant difference in all aspects.

The literature provided similar views on the influence of socio-economic status on the implementation of the new programs. Gömleksiz (2005) provided that the perceptions of teachers on the learning environments in which the new programs are implemented significantly changes according to the number of students in the classrooms. Similarly, Gömleksiz and Kan (2006) found out that schools which are in higher socio-economic status groups effectively implement the new programs whereas other schools may face some difficulties in implementing the new programs. Bulut (2006) also found out that there are significant differences in the

perceptions of teachers concerning the implementation of the new program according to the province in which they teach; and number of students in the classrooms. Güzel and Alkan (2005) reported that there is a significant difference between the perceptions of students according to whether their school is in the province center, close to province center or far away from the province center. All the SES related findings of the study revealed parallel results with the literature on different variables evolving from the SES of the students.

The infrastructure of the schools are not directly but indirectly related to the socio-economic development level of the districts. According to Gömleksiz (2005), Cheng (1994) reported that students' success is affected positively when the learning environment is designed according to the needs and necessities of the curriculum and students. So, the basic reason for the success is to have suitable learning environment during the implementation of the new primary school curriculum. As Gömleksiz (2005) puts it, this is also consistent with the results of the studies by Maiden and Foreman (1998) and Finn and Achilles (1999). Mostly the teachers also complained about the facilities that they lack especially in rural areas in the lower socio-economic development groups. They cited, "This program is very good for those schools which have facilities; however I do not think that it is convenient to the living conditions of the village kids. It is hard for them to establish a link between things that they have never seen in their lives and in the class. While we lecture we lower the levels of the courses. However in addition to all they can easily establish a link between the classes and things available in their daily lives. This makes learning more effective" and "The experiments and projects which have been conducted with groups produced very good results. But members of the group experienced problems in coming together outside of the school. Students who are coming to school with services experienced problem in being active in group work. Especially the students who are coming from villages experienced problems in doing research with Internet or finding materials for experiment".

The results of the study revealed that the students' perception of constructivist learning environment and its aspects differed significantly according to their gender. Female students (M = 3.01) perceived the learning environment and its aspects to be more constructivist than male students (M = 2.94). Further analysis of the aspects of the learning environment revealed that there was a significant

difference in shared control and student negotiation aspects but not in personal relevance, uncertainty and critical voice aspects. On the other hand, the results of the study revealed that the students' perception of constructivist learning environment and its aspects did not differ according to their grade level. While Bulut (2006) provides that the teacher perceptions may change according to the grade level, this is conflicting with the results of this study. Gömleksiz (2007) also found out that the perceptions of teachers on the new programs do not change according to the grade levels. Güzel and Alkan (2005) also reported that there was no significant difference between the perceptions of students in grades 4 and 5 concerning the constructivist learning environment in their classes. Gömleksiz (2005) in his study "An Evaluation of the Effectiveness of New Turkish Primary School Curriculum in Practice", pointed out that opinions of the teachers differed according to province they live in and according to the number of students in the classrooms.

The results of the study also revealed that the students' perception of constructivist learning environment and its aspects differed significantly according to existence of technology and Internet in the environment or at their homes. The literature also provides evidence that technology enriches the learning environment. Jonassen et al. (1999) compares the two views of technology which are traditional and constructivist. They underscore that the technology was being used in education to learn from it since it was believed that technological tools or programs can convey information more effectively than teachers, however constructivists use technology as a tool to construct knowledge with it. This is because they believe learners construct understanding by themselves instead of receiving information through technology. That is why the interest of constructivists is on the use of technology to create rich learning environments not on technology itself.

In this study, students who go to schools in which there is a computer laboratory with Internet connection (M = 3.02) perceived the learning environment and its aspects to be more constructivist than those who go to schools in which there is no computer laboratory with Internet connection (M = 2.91). Similarly, students who have Internet connection at home (M = 3.14) perceived the learning environment and its aspects to be more constructivist than those who do not have an Internet connection at home (M = 2.92). Lastly, students who provided that Internet is used during the science and technology classes (M = 3.12) perceived the learning

environment and its aspects to be more constructivist than those who provided that Internet is not used during the science and technology classes (M = 2.92). Further analysis of the aspects of the learning environment in the case of existence of a computer laboratory with internet connection at school revealed that there was a significant difference in personal relevance, uncertainty and critical voice aspects but not in other two aspects which are shared control and student negotiation. Further analysis of the aspects of the learning environment in the case of existence of Internet connection at home revealed that there was a significant difference in all aspects. Lastly, in the case of usage of Internet during the science and technology classes, further analysis of the aspects of the learning environment revealed that there was a significant difference in all aspects. Some teachers while commenting on the limited facilities they have in their schools mentioned the difficulties they face in the case of a need for Internet connection. Some provided that they even do not have a photocopy machine and students sometimes need to go to Internet cafes which have some negative sides at the end. They cited, “The general problem that we have encountered is the inadequacy of the physical structure of the school and the failure of the science and technology laboratory to meet the requirements of the new program”. One of the teachers put it so clearly, “We do experience problems since our school is not compatible with the new program. 1. We do not have a science and technology laboratory; 2. We do not have adequate equipment and have very limited computer access and no printer”. On the hand, from the instruction aspect, the main disadvantage of Internet usage mentioned by the teachers was that the students were just copying the texts from the Internet and even without reading the text submitting them as their projects. Teachers cited, “In group work they do share knowledge but unfortunately I can not see much development in research. Usually they prepare homework with the help of adults just by printing out the material and without even reading them”.

5.1.3. Conclusions Related to Relationship between the Perceptions of Teachers on Administrative support they received and Their Perceptions on Constructivist Learning Environment and its Aspects

The role of administrative support in teachers' professional development is highly discussed in the literature. Professional development efforts are influenced by the ways in which school administrators support or inhibit teacher learning (Mclaughlin, 1991 as cited in Mouza, 2003). According to Mouza (2003), if school administrators fail to provide teachers with an environment that supports continuous professional growth, professional development efforts are likely to have only short term and isolated benefits. The relationship between the perceptions of teachers on administrative support they received and their perceptions on constructivist learning environment and its aspects was investigated by the help of correlation analysis. The results indicated that there was a significant correlation between these two variables ($p < 0.05$) but the size of the correlation provides that the correlation between the two variables is low (.52). In other words, teachers' perceptions on constructivist learning environment depend but at low levels to their perceptions on administrative support they received. Further analysis of the aspects of the learning environment revealed that there was a significant correlation between all aspects of learning environment and administrative support but at very low level.

It should also be noted that most of the teachers while commenting on the administrative support they received, put the problems in front which makes it easier to identify barriers in implementing the new science and technology programs. For instance, the teachers provide that "We (they) encounter the problem of convincing the families, lack of equipment, and the Ministry making new arrangements in the middle of the education year. The lack of adequate publicity about the program is another problem". In addition, they claim that, "Lack of resources is the major problem. The resource books have problems such as their knowledge base and use". Another important issue raised by the teachers is "the high number of students" and "the extensive time spent on the measurement and evaluation activities". According to them, "The new program has the potential to make learning easier but both students and I (they) experience problems in getting used to conducting this

program". Bıkmaz (2006) points out that one of the most important hindering factors during the implementation of the new programs in Turkey is the lack of in-service training and consequently lack of internalizing by the teachers.

This goes hand in hand with what teachers provided in this study. Some of the teachers pointed out that "I (they) did not fully understand the new program. There has to be in service training given by the experts" while discussing the problems they faced during the implementation of the program. The roles and responsibilities of teachers should also be discussed while investigating the administrative support they received during the implementation of the new programs. For example, in Finland, while commenting on the success of the country in international examinations such as PISA, Ahtee, Lavonen and Pehkonen (2008) underscore that according to the education policy in Finland the teachers have a lot of freedom and responsibility. They discuss that teachers are responsible for developing the curriculum for their courses, choose the teaching and evaluation methods based on the national guidelines and also select the learning materials. Above all, most importantly, they are educated to be autonomous and reflective academic experts. In Finland, the in-service teacher training opportunities are more focused on providing teachers with new ideas on how to teach in an innovative way.

5.2. Implications

Based on the results of the study and the relevant literature, the implications for improving Science and Technology Courses and future research are provided in the following parts.

5.2.1. Implications for Improving Science and Technology Program

This part presents the implications for improving Science and Technology Program to make it more constructivist in nature including the implications for a preferred constructivist learning environment and for administrative support.

5.2.1.1. Implications for Improving Constructivist Learning Environment

Based on the findings concerning the perceptions of 4th and 5th grade students and their teachers on constructivist learning environment in Science and Technology Course and the conclusions driven in the same aspect, the implications for improving the constructivist learning environment could be as such:

1. Students should be better informed about the purpose of the new programs and the role of the students in the new system should be made clearer in their eyes.
2. There should be more emphasis on the importance of establishing links between what students learn at school and what they experience in their real lives.
3. Teachers should be more careful on including all the students in the activities to overcome the problem of participation in the classrooms.
4. The "getting ready" sections and the discussion sections of the book chapters should be more effectively considered to enhance learning in the classrooms.
5. The teachers should be well prepared to provide more examples from the daily lives of children especially in counties so that they can establish link between the topics and their daily lives.
6. Students should be guided to get prepared in advance before the classes so that they contribute more to the classroom environment.
7. Students should be encouraged to ask more questions in the class to overcome the participation problem in most of the cases.
8. Usage of drama method should be promoted.
9. Families should be better informed about the importance of activities being conducted in the classrooms and the importance of preparation of students before they come to class. This will diminish the resistance of the families on helping their children in getting prepared for the class.
10. Students should be provided with opportunities to come together in groups during after school hours so that they can get prepared for the activities of the coming days.
11. Information technology classes at schools should be used more effectively.

12. Parents should be well informed about the negative consequences of doing homework of their children.
13. The number of projects, homework and other activities should be well adjusted so that the children would get the most benefit from them.
14. Teachers should be clear on the negative consequences of using the Internet to copy homework rather than using it for research purposes.
15. Teachers should encourage students to make more analogies about their real life experiences during the courses.
16. More activities should be incorporated in the learning environments so that the students can better explain life based on what they learn during the courses.
17. Teachers should encourage students to ask the question of "why I have to learn this?" more.
18. Teachers should allow students to question how the teaching is conducted.
19. Teachers should get advice from students on the timing of the activities.
20. Students should be allowed more to become a part of the evaluation process.
21. Students should be encouraged to question their peers on their views on specific topics.

On the other hand, the findings and the conclusions relevant to whether perceptions of students differ according to certain variables may lead to some implications such as:

22. The Ministry of National Education and the Turkish government should be aware that the perceptions of students concerning the new learning environments in Science and Technology courses may change according to some SES-related factors which may be generalized to cite that the success of the reforms in the field of education goes hand-in-hand with the success of the reforms concerning the socio-economic development of different segments of the society.
23. Parents should be well informed about the fact that the number of children they have, their children's having a separate study room, their children's way of transportation to school, existence of an Internet connection at their homes

and such other SES-related factors may influence the integration of their children to the new educational system.

