

INNOVATIVENESS AS A MANAGERIAL PROCESS IN THE CONTEXT OF  
SCIENCE TEACHING: A CASE STUDY ON BAHÇEŞEHİR SCIENCE AND  
TECHNOLOGY HIGH SCHOOL

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ZEHRA PEKŞEN

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---

Prof. Dr. Sencer Ayata  
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of  
Master of Science.

---

Prof. Dr. Ali Yıldırım  
Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully  
adequate, in scope and quality, as a thesis for the degree of Master of Science.

---

Assist. Prof. Dr. Yaşar Kondakçı  
Supervisor

**Examining Committee Members**

Assoc. Prof. Dr. Cennet Engin Demir (METU, EDS) \_\_\_\_\_

Assist. Prof. Dr. Çiğdem Haser (METU, ELE) \_\_\_\_\_

Assist. Prof. Dr. Yaşar Kondakçı (METU, EDS) \_\_\_\_\_

**I hereby declare that all the information in this document has been obtained and presented in accordance with academic rules and ethical conduct, I have fully cited and referenced all materials and results that are not original to this work.**

Name, Surname: Zehra Pekşen

Signature:

## **ABSTRACT**

### **INNOVATIVENESS AS A MANAGERIAL PROCESS IN THE CONTEXT OF SCIENCE TEACHING: A CASE STUDY ON BAHÇEŞEHİR SCIENCE AND TECHNOLOGY HIGH SCHOOL**

Pekşen, Zehra

Supervisor: Assist. Prof. Dr. Yaşar Kondakçı

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This study aimed to investigate the innovation practices and the factors contributing to innovativeness in Bahçeşehir Science and Technology High School (BSTHS). The study was designed as a case study and different qualitative data collection techniques were used to collect the data. 17 participants of this study were chosen among administrators, science and mathematics teachers and 4 students.

The study documented both managerial and academic innovations at the School. Besides, the factors contributing to innovativeness at BSTHS were documented. Research findings show that the BSTHS was successful in establishing a place within the Turkish Education System as a new and original education institution. The BSTHS administration is working on, based on an effective leadership, providing most suitable conditions for education and learning, and they

are doing that with a participatory administration approach. Beyond that, they constructed an effective network with the support of the Bahçeşehir University towards the development of the school in line with its targets. According to the research findings, foremost aspects that make the BSTHS innovative and original are a new curriculum, an individual-based education system, application of new technologies in education and learning processes and the establishment of the institution as a self-learning organization.

It is argued that different factors (e.g., leadership, participative management, social interaction, knowledge share) are combined with quality inputs (e.g., students, staff, technology, physical infrastructure) have contributed to the creation of a culture of innovation. Hence, it is concluded that extensive physical or financial resources are not enough to accomplish innovativeness. Besides, a culture of innovation needs to be cultivated in order to accomplish innovation.

Keywords: Innovation, Organizational Innovation, Learning Organization, Leadership, Networking, Diffusion of Innovation

## ÖZ

### FEN BİLİMLERİ EĞİTİMİNDE YÖNETSEL BİR SÜREÇ OLARAK YENİLİKÇİLİK: BAHÇEŞEHİR FEN VE TEKNOLOJİ LİSESİ ÜZERİNE BİR ÖRNEK OLAY İNCELEMESİ

Pekşen, Zehra

Tez Yöneticisi: Yrd. Doç. Dr. Yaşar Kondakçı

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Bu çalışmanın amacı, bir orta öğretim kurumu olan Bahçeşehir Fen ve Teknoloji Lisesi'ndeki yenilikçi uygulamaları ve yenilikçiliği etkileyen unsurları incelemektir. Çalışma bir örnek olay incelemesi olarak tasarlanmış ve verilerin toplanmasında yüzyüze görüşmeler, gözlem ve hazır basılı belgelerin incelemesi olmak üzere farklı nitel veri toplama tekniği kullanılmıştır. Çalışmaya katılan toplan 17 katılımcı okul yöneticileri, fen ve matematik öğretmenleri ve 4 öğrenciden oluşmaktadır.

Çalışmanın bulguları okuldaki yönetsel ve akademik yenilikleri ortaya koymuş, aynı zamanda bu yenilikleri olanaklı kılan değişik faktörlerin ortaya çıkarılmasını sağlamıştır. Araştırma bulguları Bahçeşehir Fen ve Teknoloji

Lisesi'nin, dört yıl gibi kısa bir süre içinde, Türk Eğitim Sistemi içinde yeni ve özgün bir eğitim kurumu olarak yerini almaya başladığını göstermiştir. Bahçeşehir Fen ve Teknoloji Lisesi yönetimi etkin bir liderlikle öğretmenleri ve öğrencileri için en uygun eğitim ve öğretim koşullarını sağlamaya çalışmakta ve bunu katılımcı bir yönetim anlayışıyla yapmaktadır. Bunun da ötesinde, Bahçeşehir Üniversitesi'nin desteği ile okulun gelişimi ve hedefleri doğrultusunda etkin bir ağ (network) oluşturulmuştur. Araştırma bulgularına göre, Bahçeşehir Fen ve Teknoloji Lisesi'ni yenilikçi ve özgün yapan en önemli unsurlar uyguladığı yeni müfredat, kişiye özgü öğretim sistemi, eğitim ve öğretim süreçlerin de teknolojinin etkin kullanımı ve kurumun kendini öğrenen bir örgüt olarak ortaya koymasındır.

Çalışmanın sonuçları Bahçeşehir Fen ve Teknoloji Lisesi'ndeki yenilikçiliğin büyük ölçüde yenilikçi bir kültür yaratılması ile mümkün olduğunu göstermiştir. Bahçeşehir Fen ve Teknoloji Lisesi'nde liderlik, katılımcı yönetim, sosyal etkileşim ve bilgi paylaşımı ile nitelikli öğrenci ve personel, teknolojik ve fiziksel altyapı özellikleri bir araya gelmiştir. Bu nedenle çalışmada, yenilikçilik için fiziksel ve finansal kaynakların tek başına yeterli olmadığı, bunun yanında kurumda yenilikçi bir kültürün oluşturulmasının gerekli olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Yenilik, Örgütsel Yenilik, Öğrenen Örgüt, Liderlik, Ağlaşma, Yeniliğin Yayınımı

To my parents



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## TABLE OF CONTENTS

PLAGIARISM.....	iii
ABSTRACT.....	iv
ÖZ.....	vi
DEDICATION.....	viii
ACKNOWLEDGEMENTS.....	ix
TABLE OF CONTENTS.....	x
TABLES.....	xv
LIST OF ABBREVIATIONS.....	xvi
CHAPTERS	
1. INTRODUCTION.....	1
1.1. Background of the Study.....	1
1.2. Definition of Innovation.....	3
1.2.1. Types of Innovation.....	4
1.2.2. A Systemic Approach to Innovation.....	4
1.2.3. Innovation in Education.....	7
1.3. Science and Technology Teaching in Secondary Education.....	8
1.4. Purpose of the Study.....	10
1.5. Significance of the Study.....	11
1.6. Definition of Terms.....	13
2. REVIEW OF LITERATURE.....	14
2.1. Organizational Innovation.....	14

2.1.1. Organizational Structure and Innovation.....	15
2.1.2. Organizational Cognition, Learning and Innovation.....	16
2.1.3. Organizational Change and Innovation.....	19
2.2. Sources of Innovation.....	20
2.3. Innovation In Education.....	22
2.3.1. Significance of Innovation in Education.....	22
2.3.2. Knowledge Creation, Knowledge Management and Networking In Education.....	24
2.3.3. Systemic Innovation in Education.....	27
2.3.4. Information and Communication Technology (ICT) Usage in Education.....	28
2.4. Innovativeness In Science and Technology Education.....	29
2.4.1. History of Science Education.....	29
2.4.2. Innovativeness in Science and Technology Education.....	31
2.5. Summary of the Literature.....	34
3. METHODOLOGY.....	36
3.1. Overall Design of the Study.....	36
3.2. Research Questions.....	37
3.3. The Case: Bahçeşehir Science and Technology High School.....	37
3.4. Participants.....	40
3.5. Data Collection Instruments.....	43
3.5.1. Interviews.....	43
3.5.2. Document Analysis.....	44

3.5.3. Field Notes.....	45
3.6. Data Collection Procedure.....	46
3.7. Data Analysis Procedure.....	47
3.8. Quality of the Research.....	47
3.9. Limitations of the Study.....	50
4. FINDINGS.....	51
4.1. Innovations Practices for Bahçeşehir Science and Technology High School.....	51
4.1.1. Innovations in Academic Domain.....	52
4.1.1.1. Establishment Aim and New School Model.....	53
4.1.1.2. Curriculum at Bahçeşehir Science and Technology High School.....	54
4.1.1.3. Individual Based Teaching System.....	57
4.1.1.4. Technology Usage in Teaching.....	58
4.1.1.5. Continuous Improvement at Bahçeşehir Science and Technology High School.....	60
4.1.1.6. Social Responsibility Approach.....	61
4.1.2. Managerial Innovations.....	63
4.1.2.1. Strategic Management.....	64
4.1.2.2. Learning Organization.....	64
4.1.2.3. Corporate Culture.....	66
4.1.2.4. Networking.....	67
4.1.2.5. Diffusion of Innovations.....	68

4.1.2.6. Blue Ribbon Award.....	69
4.1.3. Science Museum.....	71
4.2. Conditions Enabling Innovations in Bahçeşehir Science and Technology	
High School.....	72
4.2.1. Vision and Mission of the School.....	72
4.2.2. Leadership.....	74
4.2.2.1. Participative Leadership.....	76
4.2.2.2. Monitoring and Responding to External Environment.....	78
4.2.2.3. Qualifications.....	80
4.2.2.4. Relations with Employees and Students.....	81
4.2.3. Innovations in Human Resources Management.....	83
4.2.3.1. Teachers Trainings.....	83
4.2.3.2. Recruitment and Performance Evaluation.....	84
4.2.3.3. Teacher Profile.....	85
4.2.4. Students.....	87
4.2.5. Financial Resources.....	89
4.2.6. Technological Resources.....	90
4.2.6.1. Laboratory Infrastructure.....	91
4.2.7. Physical Infrastructure.....	93
4.2.7.1. School Building and Dormitories.....	93
4.2.8. Social Interaction.....	95
4.3. Summary of the Findings.....	97
5. DISCUSSION AND CONCLUSIONS.....	101

5.1. Discussion.....	101
5.1.1. School as an Innovative Organization.....	101
5.1.2. Leadership.....	104
5.1.3. Creating Alternative Teaching and Learning Environment.....	106
5.1.4. Bahçeşehir Science and Technology High School as a Learning Organization.....	110
5.1.5. Networking.....	111
5.1.6. Student Qualifications and Diversity.....	112
5.1.7. Diffusion of Innovation.....	112
5.2. Recommendations Further Studies.....	113
5.3. Implications.....	114
 REFERENCES.....	 117
 <b>Appendix A:</b> Interview Protocols.....	 122
<b>Appendix B:</b> Interview Forms.....	128
<b>Appendix C:</b> Permission of METU’s Human Subjects Ethics Committee.....	131
<b>Appendix D:</b> Bahçeşehir Science Technology High School Weekly Lesson Plans for 4 years.....	132

## TABLES

Table 3.1. The distribution of participants.....	41
Table 3.2. Professional background of participants.....	42
Table 3.3. Professional work experience of participants.....	43

## **LIST OF ABBREVIATIONS**

**BSTHS:** Bahçeşehir Science and Technology High School

**ICT:** Information and Communication Technologies

**PISA:** Program for International Student Assessment

**ROSE:** The Relevance of Science Education

**SIS:** School Innovation in Science

**TIMSS:** Trends in International Mathematics and Science Study



## **CHAPTER I**

### **INTRODUCTION**

#### **1.1. Background of the Study**

In last three decades, studies on the role of innovation in economic and social life have exponentially increased and as a result a rich literature has emerged on innovation. Innovation is accepted as a key driver for economic growth and has critical role in creation, dissemination and application of knowledge. It is also accepted as necessary condition for transformation of the society (Shapiro et al., 2007). Hamel (2002) argued that the ability to innovate, to change products or services in response to market demands, or to create new products or services is recognized as a key strategic ability of the organizations in the 21st century. Since early 1980s the organizations have entered into turbulent environments. Fast adaptability, successful organizational change, and innovations have become key functions of ensuring survival.

