GIFTED STUDENTS' ATTITUDES TOWARDS SCIENCE AND CLASSROOM ENVIRONMENT BASED ON GENDER AND GRADE LEVEL

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ABSTRACT

GIFTED STUDENTS' ATTITUDES TOWARDS SCIENCE AND CLASSROOM ENVIRONMENT BASED ON GENDER AND GRADE LEVEL

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The purpose of the present study is to investigate the differences on gifted student's attitudes toward science and their preferred classroom climate during science classes based on gender and grade level.

Two questionnaires, the Test of Science Related Attitudes (TOSRA) and the Individualized Classroom Environment Questionnaire (ICEQ), were used as survey tools in this study. A group of 163 gifted and talented students among four academic levels which are eighth grade, English prep class, ninth and eleventh grade were assigned to take part in this study.

The data obtained from administration of measuring instrument were analyzed by using Two-Analyses of Variance (ANOVA).

Result indicated that grade level of students had a significant effect on attitudes towards science. The study found, first, lower-grade students show more positive attitudes toward science than the students at higher-grade level.

Secondly, there are significant differences were found among students in their perceptions of the science classroom environment based on their gender and grade level. Female students expected more personalization than male students, higher grade students preferred to have more independence and more differentiated classroom environment than lower grade students while they are learning.

Key Words: Gifted student, science education, cross-age study, attitudes towards science, attitudes towards classroom environment.

ÖZ

FARKLI SINIF SEVİYELERİNDEKİ VE CİNSİYETTEKİ ÜSTÜN YETENEKLİ ÖĞRENCİLERİN FEN VE ÖĞRENME ORTAMINA KARŞI TUTUMLARININ İNCELENMESİ.

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Bu çalışmada farklı sınıf seviyelerindeki ve cinsiyetteki üstün yetenekli öğrencilerin fen ve öğrenme ortamına karşı tutumlarının incelenmesi amaçlanmıştır.

Öğrencilere iki farklı test uygulanmıştır. Bunlardan bir tanesi ‘ Fen Dersine Karşı Tutum Ölçeği’ (TOSRA), diğeri ise ‘Sınıf Ortamına Karşı Bireyselleştirilmiş

Tutum Ölçeği' (ICEQ) dir. Bu çalışma sekizinci sınıf, lise hazırlık sınıfı, dokuzuncu sınıf ve on birinci sınıflarda olan toplam 163 üstün yetenekli öğrenci ile yapılmıştır.

Elde edilen veriler, iki yönlü varyans (ANOVA) istatistiksel tekniği kullanılarak değerlendirilmiştir.

İstatistiksel sonuçlar doğrultusunda birinci olarak, sınıf seviyelerinin öğrencilerin fen derslerine karşı tutumları üzerinde anlamlı bir etkisi olduğu gözlemlenmiştir. Bu çalışmanın sonuçlarına göre sınıf seviyesi düştükçe fen derslerine karşı tutumları artmaktadır.

Sınıf ortamına karşı tutumlarında sınıf ve cinsiyete bağlı olarak anlamlı farklılıklara rastlanmıştır. Bu çalışmaya göre kız öğrenciler erkek öğrencilere göre daha fazla kişiselleşmiş, yüksek sınıftaki öğrenciler ise daha özgür ve farklılaştırılmış sınıf ortamı beklemektedir.

Anahtar kelimeler: Üstün yetenekli öğrenci, fen eğitimi, farklı yaş grubu çalışması, fen dersine karşı tutum, sınıf ortamına karşı tutum.

To my mother, father and elder sister…

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SYMBOLS

TOSRA:	Test of Science Related Attitudes
ICEQ:	Individualized Classroom Environment Questionnaire
ANOVA:	Analyses of Variance
BİLSEM:	Science and Art Centers
IQ:	Intelligence Quotient
WISCR:	Wechsler Intelligence Scale for Children-Revised
TEV:	Turkish Educational Foundation
SEM:	School-wide Enrichment Model (SEM)
VASS P20LB:	Views about Sciences Survey
DF:	Degree of Freedom
SS:	Sum of Squares
MS:	Mean Square

CHAPTER 1

INTRODUCTION

Gifted students have different learning characteristics than other students that need to be taken into consideration when planning instruction and curriculum (Davis & Rimm, 1998; Tomlinson, 1999). For example, they often have deeper and more expansive knowledge bases than that of their same-age peers. Intellectually, they are more inquisitive, often asking more questions than a teacher has time to address in the course of a school day. In addition, they frequently learn at a more rapid pace and are capable of absorbing greater amounts of information than their peers (Hébert & Neumeister, 2000).

The primary purpose of the present study is to investigate gender- and grade level-based differences in gifted/talented students' attitudes toward science and classroom environment.

Cross-age studies are useful for describing the understanding about a particular concept held by students across several grade levels. The research reported in this thesis comprised a cross-age inquiry of gifted learners' attitudes towards science. Learners were chosen from TEV İnanç Türkeş Private High School, a boarding school in Turkey that has only gifted students population

(Akarsu, 1992), purposefully from four academic levels; 8th grade-level (age range 13-15 years old), prep classes (age range 14-16 years old), 9th grade-level (age range 15-16 years old) and 11th grade-level (age range 16-18 years. old). The reason for the existence of group of students in different ages in the same class is that, some of the students started school in earlier ages or studied English preparatory class in Anatolian high school before they come to their new school that means they studied English preparatory class for two years. Every year, a week summer camp is held in order to meet 8th grade students who will attend the school next year.

1.1 Background information

The meaning of the cross-age study is that the studies where different age students are simultaneously sampled (Westbrook, Abraham & Williamson, 1994). Cross-age study provide an opportunity to observe the shifts in concept development that occur as student mature, increase in intellectual development, and experience additional coursework (Westbrook & Marek, 1991). A considerable amount of research in science education approached student concept research form a cross-age perspective (Trumber, 2001; Trowbridge & Mintzes, 1988; Wandersee, 1986; Arnaudin and Mintzes, 1985 ; Clough & Wood-Robinson, 1985; Kargbo, Hobbs, & Erickson, 1980).The results of all the studies indicated that although children's notions of scientific phenomena change over time, certain alternative conceptions persist from the preschool through college (Westbrook & Marek, 1991).

The students' understanding of the concept through a period of years could provide insight into role reasoning ability and instructional exposure play in the students development of scientific concept longitudinal and cross-age studies are used to trace knowledge and attitude trough a period of time. Both approaches have methodological difficulties. Longitudinal studies require repeated measures with possible resulting contamination of results. These studies are difficult to carry out due to loss of subjects over the long time intervals. Cross-age studies are subject to the error of comparing nonequivalent populations, but are more easily accomplished and have been used in previous studies of concept understanding (Westbrook & Marek, 1991; Novick & Nussbaum, 1981).

1.2 Problem

The main problem of this study is;

What are the differences among the gifted learners' attitudes toward science and classroom environment between four academic levels of eight , prep-class, ninth grade and eleventh grade students in TEV İnanç Türkeş High School, a boarding school for gifted students ?

1.3 Hypothesis

Both independent and dependent variables are existed. Independent variables are academic levels and gender; dependent variables are attitudes towards science and classroom environment.

<u>Null Hypothesis 1</u>

There is no mean difference among four academic levels on attitudes towards science questionnaire.

Ho1:$\mu 1=\mu 2=\mu 3= \mu 4$

1: grade level-8th, 2: prep class, 3: grade level-9th, 4: grade level-11th

<u>Null Hypothesis 2</u>

There is no mean difference among four academic levels on Social Implication of Science Attitude scale.

Ho2:$\mu 1=\mu 2=\mu 3= \mu 4$

1: grade level-8th, 2: prep class, 3: grade level-9th, 4: grade level-11th

<u>Null Hypothesis 3</u>

There is no mean difference among four academic levels on Normality of Scientist Attitude scale.

Ho3:$\mu 1=\mu 2=\mu 3= \mu 4$

1: grade level-8th, 2: prep class, 3: grade level-9th, 4: grade level-11th

<u>Null Hypothesis 4</u>

There is no mean difference among four academic levels on Career Interest in Science Attitude scale.

Ho4:$\mu 1=\mu 2=\mu 3= \mu 4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 5

There is no mean difference among four academic levels on Leisure Interest Attitude scale.

Ho5:$\mu1=\mu2=\mu3= \mu4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 6

There is no mean difference among four academic levels on Enjoyment of Science Lesson Attitude scale.

Ho6:$\mu1=\mu2=\mu3= \mu4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 7

There is no significant main effect of gender on the attitudes towards science scores.

Ho1: $\mu m = \mu f$

Null Hypothesis 8

There is no significant main effect of gender on Social Implication of Science scale.

Ho2: $\mu m = \mu f$

Null Hypothesis 9

There is no significant main effect of gender on Normality of Scientist Attitude scale.

Ho3: $\mu m = \mu f$

Null Hypothesis 10

There is no significant main effect of gender on Career Interest in Science Attitude scale

Ho4: $\mu m = \mu f$

Null Hypothesis 11

There is no significant main effect of gender on Leisure Interest in Science scale

Ho5: $\mu m = \mu f$

Null Hypothesis 12

There is no significant main effect of gender on Enjoyment of Science Lesson scale

Ho6: $\mu m = \mu f$

Null Hypothesis 13

There is no mean difference among four academic levels on attitudes towards classroom environment scores.

Ho7: $\mu 1 = \mu 2 = \mu 3 = \mu 4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 14

There is no mean difference among four academic levels on Personalization scale in classroom environment questionnaire.

Ho8: $\mu 1 = \mu 2 = \mu 3 = \mu 4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 15

There is no mean difference among four academic levels on Participation scale in classroom environment questionnaire.

Ho9:$\mu 1 = \mu 2 = \mu 3 = \mu 4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 16

There is no mean difference among four academic levels on Independence scale in classroom environment questionnaire.

Ho10:$\mu 1 = \mu 2 = \mu 3 = \mu 4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 17

There is no mean difference among four academic levels on Investigation scale in classroom environment questionnaire.

Ho11:$\mu 1 = \mu 2 = \mu 3 = \mu 4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 18

There is no mean difference among four academic levels on Differentiation scale in classroom environment questionnaire.

Ho12:$\mu 1 = \mu 2 = \mu 3 = \mu 4$

1: grade level-8^{th}, 2: prep class, 3: grade level-9^{th}, 4: grade level-11^{th}

Null Hypothesis 19

There is no significant main effect of gender on attitudes towards classroom environment scores.

Ho7: $\mu m = \mu f$

<u>Null Hypothesis 20</u>

There is no significant main effect of gender on Personalization scale in classroom environment questionnaire.

Ho8: $\mu m = \mu f$

<u>Null Hypothesis 21</u>

There is no significant main effect of gender on Participation scale in classroom environment questionnaire.

Ho9: $\mu m = \mu f$

<u>Null Hypothesis 22</u>

There is no significant main effect of gender on Independence scale in classroom environment questionnaire.

Ho10: $\mu m = \mu f$

<u>Null Hypothesis 23</u>

There is no significant main effect of gender on Investigation scale in classroom environment questionnaire.