5.2.1.2. Implications for Improving Administrative Support and Implementation Environment

In parallel with the conclusions on the correlation between the perceptions of teachers and the administrative support they received, the following implications shall be considered:

1. Teachers should be provided with in-service training on how to encourage silent students to participate more.
2. Teachers should be provided with in-service training on teaching students how to use the Internet and other technologies to enhance learning.
3. Internet and library facilities at schools should be accessible at all of the schools for the sake of equity. Moreover, The Ministry of National Education should pay more attention to allocate funding to provide schools that have no information technology lab with adequate technological infrastructure.
4. Teachers should be provided with opportunities to come together more frequently especially with their colleagues outside of their schools so that they become a part of a huge network of teachers.
5. School principals should encourage teachers more to use new methods in their classes.
6. School principals should encourage teachers to attend professional meetings more frequently.
7. Teachers should be provided with opportunities like inviting guest speakers, conduct field work and make use of a library to increase the quality of learning in their classes.
8. The Ministry of National Education should provide quality in-service training opportunities to all teachers.
9. The Ministry of National Education should have a participative approach and consult the teachers before giving decisions on the program.

10. School principals and the Ministry of National Education should focus on solving the problems that the teachers face during the implementation of the programs.
11. The public and especially the parents should be provided with more information and more details on the new program to enhance publicity.
12. Teachers should be provided with facilities such as photocopy and other stationery materials so that they would not need to collect money from students in case of a need.
13. The class sizes should be reduced.
14. Educational software should be developed to support activities.
15. Laboratories at schools should be developed and more resources should be provided to enhance learning.
16. Teachers in the rural areas and districts who are in the low socio-economic development groups should be supported in implementing the program.
17. Alternative methods should be developed to allow students make good use of books instead of making use of only the Internet in doing homework.
18. Teachers should be provided with rationales on why there is no mass information in the books in the new program to help them adapt to the new philosophy being utilized.
19. Teachers should go through in-service training so that they develop themselves in time management during the implementation of the new program.
20. Regional, socio-cultural and economical differences should be well considered and alternative methods and examples should be provided in some cases to consider the contextual needs and expectations of the students and the teachers to enhance learning.
21. Pre-service teacher training institutions (education faculties at universities) should focus on training the teacher candidates to get used to teaching students how to learn new concepts through different activities.

5.2.2. Implications for Research

1. In future studies, the constructivist learning environments in 4th and 5th grades in Turkish primary schools could be assessed through interviews and observation of classrooms over a long period including multiple observers.
2. In future studies, more qualitative data collection and analysis could be conducted through analysis of students' portfolios, projects, homework and other related written documents.
3. More studies on perceptions of teachers and students concerning the constructivist learning environment in their classrooms could be conducted in all grade levels in primary schools and other schools in Turkey.
4. A longitudinal study could be conducted to assess the differences between the perceptions of students and teachers concerning the constructivist learning environment in time.
5. The constructivist learning environment surveys for students and teachers which were used in this study could be used in similar studies through adapting or revising it for the purpose of the particular studies so that their validities and reliabilities could be further assessed.
6. In future studies, it can be assessed whether the perceptions of teachers on constructivist learning environment differ according to variables such as gender, SES and experience of the teachers or not.
7. It is suggested that further research be conducted to assess whether the perceptions of students on constructivist learning environment differ according to their attitudes towards the Science and Technology Course and their achievement levels.

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APPENDICES

APPENDIX A

Fen ve Teknoloji Dersi
Yapılandırmacı Öğrenme Ortamı
Öğrenci Anketi

AÇIKLAMA:

Bu anket kişisel bilgileriniz, Fen ve Teknoloji dersiyle ilgili düşünceleriniz ve İnternet kullanımınızla ilgili sorulardan oluşan üç bölüm içermektedir. Anketin temel amacı, sizlerin Fen ve Teknoloji dersindeki öğrenme ortamı ile ilgili düşüncelerinizi öğrenmektir. Her soruyu dikkatle okuyunuz ve size uygun olan seçeneği işaretleyiniz. Lütfen cevapsız soru bırakmayınız. Cevaplarınız kesinlikle gizli tutulacaktır. **Yardımlarınız için teşekkür ederiz.**

Birikim Özgür - *birikim@gmail.com*
ODTÜ Eğitim Bilimleri Bölümü Doktora Öğrencisi

A. Kişisel Bilgiler

1. Sınıfınız: **□ 4 □ 5**	**2. Cinsiyetiniz:** **□ Kız □ Erkek**
3. Okulunuzun ismi:	**.....**
4. Bulunduğunuz İl ve İlçe:	**.....**
4. Siz dâhil kardeş sayısınız kaçtır? **……**	**5. Evinizde size ait çalışma odanız var mı?** **□ Evet Var □ Hayır Yok**
6. Okula ulaşımınızı nasıl sağlıyorsunuz? **□ Ailem bırakıyor □ Servisle □ Yürüyerek**	
7. Annenizin eğitim durumu nedir? **□ Hiç okula gitmedi □ İlkokul mezunu □ Ortaokul mezunu** **□ Lise mezunu □ Üniversite mezunu**	
8. Annenizin mesleği nedir?	**.....**
9. Babanızın eğitim durumu nedir? **□ Hiç okula gitmedi □ İlkokul mezunu □ Ortaokul mezunu** **□ Lise mezunu □ Üniversite mezunu**	

10. Babanızın mesleği nedir? **.....**

B. Fen ve Teknoloji Dersiyle ilgili sorular

Fen ve Teknoloji dersiyle ilgili aşağıdaki maddelerin uygunluk derecesini değerlendiriniz.

			Hiçbir zaman	**Bazen**	**Çoğu zaman**	**Her Zaman**
B.1	**Yaşamla ilgili öğrenme**	1. Okul dışındaki yaşamla ilgili şeyler hakkında çıkarımlar yapıyorum				
		2. Günlük hayatımdaki bazı sorunların fen ve teknoloji sayesinde düzelebileceğini fark ettim				
		3. Okul dışındaki yaşamla fen ve teknoloji arasında ilişki kurabiliyorum				
		4. Yaşamı artık daha iyi açıklayabiliyorum				
		5. Günlük yaşamda fen ve teknolojiyle ilgili örnekler verebilirim				
		6. Derste öğrendiklerimle okul dışındaki yaşam arasında ilişki kurmakta zorlanıyorum				
B.2	**Fen ve Teknoloji Hakkında Öğrenme**	1. Hayatta karşılaştığım tüm sorunları teknolojiyi kullanarak çözebilirim				
		2. Teknolojinin zaman içinde değiştiğinin farkındayım				
		3. Teknolojinin okulumuzu geliştirebileceğini düşünüyorum				
		4. İnternet teknolojisi ile eski teknolojiler arasındaki farkı ayırt edebiliyorum				
B.3	**Kendini ifade**	1. Gerekirse öğretmenime “Neden bunu öğrenmek zorundayım?” sorusunu sorarım				

		2. Dersle ilgili öğretmenime yorum yaparım				
		3. Etkinliklerde anlayamadığım şeyleri sorarım				
		4. Öğrenmemi engelleyen şeyler olursa öğretmenime söylerim				
		5. Düşündüklerimi rahatlıkla söylerim				
		6. Gerek gördüğümde cesurca hakkımı savunurum				
B.4	**Öğrenmeyi Öğrenme**	1. Dersin planlama aşamasında konuları iyi öğrenmem için benim görüşlerimin önemli olduğunu düşünüyorum				
		2. Bir şeyi öğrenip öğrenmediğimi öğretmenime söylerim				
		3. Hangi etkinliklerin benim için iyi olduğuna karar verirken öğretmenime fikrimi söylerim				
		4. Etkinliklerde ne kadar zamana ihtiyacım olduğunu öğretmenime ifade ederim				
		5. Bir şeyi ne kadar iyi öğrendiğimi anlamak için bana çeşitli sorular soran öğretmenime cevaplar veririm				

			Hiçbir zaman	**Bazen**	**Çoğu zaman**	**Her Zaman**
B.5	**İletişim Kurmayı Öğrenme**	1. Ders sırasında arkadaşlarımla dersle ilgili konuları konuşma fırsatım olur				
		2. Problemlerin nasıl çözülebileceği hakkında arkadaşlarımla konuşurum				
		3. Derste öğrendiklerimi arkadaşlarıma anlatırım				
		4. Diğer öğrenciler benden dersle ilgili düşüncelerimi açıklamamı ister				

		5. Diğer öğrenciler derste öğrendiklerini bana anlatır				

C. İnternet Kullanımı ile ilgili Sorular

		Evet	**Hayır**
C.1	1. Daha önce kendi başınıza İnternet kullandınız mı?		

Yukarıdaki soruya EVET yanıtı vermişseniz, İnternet ile ilgili sorularla devam ediniz. Eğer soruya HAYIR yanıtı vermemişseniz, bundan sonraki soruları cevaplamayınız.

		Evet	**Hayır**
C.2	1. Okulunuzda İnternet erişimli bilgisayar laboratuarı var mı?		
	2. Evinizde İnternet erişiminiz var mı?		
	3. Okul veya ev dışında herhangi bir yerde İnternet kullanıyor musunuz? Cevabınız EVET ise nerede kullanıyorsunuz? …….		
	4.Fen ve teknoloji dersinde İnternet kullanır mısınız?		
	5. İnternet'i en çok hangi amaçlar için kullanırsınız? (Uygun olanları işaretleyiniz) a. Araştırma ☐ b. Dönem Ödevi ☐ c. Yazma ☐ d. Oyun ☐ e. Diğer (yazınız) ☐ …….		

APPENDIX B

Fen ve Teknoloji Dersi
Yapılandırmacı Öğrenme Ortamı
Öğretmen Anketi

AÇIKLAMA:

Bu ankette, **4. ve 5. sınıflara yönelik uygulanan Fen ve Teknoloji** dersine ilişkin sorular yer almaktadır. Ayrıca dört tane açık uçlu soruyla da sizlerin görüş ve önerilerinize başvurulacaktır. Araştırmanın amacı, Fen ve Teknoloji dersindeki öğrenme ortamı ile ilgili değerlendirmelerinizi öğrenmektir. Bunun yanı sıra, yeni Fen ve Teknoloji programının uygulaması sürecinde gerek bakanlık gerekse okul yönetiminden aldığınız destekle ilgili değerlendirmelerinizi öğrenmek de araştırmanın bir başka amacıdır. Bu nedenle, her soruyu dikkatle okuduktan sonra, her soru için kendinize uygun olan seçeneği işaretleyiniz. Lütfen cevapsız soru bırakmayınız. Cevaplarınız kesinlikle gizli tutulacaktır.

Yardımlarınız için teşekkür ederiz.

Birikim Özgür - *birikim@gmail.com*
ODTÜ Eğitim Bilimleri Bölümü Doktora Öğrencisi

A. Fen ve Teknoloji Dersiyle İlgili Sorular

Fen ve Teknoloji dersiyle ilgili aşağıdaki maddelerin uygunluk derecesini değerlendiriniz.