The same case applies to educational organizations as well. Successful change and innovation have entered into the agenda of educational organizations. The increasing interest in how people learn and where people learn best are critical to educate people needed by knowledge economies and societies.

On the other hand, although today science and technology have become an integral part of knowledge society, the apparent failure in mathematics, science and technology education is evident according to various studies such as Eurobarometer Surveys, the OECD's Program for International Student Assessment (PISA), the Relevance of Science Education (ROSE) and Trends in International Mathematics and Science Study (TIMSS). These programs have also highlighted a decline in science and mathematics skills of young people in Turkey. According to PISA results, Turkey is underperforming in key science and mathematics skills. The evaluation by PISA 2003, Turkey is ranked 33<sup>rd</sup> in mathematics, 34<sup>th</sup> in reading, 36<sup>th</sup> in science and problem solving among 41 countries. According to the results of PISA 2006, Turkey ranked 37<sup>th</sup> among 56 in reading, 44<sup>th</sup> in science among 57 countries and 43<sup>rd</sup> among in mathematics among 57 countries. The results clearly demonstrate that Turkey is performing under the OECD average.

Being a country striving for increasing its competition power Turkey have to invest in its education system in general and to its science and technology education in particular. Today one of the main requirements for coping with the rapidly changing world is having qualified human resources. Need of qualified technical staff having research skills is an extremely important point. Science high schools that had been established in the past with the aim of raising qualified technical people are far away from accomplishing this aim.

Bahçeşehir Science and Technology High School (BSTHS) offers a new and alternative science and technology education model in Turkey. The education offered by BSTHS has various innovative characteristics in its managerial and organizational aspects as well. Because of the low performance of Turkish students in mathematics, reading, and science the vision of science and technology education in Turkey

becomes critically important. Within this context in this study, BSTHS was analyzed by means of organizational innovation.

## **1.2. Definition of Innovation**

The definition of innovation is taking a new idea into implementation and it is distinguished from invention. Because, “the invention is the first occurrence of an idea for a new product or processes, while innovation is the first attempt to carry it out into practice” (Fagerberg, Mowery & Nelson, 2005, p. 4). In the literature there are different approaches to define the innovation. One frequently cited definition of innovation is proposed by the Oslo Manual (OECD, Eurostat, 2005) which defines the innovation as “the implementation of a new or significantly improved product (good or service), or processes, a new marketing method, or a new organizational method in business practices, workplace organization or external relations” (p.46). According to this definition, innovation contains novelty and brings economic benefits. According to Porter (1990, p. 780), innovation is “ a new way of doing things that is commercialized”. It “cannot be separated from a firm’s strategic and competitive context”. Edquist (1997, p.1) has stated that “innovations are new creations of economic significance. They may be brand new but are more often new combinations of existing elements”. In addition to economic aspects, Simmie and Sennett (1999) argued that innovation is a result of a learning process and this process is interactive and involves various actors from internal and external environment of the firms.

Schumpeter (1942) has developed an approach focusing on the role of innovation in economic and social change. According to the author, economic development had to be seen as a qualitative change, driven by innovation. The author

mentioned new products, new sources of supply, the exploitation of new markets and new ways to organize business as examples of innovation (Faberberg, Mowery & Nelson, 2005). Schumpeter (1942) argued that innovation causes the creative destruction and he suggested that this “creative destruction” causes continuous progress and improves the standards of living for everyone.

### **1.2.1. Types of Innovation**

There are four types of innovation in literature and these are product innovation, process innovation, marketing innovation and finally organizational innovation. A distinction has been made between technical and administrative innovation. Technical innovation is related with the new or improved products, services or processes. On the other hand, administrative innovation belongs to organizational structures and administrative processes. Organizational innovation has been defined as the adoption of an idea or behavior that is new to the organization (Damanpour, 1991). In this study, organizational innovation and literature on organizational innovation in educational context are presented in Chapter 2 in details.

### **1.2.2. A Systemic Approach to Innovation**

Innovation is related to technological development and technology in its origin. There are two important theories, which are neoclassical and evolutionary economics to develop the technology and innovation policies (Taymaz, 2001).

The neoclassical approach is also called the laissez-faire approach and this approach focuses on framework conditions rather than specific sectors or technologies. In contrast, evolutionary approach can be perceived as “systemic” and it is related to the innovation system. (Faberberg et al, 2005).

Evolutionist/Schumpeterian economists who became influential since 1980's had attained that the neo-classical approach was insufficient in explaining the technological development processes, thus ineffective in developing technology policies. The evolutionist approach had become widely known in the area of technology and economic innovation basically with the publication of *The Evolutionary Theory of the Economic Growth* by Nelson and Winter in 1982. This approach takes its sources from the work of Schumpeter in 1911 and 1942, and interprets technological innovation as the locomotive of the economic development in long term (Taymaz, 2001).

According to Taymaz, “the main difference between the evolutionist approach and neo-classic approach is its emphasis on technological innovation and learning processes within the economical development. The neo-classical approach scrutinizes resource allocation processes within present conditions, whereas the evolutionist approach investigates how companies develop new technologies and how they adopt themselves to the technological innovations.” (2001, p. 12). In this context the main research subject of the evolutionist approach is a system consisting of companies accommodating diverse skills, organizational structures and behavioral codes, and of other economic actors. Differences and diversity among companies is the basis of competitive superiority and Schumpeter's concept of creative destruction emerges from this point. Despite the fact that this process based on technological innovations is a creative process, it also has a destructive aspect in the sense that it causes divestment of companies who are not innovative. At this point evolutionist terms such as mutation (to define innovation), selection (to define elimination) has been used in order to conceptualize the situation.

Technological innovation and learning play a key role in the evolutionist approach. Production, saving and transferring information has a big significance. According to Smith (1995, p. 80-81), company information databases, in the evolutionist approach are listed as: (1) Differentiated and multilayered, (2) Company specific, (3) Have been formed within costly research, learning and adaptation processes, thus are path dependent, (4) Intrinsically systematical, because they emerge as the result of various activities within the company, and (5) Extrinsically systematical, because the information is produced as the result of inter-company relations, overtly or covertly.

In that sense mutual learning and information exchange appear to be a critical factor.

Evolutionist economist described three systemic levels: technological systems, industrial clusters and national innovation system (Smith, 1995). This study takes the national innovation system, and learning processes at national level and the network of national-institutional relations supporting those processes, as its basic conceptual tool.

According to Taymaz (2001), the notion of national innovation system had first been suggested by Freeman and Lundvall, and developed later on by other researchers. This approach had become more popular since 1990's and adopted by international organizations such as OECD, and beyond that, is being used in the field of education.

Institutions that fall into the national innovation system which are not independent from the macroeconomic order, education system, communication infrastructure and labor/commodity markets can be listed as (Taymaz, 2001, p. 26): (1) Private and state institutions working in the area of technological innovation and

networks consisted of such institutions, (2) Research institutes, (3) Science system, (4) Institutions giving support and providing technological facilities, (5) Finance institutions, (6) Policymaking, application and assessment institutions.

### **1.2.3. Innovation in Education**

Education and training systems must undergo changes to become more innovative themselves and as a result, to enhance the contributions to science, technology and innovation systems. Because of these contributions, various factors must be taken into account such as school structure, resources, stakeholder involvement in learning environments, culture, curriculum, teaching methods and learning methodologies.

The importance of education and more generally of learning for innovation has emphasized by the EU and OECD in the last ten years. Besides, various studies have been conducted on innovation in education. In these studies, education and training are accepted as the determining factors in the potential for excellence, innovation, and competitiveness and reforms in education (Shapiro et al., 2007).

There are two basic perspectives in relation to innovation and educational organizations. The first perspective explains the role of educational organizations in innovation. In this perspective, national economic performance is explained as the performance of the national innovation system and education system has a vital role to play in this system, particularly vocational education and higher education. In the mainstream research and innovation policy literature, the role of education and training focuses particularly on quality, mobility, and availability of highly skilled people to perform research and engineering and specific skills for innovation such as innovation management and ICT skills, creative skills, the presence and/or lack of

specific entrepreneurial skills and attitudes in and the role of education in stimulating entrepreneurship. Education and training system must have the innovative characteristics and the school itself must be an innovative environment in order to play role effectively in national innovation system.

The second perspective, (related to the aim of this study as well), is related to innovation in structural and functional characteristics of educational organizations. In other words, it is related to organizational innovation. In this perspective, the fundamental change is needed in schools and school systems for revitalization of school organizations away from the bureaucratic and industrial model of education created for the 20<sup>th</sup> century.

### **1.3. Science and Technology Teaching in Secondary Education**

The literature on science education is diverse and the ultimate purpose of science education research is the improvement of science teaching and learning (Abell & Lederman, 2008).

In general, research on science education can be characterized as focusing on the development of scientific literacy. In the OECD/PISA framework, scientific literacy is the “capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity” (OECD, 2003b). Anderson (cited in Abell and Lederman, 2008, p.5) argued that the scientific literacy consists a sense agency in two senses. The first one is the “social agency” and the second one is the “agency in the material world.” In the first one, “successful learners of science can gain respect for their knowledge, skills that enable them to the useful work, and access to jobs and to communities”. In the second one,



“successful learners of science can describe and measure the world around them with precision, predict and explain phenomena and act effectively to influence natural and technological systems.” (Abell & Lederman, 2008, p.5)

Although today science and technology have become an integral part of our daily life and long history of science education, recent studies show that most students in schools are not achieving the scientific literacy (Abell & Lederman, 2008). Moreover, various international organizations are analyzing the decline or failure in science and technology teaching and various projects and actions are being implemented to reverse this trend.