Ho11: $\mu m = \mu f$

<u>Null Hypothesis 24</u>

There is no significant main effect of gender on Differentiation scale in classroom environment questionnaire.

Ho12: $\mu m = \mu f$

Null Hypothesis 25

There is no relationship between the attitudes towards classroom environment scores and science score.

Ho: $\rho=0$

Null Hypothesis 26

Ho1: There is no interaction effect of gender and grade level on students' attitudes toward science.

Null Hypothesis 27

Ho2: There is no interaction effect of gender and grade level on Social Implication of Science Attitude scale.

Null Hypothesis 28

Ho3: There is no interaction effect of gender and grade level on Normality of Scientist Attitude scale.

Null Hypothesis 29

Ho4: There is no interaction effect of gender and grade level on Career Interest in Science Attitude scale.

Null Hypothesis 30

Ho5: There is no interaction effect of gender and grade level on Leisure Interest Attitude scale.

Null Hypothesis 31

Ho6: There is no interaction effect of gender and grade level on Enjoyment of Science Lesson Attitude scale.

Null Hypothesis 32

Ho7: There is no interaction effect of gender and grade level on attitudes towards classroom environment.

Null Hypothesis 33

Ho8: There is no interaction effect of gender and grade level on Personalization scale in classroom environment questionnaire.

Null Hypothesis 34

Ho9: There is no interaction effect of gender and grade level on Participation scale in classroom environment questionnaire.

Null Hypothesis 35

Ho10: There is no significant main effect of gender on Investigation scale in classroom environment questionnaire.

Null Hypothesis 36

Ho8: There is no interaction effect of gender and grade level on Differentiation scale in classroom environment questionnaire.

1.4 Definition of Variables.

Students' attitudes towards science: This helps us to obtain information about the students' positive or negative responses to the learning activities that pertain to science as a school subject. It refers specially to whether the students like or dislike science as measured by the Test of Science Related

Attitude (TOSRA) questionnaire developed by Fraser (1978). Each item was scored by using a Likert-scale format.

Students' attitudes towards classroom environment: This helps us to obtain information about the students' judgment of the psychological or socio-psychological conditions of the classroom which were measured by using Individualized Classroom Environment Questionnaire (ICEQ) developed by Fraser and Fisher (1986). Each item was scored by using a Likert-scale format.

Cross-age study: Studies where different age students are simultaneously sampled.

Gifted Student: The student whose test results are in the 97th percentile or above on national norms on one of the education's assessment instruments for identifying gifted pupils, and who is entitled, by legislative mandate, to special education commensurate with his/her academic abilities and potentials (Kraver, 1987).

1.5 Significance of the Study

There will be some desirable practical effects resulted from this present study. It is hoped that the feedback from the study will generate a new perspective among Turkish science teacher especially gifted students' science teachers in developing a more effective teaching method and classroom environment. Some gifted students who studied sciences in secondary school decide for study more social subject like; management or economics in university that may cause decreasing number scientists whose study field is science in the future. This study gives opportunities to us understanding of the students' perspective on science. In addition, the results of the study, which include gifted female students' perceptions about science will also, provide valuable information for curriculum development.

Based on the Individual Classroom Environment Questionnaire result may inform science teachers on how to improve their classroom climate for gifted learners. From cross-age comparisons that provide to analysis the students' attitudes in science across the age levels, teachers can also have opportunity to understand gifted the students' perceptions about science classroom environment among four academic levels.

Eight grade students, prep class students, ninth grade students and eleventh grade students were chosen for this study. Either researcher or BİLSEM's (Science and Art Centers) teachers employed the questionnaires in second semester of 2003-2004 and summer camp in 2004 in TEV (Turkish Educational Foundation) İnanç Türkeş High School. This school, which is the only high school includes gifted and talented students, was selected according to the purposes.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 The Meaning of Gifted

From the literature, it is clear that all communities contain a proportion of approximately 2-3% gifted students (Marland, 1971). If these individuals cannot be correctly identified and educated accordingly, they may experience psychological problems and may even become dysfunctional within the community (Marland, 1971; Feldhussen, 1986).

First attempt of identifying gifted person have started with pioneering studies of Terman (1925) on intelligence measurement. As Cline (1999) stated, identification and meaning of gifted and talented is still unclear; whereas some have equated giftedness with a particular score on an intelligence test, others have conceptualized giftedness in global terms, in terms of development or behaviors, or in terms of potential future contributions.

Renzulli’s (1978) three-ring definition of gifted behaviors consists of an interaction among three basic clusters of human traits—above average ability, high levels of task commitment, and high levels of creativity. Renzulli believes that individuals capable of developing gifted behavior are those possessing or capable of developing this composite set of traits and applying them to any potentially valuable area of human performance. Renzulli (1999), as he reflected back on his past twenty-five years with gifted education, talked of many researchers and authors who had misinterpreted this definition and he attributed this misunderstanding to the difficulty of defining a complex concept such as giftedness. He never intend to imply that a gifted person needs to display all three characteristic to be identified as gifted person only needs to have potential to develop these traits to be considered gifted. Renzulli also recognized that his 'Three Ring Conception' may not be a complete definition of giftedness and he invited to add new dimensions to this concept.

Davidson (1986) used Renzulli and Reis' 'talent pool' philosophy by selecting a liberal quota of students that feel in the top 15 to 20 of the school and those students who scored in the 90th percentile or above on intelligence, achievement or creativity tests according to local norms. Davidson rationalized that a student with an IQ (Intelligent Quotient) of 110 may show greater giftedness in the sense of originality and thought-provoking ideas than a tested of 140.

Besides Renzulli (1978 and 1999), other researcher such as Torrance (1965) included creativity as either a component of giftedness or as a kind of giftedness and talent to be identified. Fleith, Renzulli and Westberg (2002) also searched the effects of creativity training programs on 82 gifted learners. Significant differences have been found between the experimental and control groups.

Recent works define giftedness as having multiple qualities and dispute the use of an IQ score as an inadequate measure of giftedness. Motivation, high self-concept, and creativity were found to be key qualities in many of these broadened conceptions of giftedness (Siegler & Kotovsky, 1986). Giftedness and high IQ are synonymous continues to exist despite more current research supporting multiple components of intelligence (Gardner, 1993; Sternberg & Davidson, 1986).

Gardner's (1993) theory of multiple intelligence suggests a new way of thinking about intelligence and counters the idea that human problem solving is driven by a single intelligence that is general in nature. Instead of one-dimensional theory of intelligence, Gardner (1993) proposed seven different domains of intelligence, each operating more or less independently and autonomously of each other. Intelligence is dynamic, not static, construct; it can be developed and nurtured (Prescott, 2001). The seven intelligences are linguistic, musical, logical-mathematical, spatial, bodily kinesthetic, intrapersonal, and interpersonal. An eighth intelligence, the naturalist, was added later (Gardner, 2000). More recently spiritual/existential intelligence is being offered as the ninth intelligence identified (Williams, 2000; Roper & Davis, 2000).

Feldhussen (1986) has described giftedness as a complex of intelligence, aptitudes, talents, expertise, motivation and creativity that lead an individual to productive performance in intellectual, scientific, leadership, creative, artistic, dramatic, musical, mechanical and physical areas.

A basic problem in the effort to find talent is that all too often; talent is manifested differently in childhood and adulthood. Among adults, talent is expressed in an extraordinary quality of task performance and/or in making significant breakthroughs in those talent areas (Gardner, 1993). More often, children may show a potential to reach such extraordinary performance. This potential may be expressed in signs of talent and interest. For instance, some children want to know how machines work, ranging from toy cars to computers, so they ask questions incessantly and conduct their own explorations by taking these machines apart. Others exhibit a great sense for rhythm and an excellent psychomotor coordination, which may be expressed in playing a musical instrument or in dancing. All of these signs of talent and interest may be necessary but not sufficient conditions for accomplished performance. The actualization of potential depends on recognizing signs of potential among individuals and nurturing them (Zorman, 1997).

Clark (1997) offered a multi-dimensional screening process to identify those children most likely to gifted, thus narrowing down the candidates to a manageable pool for individual testing. She also offered other assessment procedures for those areas of giftedness such as leadership and visual and performing arts that are not readily identified thorough traditional testing methods. This identification procedure of Clark's would be useful where a more liberal conception of giftedness was being accepted. Clark's multidimensional screening process consisted of the following seven screening approaches;

- Nominating forms from teachers, principal, counselor, psychologists, and others.

- Teacher reports of student functioning including intellectual, physical, social, and emotional functioning: learning style and motivation.
- Family history and student background including students' medical records, educational and occupational background of parents, etc.
- Peer identification.
- Student inventory of values, interests, and attitudes toward school, and out-of-school activities.
- Student work and achievements.
- Multidimensional screen tests including group achievement and group intelligence tests.

Davis and Rimm (1998) also mentioned that parents and peers can contribute significantly to identification procedures of gifted children but there are some dangers with relying on these means exclusively. Some parents either overestimate or underestimate their child's abilities and children tend to nominate their friends. Both methods of identification can be successful if done with these precautions in mind.

Gallagher and Gallagher (1994) pointed out that teacher identification of gifted children has been the most common means of identification for years but this type of identification limits the definition of gifted children to those who do well in school.

2.2 Education of Gifted Students

Gifted education is a subset of special education. Educators and researchers have emphasized the importance of a qualitatively differentiated curriculum for high-ability students (Davis & Rimm, 1998; VanTassel-Baska, 1994). Gifted students need to be educated through different programs and with different strategies to make their own psychological development healthier and to use their own potential for the benefit of the society in which they live (Feldhussen, 1986; Freeman, 1999; Renzulli, 1998).

VanTassel-Baska (1994) lists the following key points as understandings, which emanate from appreciating the nature of gifted children:

- Gifted students have learning needs that require a special education program.
- Most gifted learners will not develop their potential commensurate with their capacity without careful nurturance.
- General education program does not respond adequately to such specialized needs.
- Change in school is slow and reactive in nature, and innovative efforts are frequently diffused.

Researchers have found that gifted students are more motivated than the other students (Mosse, 2003, Stake & Mares, 2001; Winebrenner, 2000; Gottfried & Gottfried, 1996; Vallerand, Gagné, Senecal, & Pelletier, 1994). In order to sustain this intrinsic motivation, however, gifted students must find the curriculum intellectually challenging (Gottfried & Gottfried, 1996; Porath, 1996). In order to sustain gifted students' intrinsic motivation in a regular classroom, the instructional strategies must be varied to provide them challenges that will meet their higher levels of knowledge and skill (Hebert & Neumeister, 2000). There are some important instructional strategies developed by researchers for gifted and talented students. One of them is called differentiated learning model.

Differentiating educational experiences in mixed-ability classrooms allow the varied needs of high-ability students to be met (Hebert & Neumeister, 2000). According to Renzulli (1988) differentiated curricula involve attending to the characteristics of high-ability students. Learning experiences in the classroom should reinforce these characteristics and develop them to higher levels. In a differentiated classroom, teachers may use a variety of strategies to meet these goals, including adopting one or more curricular elements, such as content, process, and product, in response to student readiness, interest, and learning profile (Tomlinson, 1999).