			Hiçbir zaman	**Bazen**	**Çoğu zaman**	**Her zaman**
A.1	**Yaşamla ilgili öğrenme**	1. Öğrenciler okul dışındaki yaşamla ilgili şeyler hakkında çıkarımlar yapar				
		2. Öğrenciler okul dışında yaşanan sorunlardan yola çıkarak yeni şeyler öğrenir				
		3. Öğrenciler fen ve teknolojiyle yaşam arasında ilişki kurar				
		4. Öğrenciler yaşamı daha iyi açıklayabiliyor				
		5. Öğrenciler derste öğrendikleri sayesinde günlük yaşamda fen ve teknolojiyle ilgili ilginç örnekler verebilir				
		6. Öğrenciler öğrendiklerinin okul dışındaki yaşamla hiçbir ilgisi olmadığını öğrenirler				

			Hiçbir zaman	Bazen	Çoğu zaman	Her zaman
A.2	**Fen ve Teknoloji hakkında öğrenme**	1. Öğrenciler hayatta karşılaştıkları sorunları teknolojiyi kullanarak çözebileceğini düşünür				
		2. Öğrenciler teknolojinin zaman içinde değiştiğinin farkına varır				
		3. Öğrenciler teknolojinin öğrenme ortamını değiştirebileceği çıkarımını yapar				
		4. Öğrenciler İnternet teknolojisinin uzun yıllar önce kullanılan teknolojilerden farklı olduğunu ayırt eder				
A.3	**Kendini ifade etmeyi öğrenme**	1. Öğrenciler gerek duyduklarında "Neden bunu öğrenmek zorundayım?" sorusunu yöneltir				
		2. Öğrenciler bir dersin nasıl işlendiğini sorgularlar				
		3. Öğrenciler anlayamadıkları etkinliklerle ilgili görüşlerini ifade ederler				
		4. Öğrenciler öğrenmelerini engelleyen herhangi bir şeyle ilgili eleştiri yapmaktan çekinmezler				
		5. Öğrenciler düşündüklerini rahatlıkla ifade ederler				
		6. Öğrenciler haklarını savunabilme cesaretini gösterirler				

			Hiç uygun değil	Bazen uygun	Çoğu zaman uygun	Her Zaman uygun
A.4	**Öğrenmeyi Öğrenme**	1. Dersin planlama aşamasında öğrencilerin konuları en iyi şekilde öğrenmesi için özen gösterilir				
		2. Öğrenciler ne kadar iyi öğrendikleri konusunda karar verirken bana yardımcı olurlar				
		3. Öğrenciler hangi etkinliklerin kendileri için en iyi olduğuna karar verirken bana yardımcı olurlar				
		4. Etkinliklere ne kadar zaman ayrılması gerektiği konusunda karar vermemde öğrenciler bana yardımcı olurlar				
		5. Öğrenciler öğrenme düzeylerini değerlendirirken bana yardımcı olurlar				
A.5	**İletişim Kurmayı Öğrenme**	1. Öğrenciler başka öğrencilerle iletişim kurma fırsatı bulurlar				
		2. Öğrenciler problemlerin nasıl çözülebileceği hakkında diğer öğrencilerle bilgi paylaşımında bulunabilirler				
		3. Öğrenciler düşüncelerini diğer öğrencilere anlatma fırsatı yakalarlar				
		4. Öğrenciler diğer öğrencilerden kendi düşüncelerini onlarla paylaşmalarını isterler				
		5. Öğrenciler arkadaşlarına kendi düşüncelerini ifade ederler				

B. Okul Desteğiyle İlgili Sorular

Yeni Fen ve Teknoloji programını uygularken…

		Hiçbir zaman	Bazen	Çoğu zaman	Her zaman
Bakanlık / Okul Yönetimi Desteği	1. Okul dışı çevreyi de kapsayan geniş bir profesyonel eğitimci grubunun üyesi olduğumu hissediyorum				
	2. Yöneticilerim öğretmenleri yeni yöntemler kullanma konusunda destekliyor				
	3. Okulumdaki öğretmenler eğitimde kaliteyi artırmak için birlikte çalışıyor				
	4. Okulum öğrenme için olumlu bir ortam sağlıyor				
	5. Yöneticilerim profesyonel toplantılara katılmam konusunda beni destekliyor				
	6. Yöneticilerim fen ve teknoloji dersi için gerekli olan ve çoğu öğretimle ilgili araçları kullanmama imkân sağlıyor				
	7. Fen ve teknoloji dersinin geliştirilmesi için diğer öğretmenlerle sürekli düşüncelerimizi paylaşmamız teşvik edilir				
	8. Fen ve teknoloji dersini işlerken misafir konuşmacı, kütüphane ve alan gezileri gibi imkânlara sahibim				
	9. Hizmetiçi eğitim konusunda Milli Eğitim Bakanlığı'nın sağladığı olanaklar yeterlidir				
	10. Bugüne kadar yeni programla ilgili hizmetiçi eğitim çalışmalarına en az bir kez katıldım				
	11. Bakanlık yeni programın uygulanması konusunda öğretmenlere danışarak yeni karar üretir				
	12. Yeni programla ilgili merak ettiğimiz sorular veya karşılaştığımız sorunlar okul yönetimi veya Milli Eğitim Bakanlığı tarafından giderilir				

C. Açık Uçlu Sorular

1. **Yeni programların öğrencilerin günlük hayatlarıyla ilişkilendirilmesi öğrenme sürecinde herhangi bir değişiklik ortaya çıkardı mı? Eğer çıkardıysa bunlar nelerdir?**

2. **Ders süresince öğrenme ortamına öğrencilerin ne tür katkıları oldu?**

3. **Ders süresince öğrenciler arasında oluşan etkileşimlerin niteliği öğrenme sürecine (bilginin yapılandırılması, araştırma, vb.) ne tür katkılarda bulundu? (ör: Grup çalışmaları, işbirliği, projeler, dönem ödevleri, vb.)**

4. **Yeni programı uygularken ne gibi zorluklarla karşılaşıyorsunuz?**

BİTTİ

APPENDIX C

Electronic Mail Correspondence with Peter Taylor

Birikim Ozgur <birikim@gmail.com>Tue, Sep 5, 2006 at 2:10 PM

To: p.taylor@curtin.edu.au

Dear Dr. Taylor,

I'm a Ph. D. candidate in Turkey; doing my Ph. D. on the new programs as part of the educational reforms being conducted here in Turkey.

I'm thinking of making use of CLES for the purpose of assessing the classroom environments to what extent they are constructivist. I would like to simply ask you if it was possible to adapt CLES to Turkish and use it in my study. Or should we go through a legal permission process? I see that it is being used in plenty of research studies and you share it with everyone on the net. But for ethical concerns I would love to hear from you about this issue.

Hope to see you in Turkey soon!

Regards and good luck in your studies!

Birikim Ozgur, Ph. D. Candidate
Facult of Education, Department of Educational Sciences
Middle East Technical University

Peter Taylor
<P.Taylor@curtin.edu.au> **Mon, Sep 11, 2006 at 3:05 PM**

To: Birikim Ozgur <birikim@gmail.com>

Hello Birikim

Thanks you for your request to use the CLES in your doctoral research. You are very welcome to adapt the CLES to your local situation and use it for your research. I understand that you have access to the web site: surveylearning.com so you will be able to download a copy of the instrument and supporting documents.

Very best wishes

Peter

Dr Peter Charles Taylor
Associate Professor of Transformative Education
Science and Mathematics Education Centre (SMEC)
Curtin University of Technology
post: GPO Box U1987, Western Australia, 6845
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tel: + 61 8 9266 7501
fax: + 61 8 9266 2503
web: http://pctaylor.com

APPENDIX D

Districts and Provinces According to Socio-Economic Status (SES) Groups

No.	SES Group	District	Province
1	1	Center	Eskişehir
2	1	Çorlu	Tekirdağ
3	1	Gebze	Kocaeli
4	2	Alanya	Antalya
5	2	Center	Şanlıurfa
6	2	İskenderun	Hatay
7	2	Center	Yalova
8	2	Didim	Aydın
9	2	Seferhisar	İzmir
10	2	Center	Bolu
11	3	Kızılcahamam	Ankara
12	3	Center	Bartın
13	3	Center	Şırnak
14	3	Center	Bitlis
15	3	Center	Bingöl
16	4	Center	Ardahan
17	4	Bala	Ankara
18	5	Araban	Gaziantep
19	6	Siverek	Şanlıurfa
20	6	Başkale	Van

APPENDIX E

Basic Understandings Emphasized in 2004 Science and Technology Program

Less emphasize	More emphasize
Memorizing and remembering knowledge	Developing skill and understanding
Details in the scope of subjects	Developing understanding towards concept and life
Tests in assessment	Alternative assessment methods
Simple explanation	Constructivism
Teacher and program centered teaching	Learner centered teaching
Average learner type centered teaching	Individual differences of learners
Implementing the program strictly	Implementing the program in a flexible way
Competitive and individual learning	Cooperative learning

Source: (Yaşar & Duban, 2007, p. 10; MEB, 2004)

APPENDIX F

Comparison of 2000 Science Course Program and 2004 Science and Technology Course Program

Aspects of the Program	2000 Science Course Program	2004 Science and Technology Course Program
Teacher	Active, teaching	Leader, facilitator, encouraging
Student	Passive, listener	Active, constructing his / her own knowledge
Content	Technology not included, too much information	Technology and its applications is included, meaningful learning is considered
Acquisitions	Mainly knowledge acquisition	Cognitive, affective and psychomotor acquisitions, science and technology literacy related skills
Philosophy of the program and the basic approach	Behaviorist approach	Constructivist approach
Instruction	Teacher and content centered learning-teaching activities	Student centered learning – teaching activities
Measurement and evaluation methods	Product based evaluation, traditional measurement and evaluation methods based on content and end of semester measurement	Process based evaluation, alternative measurement and evaluation methods as part of the learning process
Sequence of topics and concepts	Linear and sequential unit and topic sequence	Spiral unit and topic sequence
Link between the topics	Topics are not related with other courses and real life	Topics are related with other courses and real life
Individual differences of students	Individual differences are not considered in learning-teaching activities	Individual differences are considered in learning-teaching activities

Source: (MEB, 2004)

CURRICULUM VITAE

PERSONAL INFORMATION

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Nationality: Turkish Cypriot (TRNC)
Date and Place of Birth: 22 March 1978, Lefkoşa
Marital Status: Married
Phone: +90 312 482 57 20
email: birikim@gmail.com

EDUCATION

Degree	Institution	Year of Graduation
MS	METU Computer Education and Instructional Technologies	2002
BS	METU Computer Education	1999
High School	Turkish Maarif College, Lefkoşa	1995

WORK EXPERIENCE

Year	Place	Enrollment
2005-Present	MSI "From Field to School" Project	Program Development Specialist
2002-2005	METU Faculty of Education	Research Assistant
1999-2002	BILKENT Computer Technology and Programming	Instructor

FOREIGN LANGUAGES

Advanced English

TURKISH SUMMARY

Giriş

Günümüz dünyasında bireyin yaşanan değişimlere ayak uydurabilmesi için hem günlük hayatında hem de iş hayatında kendini düzenli olarak geliştirebilmesi gerekmektedir. Bu yönelime uygun olarak temel eğitim düzeyindeki öğrencilerin kritik düşünme, problem çözme ve ekip çalışması becerilerini kazanması (Doolittle ve Camp, 1999; Rice ve Wilson, 1999) ve hayat boyu öğrenme konusunda kendilerini geliştirmeleri beklenmektedir. Örneğin, Rice ve Wilson'a göre (1999) öğrenme, irdeleme ve problem çözme becerileri toplumun da bireyden beklentilerinin başında gelmektedir. Yapılandırmacılık, öğrencilere toplumun beklentileri olan becerilerin kazandırılmasına yönelik bir eğitim paradigması olarak gündeme gelmiş ve öğrencilerin bilgileri öğretmenden almaktan ziyade kendi bilgilerini oluşturmalarını ön plana çıkarmaktadır.