In the last two decades, various activities and reforms have been conducted for knowledge-based society’s needs in Turkey. But, the Turkish Education System is still widely beyond the reach of this approach. There are wide differences between regions and school types. At this point, for science and technology teaching, Science High Schools are critically important for Turkey.

Ankara Science High School, the first science high school, was established in 1964 by supports of Ministry of National Education, Ford Foundation, Middle East Technical University and the USA Agency for International Development. This School was categorized as secondary educational institutions and subjected to special rule. The establishment aims of these schools can be listed as: (1) to educate the talented students in science and mathematics, (2) To educate the future genius scientists who are required by country’s science and technology, (3) To lead the students into the research areas, (4) To create learning and practice environments for student who interest the inventions, and (5) To provide the laboratory conditions for other secondary education institutions for developing their teaching conditions.

Today, the first three aims are the same in Science High School Regulation

and last two aims were changed as to educate persons who can use new technologies, can create new knowledge's and can prepare projects and to teach ideally a foreign language which students can use for making scientific research and following the scientific and technological developments.

Until 1982, there was only one Science High School in Turkey, Ankara Science High School. However, today, there are 95 Science High School in Turkey. In 2008, 5.978 applicants applied to university exam and 67,4 % of them were registered to undergraduate programs. There are not enough qualified teachers and appropriate learning environment by means of physical infrastructure and laboratory conditions for 95 Science High School in Turkey. As a result, today in Turkey, Science High Schools are completely separated from the establishment aims. Therefore, BSTHS is important by means of its innovative and alternative education approach for science and technology schooling.

#### **1.4. Purpose of the Study**

The purpose of this single case study is to investigate innovativeness practices in the context of a secondary educational organization, BSTHS. The study will document innovations, innovation processes and factors facilitating innovative practices at BSTHS.

The specific research questions of the study are as follows:

**Research Question1:** What are the innovative practices at BSTHS?

**Research Question2:** What are the factors facilitating innovation at BSTHS?

### **1.5. Significance of the Study**

Today's contemporary societies aim to develop their students for the 21st Century. The increasing interest in how people learn and in where students learn best is critical to educate people needed by knowledge economies and societies. Because of these expectations, many countries have invested significant resources aimed at transforming their education systems. Teacher training programs, and school systems restructuring are some of these investments (OECD, 2008).

Although today science and technology have become an integral part of our daily life, the apparent failure in science and technology education is evident according to various sources (i.e., Eurobarometer Surveys, PISA, ROSE, TIMSS). These studies have highlighted a decline in science and mathematics skills of young people. It is commonly agreed that an urgent action is required to address the current issues involving science, technology and science teaching and learning. There are 5 key reasons for global decline in the level of interest in science and technology. These were stated as difficulty in finding, training and retaining well-qualified science teachers, lack of resources devoted to science and science education globally, inappropriate teaching practices for new and emerging ways of doing science, public misconceptions of science and science careers and students disengagement because lack of relevancy of modern science curricula (Perth, 2007).

The decline or failure in science and technology teaching emerged as one of the basic concerns of governments. Therefore, numerous projects and actions are being implemented to reverse this trends and the number of publications focusing on education and training system as well as science education in the context of innovation.

This study is expected to inform theory, practice and research. On the one hand, there is lack of studies on innovation in educational organizations. In Turkey studies on innovation in educational organizations are even scarcer. Hence, this study will be one of the first attempts investigating innovations in educational organizations. However, in doing so theories and approaches developed for production organizations will be utilized. In other words, common innovation theories are applied to a unique service sector, education. Secondly, concerning practice, this study makes significant contribution to education systems both at micro and macro levels. At micro level the results both on innovation practices and factors facilitating innovation have potential to guide other schools in advancing innovation practices, and bringing structural and functional characteristics facilitating innovation. The results of the study are expected to document the role of leadership, the participative management and culture in innovation process.

Most of the reforms and improvement in Turkish Education System are related with the daily training applications such as curriculum, materials, and exams. In fact, all of these improvements are very eclectic and could not help to solve the problems of whole system. These reforms and improvements must cover the organizational changes in school level and the innovativeness must be put on the agenda. Moreover, the Turkish Education System and educational policies must correspond with Turkish Science Technology Systems and policies. The study is expected to provide insights into examining how effectively these new applications were carried out in the Turkish schools and what could be done to improve the school's administrative processes.

## 1.6. Definition of Terms

**Innovation:** “A new way of doing things that is commercialized. The process of innovation cannot be separated from a firm’s strategic and competitive context.” (Porter, 1990, p.780).

**Organizational Innovation:** “Organizational innovation refers to the creation or adoption of an idea or behavior new to the organization” (Fagerberg et al., 2005, p. 115)

**Diffusion of Innovation:** “Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with special type of communication, in that the messages are concerned with new ideas.” (Rogers, 1995, p.5)

**Learning Organization:** “Organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together” (Senge, 1990, p. 3)

**Networking:** The term “networking” refers to the systematic establishment and use of internal and external links between people, teams or organizations in order to improve performance (OECD, 2003a).

**Stakeholders:** Many educational networks bring together different stakeholders who, despite their different functional roles within the education system, respect each other professionally and perceive mutual exchange and collaboration as beneficial. Typical stakeholders in education networks are teachers, principals, universities, research institutions, government agencies and charitable foundations, consultants and trainers, evaluators and researchers, policy-makers (OECD, 2003a)

## **CHAPTER 2**

### **REVIEW OF LITERATURE**

This chapter presents a literature review on organizational innovation, innovation in education and innovativeness in science education. The chapter is organized as follows: it first deals with the organizational innovation and sources of innovation; second, it reviews innovation in education within systemic approach and in this part, networking, learning organization concept and ICT usage have been discussed as innovative applications in schools; third, it reviews the science and technology education and it analysis the relationship between educational innovation and science and technology education.

#### **2.1. Organizational Innovation**

In the literature, the definition of organizational innovation is uncertain. The organizational innovation generally means that the creation or adoption of a new idea or new behavior to the organization (Damanpour & Evan, 1984). Lam (2005) also argued that the existing literature on organizational innovation is very diverse and Lam (2005) stated that there are three main approaches in organizational innovation literature: Organizational design theories, organizational cognition and learning theories and finally organizational change and adaptation theories.

The first one is related to the literature on technological innovation. The unit of analysis in this literature is the organization. These studies generally define the impact of structural characteristics of an organization on product and process innovation. The second one is related to the literature on organizational cognition and learning. This approach analyzes the cognitive foundations of organizational innovation and it is related to learning and organizational knowledge creation process. Finally, in the third approach, innovation is considered as a capacity to respond changes in the external environment by means of organizational change and adaptation (Lam, 2005).

### **2.1.1. Organizational Structure and Innovation**

Lam (2005) has stated that the work of Weber on the bureaucracy and of Chandler on the multidivisional form has affected theories of innovation. The classical theory of organizational design was related to the idea of “one best way to organize”. On the other hand, the contingency theory has explained the diversity of organizational forms and their variations and the most appropriate structure for an organization is the one that best fits a given operating contingency such as scale of operation, technology or environment.

With respect to organizational innovation, Burns and Stalker (1961; cited in Lam, 2005: p.118) argued that there are two main firm types; mechanistic and organic. The mechanistic organization has a more rigid structure and is typically found where the environment is stable and predictable. On the other hand, the organic organization has a much more fluid set of arrangements and is an appropriate form of changing environmental conditions which require emergent and innovative responses.

On the other hand, Lawrence and Lorsch (1967, cited in Lam, 2005, p.119) argued that “organic and mechanic structures can coexist in different parts of the same organization owing to the different demands of the functional sub-environments”. Burns and Stalker’s model remains highly important analyzing the contemporary challenges facing many organizations with respect to organizational innovation.

Mintzberg (1979) has made another early contribution to organizational innovation. According to Mintzberg, for successful organization designs, organization’s structure needs to match its situation. He suggested that a series of archetypes that provide the basic structural configurations of firms operating in different environments. Mintzberg’s structural archetypes are simple structure, machinery bureaucracy, professional bureaucracy, divisional form and adhocracy.

The links between firm’s strategy, structure and the nature of innovation are another critical point for organizational structure. Teece (1998) argued that different organizational arrangements are appropriate for different types of competitive environments and innovation. According to Teece, there are two main types of innovation. The first one is autonomous and the second one is systemic. These two match with different organizational structures. On the other hand, Teece pointed out that both the formal (governance modes) and informal (cultures and values) structures as well as external networks, powerfully influence the rate and direction of innovative activities.

### **2.1.2. Organizational Cognition, Learning and Innovation**

The cognitively oriented literature in organization and management research is rooted in cognitive psychology. Lam (2005, p. 123) stated that “the term



'cognition' refers to the idea that individuals develop mental models, belief systems and knowledge structures that they use to perceive, construct and make sense of their worlds and to make decisions about what actions to take.” Understanding the role of cognition and organizational learning in fostering or inhibiting innovation becomes crucially important. In this perspective, an innovative organization is capable of learning effectively (Senge 1990), intelligent and creative (Woodman et al, 1993) and creates new knowledge (Nonaka, 1994).

Analyzing organizational innovation from the cognitive perspective shifts the approaches from organizational structures to the processes of organizational learning and knowledge creation. Lam (2005, p. 124) argued that “ innovation can be understood as a process of learning and knowledge creation through which new problems are defined and new knowledge is developed to solve them.”

To a large extent, the literature on organizational learning emphasizes the importance of social interaction, context and shared cognitive schemes for learning and knowledge creation. Nonaka's approach for organizational knowledge creation is based on the idea that shared cognition and collective learning generates the organizational knowledge creation (Nonaka, 1994; Nonaka & Takeuchi, 1995). The origin of this approach is based on Polanyi's argument on knowledge. Polanyi (1966, cited in Lam, 2005, p.125) suggested that a large part of human knowledge is subjective and tacit, and cannot be easily codified and transmitted. Nonaka (1994) argued that tacit knowing creates the origin of all human knowledge. Moreover, in this perspective, organizational knowledge creation is a process of mobilizing individual tacit knowledge and fostering its interaction with the explicit knowledge base of the firm. Durrance (1998) also argued that innovative organizations could reveal their own tacit knowledge from internal environment.

Collective learning and knowledge creation have taken place in various organizational and management researches. For example, Nonaka and Takeuchi (1995) have analyzed the knowledge creating company; Nelson and Winter (1982) have suggested the concept of organizational routines as a kind of collective knowledge rooted in shared norms and beliefs that helps joint-problem solving. Prahalad and Hamel (1990) suggested that the notion core competence which implies that the learning and knowledge creation activities of firms tend to be cumulative and path-dependent.