School-wide Enrichment Model (SEM) (Renzulli & Reis, 1994) another type of learning model allowed to students to move in and out of special programs depending on their needs and interests. This model required a talent pool of one-quarter of the student population and students were allowed to pursue in-depth research on a topic until their was satisfied. Then they move out of the program until another topic interested them at which time they moved back again. SEM if properly implemented would provide modifications to all three curricular elements: content, process, and product. This model was design to include a larger population of capable learners than what is typical for most programs for gifted. Renzulli (1998) interpreted this model to be one that will help develop the gifts and talents in all students.

Operating with the use of a strength assessment guide called the 'Total Talent Portfolio' the SEM focuses on student interests and learning-style preferences as well as on strengths in academic subjects (Renzulli, 1998). Renzulli and Reis (1994) describe the SEM to include five service delivery components and they are: Assessment of student strengths, modification of regular curriculum, general exploratory activities, group training activities finally individual and small group investigations. The success of SEM relies on thorough examination of the students' achievement levels, interests and ways present interest can be enhance or new ones triggered, and on preferred learning styles that will improve the motivation of these students. Schools are places for developing the broadest and richest experiences imaginable for young people. The atmosphere is favorable for a broader application of the strategies and techniques that originated in special programs, and they can serve as a basis for making all schools into laboratories for talent development (Renzulli, 1998).

Another model is Curriculum Compacting, even though it is one of the components of the SEM described before has appeared as a separate modification and/or differentiated instruction technique in much of the literature on curricular changes for gifted students (Gallagher & Gallagher, 1994). Curriculum compacting is a flexible, research-supported instructional technique for modifying the regular curriculum to meet the needs of high ability students. This technique is a form of content acceleration that enables high-ability students to skip work they already know and substitute more challenging content. The goals of compacting are to streamline work that may be mastered at a pace commensurate with the student's ability, create a challenging learning environment, guarantee proficiency in basic curriculum, and buy time for enrichment and acceleration (Reis & Purcell, 1993).

The Integrated Thematic Units is another way to differentiate curriculum for gifted students and for all students. Proper implementation of this curricular modification alters what all children learn (content), how they learn it (process), and how they demonstrate what have learned (product). An overarching theme is chosen as the focus for the year, semester, grading period, etc. and specific unit are selected around this theme, as well as students' interest and local opportunity for meaningful field trips, speakers and other enrichment activities. This unit may cross over into any discipline and basic skills are taught as a part of larger project goals. For example, students may work on punctuation and spelling while editing their own books. As a result repetition of basic skills is eliminated and this is particularly useful for gifted students since they are able to learn material at a faster pace (Tucker, Hafenstein, Jones, Bernick, & Haines, 1997).

Coleman (1999) mentioned that cooperative learning is another method of groping students to help provide differentiated instruction in the regular classroom. Students have opportunity to offer their strengths and expertise to groups to help accomplish group goals.

Over-reliance on textbooks is a problem that is magnified in the context of educating the gifted because gifted children become bored more quickly by the mundane presentations found in many science texts. Gifted children need challenge, the time to reflect on their experiences and their thoughts, and, most of all, the time to explore a subject to a depth that meets their own personal needs. In many ways, gifted and talented students are not significantly different from other children. However, students who are gifted cognitively and academically are usually quick to understand abstract concept and are able to organize them into complex, effective schemes. Many times, they use unusual ways of solving problems which means the teacher facilitator can expect the unexpected and should be ready to deal with it (Keble & Howard, 1996).

Winebrenner (2000) also described that gifted students learn new material faster than their same age-level peers and they tend to remember what they learn making spiral curriculums and reviewing mastered concepts and skill painful. In addition, gifted students perceive ideas and concepts at more abstract and complex levels than do their peers. Since they have many mastered grade-level work gifted students should be given more advanced and complex work and this work may even encompass their own passionate interest.

There is not one generally accepted program design that is the best for gifted students and ultimate goal should be to challenge all students in the curriculum they encounter (Mosse, 2003). Winebrenner (2000) said this is not easy task and actualizing one's learning potential can only be done when teachers know how to challenge all students. For gifted it means they should not be given high grades for work that often takes little or no effort.

2.3 Science Education of Gifted Students

Story and Brown (1979) noted that the development of positive attitudes towards science was one of the major goals of science education. Ayers and Price

(1975) also reported the necessity for students to develop positive attitudes towards the study of science at an early age.

Some science educators have focused on the needs of high-ability boys and girls because these students have the most potential to achieve in science. Interestingly, the same pedagogic themes espoused for general students are considered important for gifted students (VanTassel-Baska 1994; Harwood & McMahon, 1997).

Keller (1980) remarked that the identification of youngsters for science-gifted programs throughout the country has been an important issue. Activity-based exploratory science education offers unique opportunities for gifted students. This type of science learning has cognitive, mastery, and social aspects, and encompasses a range of learning situations that motivate students in many ways (Martinez & Haertel, 1991). Properly taught, science is fun and exactly the sort of academic exercise that encourages gifted students to learn more. In addition to science content, science instruction provides ways to introduce critical thinking skills and can be the vehicle for the integration of the physical and biological sciences with mathematics, social science, and reading through real life problems (Romance & Vitale, 1992).

Stake and Mares (2001) evaluated the impact of two science enrichment programs on the science attitudes of 330 gifted high school students who had attended this full-time summer program over a 4-week period. Significant differences were found the effects of science enrichment programs for gifted high school students between the experimental and control group ($p<0.01$).

Öğretme (2001) aimed to delineate the effect of differentiated 9th grade physics instruction on gifted learners in terms of attitude and achievement. The 11-week physics instruction was differentiated in one or more of the three components (content, process, and products) on the basis of students' readiness and/or learning styles. 28 ninth grade gifted students formed the sample. Attitude toward physics/science was probed by Views About Sciences Survey (VASS P20LB) as a pre-test. Appropriate teaching/learning environments and experiences were tailored to respond to the educational needs of all learners. At the end of the treatment, to probe the change in attitude VASS P20LB as a posttest, and to collect students' evaluation about the period, Sethian Questionnaire was administered. Statistical tests and qualitative analysis showed that differentiated instruction had a positive effect on learner's views about science/physics. The mean of the physics grades was significantly higher, and the standard deviation of the physics grades was significantly lower compared to those of mathematics grades in the previous year and in the same term, and to those of science grades in the previous year. Öğretme (2001) has found that differentiated instruction changed the view/attitude toward science/physics, and achievement level of the sample set positively.

2.4 Teachers of Gifted Students

Limited backgrounds in science, a lack of confidence in its teaching, and a reliance on textbooks all combine to lower the quality of instruction. There are a few teachers and few gifted specialists with strong science backgrounds. That was found lack of confidence pronounced among teachers of gifted, who face probing questions from highly able students. Even teachers with strong than average backgrounds in science find teaching science to gifted students a challenge and, given a choice, may avoid it or rely heavily on textbooks (Keble & Howard, 1996).

Experts agreed that the role of a teacher of gifted children differs from more traditional teacher. It is the responsibility of regular classroom teachers to find out what their gifted students already know, give them credit for it, and provide them alternative activities. Experts also agreed that it is the responsibility of teachers to develop learning experiences around student interests and needs; and the ability to be flexible in making adaptation to the curriculum was seen as a necessary characteristic for teachers of gifted. Teachers need to be supportive and accepting, teach independent or self-directed skills and allow students to choose products and outcome criteria (Tomlinson, 2001; Clark, 1997).

Feldhussen (1997) listed desirable characteristics of teachers of the gifted that included the following: Teacher is highly intelligent, has cultural and intellectual interests, strives for excellence and high achievement. Teachers is enthusiastic about talent, has a broad general knowledge, is self-confident, can see things from the students' points of view, is well organized, is imaginative, innovative and experimental, aligns more closely with students than a formal teacher, can create a democratic environment, guides rather than coerces, seeks new solutions through continued learning and can muster support for gifted program. An individual possessing these characteristics would be an ideal classroom teacher of gifted students since he/she would be more likely to assume a role most conductive to the needs of these children.

However, Freeman (1990) mentioned that it is not essential that teachers should be extremely knowledgeable themselves in order to help their outstanding pupils, but they must be intellectually curious and keen. They can then act as guides, directing their student's search for information, and maybe even learning with the pupil.

2.5 Gender differences

When teachers avoid science during the elementary years, they steer capable students away from careers in science. This is a particular concern in the case of female students, who may have feelings of gender inequity reinforced. There are clear indications that gifted young women tend to turn towards science and mathematics when they have a model with whom to identify at early age (Piirto, 1991).

Despite documentation that gender differences exist in attitudes toward science, the process of how these attitudes affect science outcomes is unclear (Weinburgh, 1995; Simpson & Oliver, 1990; Wilson, 1983; Fraser, 1980). Further, the research demonstrates that as girls grow older, they are less interested in science than are boys (Weinburgh, 1995; Catsambis, 1995; Simpson & Oliver, 1990; Shymansky & Kyle 1988)

Swiatek and Lupkowski-Shoplik (2000) found attitude differences in gifted elementary school students, with boys favoring science and technology and girls favoring English, writing, foreign language, and reading. In addition, this study suggested that negative attitudes increase with age from third through sixth grade.

Siegle and Reis (1994) found that adolescent female gifted students indicated they had higher ability than males in language arts only, while male gifted students indicated they had higher ability than females in mathematics, science, and social studies. Fennema, Peterson, Carpenter, and Lubinski (1990) found that teachers' behavior is one of the reasons of gender differences. Some evidence exists that the amount of teacher attention given to girls is lowest in science classes (Handley & Morse, 1984; Jones & Wheatley, 1990). The climates of elementary, middle, and high school, as well as college, may be another responsible for changes in the attitudes of girls and women relative to achievement in math and science. Research has indicated that boys actively participate in school more and receive more attention from teachers (Jones, 1989).

2.6 Gifted Education in Turkey

Although the track of providing different education for gifted bright students in history of Turkey can be back to dates between 15th and 18th centuries as ENDERUN Palace School of Ottoman Empire, significant efforts only appeared in the 1990s in Turkish Republic (Akarsu, 1991).

Turkey began studies of gifted education relatively recently. In 1960, Ergenekon Primary School was founded to educate the students who have more IQ of 125, however after they graduated from primary school, the students could not continue, then they were transferred Maarif College (Davaslıgil, 2000).

Sezai Türkeş, one of the prominent industrial leaders in the country, decided to found a school for the highly gifted and impoverished children in 1990. He founded the İNANÇ Foundation bearing his late wife's name and endowed it with his shares of the holding company. İnanç High School was found by İnanç Foundation of STFA in 1993, on August 1, 2001, the İnanç Foundation was taken over by Turkish Education Foundation (TEV).

The İnanç School curriculum consists of one year of intensive English preparation, called Prep and three years of high school (Grades 10-12). The academic program is bilingual and bicultural, with Turkish, fine arts, physical education, religion and social studies taught in Turkish. The natural and physical sciences, mathematics, and computer studies are taught in English, while the second foreign language (German) is taught in that language. The curriculum is based on that required by the Turkish Ministry of National Education. A different curriculum for gifted/talented students was suggested to Turkish Ministry of National Education, but that was not accepted (Akarsu, 2001).