Değişik ülkelerde gerçekleştirilen eğitim reformlarının da bir sonucu olarak yapılandırmacı yaklaşımın etkili bir şekilde uygulanabilmesi ancak da işbirliğine dayalı ekip çalışmalarında gündeme gelebilmektedir. Bu yeni paradigma ile şekillenen öğretim ortamlarında öğrenciler daha fazla sorumluluk üstlenmektedir. (Lunenburg, 1998). Bu tarz bir öğrenme, üst düzey düşünmeyi geliştirmeyle doğrudan bağlantılıdır.

Burada kritik soru, yapılandırmacı öğrenme ortamı olarak nitelendirilen ortamların nasıl değerlendirileceğidir. Öğrenme ortamlarının özellikleri eğitim araştırmalarının önemli bir boyutunu teşkil etmektedir. Literatürde, öğrenme ortamının tanımı ve ideal bir öğrenme ortamının özellikleri detaylı bir şekilde yer almaktadır. Kesal'ın (1996) belirttiği gibi Arends'e göre (1988) ideal bir öğrenme ortamı öğrencilerin yüksek düzeyde motivasyona erişebildikleri, öğrenmeye ve

öğrenme materyallerine yönelik olumlu bir tutum geliştirdikleri ortamdır. Aynı zamanda Kesal (1996), öğrenme ortamını etkin, bireysel olarak anlamlı öğrenmenin gerçekleştiği ortam olarak tanımlar. Son yirmi yılda uluslar arası düzeyde temel eğitim düzeyindeki okullardaki öğrenme ortamlarının psikolojik özelliklerini kavramsallaştırma, ölçme ve araştırma konusunda önemli düzeyde bir ilgi söz konusu olmaktadır. (Taylor, Fraser ve Fisher, 1997). Bunun için çeşitli araçlar geliştirilmiştir. Öğrenme Ortamı Envanteri (Fraser, Anderson ve Walberg, 1982), Sınıf Ortamı Ölçeği (Moos ve Trickett, 1974) ve Bireyselleştirilmiş Sınıf Ortamı Anketi (Rentoul ve Fraser, 1979) orta düzeyde sınıf ortamlarını değerlendirmek için geniş çapta kullanılmıştır. Benim Sınıfım Envanteri (Fisher ve Fraser, 1981; Fraser, Anderson ve Walberg, 1982) ve Üniversite Sınıf Ortamı Envanteri (Fraser ve Treagust, 1986) temel düzeyde kullanılan araçlardan bazılarıdır. Fen eğitiminin önemi ve laboratuar ortamlarının kendine özgülüğü nedeniyle fen laboratuar sınıflarını değerlendirmek için Fen Laboratuarı Ortamı Envanteri geliştirilmiştir (Fraser, Giddings ve McRobbie, 1995). Bunun yanı sıra, sınıf dışında fen öğrenme ortamlarına yönelik olarak ise Fen Sınıfdışı Öğrenme Ortamı Envanteri geliştirilmiştir (Orion, Hofstein, Tamir ve Giddings, 1997). Çoğu sınıf ortamı araştırmalarının öğrenmeyi ve öğretmeyi geliştirmeye dönük değerlendirmelere odaklanmışsa da bunlar daha çok geleneksel epistomolojilere dayalı sınıf ortamları dikkate alınarak yapılmış çalışmalardır (Taylor, Fraser ve Fisher, 1997). Ancak geleneksel öğretmen merkezli, didaktik yaklaşımlara dayalı öğretme geniş şekilde eleştirilmiş ve bilginin geliştirilmesi konusunda daha iyi bir anlayış olduğu kabul edilmiştir. Bu nedenle öğrenmeye psikolojik bir yaklaşımla ve öğrencilerin kendi bilgilerini oluşturduklarından hareketle Yapılandırmacı Öğrenme Ortamı Anketi (CLES) geliştirilmiştir (Taylor ve Fraser, 1991). CLES'in geçerliliği olan bir araç olduğu anlaşılmıştır (Taylor ve Fraser, 1991; Taylor, Fraser ve Fisher, 1997) ve sınıf öğrenme ortamıyla ilgili daha iyi bilgi elde edilmesine katkı sağladığı kabul edilmiştir (Roth ve Roychoudury, 1993;1994).

Türk Eğitim Sistemi de güçlü yanları ve zayıflıklarıyla birlikte dünyadaki yönelimler ışığında gözden geçirilmektedir. Milli Eğitim Bakanlığı öğretim programlarında gerçekleştirilen değişikliklerin gerekçelerini açıklamış ve ülkenin eğitim alanındaki temel hedeflerine yönelik reformların başını çekmektedir. Örneğin, fen ve teknoloji alanlarındaki değişimin, öğretim programlarına da

yansıtılması konusu uzun süre tartışıldı. Bunun yanı sıra, toplumsal değişimin de etkisiyle yeni öğretim yaklaşımlarının ve öğrenme stillerinin bir paradigma değişikliğinin parçası olarak dikkate alındığı göze çarpmaktadır. Ayrıca, Türk Eğitim Sistemi'nin daha çok sosyal eşitlik içermesi ve daha demokratik olması gerektiği yönünde ciddi tartışmalar da yaşanmaktadır.

2004 yılında Talim Terbiye Kurulu eğitim reformları çerçevesinde yeni öğretim programlarını geliştirmiş ve bunun bir parçası olarak 4. ve 5. sınıflar için yeni fen ve teknoloji derslerini yürürlüğe koymuştur. 2005-2006 öğretim yılından itibaren yeni programlar uygulanmaya başlanmıştır.

PISA, TIMMS ve PIRLS gibi uluslararası eğitim araştırmalarının bulguları ve sonuçları akademik çevrelerce yapılandırmacı yaklaşımın geçerliliğinin sorgulanmasına sebep olsa da Milli Eğitim Bakanlığı bu bulgu ve sonuçları ve Türkiye'nin bu çalışmalar ışığında belirginleşen dünyadaki pozisyonunu eğitim alanında hızlı bir değişimin rasyoneli veya göstergesi olarak ifade etmektedir.

Bu çalışma, Türkiye'nin ulusal eğitiminde yapılandırmacı yaklaşımın etkileri üzerinden reformların 4. ve 5. sınıflara yönelik fen ve teknoloji dersi boyutuyla başarısına odaklanmıştır. Bu amaçla, yapılandırmacı bir öğrenme ortamlarının araştırmalarda vurgulanan beş temel özelliği üzerinde durulacaktır. Bu özellikler, yaşamla bağdaştırma (ilişkilendirme), öğrenciler arası dialog, ortak kontrol, bilimsel belirsizlik ve eleştirel ses olarak sıralanabilir. Bu özellikleri ölçmek için bunlara paralel bölümlerden oluşan bir anket kullanılacaktır. Anket, "Dünya hakkında öğrenme", "Fen ve teknoloji hakkında öğrenme", "Kendini açıkça ifade etmek", "Öğrenmeyi öğrenme" ve "İletişim kurmayı öğrenme" bölümlerinden oluşmaktadır.

Bu çalışmanın çıkış noktası Türkiye'de ilköğretim düzeyinde 4. ve 5. sınıflarda Fen ve Teknoloji Dersi'nin öğrenme ortamlarının yapılandırmacı bir yaklaşımla değerlendirilmesidir. Çalışmanın amacı esasen ilköğretim düzeyinde 4. ve 5. sınıf Fen ve Teknoloji Derslerinde kişisel bağlantılılık, belirsizlik, eleştirel ses, paylaşılan kontrol ve öğrenci iletişimi gibi yapılandırmacı öğrenme ortamı boyutlarının ne düzeyde var olduğunu öğrenci ve öğretmen algılarına göre araştırmaktır. İkinci olarak bu çalışma öğrencilerin yapılandırmacı öğrenme ortamı algılarının belirli özelliklerine göre değişip değişmediğini incelemektedir. Bu özellikler çocukların bulunduğu ilçenin sosyo ekonomik statü grubu, çocukların sınıf düzeyi, kardeş sayıları, ayrı çalışma odaları olup olmadığı, annenin eğitim düzeyi,

babanın eğitim düzeyi, cinsiyetleri, okullarında İnternet bağlantısı olan bilgisayar laboratuvarlarının olup olmadığı, evlerinde İnternet bağlantılarının olup olmadığı ve Fen ve Teknoloji Derslerinde İnternet kullanımıdır.

Son olarak bu çalışma öğretmenlerin okul yönetimi desteği algıları ile yapılandırmacı öğrenme ortamı algıları arasındaki ilişkinin düzeyini araştırmayı hedeflemektedir.

Bu amaçlar doğrultusunda oluşturulan araştırma soruları şu şekildedir:

1. Öğrenci ve öğretmen algılarına göre ilköğretim düzeyinde 4. ve 5. sınıfların Fen ve Teknoloji dersi öğrenme ortamı ideal bir yapılandırmacı öğrenme ortamının 5 temel boyutunu (kişisel bağlantılılık, belirsizlik, eleştirel ses, paylaşılan kontrol ve öğrenci iletişimi) ne düzeyde temsil etmektedir?

1.1. Öğrenci algılarına göre ilköğretim düzeyinde 4. ve 5. sınıfların Fen ve Teknoloji dersi öğrenme ortamı ideal bir yapılandırmacı öğrenme ortamının 5 temel boyutunu (kişisel bağlantılılık, belirsizlik, eleştirel ses, paylaşılan kontrol ve öğrenci iletişimi) ne düzeyde temsil etmektedir?

1.2. Öğretmen algılarına göre ilköğretim düzeyinde 4. ve 5. sınıfların Fen ve Teknoloji dersi öğrenme ortamı ideal bir yapılandırmacı öğrenme ortamının 5 temel boyutunu (kişisel bağlantılılık, belirsizlik, eleştirel ses, paylaşılan kontrol ve öğrenci iletişimi) ne düzeyde temsil etmektedir?