On the other hand, an organization is needed, in its learning processes, to maintain an external boundary and identity. Lam (2005, p.126) argued that “whereas knowledge creation is often a product of an organization's capability to recombine existing knowledge and generate new applications from its existing knowledge base, radically new learning tends to arise from contacts with those outside the organization who are in a better position to challenge existing perspectives and paradigms”.

According to results of empirical studies, Von Hippel (1988) and Lundvall (1992) based on their empirical research, argued that sources of innovation often lie outside an organization and learning processes are critically important for these sources. According to Callan (2004, p. 8), “the innovative organizations create a culture in which the *diversity* is a source of occasion and these organizations have 6 basic criteria as; “(1) The innovative organizations are learning organizations, (2) The innovative organizations have leaders who tolerate failure, (3) The innovative organizations can disclosure own innovative talents and innovators, (4) The innovators are supported and encouraged as well as awarded, (5) Networks are used, and (6) Teams and team-works are supported for innovation processes.”

Another important concept for learning organizations is networking. OECD report (2003a, p.33) stated that “the term ‘networking’ refers to the systematic establishment and the use of internal and external links between people, teams or organizations in order to improve performance.” In this definition, the key elements are systematic management, nodes as experts, teams and institutions, links as communication, interactions and coordination between nodes and finally performance improvement. According OECD report (2003a, p.35) network learning is attractive. Because “networks open access to a variety of sources of information, they offer a broader range of learning opportunities in contrast to hierarchical organizations, they offer a more flexible and more stable base for coordinated and interactive learning and they represent mechanisms for creating and accessing tacit knowledge.”

On the other hand, Lundvall and Borrás (1997, p.104) also recognized the instrumentality of networks in innovation and they argued that “more and more of the innovation processes takes place in networking as opposed to hierarchies and markets only a small minority of firms and organizations innovate alone, and... most innovations involve a multitude of organizations”.

### **2.1.3. Organizational Change and Innovation**

Change and innovation play an important role in organizations. Whether it is the development of a new product or process, the introduction of a new service, a technological invention that changes business processes or a new administrative practice, innovation and organizational change helps to decide for organizations strategy and structure.

Lam argued that the organizational change and innovation literature generally consists of three perspectives on the organizational change and adaptation. These are incremental/evolutionary view, punctuated equilibrium view and strategic adaptation and continuous change view (2005, p. 133). In the first one, the organizations respond slowly and incrementally to changes. The environments select organizations and this selection creates change in organizations. In the punctuated equilibrium view, suggests that “organizations evolve through long periods of incremental and evolutionary change punctuated by discontinuous or revolutionary change. And finally, third view stresses the management and learning processes indicating that “organizations are not always passive recipients of environmental forces but also have the power to influence and shape the environment”( 2005, p. 133)

Hage (1999, p. 598) suggested that “theoretically, research on organizational innovation opens new perspectives... including the issues of societal evolution and institutional change, the dynamics of knowledge societies and integration of macro and micro level analysis.”

## **2.2. Sources of Innovation**

Drucker (1985) has defined the seven specific sources of innovation from which innovation emerges. Four of them are found within an organization. Drucker has described these four sources as symptoms, and holds that they are “highly reliable indicators of changes that have already happened or can be made to happen with little effort” (p.35).

Sources within the organization include: (1) The unexpected – the unexpected success, the unexpected failure, the unexpected outside event; (2) The incongruity – between reality as it actually is and reality as it is assumed to be or as it “ought to

be”, (3) Innovation based on process need; and (4) Changes in industry structure or market structure that catches everyone unawares.

Sources external to the enterprise include: (1) Demographics; (2) Changes in perception mood and meaning; and (3) New knowledge, both scientific and unscientific.

Hargadon (2002) argued that intense, ongoing environmental scanning is fundamental to the concept of technology brokering and recombinant innovation. Recombinant innovation is simply “the notion that innovations can be seen as recombination of existing ideas” (Hargadon, 2002, p. 31). In addition, Hargadon has suggested that innovations are described using “terms like evolutionary versus revolutionary, incremental versus radical, continuous versus discontinuous” (p. 32).

Nelson and Winter (cited in Hargadon, 2002, p. 32) observed that “innovation in the economic system and indeed the creation of any sort of novelty in art, science, or practical life consists to a large extent of a recombination of conceptual and physical materials that were previously in existence”.

Christensen (1997) has discussed the sources of innovation as recombinant innovations and has defined most new technologies as breakthroughs that improve the performance of existing products. He argued that such innovations as sustaining technologies.

Byrd and Brown (2003) have identified seven drivers of creativity and risk-taking. Each of these characteristics enables innovative activity and these characteristics can be found in individuals and/or organizations. These characteristics are divided into those that support creativity (i.e., ambiguity, independence, inner-directedness, and uniqueness) and those that enable risk-taking (i.e., authenticity, resiliency, and self-acceptance).

Risk is a critical part of innovation and innovative organizations.

In related literature, risk taking and failure-tolerant leadership are related and failure-tolerant leaders help people overcome fear and in the process, create a culture of intelligent risk-taking, which leads to sustained innovation (Callan, 2004). Various case studies have suggested that highly competitive companies like Sony, Canon, 3M and Virgin have failure-tolerant leaders who tend to treat mistakes as an opportunity for organizational learning (Callan, 2004). On the other hand, teams are a major source for learning and creating innovation. Recent case studies point out such teams must draw upon expertise from across the organization (Callan, 2004).

### **2.3. Innovation in Education**

#### **2.3.1. Significance of Innovation in Education**

Recently, many countries have experienced a rapid transformation from an industrial to a knowledge economy, which is based on “the production and distribution of knowledge and information rather than the production and distribution of things” (Drucker, 1993, p.182). However, today, many scholars argued that that standard model schools were not aligned with the knowledge economy and many of today’s schools are not teaching the deep knowledge that underlies innovative activity. Three points can be made regarding how education systems generally deal with innovation. First, education in general and schools in particular are poor in knowledge management because many educational practices takes place in isolated class environments using old fashioned methods in bureaucratic organizations. Second, educational research and development is not given the support it needs to effect change and promote innovation. Third, much educational decisions making is preoccupied by the short-term with disincentives to innovate (OECD, 2008).

Today, education is on the agenda of almost all countries and various international organizations in a wide range. Various international organizations such as OECD, EU, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and World Bank (WB) have focused on educational innovation and have conducted many projects as well as published documents in recent years. These documents are very important because of their contemporary and multinational perspectives.

OECD Centre for Educational Research and Innovation is carrying a project which is called “21st Century Learning and Teaching: Innovative Learning Environment” in order to focus on teaching and learning at the micro-level as opposed to educational policies, management or organizational structures.

In USA, an innovation strategy document which is called ‘A Strategy for Innovation: Driving Towards Sustainable Growth and Quality Jobs’ was published by Executive Office of the President National Economic Council Office of Science and Technology Policy on September 2009. According to this document, in order to educate the next generation with 21st century knowledge and skills while creating a world-class workforce, “President B. Obama has proposed initiatives to dramatically improve teaching and learning in K-12 education, expand access to higher education and training, and promote student achievement and careers in science, technology, engineering, and mathematics fields.” (Executive Office of the President National Economic Council Office of Science and Technology Policy 2009, p. ii)

Shapiro et al. (2007) argued that the education system must contribute to innovation system and must create an effective learning environment for young generations; of course, in order to enhance the contribution of education to innovation, education and training systems must be more innovative themselves.

Therefore, the structure, resources, stakeholders involvement in learning environments, culture, teaching methods, learning methodologies must be taken into account for innovative environment in schools.

To prepare students for the 21<sup>st</sup> Century, secondary school educators must be armed with the knowledge and understanding of what it means to be successful in knowledge based society and empowered to act in response to changing environments. Teachers and administrators need to be prepared to cultivate not just academic standards but the attitudes, technical skills and global mind-sets necessary to be citizens of this new world (NCREL, 2003; Stewart & Kagan, 2005)

NCREL (2003) offers four skills clusters to provide the public, business and industry, and educators what is needed by students, citizens, and workers in the digital age. These are listed as: (1) Digital-age literacy (Basic literacy, scientific literacy, economic literacy, technological literacy, visual literacy, information literacy, multicultural literacy, global awareness), (2) Inventive thinking (Adaptability and managing complexity, self-direction, curiosity, creativity, risk taking, higher-order thinking), (3) Effective communication (Teaming and collaboration, interpersonal skills, personnel responsibility, social and civic responsibility, interactive communication) and (4) High productivity (Prioritizing, planning, and managing for results, effective use of real-world tools, ability to produce relevant and high quality products).

### **2.3.2. Knowledge Creation, Knowledge Management and Networking in Education**

In the 21<sup>st</sup> century, the roles of the managers are to manage and constitute flexible constructions as well as manage systematic and unsystematic conditions for



learning organization (Tetenbaum, 1998). On the other hand, leaders in educational institution need to have leadership actions and thinking structures such as acting in proactively, having a vision, being a transformational leader, managing change, risks and crisis in order to exist in a knowledge or a postmodern society (Aytaç, 2000). At this point, “managing human knowledge might be emerged as a critical dimension of organizational survival” and “knowledge is often taken as the basis for what an organization does in order to survive” (Harris, 2008; p.219).

Nonaka and Takeuchi (1995: p.84) argued that the organization moves from tacit knowledge to explicit knowledge by “sharing, creating concepts, justifying concepts, building an archetype, and cross-leveling knowledge”. Hargreaves (1999) has discussed the relevance to education and to school effectiveness and improvement of the knowledge management field, drawing upon Nonaka and Takeuchi’s book in particular. Hargreaves (2003, p. 17) argued that the “virtuous circle of co-construction” is at the heart of a culture of personalized learning” and Hargreaves suggested that co-construction places less emphasis “on the teacher having to take account of the learner as a knowledge constructor and more on the need for the teacher to treat the learner as an active partner in the jointly constructed activity of learning and teaching co-construction” (p. 17).

As another source of learning and knowledge creation in educational organizations is networking. The literature on learning organizations highlights how professional networks can constitute the infrastructure for new knowledge and new learning (Harris, 2008).

Senge (1990, p. 13) has defined learning organizations as “Organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective

aspiration is set free, and where people are continually learning to learn together.”

According to Senge, a learning organization has five basic characteristics. These are system thinking, personal mastery, mental models, a shared vision and team learning. Senge (1990, p. 10) argued that “team learning is vital because team, not individuals, are the fundamental learning unit in modern organizations... unless teams can learn, the organizations cannot learn.”

Stoll and Louis (2007, cited in Harris, 2008, p. 221) suggested that “learning can no longer be left to individuals. To be successful in a changing and increasingly complex world, it is suggested that school communities need to work and learn together in networks of practice to take charge of change, finding the best ways to enhance young people’s learning.”

Hargreaves (2003, p.9) suggested that “a network increases the pool of ideas on which any member can draw” and that “networks extend and enlarge the communities of practice with enormous potential benefits”.