The students come from low social economic level and they have full scholarship. Students live in houses of 36 with their house parents. The headmaster and almost half of the teachers are non-Turkish educators who add an international flavor to the learning environment. Teachers receive occasional in-service training in gifted education; each year, some are sent abroad to participate in conferences and seminars. Especially in the initial years, the school had very close relations with the World Council for the Gifted and Talented (WCGT) and with the European Council of High Ability (ECHA) (Akarsu, 2001).

In 1991-1992 Yeni Ufuklar College, a private school, was founded in Istanbul to educate gifted and talented students, but Ministry of National Education didn't give a special statue to this school.

Some of the businessman, scientist and educators found the 'Turkish Gifted Children Educational Foundation' in 1993 in Istanbul.

By the 1980's new starts had been made and some projects have been developed. These projects helped develop talent centers called BILSEM (Science and Art Centers). By 1993, Science Art Centers had been established in five cities. Now, there are many Science and Art Centers in Turkey under the control of The National Ministry of Education. Teachers would like academic support from teacher educators about subject areas which they are not familiar with through in-service courses. Such courses need to include laboratory approaches and increased laboratory skills, guidance and research, and ways of planning and conducting research projects. The last item is important as the lack of implementation of research projects is a widespread problem among Turkish teachers (Akarsu, 2001).

2.7 Students' Attitudes toward Science

In general, the 'Attitude toward Science' is a way feeling about science. A large number of studies on students' attitudes toward science have been documented in the literature (Zacharia & Barton, 2004; Pell & Jarvis, 2003; Morrell & Lederman, 1998; Freedman, 1997; Weinburg, 1995; Steinkamp & Maher, 1983; Haladyna & Shaughnessy, 1982).

While science educators believe that attitudes toward science play a significant role in students' learning process, the results, particularly of studies investigating the impact of this affective domain toward either students' achievement or their interest in science, have been inconclusive (Greenfield, 1996). 1985). Zacharia and Barton (2004) also developed a detailed argument for why science needs to be more clearly defined in attitude instruments.

Koballa (1988) suggested that attitudes can be changed, but such occurrences are not random: something must happen to cause the change; students are not liking or disliking science in school: they learn to like it or dislike it.

Haladyna and Shaughnessy (1982) mentioned that students' attitudes toward science are determined by three independent constructs: teacher, student, and learning environment. Parental involvement was also found to play a very important role in the development of science attitudes of students (George & Kaplan, 1998).

George (2000) found in his study that the results showed that students' attitudes toward science generally decline over the middle and high school years. Science self-concept has been found to be the strongest predictor of attitudes toward science. Teacher encouragement of science and peer attitudes are also significant predictors of students' attitudes. The effect of the parent variable was found to be quite small and statistically no significant, with the exception of the seventh grade. Boys were found to have higher initial status on attitudes toward science and their attitudes dropped faster than girls. In addition, it has been found that students in metropolitan and rural schools have less positive attitudes toward science in the seventh grade compared to students in suburban schools. Latent variable growth modeling allows one to examine change in attitudes and also examine the effects of time-varying and time-invariant predictors.

2.8 Classroom Environment

Reis and Renzulli (2004) suggest that gifted and talented students are a very diverse group of individuals who have ability, in one or more domains, that is sufficiently advanced and requires changes in the school environment, such as; the instructional curriculum and teacher behaviors.

In science educational research, the classroom environment has been described in several ways, namely: the learning environment, the psychosocial environment or the classroom climate. These terms are similar each other. The classroom environment is defined as the interactive combination of teacher behaviors, curriculum expectations, and students' interactions that develop in the classroom setting (Myers & Fouts, 1992). It has been found that in addition to influencing students' achievement, the structure of the classroom may have an impact on students' attitudes and pursuit of science (Fraser, 1998; Fraser & Fisher, 1982).

To date, several questionnaires have been developed to measure both students' and teachers' perceptions of the classroom environment. The established instruments, which have been devised to measure classroom learning environment, include the Learning Environment Inventory (LEI), the Classroom Environment Scale (CES), the Individualized Classroom Environment Questionnaire (ICEQ), My Class Inventory (MCI), The College and University Classroom Environment

Inventory (CUCEI), Questionnaire on Teacher Interaction (QTI), and the Science Laboratory Environment Inventory (SLEI). With the development of various classroom environment questionnaires, researcher could study student perspective on the psychological nature of the classroom (Chaerul, 2002).

Research on classroom environment provides much consistent evidence indicating that there is a correlation between the classroom climate and students outcomes, even when students' characteristic such as pre-test performance and IQ are controlled (Fraser & Fisher, 1982).

CHAPTER 3

METHOD

In the previous chapter; problems, hypotheses of the study were presented, related literature was reviewed accordingly and the essence of the study was justified. In this chapter, population and sampling, development of measuring tools, procedure, and methods used to analyze data and assumptions and limitations will be explained.

3.1 Sample

Sample of the study consists of English preparatory class students, ninth grade students and eleventh grade students in TEV İnanç Türkeş High School and also the eighth grade students who will be students for next year selected by BİLSEM's specialists in the summer camp. The sample nearly consists of 30 % female and the age range of the sample is from about 13 to 18 years old.

TEV İnanç Türkeş High School is a boarding school for gifted students who come from academically disadvantaged families. The school was founded by İnanç Foundation of STFA in 1993, on August 1, 2001, the İnanç Foundation was taken over by Turkish Education Foundation (TEV). Today, the TEV foundation is responsible for financing the school.

The researcher selected this school for mainly two reasons. Firstly, TEV İnanç Türkeş High School is the only school in Turkey that has a gifted student population. The students are selected to this school in cooperation with the Ministry of Education, the most of the primary school teachers in the country are asked to nominate students. About eight thousand are invited to take the screening test proctored in provinces near their hometowns. The top scoring 300 candidates were individually given Wechsler Intelligence Scale for Children-Revised (WISC-R) by a trained psychologist. This is an intelligence test that can be administered only by a licensed psychologist or tester. The scores may be interpreted in several different ways by specialists and non specialists alike who understand the significance of the numbers. A WISC score is derived from the scaled combination of two sets of subtests, Verbal and Performance.

Finally, at a one-week summer camp, the list of accepted students is finalized to become Inanç students.

Secondly, the researcher has been working as a science/physics teacher at this school.

Table 1 presents distribution of the sample based on grade level and gender. 9^{th} grade and 11^{th} grade students attended one year of English preparatory class when they first came to the school. All 11^{th} grade students are science class students; the other students have not chosen their study field, when the survey was done.

Table 1 *Distribution of the sample based on grade level and gender.*

	8th Grade Level	Prep. Class	9th Grade Level	11th Grade Level	Total
Female	19	15	11	4	49
Male	53	18	19	24	114
Total	72	33	30	28	163

3.2 Variables

In this study, there are independent variables and dependent variables. Here dependent variables are attitudes towards science and classroom environments; the independent variables are gender and grade level.

3.3 Instruments

Two questionnaires, the Test of Science Related Attitudes (TOSRA) and the Individualized Classroom Environment Questionnaire (ICEQ), were used as survey tools in this study. The first instrument, which was initially developed by Fraser (1978), was applied to measure students' attitudes towards science. The second questionnaire, which was developed by Fraser and Fisher (1983), was administered to investigate the classroom climate.

3.3.1 Test of Science Related Attitudes (TOSRA)

The Test of Science Related Attitudes (TOSRA) questionnaire is design to measure science-related attitudes of students in middle and high schools. The final version of TOSRA contained 70 items which were arranged into seven subscales namely: social implication of science, normality of scientists, attitudes toward inquiry, adaptation of scientific attitudes, enjoyment of science lessons, leisure interest in science, and career interest in science. The final version of the TOSRA has subscale reliabilities ranging from 0.67 to 0.93 (mean 0.80) and reliability of the instrument is 0.78 (Fraser, 1978).

The TOSRA is a multidimensional instrument with strong theoretical foundation (Smist & Owen, 1994). In addition, Schibeci et al. (1982) compared this test with a semantic differential instrument and concluded that the TOSRA was more effective in measuring specific attitudes than open-ended questions. The instrument was firstly validated in Australia and involved 1337 students' grades 7-10 from 11 different schools in 1977. Since that time, cross-validation data from new samples of secondary science classes in Australia and the United States have become available. For instance, Khalili (1987) investigated the TOSRA for cross-cultural validation in USA obtaining reliabilities of 0.69 to 0.93 with median of 0.87.

Intercorrelations among TOSRA's scales were calculated as indices as discriminant validity. These intercorrelations were generally fairly low, ranging from 0.10 to 0.59 with a mean of 0.33 In addition test re-test reliability coefficients on the seven scales range from 0.69 to 0.84. Using the Cronbach reliability alpha coefficient, the internal consistency of the scales was tested with data for grades 7-10. Alphas on the seven scale ranged from 0.66-0.93 (Fraser, 1981).

TOSRA is organized into seven scales in which each scale has ten statements. Students are asked to indicate whether they strongly agree (SA), agree (A), undecided or neutral (N), disagree (DA), or strongly disagree (SD) with each statement. For the purpose of the study, the researcher selected five out the seven subcategories as being the most related to the topic of this study. The selected scales are social implication of science, normality of scientist, enjoyment of science lessons, leisure interest in science, and career interest in science. Chaerul (2002) design a short version of the TOSRA, applied the questionnaire in Senior high school students; five items from each scale were dropped. Squared Multiple Correlation and Alpha If Item Deleted were considered as a means to select five designated items. Alphas on the five scales ranged from 0.79-0.84. Five out of seven, scales social implication of science, normality of scientists, enjoyment of science lessons, leisure interest in science, and career interest in science, this short form of TOSRA were used in this research.

The items are arranged into five blocks of five statements In addition, this research also five statements from each scale instead of ten as appeared in the original version. This questionnaire was translated into Turkish by researcher and checked by foreign language specialists and professors from METU and Bosporus University. Table 2 shows description of scales in the Test of Science Related Attitudes (TOSRA).

Table 2 *Description of Scales in the Test of Science Related Attitudes (TOSRA)*

Scale Name	Description of scale	Associated items
Career Interest in Science	Students' future interest in science	1, 2, 3, 4, 5
Leisure Interest in Science	Students' desire to participate in out-of-school science-related activities.	6, 7, 8, 9, 10
Social Implication of Science	Students' attitude regarding the positive and negative effects of science society	11, 12, 13, 14, 15
Enjoyment of Science Lesson	Students' level of enjoyment of classroom science lessons	16, 17, 18, 19, 20
Normality of Scientist	Students' belief about scientist lifestyles	21, 22, 23, 24, 25

3.3.2 Individualized Classroom Environment Questionnaire (ICEQ)

Individualized Classroom Environment Questionnaire (ICEQ) intend to measure students' perceptions of the secondary school classroom environment with variables that distinguish individualized classrooms with open or inquiry-based approaches from conventional classrooms (Fraser & Fisher, 1986). This instrument has been useful in a number of studies of psychological environments within science classrooms (Fraser & Fisher, 1982; 1983; 1986).