2. Türkiye'deki ilköğretim 4. ve 5. sınıf öğrencilerin Fen ve Teknoloji dersindeki Yapılandırmacı Öğrenme Ortamı boyutlarına (kişisel bağlantılılık, belirsizlik, eleştirel ses, paylaşılan kontrol ve öğrenci iletişimi) ilişkin algıları belirli özelliklerine göre (çocukların bulunduğu ilçenin sosyo ekonomik statü grubu, çocukların sınıf düzeyi, kardeş sayıları, ayrı çalışma odaları olup olmadığı, annenin eğitim düzeyi, babanın eğitim düzeyi, cinsiyetleri, okullarında İnternet bağlantısı olan bilgisayar laboratuvarlarının olup olmadığı, evlerinde İnternet bağlantılarının olup olmadığı ve Fen ve Teknoloji Derslerinde İnternet kullanımı) değişkenlik gösterir mi?

2.1. 4. ve 5. sınıf öğrencilerin Fen ve Teknoloji Dersi'nde Yapılandırmacı Öğrenme Ortamı algıları bulundukları ilçenin sosyo-ekonomik düzey grubuna göre değişkenlik gösterir mi?

2.2. 4. ve 5. sınıf öğrencilerin Fen ve Teknoloji Dersi'nde Yapılandırmacı Öğrenme Ortamı algıları sınıf düzeylerine göre değişkenlik gösterir mi?

2.3. 4. ve 5. sınıf öğrencilerin Fen ve Teknoloji Dersi'nde Yapılandırmacı Öğrenme Ortamı algıları cinsiyetlerine göre değişkenlik gösterir mi?

2.4. 4. ve 5. sınıf öğrencilerin Fen ve Teknoloji Dersi'nde Yapılandırmacı Öğrenme Ortamı algıları kardeş sayısı, ayrı çalışma odasının olup olmadığı, okula ulaşım yöntemleri, annenin eğitim düzeyi ve babanın eğitim düzeyi ile belirlenen sosyo-ekonomik düzeylerine göre değişkenlik gösterir mi?

2.5. 4. ve 5. sınıf öğrencilerin Fen ve Teknoloji Dersi'nde Yapılandırmacı Öğrenme Ortamı algıları okullarında İnternet bağlantısı olan bilgisayar laboratuvarının bulunup bulunmadığı, evlerinde İnternet bağlantısı olup olmadığı ve Fen ve Teknoloji dersinde İnternet kullanıp kullanmadıkları ile belirlenen teknoloji kullanımlarına göre değişkenlik gösterir mi?

3. Öğretmenlerin Yapılandırmacı Öğrenme Ortamı algıları ile yönetim desteği algıları arasında bir bağıntı var mı?

Çalışmanın Önemi

Bu çalışmanın önemi Türkiye'de yeni uygulanmaya başlanan programlardan kaynaklanmaktadır. Milli Eğitim Bakanlığı'nın açıklamalarına göre yeni programlar bilimsel çalışmaların dönütleri ışığında gözden geçirilmektedir. Bu çalışmalardan bir tanesi Güzel ve Alkan (2005)'ın pilot uygulamayı değerlendiren çalışmasıdır. Çınar, Teyfur ve Teyfur (2006) ilköğretim öğretmenlerinin ve yöneticilerinin yapılandırmacı eğitim yaklaşımı ve yeni programlarla ilgili görüşlerini inceleyen bir çalışma yapmıştır. Bıkmaz (2006) öğretmenlerde yanlış kavram algılamalarına neden olabilecek yeni programlarda sürekli tekrarlanan belirli konular üzerinde durmuştur.

Son zamanlarda Fen ve Teknoloji dersini dikkate alan yeni programlarla ilgili çalışmaların hemen hemen tümü öğretmen ve öğrencilerin yeni programlarla ilgili görüş ve önerilerine ilişkin veri toplamayı hedeflemektedir. Bu çabalar ideal yapılandırmacı öğrenme ortamı boyutlarını irdelemekten ziyade doğrudan programlar üzerine odaklanmaktadır. Bu çalışmada araştırmacı yeni programla ilgili

genel sorulardan özellikle uzak durmaya çalışmaktadır. Bunun yerine, öğrenci ve öğretmenlerin algıları, tipik bir yapılandırmacı öğrenme ortamının temel özellikleri dikkate alınarak analiz edilmektedir.

Bu çalışmanın bir başka özelliği ise kullanılan örneklemdir. Yeni Fen ve Teknoloji programı ile ilgili son zamanlarda yapılan hemen hemen tüm çalışmalar amaçlı örneklem tekniği ile uygulanmış ve veriler belirli bir ilden toplanmıştır. Bu çalışmada ise değişik ilçelerden veri toplanmış ve bu ilçeler Devlet Planlama Teşkilatı (DPT)'nın 6 sosyo-ekonomik gelişmişlik sıralaması grubu dikkate alınarak belirlenmiştir; bu sayede bütün ülkeyi temsil etmektedir. Bilimsel bir bakış açısıyla bu çalışmanın sonuçlarının Türkiye'ye genellenebilir olduğu söylenebilir.

Ayrıca, araştırmacı öğretmenlerin yapılandırmacı öğrenme ortamı algılarının okullarında aldıkları yönetim desteğinden ne şekilde etkilendiğini de ölçmek istemektedir. Bu sayede, bu ve benzeri reform çabalarının uygulamasının öğretmenlere verilen yönetim desteği arasındaki ilişki tartışılabilecektir.

Bu çalışmada survey araştırma deseni kullanılarak Fen ve Teknoloji derslerinde 4. ve 5. sınıflarda yapılandırmacı öğrenme ortamı boyutlarının olup olmadığı incelenmiş; karşılaştırma araştırma deseni kullanılarak öğrencilerin algılarının belirli değişkenlere göre değişip değişmediği incelenmiş ve son olarak korelasyon araştırma deseni kullanılarak öğretmenlerin yapılandırmacı öğrenme ortamı algıları ile yönetim desteği algıları arasındaki ilişki incelenmiştir. Araştırma deseni 5 temel adımdan oluşmaktadır. Bunlar planlama, örneklem planlamasının geliştirilmesi, veri toplama, veri analizi ve raporlama ve sonuçların yorumlanmasıdır. Öğretmen ve öğrencilerden veri toplamak için iki anket kullanılmıştır. Öğrenci anketi öğrencilerin demografik bilgileri ve yapılandırmacı öğrenme ortamı algılarına ilişkin sorulardan oluşmaktadır. Öğretmen anketi, öğretmenlerin yapılandırmacı öğrenme ortamına ilişkin algıları, yönetim desteğine ilişkin algıları ve açık uçlu sorulardan oluşmaktadır. Açık uçlu sorular, öğretmenlerin kişisel bağlantılılık, belirsizlik ve eleştirel ses boyutlarındaki görüşleri hakkında daha fazla veri toplamayı hedeflemektedir. Ayrıca, yeni programlar uygulanırken karşılaştıkları zorluklar üzerinde durulmaktadır.

Sınırlılıklar

Bu çalışma belirlenen ilçelerde 2006-2007 öğretim yılında 4. ve 5. sınıflara kayıtlı öğrencilerle sınırlıdır. Öğrenci ve öğretmen algıları kişisel raporlama ölçümleridir; dolayısı ile katılımcıların verdikleri yanıtların kendi doğru yaklaşımları ve algıları olup olmadıkları kesin değildir. Bunun yanı sıra, çalışmanın geçerliliği, kullanılan araçların güvenilirliği ile sınırlıdır. Son olarak, çalışmanın geçerliliği, sorulara yanıt veren öğretmen ve öğrencilerin dürüstlüğü ile sınırlıdır.

Tanımlar

1. Yapılandırmacı Sınıf Ortamı: Öğrenci, öğretmen, öğretim programı ve öğretme yöntemlerini içeren, yapılandırmacılığın öğretme paradigması olarak benimsendiği sınıf. Ortamın özellikleri, "yaşamla bağdaştırma (ilişkilendirme)", "öğrenciler arası diyalog", "ortak kontrol", "bilimsel belirsizlik" ve "eleştirel ses" olarak kabul edilir. Bu özelliklerin, Yapılandırmacı Öğrenme Ortamı Anketi'ndeki bölümlerle bağıntısı (korelasyon) vardır.
2. Eleştirel ses: Yapılandırmacı öğrenme ortamının bir boyutu. Buna göre sosyal iklim öğrencilerin öğretmenin pedagojik planları ve yöntemleri ile ilgili sorgulamalarını ve endişelerini ifade etmelerine imkan sağlar. (Taylor, Fraser & White, 1994, April).
3. Yaşamla bağdaştırma (ilişkilendirme): Öğrencilerin günlük tecrübelerinin fen ve teknoloji konularını anlamak için bir temel teşkil ettiği anlayışına dair yapılandırmacı öğrenme ortamının bir boyutu (Taylor, Fraser & White, 1994, April).
4. Bilimsel belirsizlik: Öğretmenlerin öğrencilere bilimsel bilginin belirsizliğini, öznelliğini ve sınırlılıklarını tecrübe edebilmeleri için yarattığı olanaklara dair yapılandırmacı öğrenme ortamının bir boyutu (Taylor, Dawson, & Fraser, 1995, April, p. 5).
5. Ortak kontrol: Öğrencilerin öğretmenle birlikte öğrenme ortamının planlanması, kendi öğrenme hedeflerinin somutlaştırılması, öğrenme faaliyetlerinin tasarlanması ve yönetimi ve değerlendirme kriterlerinin uygulanması konularına katkıda bulunmalarına dair yapılandırmacı öğrenme ortamının bir boyutu (Taylor, Dawson, & Fraser, 1995, April, p. 4).

6. Öğrenciler arası etkileşim: Öğrenciler arasında işlenen konularla ilgili açıklama, anlama ve anlamlandırma üzerine yaşanan etkileşimlere dair yapılandırmacı öğrenme ortamının bir boyutu (Taylor, Dawson, & Fraser, 1995, April, p. 4).

Evren ve Örneklem

Bu çalışmanın evreni, TC Milli Eğitim Bakanlığı'na bağlı tüm ilköğretim okullarındaki 4. ve 5. sınıf öğrencileri ve öğretmenleridir. Çalışmada, Devlet Planlama Teşkilatı'nın Bölgesel Gelişme verilerinde ilçeler bazındaki sosyo-ekonomik düzey sıralaması ve buna göre oluşturulan 6 grup üzerinden bir örneklem geliştirilmiştir.

Her gruptaki 4. ve 5. sınıf öğrenci nüfusu dikkate alınarak gruplar için ayrı ayrı toplam nüfus baz alınarak oranlar belirlenmiştir. Daha sonra ise nüfus oranlarına göre çalışmada her gruba düşen ilçe sayısı belirlenmiştir. İlçeler, gruplardaki tüm ilçelerin yer aldığı bir listeden rasgele seçilmişlerdir. Ayrıca her grup ve her gruptaki ilçeler için ayrı ayrı 4. sınıf öğrenci, 5. sınıf öğrenci ve öğretmen sayıları belirlenmiştir.

Araştırmanın örneklemi, 700 4. sınıf öğrenci, 700 5. sınıf öğrenci ve 400 öğretmenden oluşmaktadır. Söz konusu örneklem, yukarıda anlatılan süreç takip edilerek Türkiye genelini temsil edecek şekilde oluşturulmuştur.