Hite, Williams & Baugh (2005) have examined a public school administrator network from a qualitative paradigm by means of network theory and methods. In their findings, four distinct networks have emerged from administrator’s relationship and these are the innovative network, the resources network, the social/emotional support network and the university-school partnership network. Hite et al. (2005, p.114-115) argued that “within the four networks pathways were not equally accessible to all administrators and they suggested that “ to increase network and organizational effectiveness, educational leaders need to strategically understand, monitor, and manage the structure of these network relationships and the pathways they create.

### **2.3.3. Systemic Innovation in Education**

Most literature on innovation in education defines innovation as the implementation not only of new ideas, knowledge and practices but also of improved ideas, knowledge and practices (Kostoff, 2003). In this respect, innovation could be differentiated from reform or change, in other words, the level of change related with the innovation might be classified as incremental, radical and systematic. According to OECD report (2009, p.66) these innovation types can be defined as incremental innovation, radical innovation and systemic innovation (2009, p.66). “Incremental innovation is related with small changes to existing services or processes”. “Radical innovation is related with the introduction of new services or ways of “doing things” in relation to process or service delivery”. And finally, “systemic innovation is related with new workforce structures, organizational types, and inter-organizational relationships, aiming to improve the overall performance of a system.”

Various studies argued that innovations in education and training are generally incremental. However, Anderson and Helms (2001) emphasized the need to examine reform efforts systematically to understand the successful reform. The systemic change paradigm in education was led by Banathy (1991; cited in OECD 2009a, p. 67) and popularized by Reigeluth et al. (1993: cited in OECD 2009a, p. 67) Their main aim was to understand the nested interdependencies among system components that allow the system to function and systemic innovation depends on ensuring stakeholder involvements, designing for ideal and understanding interrelationships.

#### **2.3.4. Information and Communication Technology (ICT) Usage in Education**

In the late 20<sup>th</sup> century technology become cheaper, faster and more accessible with such innovations as fax machine, e-mail, desktop publishing, laptop computers, cellular phones and the increased used of the Internet. People now use the Internet for business transactions, shopping, entertainment, information searches, communication and learning. Recently, fiber optic cable currently serve high speed and low-cost connection; digitalization of data and transmission of ideas make it possible for more people's collaboration and communication in different places of the world. These and other developments in technology have created whole new markets and careers, while eliminating entire occupations and dramatically changing most existing jobs and almost all jobs today require computer skills ( NCREL, 2003; Stewart & Kagan, 2005).

In education, computers are used in two broad contexts: (1) to provide computer skills' training, and (2) to provide technology supported learning in which computers are used to enhance teaching and learning methods, strategies and activities. There is neither a strong, well-developed theoretical case nor much empirical evidence, supporting the expected benefits accruing from the ICT in schools (Kirkpatrick and Cuban, 1998). The study carried out by Machin, McNally & Silva (2006) has found a positive effect of the use of ICT on educational attainment. However, the research carried out by Goolsbee and Guryan (2002; cited OECD 2009b, p. 34) has found no positive correlation between the use of ICT and educational results, once other factors, such as school characteristics or socio-economic background, are taken into account.

On the other hand, Kozma (2008; cited OECD 2009b, p. 51) argued that ICT is one of the most important potential sources of systemic innovation in education and he has identified four alternatives for justifying the ICT investments in education: (1) To support economic growth by developing the human capital and the increasing the productivity of the workforce, (2) To promote social development by sharing knowledge, encouraging cultural creativity, increasing democratic participation, improving access to government services, (3) To advance education reform and (4) To support educational management and accountability.

Additionally, Kozma (2008; cited OECD 2009b, p. 52) identified five components in order to realize the ICT vision in the context of operational policies as: (1) Infrastructure development, (2) Teacher training, (3) Technical support, both in terms of assistance to teachers to connect hardware and software as well as for integration of ICT and curricular subjects, (4) Pedagogical and curricular change for information skills, thinking skills and creativity, communication skills, knowledge application skills, self-management skills and (5) Content development because of the country uniqueness in curriculum.

## **2.4. Innovativeness In Science and Technology Education**

### **2.4.1. History of Science Education**

In 1867, The British Academy for the Advancement of Science (BAAS) has published a report and in this report BAAS has promoted teaching of “pure science” and training of “scientific habit of mind”. BAAS has pointed out separately training in secondary science education in order to prepare future BAAS members. After this report, in 1870, science education has begun in secondary education in the UK (Layton, 1981).

In the US, as a result of a conference of leading secondary and college educators in 1892, the National Education Association appointed a committee that is called “Committee of Ten” and it had authority to organize future meetings and appoint subjects matter committees of the major subjects taught in American secondary schools. After various studies of this committee, many changes has realized in US schools. For science education, the curriculum has been largely changed and the classical courses of Greek have been replaced by biology, chemistry and physics in most high schools (Jenkins, 1985).

Before 1900, science was viewed as a body of knowledge that students were to learn through direct instruction. But, in 1909, John Dewey argued that science is more than a body of knowledge and a process or method is needed to learn it. Between the 1950s and 1960s, Joseph Schwab was an important educator for science education and he argued that science should be viewed as conceptual structures that were revised as a result of new evidence. His view proposed that teacher should present science as inquiry and students should use inquiry to learn science. The perspectives and works of Joseph Schaub, John Dewey, Jerome Bruner and Jean Piaget, and others influenced the science teaching especially for curriculum materials (National Research Council, 2008).

In 1996, the U.S. National Academy of Sciences published the ‘National Science Education Standards’. The approaches of these standards are based on inquiry-based science and on the theory of constructivism, in other words, learning theory. Today’s widespread approaches on science and technology education, reforms and projects are based on the above historical perspectives. There are many approaches to the definition of effective science teaching and learning that are described in the literature.

#### **2.4.2. Innovativeness in Science and Technology Education**

Recent researches show that most students in schools are not achieving the scientific literacy among countries worldwide and researchers in science education generally point out that “institutions of formal education do not help most students to learn science with understanding” (Abell & Lederman, 2008, p. 5). Moreover, various international organizations are analyzing the decline or failure in science and technology teaching. On the other hand, concerns about maintaining a scientifically workforce for the emerging high-tech and knowledge based economy, coupled with high hopes for educational potential of ICT have increased science and technology issues into prominence in the education debate in the 1990s.

The 56<sup>th</sup> Annual Conference of the Australian Science Teachers Association (ASTA) was held in Perth in 2007. At the end of the Conference, the delegates have agreed that urgent action is required to address the current issues involving science, technology, science teaching and learning and the engagement of student in science. The five key reasons have been stated for global decline science teaching (The Perth Declaration on Science and Technology Education, 2007, p.1). These are: (1) “Difficulty finding, training and retaining well-qualified science teachers; (2) Lack of resources devoted to science and science education globally; (3) Teaching practice that generally does not reflect new and emerging ways of doing science, (4) Public misconceptions of science and science careers and (4) Perceived lack of relevancy of modern science curricula resulting in student disengagement”.

Recently, many studies on different aspects of science and technology education have conducted all over the world and especially in OECD countries. There are different research subjects in science and technology education such as science

learning, culture, gender society and science learning relationship, science teaching, curriculum and assessment in science and science teacher education.

In these areas, inquiry has been prominent subject of science curriculum improvements efforts and it is still most important and widely accepted issue in science and technology education (Anderson, 2008: cited in Abell & Lederman, 2008). School principals, other educational administrators and teacher leaders such as department chairs are essential links in effective and inquiry based science and technology teaching. Various research evidence gathered over many years points to the importance of leadership from principals and other administrators in improving the quality of teaching and learning in schools. Support, guidance and leadership are vital if teachers are to make major shifts from a traditional didactic style of teaching to one that alternative style (Prather, 1996). On the other hand, teaching science technology through inquiry requires a new way of engaging students in learning. Therefore, it requires that all educators take on the role of change agents and to foster the changes in teaching required by inquiry based approach, administrators and other leaders need to provide a wide array of support from opportunities to learn, to material and equipment, to moral support, encouragement, etc. (National Research Council, 2008).

In Australia, School Innovation in Science (SIS) has been started as Victorian Government Initiative at the end of the 1990s. The initiative was developed and rolled out to more than 400 schools over the period 2000-2004. The aim of the research phase of SIS was to develop and trial a model for improving science teaching and learning in schools. In 2000, the researchers have worked with 27 schools to develop, refine, and test their School Innovation Model which consisted of the SIS Components and the SIS Strategy. The SIS Components was a framework



for describing effective science teaching and learning and the SIS Strategy was the process by which schools can improve their science teaching and learning.

Through the three research years, tests of student learning outcomes, attitudes and perceptions have been used to monitor progress and outcomes. Additionally the researchers have collected the qualitative data, which provide the information about how the project progressed in schools, the processes of teacher and school change.

As a result, the SIS components were described as (Tytler, 2009, p.1781): (1)

“Encouraging active engagement with ideas and evidence; (2) Challenging students to develop meaningful understandings; (3) Linking science with students lives and interests; (4) Catering for individual students learning need; (5) Embedding assessment within the science learning strategy; (6) Representing the nature of science in its different aspects; (7) Linking science with the broader community; and (8) Exploiting learning technologies for their learning potentials

Tytler (2009, p.1805) argued that;

“...Effective science teaching and learning must be framed more widely... Including for instance attention to student engagement, students’ lives and perspectives and interests, and the nature of schooling more generally including its relation to community... the culture of science teaching and learning in primary compared with secondary schools is very different, and teacher needs and patterns of change differ accordingly... teacher learning proceeds most effectively when situated within school-based professional learning teams, and can be effectively supported through a variety of experiences including reflection on practice, workshops, shared discussions and action research, and mentor support, the science team and its leadership is a critical factor in achieving fundamental change in teaching and learning.”.

Davis (2003) examined the needs to be considered in order to support teachers’ learning of new and innovative teaching practices at Fort Sheridan Middle School. Participants of the researches were science teachers, students and administrators. The findings of the study indicated that the goals and plans for

educational change need to be constructed by school communities comprised cooperative teams of teachers, students, parents, administrators and outside experts; the daily questions, knowledge, beliefs, skills, approaches, and talk of both teachers and students must be considered in curriculum; just like for students, teacher's learning activities must begin with their knowledge, beliefs and skills. In sum, educational leaders must recognize the many factors that are critical to the success of reform, including the ways and practices that support teacher learning as well as the obstacles that can inhibit its progress.

## **2.5. Summary of the Literature**

Crucial importance of gaining competence in innovation for countries regarding economic growth and social development has been intensely discussed last twenty years. Within that context, several researches and studies on innovation at various levels have been conducted, thus the literature on innovation fastly increased. Innovation in connection with education has also been discussed in both academic circles and international institutions since 10 years, and several researches have been conducted in that area. And behind that interest lies the fact that industrialized countries have achieved the economic growth and competition based on technological innovation. Newly industrializing countries also follow a similar path.

One of the most important points here is the need of an innovative education system and an innovative school structuring that will grow up human resources necessary for the establishment of an innovative science and technology system. It has been argued that the school structuring that emerged following the industrial revolution had lost its influence in today's information society, in other words remained insufficient.