The ICEQ exists in four forms are designed to assess student perception of the actual environment, students perceptions of the preferred environment, teacher perceptions of the preferred environment, and teacher perceptions of the actual classroom environment (Fraser & Fisher, 1983). Since focus of this study was gifted students perception of the learning environment, only student version of the preferred form of the ICEQ was used.

The research version of the ICEQ consists of 50 items. The items are segregated into five scale dimensions and each scale contains 10 items. The scale dimensions are Personalization, Participation, Independence, Investigation, and Differentiation. Fraser and Fisher (1986) developed a shortened version of the ICEQ to encourage practitioners to use the instrument to evaluate their own classroom environments. The shortened version facilitates easier scoring and can be administered to small samples. The items are arranged into five blocks of five statements. Each item was scores on a five-point scale using a Likert-scale format with responses ranging from agree (SA), agree (A), undecided or neutral (N), disagree (DA), or strongly disagree (SD).

The shortened version of the ICEQ was validated using a sample of 116 students in the eight and ninth grades and their teachers in 33 different school in Tasmania, Australia (Fraser & Fisher, 1986). Based on their study, the alpha reliability ranged from 0.63 to 0.85 with a mean of 0.75 in measuring the internal consistency of the items. Concurrent validity – a measure to assess the correlation of the shortened version to the long version – ranged from 0.84 to 0.97 with a mean of 0.92. This evidence indicates that the dimensions assessed by the long version were strongly associated with the dimension measured by the shortened version.

Table 3 shows description of scales in the Individualized Classroom Environment Questionnaire (ICEQ).

Table 3 *Description of Scales in the Individualized Classroom Environment Questionnaire (ICEQ)*

Scale Name	Description of scale	Associated items
Personalization	Opportunities are provided for individual students to interact with the teacher	1, 6, 11, 16, 21
Participation	Students are encourage to participate	2, 7, 12, 17, 22
Independence	Students are allowed to make decisions.	3, 8, 13, 18, 23
Investigation	Students are encourage to make investigation	4, 9, 14, 19, 24
Differentiation	There is emphasis on the selective treatment of students on basis of ability, learning style, interests and rate of working.	5, 10, 15, 20, 25

This questionnaire was translated into Turkish by researcher and checked by foreign language specialists and professors from the METU and Bosporus University.

3.3.3 Reliability and Validity of the Instruments

Cronbach Alpha internal consistency coefficient for the five sub-dimensions of TOSRA calculated in the current study are between 0.72 and 0.84, each alpha value of this study given result section. When we compared the reliability coefficient of the study with the previous study, the dimensions were very similar. To provide construct validity, factor analysis was conducted to check the whether the five scale of TOSRA. . The scree plot and the number of eigen values greater than one were used to determine the number of factors underlying item responses. After all factors were extracted, six factors remained, according to rotated matrix, except 12 and 13 items under Social Implication of Science , rest of the items in each scale were fit into their components.

Cronbach Alpha internal consistency coefficient for the five sub-dimensions of ICEQ calculated in the current study is between 0.74 and 0.84, each alpha value of this study given result section. When we compared the reliability coefficient of the study with the previous study, the dimensions were very similar. The scree plot and the number of eigen values greater than one were used to determine the number of factors underlying item responses. However, not only five distinctive dimensions among the 25 items were not found; one more dimensions were also found as a sixth factor under personalization scale(Item number 8 and 18). Majority of the items in ach scale were fit into their component.

3.4 Procedure

Design that used in this study is a causal comparative because academic levels' of the students are pre-existed. As seen in hypotheses, gender differences, which also pre-existed characteristics of the population, are important for this research. The study started with detailed review of the literature. After determining the key words lists, which are mentioned at the end of the part, Educational Research Information Center (ERIC), EBSCOhost, ProQuest Digital Dissertation (UMI), Internet were researched systematically. Useful articles of the journals were obtained from library of METU, Bilkent University, Gazi University, Bosporus University and TUBİTAK Ulakbim. MS and PhD theses made in Turkey and other countries searched. Hacettepe Eğitim Dergisi and Eğitim ve Bilim were investigated.

The questionnaires were applied in the June of the 2004 by researcher, BILSEM's specialists and instructors. One class hour is given to students to complete both questionnaires. Necessary information and explanations was given by researcher to all specialists.

To control the threats to internal validity is necessary. The same questionnaires was applied to all students, morality was considered, not all of but some of the subject was taken up. These are age, gender and attitude.

3.5 Analysis of the data

Description of the data collection procedure was given in procedure part. Data were collected by researcher by using Excel and SPSS. Statistical analyses was done by using SPSS. The data obtained from the study was analyzed in terms of descriptive statistics and inferential statistics. There were missing data, for this problem, using average score of the whole sampling instead of missing data was followed.

3.5.1 Descriptive statistics

The mean for finding the average, median for point below and above 50% of the score were presented.

3.5.2 Inferential statistics

In order to test hypotheses, statistical method called a two-Analyses of Variance (ANOVA) was applied to examine the main effect of gender and grade level on both students' attitudes toward science and classroom environment. Using the ANOVA, students' mean score resulted from TOSRA were compared based on their gender and grade level differences. The interactions effect of gender and grade level was examined to analyze the magnitude of interdependency level of the two variables in contributing to the attitudes differences. In addition, the main effects of each gender and grade level were also investigated. Using the same method and the procedure, the results of the ICEQ questionnaire were also analyzed to examine gender and grade level differences on students' perceptions towards classroom climate.

CHAPTER 4

RESULTS

The first section of this chapter presents the analysis of students' attitudes toward science, measured by the Test of Science Related Attitudes (TOSRA) questionnaire. The classroom environments, which were measured by the Individualized Classroom Environment Questionnaire, are presented in the next section.

In the first section, using a statistical method called Two-Way Analysis of Variance (ANOVA), main effects of both gender and grade level as well as interaction effect of the two variables on the students' attitudes towards science are explained. Both the overall and each scale result of the TOSRA questionnaire are presented.

Using the same statistical method, the classroom environment results are provided in the second section of this chapter. Using ANOVA method, main effects of gender and grade level as well as interaction effect of the two variables on the students' attitudes towards classroom environment are explained.

4.1 Students' Attitudes towards Science

Using a Two-Way ANOVA technique, the Test of Science Related Attitudes (TOSRA) questionnaire results were carefully analyzed, In fact, the main effects of both gender and grade level, as well as the interaction effect of those two variables were examined. Having been analyzed statistically, the result of the overall TOSRA questionnaire are presented in the Table 4, Table 5 and Table 6. Alpha value of this test was found 0.86.

Table 4 *Total Scores of Overall TOSRA Questions based on Gender and Grade level*

Source	8^{th} Grade Level		Prep. Class		9^{th} Grade Level		11^{th} Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	97.67	9.31	97.50	8.64	87.11	10.67	87.75	9.83
Female	97.11	9.72	86.60	11.48	88.10	14.50	92.50	9.68
Total	97.51	9.36	93.61	10.92	87.46	11.91	88.43	9.78

Table 5 *ANOVA Results for Overall TOSRA Questionnaire.*

Source	DF	SS	MS	F	Sig.
Gender	1	101.676	101.676	1.000	0.773
Grade	3	4.866	1.622	9.269	.000
Gender*Grade	3	750.167	250.056	2.458	0.065
Error	144	14647.64	101.72		

Table 6 shows Tukey multiple comparison test results for overall TOSRA questionnaire in order to compare grade levels each other, there is a significant mean differences between the 8^{th} grade students' score and both 9^{th} and 11^{th} grade students' score. Table 4 illustrates that 8^{th} grade students score are higher than both 9^{th} and 11^{th} students' score (<0.001).

Table 6 *Tukey Multiple Comparisons Test Results for Overall TOSRA Questions*

Grade Levels	Sig.
8^{th} Grade / Prep. Class	>0.05
8^{th} Grade / 9^{th} Grade	<0.001
8^{th} Grade/ 11^{th} Grade	<0.001
Prep. Class / 9^{th} Grade	>0.05
Prep. Class / 11^{th} Grade	>0.05
9^{th} Grade / 11^{th} Grade	>0.05

Since the applied TOSRA questionnaire comprises 5 dimension: Social Implication of Science, Normality of Scientist, Enjoyment of Science Lessons, Leisure Interest in Science, and Career Interest in Science, it is critical to closer look in examining which dimension may differ significantly based on the students' gender and grade level differences. The remaining paragraphs describe these differences in more detail. Table 7 shows mean results for Social Implication of Science Attitude scale; Table 8 shows ANOVA results for Social Implication of Science scale.

This scale intend to measure students' attitudes regarding the positive and negative effects of science and society.

Table 7 *Mean Results for Social Implication of Science Attitude Scale*

Source	8^{th} Grade Level		Prep. Class		9^{th} Grade Level		11^{th} Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	20.00	1.30	20.06	1.43	19.63	1.46	19.88	1.30
Female	20.21	1.47	19.23	2.80	19.80	1.69	21.25	0.50
Total	20.06	1.34	19.71	2.12	19.69	1.51	20.07	1.30

Table 8 shows that there is no mean difference among four academic levels and no significant main effect of gender on Social Implication of Science scale. The study reveals that there is no significant interaction effect of gender and grade level too. Alpha value of this scale found 0.82.

Table 8 *ANOVA Results for Social Implication of Science Attitude Scale*

Source	DF	SS	MS	F	Sig.
Gender	1	0.200	0.200	0.083	0.773
Grade	3	4.866	1.622	0.674	0.569
Gender*Grade	3	12.216	4.072	1.717	0.166
Error	150	355.806	2.372		

Many educators believe that these students' perception of the social implication of science may contribute to their decision as to whether or not they select science as their future career. It has been found that students' perception of the usefulness of science was curial in determining their science elective decisions, especially among females (Khoury as cited in Chaerul, 2002).

Table 9 shows mean results and Table 10 shows ANOVA result for Normality of Scientist Scale. This scale was intended to assess student's belief about scientists' life styles. Table 10 shows that there is no mean difference among four academic levels and no significant main effect of gender on Normality of Scientist scale and also there is no significant interaction effect of gender and grade level for this scale. It might be interpreted that students do not know or have not any idea about a scientist life. Alpha value of this scale is 0.72.

Table 9 *Mean Results for Normality of Scientist Attitude Scale*

Source	8th Grade Level		Prep. Class		9th Grade Level		11th Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	16.43	2.76	15.72	2.99	15.94	2.31	15.46	2.95
Female	15.42	2.17	16.17	1.99	16.00	1.90	14.25	2.22
Total	16.16	2.64	15.90	2.60	15.97	2.13	15.29	2.85

Table 10 *ANOVA Results for Normality of Scientist Attitude Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	6.763	6.763	1.012	0.316
Grade	3	15.272	5.091	0.762	0.517
Gender*Grade	3	13.816	4.605	0.685	0.563
Error	149	1002.072	6.725		

In order to examine the extent of students involved in the study who enjoy their science classes, the tables below are offered. This scale refers to gladness or happiness students feel resulting from their experience in science classes. Table 12 shows that there is a significant mean difference among four academic levels on enjoyment of science lesson scale ($p<0.0001$).