Buna göre 6 sosyo-ekonomik gelişmişlik düzeyi grubundaki 4. ve 5. sınıf öğrencilerin ülke genelindeki toplam 4. ve 5. sınıf öğrenci nüfusuna oranları, buna göre her gruba düşen 4. ve 5. sınıf öğrenci ve öğretmen sayıları, ilçeler ve her ilçeye düşen öğrenci ve öğretmen sayılarının yer aldığı tablo şöyledir:

Grup	Gruplardaki 4. ve 5. sınıf öğrencilerin ülke genelindeki öğrenci nüfusuna oranları %	Nüfus oranlarına göre çalışmada her gruba düşen ilçe sayısı	Nüfus oranlarına göre çalışmada her gruba düşen 4. sınıf öğrenci sayısı	Nüfus oranlarına göre çalışmada her gruba düşen öğretmen sayısı	İlçe	4. Sınıf Öğrenci Sayısı	5. Sınıf Öğrenci Sayısı	Öğretmen Sayısı
1	13	3	105	60	Eskişehir (Merkez)	25	25	15
					Tekirdağ (Çorlu)	25	25	15
					Kocaeli (Gebze)	25	25	15
2	26	7	245	140	Antalya (Alanya)	25	25	15
					Şanlıurfa (Merkez)	25	25	15
					Hatay (Iskenderun)	25	25	15
					Yalova (Merkez)	25	25	15
					Aydın (Didim)	25	25	15
					İzmir (Seferhisar)	25	25	15
					Bolu (Merkez)	25	25	15
3	20	5	175	100	Ankara (Kızılcıhamam)	25	25	15
					Bartın (Merkez)	25	25	15
					Şırnak (Merkez)	25	25	15
					Bitlis (merkez)	25	25	15
					Bingöl (merkez	25	25	15

Grup	Gruplardaki 4. ve 5. sınıf öğrencilerin ülke genelindeki öğrenci nüfusuna oranları %	Nüfus oranlarına göre çalışmada her gruba düşen ilçe sayısı	Nüfus oranlarına göre çalışmada her gruba düşen 4. sınıf öğrenci sayısı	Nüfus oranlarına göre çalışmada her gruba düşen öğretmen sayısı	İlçe	4. Sınıf Öğrenci Sayısı	5. Sınıf Öğrenci Sayısı	Öğretmen Sayısı
4	8	2	70	40	Ardahan (Merkez)	25	25	15
					Ankara (Bala)	25	25	15
5	4	1	35	20	Gaziantep (Araban)	25	25	15
6	6	2	70	40	Şanlurfa (Siverek)	25	25	15
					Van (Başkale)	25	25	15
					Toplam:	500	500	300

Verilerin Toplanması

Bu çalışmada iki veri toplama aracı kullanılacaktır. Birincisi evet-hayır cevaplı ve likert tipi bir ölçekten oluşan öğrenci anketidir (Ek. 2). Ölçek, öğrencilerin internet kullanımı ve fen ve teknoloji dersinde oluşturulan yapılandırmacı öğrenme ortamı ile ilgili algı sorularından oluşmaktadır. Ayrıca öğrencilerin sınıfı, okulu ve cinsiyeti de bu veri toplama aracında sorulmaktadır. Aracın Yapılandırmacı Öğrenme Ortamı ile ilgili kısmı, Taylor ve Fraser'in Yapılandırmacı Öğrenme Ortamı Anketi'nden (YÖOA) (Taylor, 1997) adapte edilmiştir. YÖOA öğrencilerin yapılandırmacı öğrenme ortamıyla ilgili algılarını ölçmek için beş ölçekten oluşmaktadır. Bu ölçekler, "yaşamla bağdaştırma (ilişkilendirme)", "öğrenciler arası etkileşim", "ortak kontrol", "bilimsel belirsizlik" ve "eleştirel ses" olarak isimlendirilebilir. Ölçeklerin veri toplama araçlarına yansıması, sırasıyla, "yaşamla ilgili öğrenme", "iletişim kurmayı öğrenme", "öğrenmeyi öğrenme" , "Fen ve teknoloji hakkında öğrenme" ve "Kendini ifade etmeyi öğrenme" şeklinde olmaktadır. Daha açıklayıcı olması açısından aşağıdaki tabloda ölçeğin adı, açıklaması, veri toplama aracına yansıması ve örnek bir madde yer almaktadır:

Ölçek	Açıklama	Veri Toplama Aracındaki Karşılığı	Örnek madde
Yaşamla Bağdaştırma (İlişkilendirme)	Öğrencinin yaşamıyla öğrenmenin ilişkilendirilmesi	Yaşamla ilgili öğrenme	Fen ve teknolojinin okul dışındaki yaşamımın bir parçası olabileceğini öğrendim
Öğrenciler Arası Etkileşim	Öğrencinin yeni düşüncelerini sorgularken diğer öğrencilerin sürece dâhil olması	İletişim kurmayı öğrenme	Dersle ilgili düşüncelerimi arkadaşlarımla paylaşırım
Ortak Kontrol	Öğrenme sürecinin planlanması, uygulanması ve değerlendirilmesi sürecine öğrencinin katılımı	Öğrenmeyi öğrenme	Derslerin planlanmasında öğretmenime yardımcı olurum
Bilimsel Belirsizlik	Bilimsel bilginin göreceliği	Fen ve Teknoloji hakkında öğrenme	Teknolojinin zaman içinde değiştiğini öğrendim
Eleştirel Ses	Eleştirel bir düşünceyi ifade etmenin meşruluğu	Kendini ifade etmeyi öğrenme	Öğrenmemi engelleyen herhangi bir şeyle ilgili öğretmenime eleştirilerimi ifade ederim

İkinci veri toplama aracı olan Öğretmen Anketi ise yine YÖOA'dan adapte edilmiş sorulardan ve açık uçlu üç sorudan oluşmaktadır.

Taylor ve Fraser'in Yapılandırmacı Öğrenme Ortamı Anketi (YÖOA) (Taylor, 1997), İnternet üzerinde öğretmenlere, öğrencileriyle ilgili veri toplayabilecekleri bedava bir araç olarak sunulmaktadır. Taylor'un kişisel İnternet sayfasından da aracın bulunduğu İnternet sayfasına kısa yol bulunmaktadır. Ayrıca Taylor ile elektronik posta aracılığıyla iletişim kurulmuş ve aracı kullanma konusunda onayı alınmıştır. Ek 1'de söz konusu yazışma örneklerine yer verilmektedir.

Veri toplama süreci, gerekli hazırlıklar yapıldıktan sonra ilgili okullardaki tüm 4. ve 5. sınıf öğrencilerine öğrenci anketinin uygulanması ve yine aynı okullardaki 4. ve 5. sınıf öğretmenlerine öğretmen anketinin uygulanmasından ibarettir.

Veri toplama araçlarının geliştirilme süreci

Her iki veri toplama aracının geçerlik ve güvenilirlik yönünden güçlendirilmesi için sırasıyla şu çalışmalar yapılmıştır:

Taylor'un Yapılandırmacı Öğrenme Ortamı Anketi (YÖOA) tercüme / geri tercüme yöntemiyle Türkçeleştirildi. Doğu Akdeniz Üniversitesi Hazırlık Okulu'nda öğretim elemanı olarak çalışan 4 İngilizce dil öğretmeni tarafından tüm maddeler Türkçe'ye çevrildi. Daha sonra, yine Doğu Akdeniz Üniversitesi Hazırlık Okulu'nda okutman olarak görev yapan 4 farklı öğretim elemanı, Türkçeleştirilmiş maddelerden kendilerine göre en uygun olanını seçti. Böylelikle anketteki maddeler için ayrı ayır en iyi tercümenin belirlenmesi mümkün oldu. Bu sürecin en zor tarafı, gerek duyulduğu zamanlarda söz konusu orijinal maddelerin eğitim bilimleri ve yapılandırmacı yaklaşım çerçevesinde neyi ifade etmeye çalıştığı ile ilgili olarak 8 farklı kişiye açıklamalar ve geribildirimler sağlamaktı. Bu sürecin sonunda, Yapılandırmacı Öğrenme Ortamı Anketi (YÖOA)'nin hem öğrencilere hem de öğretmenlere yönelik Türkçeleştirilmiş uyarlamaları elde edildi.

Anketler Türkçeleştirme sürecinden sonra düzenlendi ve çeşitli konularda uzmanlar tarafından incelendi. Tez danışmanı, Doç. Dr. Ercan Kiraz ile birlikte çok dikkatli ve detaylı bir gözden geçirme süreci yaşandı. Daha sonra, ODTÜ Eğitim Fakültesi Eğitim Bilimleri Bölümü emekli öğretim üyeleri Prof. Dr. Fersun Paykoç ve Prof. Dr. Füsün Akkök'ten geri bildirimler alındı. ODTÜ Eğitim Fakültesi'nde İnsan Kaynakları Geliştirme alanında Yüksek Lisans Derecesi'ne sahip Levent Gaşgil'den geribildirimler alındı. Anketin uygulanacağı hedef kitleyi iyi tanıyan ve ODTÜ Eğitim Fakültesi'nde Ortaöğretim Fen ve Matematik Alanları Eğitimi Bölümü'nde doktorasını tamamlamış ve Ölçme ve Değerlendirme Alanı'nda halen çalışmalarını sürdürmekte olan Hüseyin Hüsnü Yıldırım'ın görüşü alınarak anketlerde gerekli düzenlemeler yapıldı. Ayrıca, çeşitli İlköğretim okullarında öğretmenlik tecrübesine sahip iki kişi anketleri detaylı şekilde gözden geçirdi ve anlaşılmayan maddeler saptanarak gerekli düzeltmeler yapıldı. Öğretmen anketi ayrıca Gazeteci Hasan Tahsin İlköğretim Okulu'ndan 5 sınıf öğretmeni tarafından incelendi ve anlaşılamayan maddelerle ilgili geribildirim alındı. Son olarak ise 20 kız 20 erkek olmak üzere halen 4. ve 5. sınıflara devam etmekte olan 40 öğrencinin öğrenci anketini doldurmaları sağlandı ve anlaşılamayan maddelerle ilgili

düşünceleri sorularak öğrenci anketinin daha anlaşılır bir dille uygulanabilmesi için hassas bir süreçten geçildi.