The literature emphasize the need for revitalization school organizations away from the bureaucratic models of education and these should be changed with flexible and more professional models appropriate for the 21<sup>st</sup> century. In this context, the role of organizational change, leadership, networking, partnerships, learning organization and knowledge management are the critical topics for educational innovation.

Moreover, another important topic in the literature on innovation in education is related to the use of communication technologies in education. In that context, ever changing student profile, alternative means of learning, long distance education opportunities, information becoming relatively more accessible and technology becoming more cheap and accessible versus teachers adopting themselves relatively slower to the technological developments is another important topic of debate in that area.

As a result, school as an education institution should systematically take its place within the innovative science and technology system, and acquire a structure, which is more flexible regarding changes, open to diversity and should be a place that gives diversity an opportunity to flourish.

## **CHAPTER 3**

### **METHODOLOGY**

In this chapter, firstly the research questions are stated. Secondly, detailed information about participants is given. Then, the instrument of this study is introduced and data collection and analysis procedures are explained extensively. Finally, the measures taken to ensure the trustworthiness of the study are presented at the end of this chapter.

#### **3.1. Overall Design of the Study**

The study was designed as a case study and it analyzed the BSTHS as a single case. According to Yin (1994, p.20), the central components of the a case study design are a study's questions, its propositions, its unit of analyses, the logic linking the data to the propositions and the criteria for interpreting the findings. The study's questions are usually "how" and "why" and these questions are helpful in focusing the study's goals. The unit analysis defines what the case is and this can be groups, organizations or countries. Case studies can be either multiple cases or single case. Single cases are used to confirm or challenge a theory, or to represent a unique or extreme case (Yin, 1994). In this context, as mentioned above, this study is a single case study because the BSTHS is unique case in Turkish Education Systems.

Additionally, this study's aims to find the sources of innovativeness of the School and to represent a unique case.

There were three main data sources for this study. First, one-to-one interviews with the participants. Second, document analysis was conducted. School's brochure, the web site of the school, and students and teachers handbooks were analyzed. The third data collection source was unstructured observations.

### **3.2. Research Questions**

This study aimed to investigate the innovation practices and managerial factors contributing to innovativeness at a secondary school, Bahçeşehir Science and Technology High School (BSTHS). The study is documenting innovations and factors facilitating innovative practices at BSTHS. Considering this broad purpose, the specific research questions of the study are as follows:

**Research Question1:** What are the innovative practices at the BSTHS?

**Research Question2:** What are the factors facilitating innovation at the BSTHS?

### **3.3. The Case: Bahçeşehir Science and Technology High School**

This study was conducted in a secondary school, Bahçeşehir Science and Technology High School. BSTHS, with its completely unique and new school model secured holds a distinctive place within the Turkish Education System. The School model has been applied since four years. The curriculum applied in collaboration with the Bahçeşehir University. BSTHS collaborates with various national and international institutions. The School uses information technologies for institutional purpose widely. The Science Museum can be considered as another element of BSTHS' innovativeness. Regarding general conditions of the present science high

schools in Turkey and the problems in science and technology education, the model of BSTHS is an example worth to investigate.

The BSTHS started education and learning as a Science High school in 2006 under Uğur Education Institutions. Main target of the school is growing up youngsters who will constitute the engine of the country in science and technology. The Bahçeşehir College and BSTHS give education at old buildings of the Bahçeşehir University. The Science Museum is also located in the same campus.

The school accepted 40 students in its first academic year, however decreased the number of enrolled students to 24 following years since they could not get the support they expected from private sector and other institutions. Today, 112 students receive education in School and the were accepted to the School based on their SBS examination results. That is a science high school preferred by students with highest scores in this examination since two years. School administration accepts students having a tendency to make an academic carrier only in the areas of science and mathematics.

The School is located in Bahçeşehir in İstanbul province. Bahçeşehir region is a settlement area, which is a safe environment that has been granted several awards in the area of “Satellite City” in contests organized by the European Union. As mentioned above, the School is located at the old building in Bahçeşehir University campus and it is atypical regarding its architectural aspects compared to other primary and secondary schools. Classes and laboratories are well lit, comfortable and equipped with necessary technological infrastructure. The School being located in a public housing area is a safe place, isolated from the city of İstanbul. 95 % of the students are accommodated in dormitories just next to the School. The dormitory consists of triplex housing units where students have an opportunity to live in rooms

for 2 to 4 people. Sometimes teachers also stay at the dormitories and conduct projects and other activities with the students during off-school times. That vicinity also gives an opportunity to students to benefit from the School library and laboratories on a 24-hours basis. In addition, caretakers responsible of the dormitory fulfill other needs of students such as laundry, ironing and dormitory cleaning.

Teachers are given offices, in which each teacher has a desk and a PC. The course program is planned in a way to allow spare time to teachers to prepare for the courses. Teachers are encouraged to use all the potential of the technological infrastructure.

BSTHS and Bahçeşehir College give educational services in the same building. Each college has a director, but heads of departments are the same person in two colleges. The two colleges also share the same deputy directors.

Authority and responsibility of head of departments are clearly defined. They have authority regarding the management and trouble shooting in their respective departments. They are given a considerable responsibility in the selection of teachers to their departments, in the creation of course syllabus and in organizing the division of labor.

Selection of science and mathematics teachers who will work at BSTHS is based on different criteria. Effective use of technology, good command of English, openness to research and learning and being a good team player are skills that are taken into consideration in the selection of those teachers. Extracurricular courses out of the science high school curriculum defined by the Ministry of National Education, are mainly given by the academic staff of the Bahçeşehir University.

In addition to that some more teachers can be recruited who have project experience in the area of Science Olympics.

All students accepted to the BSTHS are granted nonrefundable scholarships covering 100 % of expenses. This scholarship covers education fees as well as meal, accommodation, computer and stipend. In addition, students attend several trips and education programs at national and international levels throughout their education life at the college. Financial source of those scholarships are Uğur Education Institutions as well as various private sector institutions and foundations.

Bahçeşehir Science Museum is a very important example as being an innovative rapprochement of the School and is unique initiative. Because it has been created by student and teachers in school building and there is no another science museum like this in the world.

### **3.4. Participants**

The interviews were conducted with a group of 17 participants. This group consists all of the administrators, science and mathematics teachers and four students. BSTHS is a relatively new and small school. Therefore, it was possible to interview with all administrators, science and mathematics teachers. Table 3.1. presents the list of participants.



Table 3.1. The distribution of participants

<i>Groups</i>	<i>Participants</i>	<i>Frequency</i>
Administrators	General Manager (Female)	1
	School principle (Male)	1
	Head of math department (Female)	1
	Head of science department (Female)	1
Teachers	Math teachers (2 female, 2 male)	4
	Biology teachers (1female, 1 male)	2
	Physics teachers (female)	1
	Chemistry teachers (1 female, 1 male)	2
Students	Females (10 <sup>th</sup> grade and 11 <sup>th</sup> )	2
	Males (11 <sup>th</sup> grade)	2

Each participant was given a code. Coding the data files contributed to make the data analysis, write up processes systematically. Regarding all of the varieties among the participants of this study, the following tables give the detailed information about each of them.

Table 3.2. Professional background of participants

<i>Participants (Code)</i>	<i>Professional Background</i>
General Manager (GM)	METU Department of Foreign Language undergraduate; METU Educational Sciences PhD
School principle (SP)	METU Department of Foreign Language undergraduate; METU Educational Sciences MSc
Head of math department (HM)	METU Department of Mathematics undergraduate,
Head of science department (HS)	Marmara University Department of Physic Education undergraduate; Marmara University Department of Physic MSc
Math teacher - 1 (M1)	METU Department of Mathematics Education, undergraduate
Math teacher - 2 (M2)	METU Department of Mathematics Education, undergraduate
Math teacher - 3 (M3)	Marmara University Department of Mathematics Education, undergraduate
Math teacher - 4 (M4)	METU Department of Mathematics Education, undergraduate
Biology teacher – 1 (B1)	Marmara University Department of Biology Education, undergraduate
Biology teachers – 2 (B2)	Marmara University Department of Biology Education, undergraduate
Physics teacher (P1)	METU Department of Physics Education, undergraduate
Chemistry teacher -1 (C1)	Boğaziçi University Department of Chemistry Education, undergraduate
Chemistry teacher – 2 (C1)	Marmara University Department of Chemistry Education, undergraduate

Table 3.3. Professional work experience of participants

<i>Participants (Code)</i>	<i>Total Work Experience Duration</i>	<i>Work Experience Duration In BSTHS</i>
General Manager (GM)	13	4
School principle (SP)	13	4
Head of math department (HM)	19	4
Head of science department (HS)	19	4
Math teacher - 1 (M1)	20	1
Math teacher - 2 (M2)	19	1
Math teacher - 3 (M3)	21	4
Math teacher - 4 (M4)	10	1
Biology teacher – 1 (B1)	13	3
Biology teachers – 2 (B2)	10	1
Physics teacher (P1)	15	2
Chemistry teacher -1 (C1)	19	1
Chemistry teacher – 2 (C1)	12	1

As indicated in the tables, teachers and administrators are the graduates of three different universities. All of them are relatively young and their average of age is approximately 40. Most of them have job experiences in different schools in public/private sector. General Manager of the School is the first school principle and she has the job experience in Bahçeşehir University as academician.

### **3.5. Data Collection Instruments**

In this study, semi-structured interviews and observations were conducted as data collection techniques. Documents are also collected as data.

#### **3.5.1. Interviews**

Semi-structured interviews were the main data source of this study (see Appendix A). As indicated above 17 participants from administrative positions,

teachers and students participated in the study. For each of these groups a different interview guide was developed. Although the main questions in the interview guides remained the same, each guide covered different questions to reveal different perspectives and experiences of each group of participants. The interview guides for the administrators, teachers and students respectively covered 25, 22, and 9 questions.

Administrators and teachers were initially asked to define and discuss the innovation concept, dynamics and sources of innovation and leadership in school. Secondly, their perceptions and evaluations on various innovative applications related with organizational innovation literature, asked to discuss and give information such as innovative curriculum, relationships with stakeholders, diffusion of innovation, characteristics of human resources, rewarding-punishment mechanisms, social and professional interactions, knowledge sharing, communication, motivation, to be learning organization and participation to decisions processes.

Student participants were initially asked to discuss their perceptions on school and school's applications such as curriculum, teaching methods and ICT usage in teaching and participation to decisions processes. Secondly, their perceptions and evaluations to be student of BSTHS and values, which have acquired in school, were discussed and evaluated. See Appendix B for details about the interview guides.

### **3.5.2. Document Analysis**

Different documents informing about innovative practices and depicting the factors facilitating these innovative practices were identified and then reviewed.

These documents are school brochures, regulation about science high schools and additional decision for BSTHS extra-curricular program, Teacher Handbook, Student Handbook and School website.