Table 11 *Mean Results for Enjoyment of Science Lesson Attitude Scale*

Source	8th Grade Level		Prep. Class		9th Grade Level		11th Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	19.87	3.14	19.39	3.76	16.74	3.23	16.46	4.36
Female	20.26	3.40	17.33	3.58	17.09	3.11	19.25	3.86
Total	19.97	3.19	18.45	3.77	16.87	3.14	16.86	4.34

Table 12 *ANOVA Results for Enjoyment of Science Lesson Attitude Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	1.717E-02	1.717E-02	0.001	0.970
Grade	3	311.175	103.725	8.306	0.000
Gender*Grade	3	64.332	21.444	1.741	0.161
Error	155	1908,672	12.314		

Table 13 below shows Tukey multiple comparisons test result on this scale in order to compare grade levels each other, there is a significant mean differences between the 8th grade students' score and both 9th and 11th grade students' score. Table 11 illustrates that 8th grade students' scores are higher than both 9th and 11th students' score ($p<0.001$). There is no significant main effect of gender on this scale (p>0. 05) and there is no significant interaction effect of gender and grade level for this scale (p>0. 05). Alpha value of this scale is 0.84.

Table 13 *Tukey Multiple Comparisons Test Results for Enjoyment of Science Lesson Attitude Scale*

Grade Levels	Sig.
8th Grade / Prep. Class	>0.05
8th Grade / 9th Grade	<0.001
8th Grade/ 11th Grade	<0.001
Prep. Class / 9th Grade	>0.05
Prep. Class / 11th Grade	>0.05
9th Grade / 11th Grade	>0.05

Apparently, more eight-grade students than student in the ninth and eleventh grade feel more enjoyment in learning science and they have stronger opinions had science is one of the most interesting school subject. Previous studies reported that type of classroom instruction greatly effected students' enjoyment in learning science (Freedman, 1997; Gallagher, 1994). For example, Freedman (1997) mentioned in his study that laboratory instruction positively affect students' enjoyment of science lessons.

Tables 14 given below show students' pleasure from science related subjects and Table 15 illustrates that there is a significant mean difference among four academic levels Leisure Interest in Science on scale (p<0.0001).

Table 14 *Mean Results for Leisure Interest in Science Attitude Scale*

Source	8th Grade Level		Prep. Class		9th Grade Level		11th Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	20.55	3.26	21.61	2.25	17.42	3.40	18.50	3.45
Female	20.63	3.42	18.00	4.04	17.18	4.90	19.25	1.50
Total	20.57	3.28	19.97	3.63	17.33	3.93	18.61	3.24

Table 15 *ANOVA Leisure Interest in Science Attitude Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	23.157	23.157	1.933	0.166
Grade	3	252.744	84.248	7.032	0.000
Gender*Grade	3	85.962	28.654	2.458	0.065
Error	155	1806.849	11.657		

Table 16 shows Tukey multiple comparisons shows test result on this scale in order to compare grade levels each other, there is a significant mean differences between the 8th grade students' scores and both 9th and 11th grade students' scores ($p<0.001, p<0.05$). In addition, there is a significant mean difference between the prep class students' scores and 9th grade students' scores ($p<0.05$). Table 14 illustrates that 8th grade students' scores are higher than both 9th and 11th students' score, and prep class students' scores are higher than the students' scores in 9th grade. It has been discovered that compared to lower grade students have a more favorable feeling toward out-of-school science activities such as listening to science programs on the radio, visiting a science-related museum during a weekend, or reading newspaper articles about science.

There is no significant main effect of gender on this scale (p>0.05) and there is no significant interaction effect of gender and grade level for this scale (p>0. 05). According to these result, it might be said that both female and male students have the same intention to be a member of a science club or interested to watch a science program on. Alpha value of this scale is 0.80.

Table 16 *Tukey Multiple Comparisons Test Results for Leisure Interest in Science Attitude Scale*

Grade Levels	Sig.
8^{th} Grade / Prep. Class	>0.05
8^{th} Grade / 9^{th} Grade	<0.001
8^{th} Grade/ 11^{th} Grade	<0.05
Prep. Class / 9^{th} Grade	<0.05
Prep. Class / 11^{th} Grade	>0.05
9^{th} Grade / 11^{th} Grade	>0.05

The result of Career Interest in Science Scale presented below describes to what extent students expect to pursue science for their career choices. Table 18 illustrates that grade level effect has been found to be statistically significant, in which the 8th grade students' mean scores are higher than both 9th and 11th grade students' scores ($p<0.001$). In addition, prep class students' scores are higher than 9th grade students' score ($p<0.05$) as seen in Table 17.

Table 17 *Mean Results for Career Interest in Science Attitude Scale*

Source	8th Grade Level		Prep. Class		9th Grade Level		11th Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	20.68	2.34	20.72	2.49	17.05	3.61	17.46	3.76
Female	20.58	2.52	17.33	2.79	17.36	5.41	18.50	3.70
Total	20.65	2.37	19.18	3.11	17.17	4.27	17.61	3.71

It can be interpreted that students in lower grade-students have a greater intention to pursue a career in science-related fields than higher-grade students even 11th grade students are studying science. There is no significant main effect of gender on this scale ($p>0. 05$) however, statically significant interaction effect of gender and grade level has been detected for the Career Interest in Science scale ($p<0.05$) interpreted that students do not know or have not any idea about a scientist life.

Table 18 *ANOVA Results for Career Interest in Science Attitude Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	16.804	16.804	1.668	0.198
Grade	3	347.031	115.677	11.486	0.000
Gender*Grade	3	81.696	27.232	2.796	.042
Error	155	1509.574	9.739		

Alpha value of this scale is 0.81. It might be said that the mean differences between the male and female students on this scale are not constant among grade level in this scale.

Although there is no significant main effect of gender on this scale, number of studies have been conducted to explore factors affecting career aspiration of students. The studies discovered that gender has been found to be the strongest predictor of science career preference, with boys having a greater interest than girls in such careers (Kahle, Matyas, & Cho, 1985).

Table 19 *Tukey Multiple Comparisons Test Results for Career Interest in Science Attitude Scale*

Grade Levels	Sig.
8^{th} Grade / Prep. Class	>0.05
8^{th} Grade / 9^{th} Grade	<0.001
8^{th} Grade/ 11^{th} Grade	<0.001
Prep. Class / 9^{th} Grade	<0.05
Prep. Class / 11^{th} Grade	>0.05
9^{th} Grade / 11^{th} Grade	>0.05

This study discovered that grade level has been a significant factor in contributing to the existence of students' attitudinal differences. As a matter of fact, it has been found that based on the overall TOSRA result, 8^{th} grade students have more positive attitudes toward science compared with the other grade levels students.

The students in the higher grade show less positive attitude toward science than the students in lower grade students. These differences can be seen in Figure 1 which is presented below.

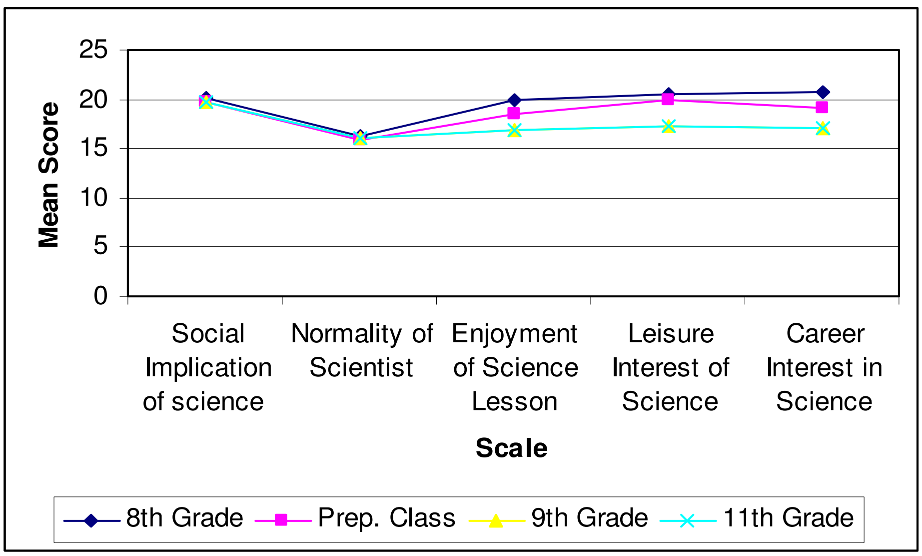

Figure 1 Mean score for Each Scale of the TOSRA Based on Grade Level

4.2 Classroom Environment

A two-way Analyses of Variance (ANOVA) method was used to investigate both main effects of gender and grade level, as well as the interaction effect between gender and grade level of classroom environment. The Individualized Classroom Environment Questionnaire (ICEQ) was administered to students to examine this area. Table 20 shows total scores for overall Individualized Classroom Environment Questionnaire.

Table 20 *Total Scores for Overall Individualized Classroom Environment Questionnaire (ICEQ) based on Gender and Grade level*

Source	8^{th} Grade Level		Prep. Class		9^{th} Grade Level		11^{th} Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	95.12	6.33	97.53	6.21	98.21	7.01	103.04	6.91
Female	99.63	4.54	100.07	8.29	101.00	7.59	98.33	6.66
Total	96.38	6.19	98.68	7.21	99.17	7.21	102.52	6.92

The overall ICEQ results shows that there is a significant mean difference among four academic levels ($p<0.001$). There is significant main effect of gender ($p<0.05$) and there is no significant interaction effect of gender and grade level for this scale ($p>0.05$). Alpha value of this scale is 0.84.

Table 21 *ANOVA Result for Overall Individualized Classroom Environment Questionnaire (ICEQ)*

Source	DF	SS	MS	F	Sig.
Gender	1	247.297	247.297	5.689	.018
Grade	3	754.327	251.442	5.785	.001
Gender*Grade	3	190.781	63.594	1.463	.227
Error	147	6389.633	43467		

‘

It has been found that 11th grade level students ‘mean score are higher than 8th grade students’ score, in addition 9th grade students’ mean score are higher than both 8th grade and prep. class students’ score

Table 22 *Tukey Multiple Comparisons Test Results for Overall Individualized Classroom Environment Questionnaire (ICEQ)*

Grade Levels	Sig.
8th Grade / Prep. Class	>0.05
8th Grade / 9th Grade	<0.05
8th Grade/ 11th Grade	<0.001
Prep. Class / 9th Grade	<0.05
Prep. Class / 11th Grade	>0.05
9th Grade / 11th Grade	>0.05

This questionnaire contains five scales such as Personalization, Participation, Independence, Investigation, and Differentiation to intend to measure the students' perceptions of the preferred of the secondary school classroom environment with details (Fraser & Fisher, 1986).

Table 24 shows that there is no significant mean difference among four academic levels ($p>0.05$) and there is no significant interaction effect of gender and grade level on Personalization scale ($p>0.05$) however, there is a significant main effect of gender for this scale ($p<0.05$). The statistical analyses shows that female students have higher mean scores than male students as shown in Table 23.

Table 23 *Mean Results for Personalization Scale*

Source	8th Grade Level		Prep. Class		9th Grade Level		11th Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	22.80	1.88	22.88	1.65	22.84	1.92	23.25	2.49
Female	23.79	1.78	23.53	2.13	23.64	2.11	23.00	1.41
Total	23.07	1.89	23.19	1.89	23.13	2.00	23.21	2.35

Since this result, it can be said that female students expected more personalization than male students. For example, female students preferred that teachers talk with each student, be friendly, and even consider students feelings.