Veri toplama araçlarının iç tutarlılığı (alpha güvenilirliğiyle) ilgili alanda söz konusu aracın kullanıldığı çalışmalarla ilgili araştırma yapılarak aşağıdaki tablo oluşturuldu:

Çalışmanın Başlığı	Araştırmacı	N	Bireysel Bağlantılılık (α)	Öğrenciler Arası Diyalog (α)	Ortak Kontrol (α)	Bilimsel Belirsizlik (α)	Eleştirel Ses (α)
Fen ve Öğrenme Ortamları: Değerlendirme, Etkiler ve Determinantlar	Barry J. Fraser	1081	0,88	0,89	0,91	0,76	0,85
Yapılandırmacı Sınıf Ortamlarının İzlenmesi	Peter C. Taylor, Barry J. Fraser ve Darrell L. Fisher	1574 - 1626 arası	0,70	0,89	0,89	0,61	0,82
Tayvan (RC) ve Avustralya'da (AUS) ülkelerarası bir çalışmadaki yapılandırmacı öğrenme ortamları	Jill M. Aldridge, Barry J. Fraser, Peter C. Taylor ve Chung-Chi Chen	RC: 1879 AUS: 1081	RC: 0,87 AUS: 0,88	RC: 0,85 AUS: 0,89	RC: 0,92 AUS: 0,91	RC: 0,83 AUS: 0,76	RC: 0,73 AUS: 0,85

Çalışmanın Başlığı	Araştırmacı	N	Bireysel Bağlantılılık (α)	Öğrenciler Arası Diyalog (α)	Ortak Kontrol (α)	Bilimsel Belirsizlik (α)	Eleştirel Ses (α)
Kore'de Yapılandırmacı Öğrenme Ortamlarının İncelenmesi ve Değerlendirilmesi	Heui-Baik Kim, Darrell L. Fisher and Barry J. Fraser	1107	0,79	0,87	0,86	0,64	0,84
YÖOA Yapılandırmacı Öğrenme Ortamlarının İzlenmesi için bir Araç	Peter C Taylor, Barry J Fraser ve Loren R White	34	0,81	0,68	0,85	0,54	0,79
Mezunlarımız nasıl öğretiyor? Mezunlarımızın sınıflarındaki öğrenme ortamlarına bir bakış	Bruce Johnson ve Robert McClure	476	0,80	0,91	0,85	0,81	0,83

T.C. Milli Eğitim Bakanlığı Eğitim Araştırma Geliştirme Daire Başkanlığı (EARGED) desteğiyle yürütülen çalışmanın veri toplama süreci şu şekilde olmuştur:

Araştırmacı EARGED desteği için öneri hazırlayıp sunmuştur. Söz konusu öneri, problemi, amacı ve çalışmanın önemini ile sınırlılıklarını, tanımları, araştırma desenini ve veri toplama araçlarına ilişkin bilgileri içermekteydi. EARGED öneriyi inceleyip değerlendirdi. EARGED bazı değişiklikler önerdi ve bunlar ışığında çalışma geliştirildi. Bu sayede çalışmanın geçerlik ve güvenirliği artırıldı. Öneri EARGED tarafından kabul edilerek tez danışmanı, araştırmacı ve EARGED arasında protokol imzalandı. EARGED Veri toplama araçlarının çoğaltılıp ilgili İl Milli Eğitim Müdürlüklerine ulaştırılmasını sağladı. İl Milli Eğitim Müdürlükleri veri toplama araçlarını resmi yazıyla okullara iletti. İl Milli Eğitim Müdürlükleri okul yönetimlerinin etik konuları da dikkate alarak verilerin toplanmasını sağlayarak 1 hafta içinde sürecin tamamlanmasını önerdi. Öğrenciler anketleri sınıf ortamında; öğretmenler ise öğretmen odasında yarım saat içinde doldurdu. İl Milli Eğitim Müdürlükleri doldurulan anketleri resmi yazıyla EARGED'e iletti ve EARGED bu verileri araştırmacı ile paylaştı. Bu süreç 2006-2007 bahar döneminde tamamlandı.

Verilerin Analizi

Verilerin analizi için şu yöntemler izlendi:

Birinci araştırma sorusunda, öğretmenlerin ve öğrencilerin yapılandırmacı öğrenme ortamı ile ilgili algıları ölçüleceği için hem öğretmenlerin hem de öğrencilerin yapılandırmacı öğrenme ortamındaki beş temel özellikle ilgili algılarına ilişkin teker teker ortalama ve standart sapma değerlerine bakıldı. İkinci araştırma sorusunun cevaplandırılabilmesi için ise kategorik verilerle (cinsiyet, sınıf, sosyo-ekonomik düzey ve İnternet kullanımı) öğrencilerin yapılandırmacı öğrenme ortamında bulunması beklenen 5 temel özellikle ilgili algıları arasındaki ilişkiye bakıldı. Bunun için cinsiyet ve sınıf karşılaştırmalarında bağımsız gruplar için t-testi, sosyo-ekonomik düzey ve İnternet kullanımı karşılaştırmalarında ise MANOVA kullanılmıştır. Üçüncü araştırma

sorusuyla, öğretmenlerin yapılandırmacı öğrenme ortamındaki 5 temel özellikle ilgili algılarının, aldıkları yönetim desteği ile bir bağıntısının olup olmadığı incelenmiştir. Bunun için her bir yapılandırmacı öğrenme ortamı özelliği için çıkacak ortalama değerlerle öğretmenlerin yönetim desteği algısı ortalama değerleri arasında r - bağıntı katsayısına bakılmıştır.

Araştırma Sorusu	Değişkenler	İstatistik yöntemi
1. Öğrencilerin ve öğretmenlerinin algılarına göre Türkiye'de İlköğretim okullarında 4. ve 5. sınıfta fen ve teknoloji ders ortamı yapılandırmacı öğrenme ortamlarında bulunması beklenen 5 temel özelliği (Yaşamla bağdaştırma, öğrenciler arası etkileşim, ortak kontrol, bilimsel belirsizlik ve eleştirel ses) içeriyor mu?	1. Öğrencilerin dersteki bireysel bağlantılılığa ilişkin algıları 2. Öğrencilerin kendi aralarındaki diyaloga ilişkin algıları 3. Öğrencilerin ortak kontrole ilişkin algıları 4. Öğrencilerin bilimsel belirsizliğe ilişkin algıları 5. Öğrencilerin eleştirel sese ilişkin algıları 6. Öğretmenlerin dersteki bireysel bağlantılılığa ilişkin algıları 7. Öğretmenlerin öğrenciler arasındaki diyaloga ilişkin algıları 8. Öğretmenlerin ortak kontrole ilişkin algıları 9. Öğretmenlerin bilimsel belirsizliğe ilişkin algıları 10. Öğretmenlerin eleştirel sese ilişkin algıları	Tümü için ortalama ve standart sapmaya bakılacaktır

Araştırma Sorusu	Değişkenler	İstatistik yöntemi
2. Öğrencilerin bazı özellikleri (sınıf, okul, kardeş sayısı, kendisine ait çalışma odası olup olmaması, okula ulaşımı, annenin eğitim durumu, babanın eğitim durumu, cinsiyet, İnternet kullanımı) ile fen ve teknoloji dersindeki yapılandırmacı öğrenme ortamına ilişkin algıları arasında ilişki var mı?	1. Öğrencilerin dersteki yaşamla bağdaştırmaya ilişkin algıları 2. Öğrencilerin kendi aralarındaki etkileşime ilişkin algıları 3. Öğrencilerin ortak kontrole ilişkin algıları 4. Öğrencilerin bilimsel belirsizliğe ilişkin algıları 5. Öğrencilerin eleştirel sese ilişkin algıları 6. İlçesinin sosyo-ekonomik düzey grubu 7. Sınıf 8. Okul 9. Kardeş sayısı 10. Kendisine ait çalışma odası olup olmaması 11. Okula ulaşım 12. Annenin eğitim durumu 13. Babanın eğitim durumu 14. Cinsiyet 15. İnternet Kullanımı	7,10 ve14 'deki kategorilerle 1,2,3,4,5'in ortalamaları arasındaki ilişkilere bakmak amacıyla her bir ilişki için bağımsız t-testi yapılacak 6, 8, 9, 11, 12, 13, 15'daki ikiden fazla kategoriyle 1,2,3,4,5'in ortalamaları arasındaki ilişkilere bakmak amacıyla her bir ilişki için MANOVA kullanılacaktır
3. Öğretmenlerin yapılandırmacı öğrenme ortamı ile ilgili algıları ile yönetim desteğiyle ilgili algıları arasında nasıl bir bağıntı (korelasyon) vardır?	2. Öğretmenlerin dersteki bireysel bağlantılılığa ilişkin algıları 3. Öğretmenlerin öğrenciler arasındaki diyaloga ilişkin algıları 4. Öğretmenlerin ortak kontrole ilişkin algıları 5. Öğretmenlerin bilimsel belirsizliğe ilişkin algıları 6. Öğretmenlerin eleştirel sese ilişkin algıları 7. Öğretmenlerin aldıkları yönetim desteğiyle ilgili algıları	6'nın ortalamaları ile 1,2,3,4,5'in ortalamaları arasındaki korelasyona bakmak amacıyla her bir ilişki için r- korelasyon katsayısına bakılacak

Öğrencilerin Yapılandırmacı Öğrenme Ortamına İlişkin Algıları

Birinci araştırma sorusuna yanıt bulmak için ilk olarak Fen ve Teknoloji dersine devam eden 1143 (160'i 1. Sosyo ekonomik gelişmişlik grubundan, 343 tanesi 2. Gruptan, 251 tanesi 3. Gruptan, 246 tanesi 4. Gruptan, 62 tanesi 5. Gruptan ve 51 tanesi 6. Gruptan) 4. ve 5. sınıf öğrencisi öğrenci anketini dolmuşlardır. Her bir madde her zaman 3.26-4.0; sık sık 2.51-3.25; bazen 1.76-2.50 ve hiçbir zaman 1-1.75 şeklinde skorlandırılmıştır.

İlk olarak anketlerden elde edilen toplam skorlar ortalama ve standart sapmalarıyla sunulmuştur. Buna ek olarak yapılandırmacı öğrenme ortamı boyutlarının ortalamaları arasındaki farkın anlamlı olup olmadığına bakmak için tekrarlı ölçüm ANOVA yapılmıştır. Kişisel bağlantılılık boyutundaki 6. Madde ve belirsizlik boyutundaki 1. Madde olumsuz algıyı ölçtüğü için hesaplamalar sırasında tersten okunmuşlardır. Öğrenci anketinde yapılandırmacı öğrenme ortamı ve boyutlarına ilişkin 26 soru bulunmaktadır. Anketin toplam skorlarının ortalaması 78.01 (M=3.00 / 4 – sık sık) ve standart sapması 11.51 (Sd=.44) şeklinde hesaplanmıştır. Sonuçlar öğrencilerin yapılandırmacı öğrenme ortamını ve boyutlarını çoğu zaman yapılandırmacı bulduklarını göstermektedir. En düşük elde edilen skor 40 (M=1.54 / 4) ve en yüksek elde edilen skor ise 101 (M=3.88 / 4) şeklinde hesaplanmıştır.

Öğrencilerin yarısından fazlası (68%) öğrenme ortamını ve boyutlarını çoğu zaman yapılandırmacı bulmakta ve sadece 16%'sı bazen yapılandırmacı bulmaktadır. Öğrencilerin %15'i öğrenci ortamını her zaman yapılandırmacı bulmaktadır. Diğer taraftan öğrencilerin hemen hemen hiçbirisi öğrenme ortamını hiç bir zaman yapılandırmacı bulmaktadır (0.3%).