Teacher and student handbooks are booklets in order to facilitate orientation of teachers and students to the School. Teacher's Handbook includes the approach, vision and program of the Uğur Education Institutions; awarding and punishment mechanisms applied in its schools and duties and responsibilities of its employees. Whereas Student's Handbook includes a description of the School, school and dormitory rules and awarding and punishment mechanisms. School brochures covers clear information on the vision and strategy of the School, as well as detailed information on the physical infrastructure of the School.

### **3.5.3. Field Notes**

The third qualitative data collection technique employed in this study was observation technique. The observations conducted in this study aimed to understand the values and behaviors illustrating innovations in the School environment; to understand the culture of School; and to document academic and (teaching-learning) and administrative (e.g., communication, knowledge sharing) processes in relation to innovativeness. These practices helped the researcher to demonstrate prolonged engagement with the case, which is necessary to collect trustworthy data set. Places and types of observation made by the researcher are: (1) A two-hours biology course with 10<sup>th</sup> grade students, (2) Genetics Science Training taken by school biology teachers. This three-days training consisted of theoretical and laboratory application sections, (3) Work offices of science and mathematics teachers where the researcher used time to time during her school visits or where she conducted informal

interviews, (4) A visit to the Science Museum together with two students, (5) Spending time with teachers and students during school visits at the lunchtime at the refectory, and (6) Interviews with the School administration and teachers at the School during design process of the three-days training given to the teachers by the institution of the researcher. All observations took place at the beginning of June, at the end of September and beginning of October. The researcher wrote her observations as field notes during this period.

### **3.6. Data Collection Procedure**

Before data collection process, all necessary documents have been presented to the METU's Human Subjects Ethics Committee to get their permission to conduct this study (See Appendix C). Subsequently the researcher got directly in touch with the School administration to get an appointment during which she presented information about her research and got necessary permission. The School administration, all teachers and other employees were extremely helpful to the researcher both at beginning stages and throughout the research.

The head of the Science Department organized time schedule of the interviews with the teachers and students. Interviews with the head of departments, teachers and students were conducted in an empty class and mathematics laboratory, whereas the ones with the General Director and School Director at their offices. Average duration of the interviews with the teachers and students were 45 minutes; whereas, the ones with the School administrators took around 90 minutes. All interviews were conducted and recorded at the end of September and beginning of October.

### **3.7. Data Analysis Procedure**

The collected data set was used to answer research questions. Before transcription, the researcher listened to the interviews in order to signify the data. Afterwards, the recorded interviews were transcribed verbatim and made ready for content analysis. However, before coding the researcher read the data, again in order to have a good understanding of the data set. Then the data set was subjected to content analysis. Before coding the data set, an initial code list was developed to guide coding procedure. Considering the research questions and innovation literature developed the initial code list. Afterwards, a pilot coding was conducted by use of the initial code list. The researcher together with the second experienced researcher coded one of the written transcripts chosen randomly. When this phase was finished by both coders, the researcher compared her coded data with the second coder's coded data in order to see whether their coded line segments and codes addressed a consistency. This effort resulted as successful and the initial code list proved to be effective in coding the data. Using the initial code list, the rest of the data set was coded by the researcher.

After the coding stage, the common themes were identified. The findings are presented in detail in the findings chapter of the research.

### **3.8. Quality of the Research**

Several measures were conducted in order to ensure the trustworthiness of the data set. The “objectivity of the researcher” is an important issue in qualitative studies. In this study, both in data collection and data analysis a second researcher served as a peer reviewer in all of the steps. For example, the researcher asked the questions directly to the participants without leading them to any other topic or

judging them under any circumstances. While making them feel as peaceful in such an environment, participants could tell their ideas about the questions and researcher gave the guarantee that she recorded the data as the interview was going continuously unless the participant asked for an interruption. The researcher audiotaped data and this provided the research with full account of participants' expressions. All of the participants were given the opportunity to quit and express his/her ideas of-the-record, when they feel uncomfortable about the question. Codes were first formed with another researcher in the field of educational administration and planning. In addition, a pilot coding with a second coder was conducted and then the coding results were compared in order to secure high inter-coder rate. After writing the report, the findings were checked by a second researcher, which served as a "peer review" process as described by Creswell (2007).

In these peer-debriefing sessions, the second researcher monitored the researcher and they discussed the interview experiences, their effectiveness, and the process to reach participants.

One other factor namely "thick description" which can be defined as mentioning about the setting, participants and the context overall of the study, was also used in order to provide the validity of the study (Patton, 2002). In this study the context of the study was a BSTHS. The topic of the study is innovativeness, which is a complex managerial issue. Describing innovative practices and factors facilitating innovativeness requires thick description. In this study, different innovative practices and factors facilitating innovativeness are described in details.

The interview protocol which was described above in detail could be said to cover major issues related with the general objectives of this study as the majority of the participants thought the content of the interview protocol overlaps with the



research questions and aims of the study very well. In this manner, the interview protocol was a considerably comprehensive data collection tool regarding all of the issues in innovativeness in BSTHS. While designing the research, as a first attempt, it was thought that data collection methods should be agreed that they could generate rich responses to the research questions of this study. Since the participants were directed open-ended interview questions concerning their perspectives, in order to strengthen the validity of the study were collected as to show the relations behind the participants' perspectives. By means of these documents, it was aimed to see whether the innovative facts, which participants talked about, were reflected in BSTHS.

Another measure to ensure trustworthiness of the data is using different data collection techniques. In this study, not only interviews but also document analyses as well as observations were conducted in data collection process. Hence, employing multiple data collection techniques helped to ensure triangulation of data sources (Creswell, 2007; Patton, 2002).

Finally, the researcher accomplished prolonged engagement with the case. Average duration of the interviews with the teachers and students were 45 minutes; whereas, the ones with the School administrators took around 90 minutes. There was no problem with time limits during the interviews and all interviewees replied the questions in detail. All interviews were arranged within a 3 weeks period, based on time schedules of the administrators and teachers and the researcher visited the school five times to complete the interviews. The school administration provided the researcher with necessary physical conditions in order to conduct interviews in a comfortable environment. School administration and all employees were extremely supportive to the researcher throughout the research process. Positive communication between the School administration and teachers, and the work environment giving a

high motivation to everyone facilitated the communication between the researcher and participants.

All participants of the research shared their opinions in an extremely open and frank manner without having a time limitation problem. They accompanied the researcher during her visits, providing her all necessary information. They also collaborated with the researcher during design process of the training given to the 3 teachers parallel to this research, which made the observation of the professionalism of the School and high motivation of the teachers possible.

### **3.9. Limitations of the Study**

In this study 17 interviewees were participated in the study. Although members in administrative position and teachers in science and mathematics field are fully participated, teachers in other fields and students may not be equally participated in the study. In addition, in this study three qualitative data collection techniques are implemented. However, the majority of the data leaned towards the interviews and less towards the observations and document analyses. Innovation is a complex process, which may require equal employment of all three techniques.

## **CHAPTER 4**

### **FINDINGS**

The purpose of the study was to investigate innovativeness and managerial dynamics behind innovativeness at BSTHS in the context of science teaching. This section presents innovation practices and analyzes the managerial conditions enabling innovations at BSTHS.

Innovation practices were classified as academic innovations, managerial innovations and Science Museum. On the other hand, conditions enabling innovations were analyzed according to vision and mission of the school, leadership, innovations in human resource policies, students, financial resources, technological resources, physical infrastructure and social interaction.

#### **4.1. Innovations Practices for Bahçeşehir Science and Technology High School**

The findings suggest that BSTHS is a unique case in Turkish Educational System and the School itself is an innovative implementation for science education at secondary education level in Turkey. It can be argued that the School was established with an innovative philosophy. Its mission, its name (science and technology high

school), providing scholarships for all of its students, physical infrastructure (including laboratories and buildings), and its collaboration with private sector and its parent university are some of the aspects which reflect its innovative philosophy. In this section all innovative practices and findings are presented.

#### **4.1.1. Innovations in Academic Domain**

The findings showed that BSTHS has many innovative implementations in teaching-learning practices. The teaching and learning approaches described by management team can be analyzed in the context of alternative education. One of the aims of BSTHS is to be alternative model for state science teaching at secondary school level. The findings resulted that BSTHS has innovative curriculum and has relatively a flexible program of study, which, to a large extent, is based on individual student's interests and needs.

Additionally, in Turkey, traditional vision of schooling prepares students for industrialized economy of the 20th century and the goals of standard model of schools tendency to ensure standardization. In this approach, all students are expected to learn the same core curriculum and the target is to enter into the university through getting a high score in the University Entrance Examination. However, BSTHS has unique vision and as stated in school brochure, aims to educate the students who create country's future by science and technology. The main target of the School has stated in school brochure as "... our one of the most important target is to be model for current science high school by our innovative education program and teaching methodology..."

In this section, BSTHS's academic innovations findings are presented by means of establishment aim, school model, curriculum, technology usage in

teaching, following new trends in education, individual based teaching system and social responsibility approach.

In summary, according to findings of research, the innovativeness in academic domain is reflected on the mission and vision of the Schools. The School is trying to implement a different approach in teaching-learning practices in science and technology teaching.

#### *4.1.1.1. Establishment Aim and New School Model*

The most important establishment aim of BSTHS, as indicated above, is to be new and alternative model for Science High School which is state-provided mainstream education for science and technology teaching. The interview results suggested that at the establishment stage, the aim was to establish the standard science high schools. But, in this period, the management team has visited most of the science high schools in Turkey and some education institutes in USA, Europe and South Korea. During these visits, they have stopped the establishment activities in Turkey and they have returned with a new school model. Their model has basically based on Thomas Jefferson High School for Science and Technology. This school has established in 1985 in USA as result of partnership of businesses and schools has created to improve education in science, mathematics, and technology.

The interview results suggested that the purpose of the founders of Bahçeşehir Science and Technology High School was to educate future scientists and the new school model which is created by management team, was based on a new scientist's definition. According to them, the scientist is not only academically successful but also creative, intellectual, open-minded and aware the society's needs and conditions.

Almost all of the participants (the management team, the teachers and also students) stated that BSTHS is a project to create scientifically and technologically developed country. The general manager of school stated that:

“ ... Why we established this school? To educate future scientists who pave the way of country... our most important aim is that to educate scientists who are needed by our country? ... We must produce our technology and the number of patents must increase in our country...” (GM)

Interviews with students point to the fact that they are extremely aware of the School vision and have internalized that vision. First student stated that as follows:

“For instance, previously in our conversation we’ve just mentioned about being beneficial to our country. We are receiving an education here, thus one of our aims must be contributing to the welfare of our country. That is an idea continuously given to us at school... Of course since the beginning, we have been talking about being scientists; when we say “being a scientist” we mean being people doing beneficial things for the country... I want to be in the future one of the people leading both the education and technology of the country. I develop my aim in this line. Yet this school was one of the biggest factors in that...” (S1)

#### *4.1.1.2. The Curriculum at Bahçeşehir Science and Technology High School*

The interview results suggested that BSTHS’s curriculum is certainly new and innovative curriculum. Both the content and implementation makes it different from the curriculum implemented in other science schools at secondary level. Concerning the content, there are many different courses. Compared to a traditional science high school, it is difficult to observe such variety in the content of curriculum of a traditional science high school. More importantly, these courses are provided by Bahçeşehir University instructors. See Appendix D for details about course programs. The new courses are: (1) Introduction to information and communication technologies, (2) Introduction to computer sciences, (3) Computer networks, (4) Mechatronic systems and applications, (5) Programming with V.B. Net, (6) Programming with Java, (7) Web programming, (8) Basis of engineering and technology, (9) Computer aided design, (10) Genetics, (11) Introduction to

information society, (12) Seminar for science and technology, (13) History of science, and finally (14) Statistics.