Table 24 *ANOVA Results for Personalization Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	7.514	7.514	1.903	0.038
Grade	3	0.545	0.182	0.047	0.987
Gender*Grade	3	4.275	1.425	0.361	0.781
Error	152	600.267	3.949		

However, gender differences are not constant along the grade level, 11th grade male students slightly greater than female students. Alpha value of this scale is 0.81.

The Table 25, Table 26 and Table 27 illustrate the students' participation in the classroom based on gender and grade level.

Table 25 *Mean Results for Participation Scale*

Source	8th Grade Level		Prep. Class		9th Grade Level		11th Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	23.60	1.46	24.18	0.95	22.63	2.31	24.00	1.53
Female	24.42	0.69	24.07	1.39	24.18	1.33	23.00	1.15
Total	23.82	1.35	24.13	1.16	23.20	2.12	23.86	1.51

Table 26 shows that there is no significant mean difference among four academic levels ($p>0.05$) on the Participation Scale. The same table also shows that the gender main effect is statistically significant, as well as interaction effect between gender and grade level variables on this scale ($p<0.05$) there fore it might be said that the mean differences between male and female students on this scale was not constant among grade level.

Table 26 *ANOVA Results for Participation Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	9.934	9.934	4.425	0.037
Grade	3	14.168	4.723	2.104	0.102
Gender*Grade	3	19.675	6.558	3.035	0.031
Error	154	332.772	2.161		

Female students' score is higher than the male students' score, it can be said that more female students than their male counterparts preferred to participate in learning process in the classroom.

The tables below indicate the preference of the students pertaining to the Independence issues in their classroom. Table 28 illustrates that grade level effect has been found to be statistically significant ($p<0.0001$), in which the 8^{th} grade and prep. class students' mean scores and are lower than 11^{th} grade students' scores ($p<0.001$), this result may illustrate lower grade students preferred to have less independence while they are learning.

Table 27 *Mean Results for Independence Scale*

Source	8th Grade Level		Prep. Class		9th Grade Level		11th Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	15.87	3.69	16.83	3.47	17.84	3.63	19.96	2.66
Female	17.32	2.91	18.64	2.79	18.18	3.74	18.00	1.73
Total	16.25	3.54	17.63	3.27	17.97	3.61	19.74	2.63

Table 28 *ANOVA Results for Independence Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	31.795	31.795	2.842	0.094
Grade	3	254.277	84.759	7.576	0.000
Gender*Grade	3	34.341	11.447	1.024	0.384
Error	153	1711.016	11.183		

There is no significant main effect of gender on this scale and there is no interaction effect of gender and grade level on this scale (p>0.05). Alpha value is 0.85.

Table 29 *Tukey Multiple Comparisons Test Results for Independence Scale*

Grade Levels	Sig.
8^{th} Grade / Prep. Class	>0.05
8^{th} Grade / 9^{th} Grade	>0.05
8^{th} Grade/ 11^{th} Grade	<0.05
Prep. Class / 9^{th} Grade	>0.05
Prep. Class / 11^{th} Grade	<0.05
9^{th} Grade / 11^{th} Grade	>0.05

The Table 30, Table 31, and Table 32 below indicate the preference of the students pertaining to the Investigation issues in their classroom.

Table 30 *Mean Results for Investigation Scale*

Source	8^{th} Grade Level		Prep. Class		9^{th} Grade Level		11^{th} Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	21.59	2.47	21.83	2.12	20.11	1.70	21.54	1.98
Female	22.00	1.89	21.47	2.59	21.40	2.68	21.25	2.99
Total	21.70	2.32	21.67	2.31	20.55	2.13	21.50	2.08

Table 31 shows that there is no mean difference among four academic levels and no significant main effect of gender on Investigation scale (p>0. 05). Alpha value of this scale is 0.82.

Table 31 *ANOVA Results for Investigation Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	3.240	3.240	,641	0,424
Grade	3	29.394	9.798	1,940	0,125
Gender*Grade	3	11.482	3.827	.754	0,522
Error	152	771.484	5.076		

Tables 32, Table 33, Table 34 show the analysis for Differentiation scale which indicates that grade level effect has been found to be statistically significant ($p<0.0001$), in which the 8^{th} grade students' mean scores are lower than 9^{th} grade than 11^{th} grade students' scores ($p<0.001$, $p<0.01$).

Table 32 *Mean Results for Differentiation Scale*

Source	8^{th} Grade Level		Prep. Class		9^{th} Grade Level		11^{th} Grade Level	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	11.38	3.00	11.78	3.41	14.79	2.66	14.29	5.90
Female	12.11	2.79	12.60	3.14	13.91	4.25	14.25	2.50
Total	11.57	2.94	12.15	3.26	14.47	3.29	14.29	5.51

Table 33 *ANOVA Results for Differentiation Scale*

Source	DF	SS	MS	F value	Sig.
Gender	1	3.471	3.471	0.263	0.609
Grade	3	265.967	88.656	6.723	0.000
Gender*Grade	3	14.876	4.959	.372	0.77
Error	155	2068.729	13.347		

This result may illustrate higher grade students preferred to have more differentiate while they are learning. There is no significant main effect of gender and interaction effect of gender and grade level on this scale ($p>0.05$). Alpha value of this scale is 0.74.

Table 34 *Tukey Multiple Comparisons Test Results for Differentiation Scale*

Grade Levels	Sig.
8^{th} Grade / Prep. Class	>0.05
8^{th} Grade / 9^{th} Grade	<0.001
8^{th} Grade/ 11^{th} Grade	<0.01
Prep. Class / 9^{th} Grade	>0.05
Prep. Class / 11^{th} Grade	>0.05
9^{th} Grade / 11^{th} Grade	>0.05

This fact indicate that higher grade level students more so than lower grade level students expected that science teachers in the classroom should treat the students differently from one another. For instance, they preferred that the teacher should allow students who work faster than the other to move on to the next topic instead of waiting their classmate.

Factor analysis was used to identify latent dimensions underlying the 25 statements that measured students' perception towards the classroom environment. The scree plot and the number of eigen values greater than one were used to determine the number of factors underlying item responses.

Figure 2 presents the mean score for each scale of the ICEQ based on grade level. This figure shows that 8th grade students decide less independence classroom atmosphere than the other students. Mean scores of 11th grade students are higher than the other means scores.

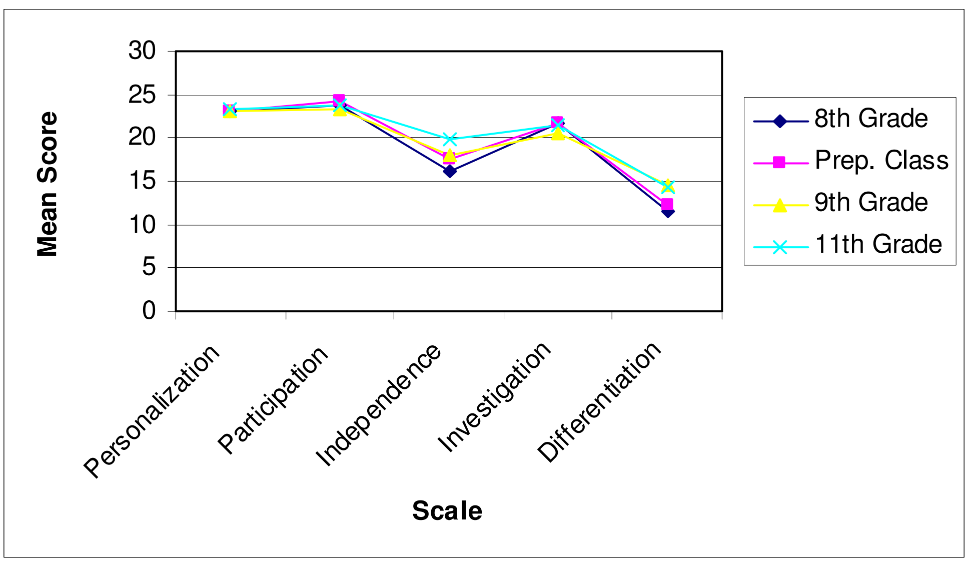

Figure 2

Mean score for Each Scale of the ICEQ Based on Grade Level

4.3 Summary of the Findings

- It has been identified that lower-grade students show more positive attitudes toward science than the students at higher-grade level.
- There are no significant differences between female and male students' score on attitudes towards science.
- Female students expected more personalization than male students in the learning environment.
- More female students than their male counterparts preferred to participate in learning process in the classroom
- Lower grade students preferred to have less independence while they are learning.
- Higher grade students preferred to have more differentiate classroom environment.

CHAPTER 5

DISCUSSION

This chapter begins with a summary of the study, which includes a review of the reason why the study was undertaken, its purpose, the research questions, the methodology, and finally the major findings. A discussion of the limitations of the study is presented in the second section. The chapter ends with a discussion of the implication of the findings and suggestion for future research.

5.1 Summary of the Study

The importance and radical applicability of science in every day life has increasingly become apparent especially for people who live in a developing country. As science and technology become so integrated in our lives, an understanding of concept, applications and reasoning is vital to becoming successful in the future. Schools, where students mostly acquire science concept and practical skills, should therefore meet these needs by teaching science subjects in the best ways. Since high school education level is very close to the future, the responses of the students at this level to be more meaningful than those expressed by students from the lower level. Based on these reasons, it seems essential and critical to investigate senior high school students' perceptions pertaining to their school environment, attitudes and their future career.

The main purposes of the present study are to examine gifted/talented students' attitudes towards science and classroom environment during learning science. Mainly, two research questions raised in the present study were: (1) Is there any significant differences among students on their attitudes toward science based on their gender and grade level? (2) Is there any significant differences among students in their perceptions of the science classroom environment based on their gender and grade level?

Two instruments, namely the Test of Science Related Attitudes (TOSRA) and the Individualized Classroom Environment Questionnaire (ICEQ) have been employed to collect the data. Quantitative method was used to analyze the collected data resulted from the questionnaires. The statistical technique called Two-Way Analyses of Variance (ANOVA) was employed to compare students' main scores generated from both the TOSRA and the ICEQ questionnaires based on their gender and grade level differences.

Having been quantitatively analyzed, some major findings which are related to the research questions were discovered. It has been identified in the current study that lower-grade students show more positive attitudes toward science than the students at higher-grade level. Numerous studies support the findings that students begin the study of science with positive attitudes, but the situation rapidly declines by middle school and high school (Farenga & Joyce, 1998; Weinburgh, 1995; Oakes, 1990; Yager & Penick, 1989). George (2000) also found the same result in his study; the results showed that students' attitudes toward science generally decline over the middle and high school years. Lupkowski-Shoplik (2000) found that negative attitudes towards science increase with age from third through sixth grade. One the reasons of the situation explained by Freedman (1997) mentioned in his study that laboratory instruction positively affect students' attitudes of science lessons. However, number of the laboratory experiments is decreasing in the higher-grade level, because experiments become more complicated and the teachers do not prefer making experiment recently, therefore higher-grade level students feel less happiness than lower grade students. Another reason why the students at lower grade level have more positive attitude than higher grade, the student at lower grade are more motivated because they came to school very newly.