Öğretmenlerin Yapılandırmacı Öğrenme Ortamına İlişkin Algıları

Öğrencilerden toplanan verilerin yanı sıra ilk araştırma sorusunu cevaplandırmak üzere öğretmenlerden de öğretmen anketi aracılığıyla veri toplantmıştır. Öğretmen anketi 264 öğretmen tarafından doldurulmuştur. Anketin toplam skorlarının ortalaması 75.16 (M=2.89 / 4 – sık sık) ve standart sapması 9.82 (Sd=.38) şeklinde hesaplanmıştır. Sonuçlar öğretmenlerin yapılandırmacı öğrenme ortamını ve boyutlarını çoğu zaman yapılandırmacı bulduklarını göstermektedir. En düşük elde edilen skor 49 (M=1.88 / 4) ve en yüksek elde edilen skor ise 96 (M=3.69 / 4) şeklinde hesaplanmıştır.

Öğretmenlerin yarısından fazlası (81.1%) öğrenme ortamını ve boyutlarını "sık sık" yapılandırmacı bulurken; 4.2%'si "her zaman" yapılandırmacı bulmuş ve 14.8%'i ise "bazen" yapılandırmacı bulmuştur. Öğretmenlerden hiçbirisi öğrenme ortamının "hiçbir zaman" yapılandırmacı olduğunu düşünmemiştir.

Özet olarak çalışmanın sonuçları şu şekilde belirtilebilir:

Öğrenciler Fen ve Teknoloji dersi öğrenme ortamını büyük oranda yapılandırmacı bulmaktadır. Aynı şekilde anketin alt başlıkları incelendiği vakit öğrencilerin yapılandırmacı öğrenme ortamı boyutlarını (kişisel bağlantılılık, belirsizlik, eleştirel ses, paylaşılan yönetim ve öğrenci iletişimi) da büyük oranda yapılandırmacı buldukları saptanmıştır.

Öğrencilere benzer şekilde öğretmen anketi ve alt başlıklarının analizi ortaya çıkarmıştır ki öğretmenler öğrenme ortamını ve boyutlarını "sık sık" yapılandırmacı bulmaktadır. Kişisel bağlantılılık boyutunda öğrenciler en yüksek skoru 4. Maddede elde etmişlerdir. Bu madde, "Hayatı daha iyi açıklayabiliyorum" şeklindeydi. Aynı bağlamda, en düşük skoru 1. Maddede elde etmişlerdir. Bu madde, "Okul dışı hayatla ders arasında bağlantı kurabiliyorum" şeklinde idi. Ayrıca kişisel bağlantılılık boyutunda öğretmenlerin en yüksek ve en düşük skorları ise şu iki maddede çıkmıştır: 1) "Öğrenciler derste öğrendiklerinin okul dışı yaşamla hiçbir bağlantısı olmadığını öğrendi" maddesi, olumsuz algıyı sorguladığından dolayı ters çevrilmiş bir madde olmasına rağmen en yüksek skoru almıştır. En düşük skor ise "Öğrenciler okul dışında

hayatla ilgili yeni şeyler öğrenirler" maddesinde elde edilmiştir. Bilimsel belirsizlik boyutunda ise öğrenciler "Teknolojinin zaman içinde değiştiğinin farkındayım" maddesinde en yüksek skoru elde ederken, en düşük skoru ise "Hayattaki tüm sorunları fen ve teknoloji sayesinde çözebilirim" maddesinde elde ettiler. Öğretmenler ise "Öğrenciler Internet teknolojisinin uzun yıllar önce kullanılan teknolojiden farklı olduğunun ayırtındadırlar" maddesinde en yüksek, "Öğrenciler hayattaki sorunları teknolojiyi kullanarak çözebileceklerini düşünürler" maddesinde ise en düşük skoru elde etmişlerdir.

Eleştirel düşünme boyutunda öğrenciler en yüksek skoru "Gerekli gördüğümde haklarımı kararlılıkla savunurum" maddesinde elde etmişler, en düşük skoru ise, "Gerektiğinde öğretmenine bunu niye öğrenmek zorundayım sorusunu sorabilirim" maddesinde elde etmişlerdir. Öğretmenler ise aynı boyutta en yüksek skoru "Öğrenciler düşüncelerini özgürce ifade ederler" maddesinde ve en düşük skoru ise "İhtiyaç duyduklarına öğrenciler bunu niye öğrenmek zorundayım sorusunu sorabilirler" maddesinde elde etmişlerdir.

Öğrencilerin özelliklerine göre yapılandırmacı öğrenme ortamı algılarının ne şekilde değişiklikler arz ettiğini ölçmek için yapılan MANOVA hesaplamalarının sonuçlarına göre en yüksek sosyo ekonomik gruplardaki (1, 2, ve 3. Gruplar) öğrenciler; 1 veya 2 kardeşi olan öğrenciler; çalışma odasına sahip olan öğrenciler; aileleri tarafından okula götürülen öğrenciler; annesi üniversite mezunu olan öğrenciler; babası üniversite mezunu olan öğrenciler, kız öğrenciler; okulunda internet bağlantılı bilgisayar olan öğrenciler; evinde internet bağlantısı olan öğrenciler ve Fen ve Teknoloji dersinde internet kullanan öğrenciler öğrenme ortamını daha yapılandırmacı bulmaktadır. Öğrencilerin sınıfı ise algılarını etkilememektedir.

Öğretmenlerin yapılandırmacı öğrenme ortamı algıları ile yönetim desteği algıları arasında bir bağlantı olup olmadığını anlamak için korelasyon katsayısı hesaplanmıştır. Bundan önce, öğretmenlerin yönetim desteği algılarından bahsetmek gerekirse; ortalama skorun 2.52 / 4 olduğu belirtilmelidir. Öğretmenlerin ortam algısı ile yönetim desteği algısı arasında anlamlı fakat düşük bir korelasyon olduğu anlaşılmıştır. Benzer şekilde yönetim desteğiyle yapılandırmacı öğrenme ortamı

boyutları arasındaki ilişkinin anlamlı ama çok düşük korelasyon olduğu anlaşılmaktadır.

Öneriler

Araştırmanın sonuçlarına ve ilgili literatüre göre Fen ve Teknoloji Dersi'nin geliştirmek için ve gelecekteki araştırmalar için öneriler şöyledir:

Dersteki yapılandırmacı öğrenme ortamını geliştirmek için:

1. Öğrenciler yeni programların amaçlarıyla ilgili daha fazla bilgilendirilmeliler ve yeni programlara göre rolleri daha açık şekilde onlara anlatılmalıdır.
2. Öğrencilerin gerçek hayatla derste öğrendikleri arasında daha güçlü bağlantılar kurabilmesi için gerekli vurguların yapılması önerilmektedir.
3. Öğretmenler bütün öğrencileri tüm faaliyetlere katma konusunda daha dikkatli olursa sınıflardaki katılım sorunu aşılabilir.
4. Sınıfta öğrenmeyi artırmak için kitap bölümlerindeki hazırlık ve tartışma başlıkları daha etkili şekilde dikkate alınmalıdır.
5. Öğretmenler günlük hayattan daha fazla örnekler vermek için hazırlıklı olmalı ve özellikle kırsal kesimde konularla günlük hayat arasında bağlantı kurulabilmesi için bu konuya önem verilmelidir.
6. Sınıf ortamına öğrencilerin daha fazla katkı yapabilmesi için önceden hazırlanmaları gerektiği konusunda daha fazla uyarılmalıdırlar.
7. Öğrenciler daha fazla soru sormaları gerektiği konusunda bilinçlendirilirse çok fazla gündeme gelen katılım eksikliği sorunu ortadan kaldırılabilir.
8. Drama yönteminin kullanımı özendirilmelidir.
9. Aileler sınıf içinde hayata geçirilen faaliyetlere ilişkin daha fazla bilgilendirilmeli ve öğrencilerin sınıfa gelmeden önce hazırlanmalarının önemi hakkında bilinçlendirilmelidir.
10. Okul saatleri dışında öğrencilerin biraraya gelebilecekler ortamlar oluşturulmalıdır. Böylece grup çalışması yapıp derslere birlikte hazırlanabilecekler.
11. Bilgi teknolojileri dersi daha etkili şekilde uygulanmalıdır.

Öğrencilerin farklı değişkenlere göre algılarında oluşan farklılıklar dikkate alındığı vakit şöyle öneriler yapılabilir:

12. Milli Eğitim Bakanlığı ve Türk hükümeti öğrencilerin yeni fen ve teknoloji derslerinde öğrenme ortamına ilişkin algılarının sosyo ekonomik statülerine ilişkin değişkenlerde farklılıklar arz ettiği ve bu durumun eğitim alanındaki reformların başarısının diğer sosyo ekonomik gelişmeyi etkileyen reformlarla birlikte başarıya ulaşabileceğini göstergesi olduğunun farkında olması gerekiyor.
13. Aileler kardeş sayısının, öğrencilerin ayrı çalışma odası olup olmadığının, çocukların okula ulaşımının, evlerinde internet bağlantısı olup olmadığının ve diğer SES bağlantılı faktörlerin çocukların yeni eğitim sistemine entegrasyonunu etkilediği konusunda bilinçlendirilmesi gerekmektedir.

Ayrıca, uygulama ortamının ve yönetim desteğinin gelişmesi açısından şu öneriler yapılabilir:

14. Öğretmenler sessiz öğrencilerin daha fazla katılımını sağlamak için daha fazla hizmet içi eğitim hizmetlerinden faydalanabilmelidir.
15. Öğrenmeyi artırmak için İnternetin ve diğer teknolojilerin nasıl daha etkili kullanabileceğine ilişkin öğretmenlere hizmet içi eğitim hizmetleri sunulmalıdır.
16. Okul yönetimleri öğretmenleri yeni öğretme metodlarını daha sık kullanmaları konusunda yüreklendirmelidir.
17. Milli Eğitim Bakanlığı programlara ilişkin kararlar alırken daha katılımcı bir yaklaşım sergilemelidir.
18. Sınıf mevcudu sayıları düşürülmelidir.
19. Bölgesel, sosyo kültürel ve ekonomik farklılıklar dikkate alınarak farklı yöntemler ve örnekler kullanılabilmelidir.

Gelecekteki araştırmalar için öneriler şu şekildedir:

20. Gelecekteki çalışmalarda 4. Ve 5. Sınıf ilköğretim okullarında yüz yüze görüşme ve gözlem yöntemleri kullanılarak daha uzun süreler çoklu bilgi toplama yaklaşımları kullanılabilir.
21. Gelecekteki çalışmalarda daha niteliksel veri toplama ve analiz yöntemleri kullanılabilir; öğrenci portfolyoları, projeleri, ödevleri ve diğer ilgili yazılı dokümanları dikkate alınabilir.
22. Öğretmenlerin ve öğrencilerin yapılandırmacı öğrenme ortamına ilişkin algılarını ölçen çalışmalar tüm sınıfları kapsayacak şekilde tekrarlanabilir.
23. Gelecekteki çalışmalarda öğretmenlerin yapılandırmacı öğrenme ortamı algılarının cinsiyet, SES ve öğretmenin tecrübesi gibi değişkenler ışığında ne gibi değişimler arz ettiği üzerinde durulabilir.
24. Gelecekteki çalışmalar öğrencilerin yapılandırmacı öğrenme ortamı algılarının Fen ve Teknoloji dersine yaklaşımları ve başarı düzeylerinden ne şekilde etkilendiği üzerrinde durulabilir.