In this research, there are no significant differences between female and male students' score on attitudes towards science. However, existence of gender-based differences in achievement and participation in science and attitude toward science has been widely recognized. Lupkowski-Shoplik (2000) found attitude differences in gifted elementary school students, with boys favoring science and technology and girls favoring English, writing, foreign language, and reading.

Less research has been conducted about talented males than talented females in math and science because more males than females have generally pursued majors and careers in these areas. Various reasons are cited in the research literature to explain why some talented females do not succeed in or pursue science. These include a lack of ability or effort; issues related to socialization of talented students' perceptions of their ability; low self-efficacy in mathematics, science, or technology; the influence of standardized tests; parent and teacher attitudes on performance; and perceptions about future careers (Reis & Park, 2001; Stumpf & Stanley, 1996; Fennema, Junge & Dretzke, 1995; Pajares & Miller, 1994). One may assume that, the main reason for not finding significant gender differences is that the applied questionnaire aims to evaluate the attitude of the gifted students towards not only a single branch of science i.e. physics, chemistry, life science, but general science. Lee and Burkam (1998) found that gender differences tend to be greater in the physical sciences than biological sciences. Since these students are gifted students, it is normal that they are highly motivated towards general science.

In addition, Julianne (1994) found that although females generally are reported as having poorer attitudes toward science, the females in her study only had less positive attitudes in the areas of career/leisure interest in science and in science classes. In terms of the social importance of science, there was no significant difference between the attitudes of males and females.

There are three significant differences were found among students in their perceptions of the science classroom environment based on their gender and grade level. Since result of the current study, it can be said that female students expected more personalization than male students. For example, female students preferred that teachers talk with each student, be friendly, and even consider students feelings. Raiford (1998) found that high ability students prefer a more personalized classroom environment. The students wanted their teacher to talk them with them, be considerate of their feelings, and provide personal attention. Since the result of the study that may illustrate lower grade students preferred to have less independence while they are learning. Raiford (1998) has been found that higher ability science students preferred to have more independence in learning environment than they actually experienced. Thus, these students wanted to make more decision about their own learning.

Differentiated scale results illustrate that higher grade students preferred to have more differentiate while they are learning, as found in the study of Chaerul (2002). This fact indicate that higher grade level students more so than lower grade level students expected that science teachers in the classroom should treat the students differently from one another. For instance, they preferred that the teacher should allow students who work faster than the other to move on to the next topic instead of waiting their classmate.

5.2 Limitation of the Study

This study is limited in many aspects. The first this analysis does not incorporate measures of other factors except grade level, gender and social economic status. In fact, the influences of students' and parent educational back ground have been excluded. Many educators believe that these factors may interact in affecting students' learning outcome. The sample size is another limitation factor, a bigger sample size provide a better opportunity to see the both attitudes towards science and classroom environment.

While the ICEQ has two forms, that is long and short forms, the original version of TOSRA is lengthy even more comprehensive. Therefore, a short version of TOSRA design by Chaerul (2002) was used.

Since the data for the study was obtained by the participant' self reporting to the inventory, they might not represent the complete objectivity.

5.3 Internal and External Validity of the Study

Lack of randomization and inability to manipulate independent variable are two major weakness of the causal comparative research. Since the group are already formed, random assignments of subjects to groups is not possible also. In this study; age and gender was assessed, and the student come from low social economic level, there fore social economic factor were kept under control. Since the tests were administered to all groups in similar condition, location and instrument cannot be treating to the study also. Only the researcher knows the name of the participant.

According to the external validity, subjects were selected from different regions of Turkey however even finding gifted students are difficult sample size can be large for population generalizability. .

5.4 Implication of the Study

The result of the study together with past studied showed that students posses different attitude toward science at different grade level. Educators should keep gifted students attitude positively from eight-grade level to eleventh grade level.

Since the females and males perceived themselves differently, teacher should provide activities that assist in meeting specific gender needs. Educator should recognize different grade level students preferred different classroom environment, teacher should provide activities that assist in meeting specific needs.

5.5 Suggestion for Future Research

- It would be beneficial to repeat the study with larger sample size.
- There is need for longitudinal studies in gifted education.
- Further studies are needed developing science learning environments that provide gifted and talented students' educational needs.
- A creation of science curriculum for only gifted and talented high students is highly recommended.
- Future studies could be made about teachers' attitude toward the gifted students, the studies should be done to train teachers about the gifted students' education in science context.

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Appendix A

TEST OF SCIENCE REALATED ATTITUDE (TOSRA)

B. J. Fraser

(TURKISH VERSION)

Fene Karşı Tutum Ölçeği

Ad, Soyad: ……………………………… Tarih:…………………………..

Annenizin Eğitim Durumu:
❑ İlkokul ❑ Ortaokul ❑ Lise ❑Üniversite ❑ Yüksek lisans (Master/Doktora)

Babanızın Eğitim Durumu:
❑ İlkokul ❑ Ortaokul ❑ Lise ❑Üniversite ❑ Yüksek lisans (Master/Doktora)

Yönerge: Lütfen; her bir cümleyi okuyunuz ve cümlenin, hoşlanacağınız bir etkinliği tanımlayıp tanımlamadığına karar veriniz. Her cümle için o etkinliğin yapılmasına ne kadar katılıp ne kadar katılmadığınızı belirten kutuyu işaretleyiniz. Her cümle için işaret koyduğunuzdan emin olunuz.

		Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1	Okulu bitirdiğimde bilim adamı olmak isterim.					
2	Mezun olunca fen ile ilgili bir laboratuarda çalışmayı istemem.					
3	Bilim adamı olarak çalışmak sıkıcı olabilir.					
4	Bilim adamı olarak çalışmak ilginç olabilir.					
5	Fenle ilgili bir işi severek yapabilirim.					
6	Evde fen ile ilgili programları izlerken sıkılıyorum.					
7	Radyoda fen ile ilgili konuda bir konuşma dinlemek sıkıcı gelir.					

		Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
8	Okuldan çıktıktan sonra arkadaşlarla bilimsel konulardan söz etmek sıkıcıdır.					
9	Hafta sonu bir fen müzesini severek gezebilirim					
10	Fen ile ilgili bilimsel gazete makaleleri okumak bana sıkıcı gelir.					
11	Bilimsel fen projelerine harcanan para boşa harcanmıştır.					
12	Devlet bilimsel araştırmalara daha fazla para yatırmalıdır.					
13	Fen bilimi, gelecekte dünyayı daha yaşanılası bir yer haline getirmede etkili olacaktır.					
14	Fen bilimi, hayatı iyileştirir.					
15	Fen bilimine harcanmış para, iyiye harcanmış paradır.					
16	Fen dersleri beni sıkar.					
17	Fen, okul dersleri arasında en ilgincidir.					
18	Fen dersleri eğlencelidir.					
19	Fen derslerine gitmekten zevk alıyorum.					
20	Okulda hafta başına düşen fen dersi sayısı daha fazla olmalıdır.					
21	Bilim adamları ailelerine yeterince vakit ayıramazlar.					
22	Bilim adamları diğer insanlar kadar spordan hoşlanırlar.					
23	Bilim adamları diğer insanlardan daha az arkadaş canlısıdır.					
24	Bilim adamları normal bir aile yaşantısına sahip olabilirler.					
25	Çok az bilim adamının mutlu bir evliliği vardır.					

Appendix B

INDIVIDUALIZED CLASSROOM ENVIROMENT QUESTIONNAIRE (ICEQ)

B. J. Fraser *D. F. Fisher*

TURKISH VERSION
Kişiselleştirilmiş Sınıf Ortamı Ölçeği

Ad, Soyad: ……………………………… Tarih:…………………………..

Annenizin Eğitim Durumu:
❑ İlkokul ❑ Ortaokul ❑ Lise ❑Üniversite ❑ Yüksek lisans (Master/Doktora)

Babanızın Eğitim Durumu:
❑ İlkokul ❑ Ortaokul ❑ Lise ❑Üniversite ❑ Yüksek lisans (Master/Doktora)

Yönerge: Lütfen; her bir cümleyi okuyunuz ve cümlenin, sınıfta olmasından hoşlanacağınız bir etkinliği tanımlayıp tanımlamadığına karar veriniz. Her cümle için o etkinliğin yapılmasına ne kadar katılıp ne kadar katılmadığınızı belirten numarayı daire içine alınız. Bunun, okulda ne yaptığınızla ilgili değil, fakat ne olmasını istediğinizle ilgili olduğunu unutmayınız. Her cümle için işaret koyduğunuzdan emin olunuz.

		Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1	Öğretmen, her öğrenciyle konuşmalıdır					
2	Tartışmalar sırasında öğrenciler kendi düşüncelerini belirtmelidir.					
3	Öğrencilerin nerede oturacağına öğretmen karar vermelidir.					
4	Öğrenciler, soruların yanıtlarını araştırarak değil, kitaplardan bulmalıdır.					
5	Farklı öğrenciler farklı ödevler yapmalıdırlar.					
6	Öğretmen, her öğrenciyle özel olarak ilgilenmelidir					

		Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
7	Öğretmen dersini öğrencilerin soruları olmaksızın ve sorulara cevap verilmeksizin işlemelidir.					
8	Öğrenciler, grup çalışmalarında ortak çalışacakları öğrencileri kendileri belirlemelidirler.					
9	Düşünceleri test etmek için öğrenciler araştırma yapmalıdır.					
10	Sınıftaki tüm öğrenciler aynı anda aynı etkinliği yapmalıdır.					
11	Öğretmen, öğrencilere dostça yaklaşmalıdır.					
12	Sınıf tartışmalarında öğrencilerin düşünce ve görüşleri kullanılmalıdır.					
13	Öğrencilere sınıfta nasıl davranacakları söylenmelidir.					
14	Öğrenciler, sınıf tartışmalarından doğan soruları yanıtlayabilmek için araştırma yapmalıdır.					
15	Sınıftaki farklı seviyedeki öğrenciler farklı kitap, malzeme ve araç gereç kullanmalıdır.					
16	Öğretmen, çalışmalarda zorlanan öğrencilere yardım etmelidir					
17	Öğrenciler, öğretmene soru sormalıdır.					
18	Hangi öğrencilerin beraber çalışacağına öğretmen karar vermelidir.					
19	Diyagram, grafik ve ifadelerin anlamlarını öğrenciler açıklamalıdır.					
20	Diğerlerinden daha hızlı çalışan öğrenciler bir sonraki konuya geçmelidir.					
21	Öğretmen, öğrencilerin duygularını önemsemelidir.					
22	Sınıf içi tartışmalar gerçekleştirilmelidir.					

		Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
23	Sınıf içinde ne kadar konuşma ve hareket olacağına öğretmen karar vermelidir.					
24	Öğrenciler kendilerini şaşırtan soruların yanıtlarını bulmak için araştırma yapmalıdır.					
25	Aynı öğretim araç gereçleri tüm öğrenciler için kullanılmalıdır (Yazı tahtası, tepegöz,vb.)					