The interviews with the top management of the School suggest that a committee which was consisted of founders of school, management team and instructors from Bahçeşehir University has decided to provide extra curricular courses. The interviews also suggest that the School has benchmarked with other science and technology high schools in developed countries. However, the interviewees argued that in addition to benchmarking the necessities of knowledge-based society were also considered in developing what they called innovative curriculum. It is also indicated that Ministry of National Education (MONE) has recognized these innovations. The extracurricular lessons have been accepted by MONE Education and Training Board (MEB Talim ve Terbiye Kurulu) and published in the *Tebliğler Dergisi* in April 2006.

According to the interview results it can be said that those extra-curriculum courses help students increasing awareness in science and technology, and beyond that, they help them to find their own orientations and decide on their university education areas. School Principal states the following regarding this topic:

“There are a couple of courses in our curriculum. There is currently no other school in Turkey giving those courses. I mean design and modeling based on Information Technologies; introduction to genetics etc. Moreover we introduce to the students some areas such as mechatronics etc. What is important here is that students get a clear knowledge about some areas that they might target in their future academic careers, at such an early stage, without having being obliged to make a firm decision for the moment? In other words they can ask: ‘OK, mechatronics sounds interesting, but is it really the area I want to pursue in future?’ and they have an opportunity here to get an answer to that question and thus to change their minds or go on with the so-called area...” (SP)

Additionally, according to the student interview results, students have extremely positive opinions about such alternative courses thanks to the fact that they

take them from the Bahçeşehir University academic staff. For example second student interviewee stated that as follows:

“For instance yesterday we had a course of introduction to the mechanical systems, that is a new technology course recently included to the curriculum. Three teachers from the Bahçeşehir University give that course. The thing is that those teachers are practically working at the university on the topics they give to us during the course. Explaining things you are already doing is one thing, things you have read from a book is another thing. These two are so different. That is the advantage of taking courses from the university teachers...” (S2)

Other novelty is related to the way the curriculum delivered. According to the common practice at the School, external people who are successful in their fields are invited to the School and deliver lectures or whole courses to students. For example, the dean of Kent University Technology Faculty, a member of Science Board of Bahçeşehir Science and Technology High School, has given lessons for two semester to students, when he came to Turkey in his sabbatical period. In the same way, other Science Board members have conducted a seminar in their visiting periods. These kinds of activities are regularly organized for students.

Another novelty in delivery of the curriculum is giving an opportunity of external visits to the students. For example, in 2009, 15 students have visited various laboratories and Science Park in South Korea. In 2010, the students are going to visit to North Western University International Institute of Nanotechnology Laboratories located in USA. In addition, the students are given the chance of visiting all science and technology fairs which are organized in İstanbul. They participate various seminars and programs such as Policy School, Entrepreneurship Programs at their parent university, Bahçeşehir University. The interview results and document analyses suggest that in addition to the planning of the committee, the School opens itself to the suggestions and needs of the students. In order to identify students' needs and expectations survey asking students' vocational preferences is applied. Based on



the results, the students are given internships opportunities in organizations (e.g., university, hospital) related to their vocational preferences. This practice suggests that the School implements an effective policy in combining guidance and curriculum implementation.

Finally, the lesson of entrepreneurship is given in the last year of school and in this lesson; all students develop a product and a marketing strategy for this product.

According to the interviewees, this lesson is the realization of the innovative culture and philosophy of the Schools.

#### *4.1.1.3. Individual Based Teaching System*

BSTHS uses a model called Individual Based Teaching System like other Bahçeşehir Schools do as well. The findings suggested that this system based on following three main stages.

The first stage is finding the right education style for the student. This system has been controlling and upgrading by Director of Creative Learning Center of Bahçeşehir Colleges who developed personal learning styles tests. Students take these tests and as a result those are possible feedbacks to make creative solutions on processing the education style: Students behaviors for beginning to study, the approaches takes on the difficulties, the stability of studying, concentration, being able to multitasking or not, the preferences of studying groups, the preference of studying with authorities, preference of an environment, preference of studying hours, the way of percept the knowledge. The students' workshops and reinforcement apart from the studies are developed through results of those tests, which has been mentioned above.

The second stage is called Smart Measurement and Learning Support System (AKORD), which is brought and developed by Bahçeşehir Uğur Education Foundations and based on works of Prof. Kikumi Tatsuoka. AKORD is a web-based system which helps to the students to process on their lack of conceptions, to identifying misunderstandings and the difficulties of learning. As a result feedbacks are made by those system and conducts to activities of learning.

The third stage underlies on Bahçeşehir TV, which is based on technology, electronically learning system has been included to this system with Bahçeşehir TV. The students can repeat and strengthens the subjects regardless of time and place. This can be considered as a micro-level online education approach. Bahçeşehir TV is not a system to lays on tests and subject statements. Students have their own specific data reserved on data bank of the School. Students can reach the information about test results, the rate of successfulness and the tests which have been taken can be reached by a student to work on their process of studying and developing the success level. After the lecturing, student take a test about the previous topic has been lectured. The success rates are saved on databanks to compare the future performance of the students. These tests and lectures repeat again until students reach the desired level of success. The information about students is shared for both teachers and the consultants.

#### *4.1.1.4. Technology Usage in Teaching*

Information and communication technologies open up new possibilities for effective learning and can affect the knowledge creation and learning processes in a number of different ways. The findings suggested that at Bahçeşehir Science and

Technology High School, management team, teachers and students were aware of the importance of technology usage in educational processes. Moreover, the interview results suggested that Information and Communication Technologies (ICT) are extensively being used in lessons and smart-boards with all facilities is being used effectively in all classrooms and laboratories by teachers and all teachers have been trained to use the smart-boards in service-training programs.

The chemistry teacher argued that the source of innovation in BSTHS is the usage of technology in teaching processes. He said that:

“Technology can only serve to innovation if you can incorporate technology into your approach to education; if you can use technology as a tool to direct him/her throughout his/her learning process and if you can put the student at the center. As you might know, there are also technological tools at state schools, there are also people using them, however they use them based on very classical methods. They would not be innovative. It is highly probable that they completely use them as a projection screen... I do know that they don't use those tools as efficient and productive as we use, let me say. Smart board is a genuinely beautiful tool, especially for innovative things. Here we use it very nicely, I think that we exhaust smart board's full potential. We, as the science department design and give our courses completely based on the smart board technology, taking what it can provide us into account.” (C1)

In addition, the interviews show that not only teachers use above mentioned technologies in education, but the students also generate education materials using those technologies. For instance second student interviewees gave the following two examples:

“We are able to use programming languages as well as flash programs produced by macromedia. For example I had prepared a multimedia material in a biology course and my teacher had given that course using my material... I had been assigned a project, my mathematics term paper. I proposed designing a mathematical calculator, a scientific calculator. I used C Shop programming language, a program we'd learned last year. I had designed a calculator which also had a logarithmic function. That program will be installed to a new computer bought for the mathematics lab. Forthcoming students will use my program...” (S2)

The findings suggested that in teacher recruitment and performance evaluation, computer literacy is one the most important criteria for evaluating

teachers and effective usage of computer in teaching and learning processes are expected from teachers.

Particularly, the interview results suggested that the School principal is critical person for information and communication technologies usage and applications in the School. He is very competent in information and communication technologies (ICT) and he is aware of all facilities of these technologies in school environment such as reducing the need for physical proximity, possibilities for creative interaction, capacity to gather and create information. The findings suggested that his competency on ICT positively effects his relations with students and his competency in use of technology makes him a model for other teachers.

In addition, all of the students have their own laptop and these laptops are being served as a part of scholarship of the School. In addition to the hardware, wireless internet connection is available in all settings of the School.

#### *4.1.1.5. Continuous Improvement at Bahçeşehir Science and Technology High School*

The findings suggested that BSTHS's management team entirely and properly have recognized the necessities of knowledge based societies and current educational approaches for science and technology systems. General manager and school principal stated that the management team visits many educational institutions from developed countries such as USA, South Korea, Japan and European countries every year. The general manager said that:

“ ... We are visiting to different institutions in order to see differences, different implementations and positive effects of these implementations. We are trying to evaluate these implementations. We usually visit the educational institutions from USA, South Korea, Chine and European countries and in these trips we met some science and technology high schools from USA and South Korea... In fact, in these

trips, we examined that who is the scientist, how does s/he get ready for science, how does s/he educated? Because we believe that the basis of these questions must be answered before university and we found the answers in these schools...” (GM)

The interview results suggested that the importance of educational innovation and the necessity of educational innovation to improve school environment were understood in administrative level in school. The School Principal stated,

“When we say innovation, we mean presenting new trends and new developments in education technologies to students by incorporating those to the present innovative course technologies. In other words we mean preparing the student to the need of the era...” (SP)

The findings showed that Bahçeşehir Uğur Education Foundation’s subsidiary institution Center of Innovative Education Research (CIER) is always support the BSTHS for innovative teaching and learning environment by training programs, and developing new models. The findings suggested that the teachers regularly participate to in-service trainings every year in order to follow new developments in education and up-to-date their competencies. For example, in December 3- 5, 2009, they participated in a seminar, which was delivered by Prof. Dr. Norman G. Lederman, the chair of Department of Mathematics and Science Education in Illinois Institute of Technology and is former president of the National Association for Research in Science Teaching. He is also editor of the Journal School Science and Mathematics. This seminar was about ‘scientific inquiry’ and ‘action research’.

#### *4.1.1.6. Social Responsibility Approach*

The findings suggested that social responsibility emerged as one of the core values at BSTHS and this value is aligned with the historical development of the sponsor of BSTHS, Bahçeşehir Education Foundation. Bahçeşehir Education Foundation has a long history grounds on for 40 years. It has been started with

Private Educational Classrooms, and then is evolved to İstanbul Bahçeşehir College in 1994-1995 and Bahçeşehir University followed this in 1998. In the terms of 2006-2007, BSTHS started the education with a wise vision built on unique school model and with % 100 scholarship accepted for students as a social responsibility. The actions and projects make BSTHS as a site of social responsibility in Turkey can be summarized as: (1) All the students hold a % 100 scholarships with no refunding in any conditions and (2) Except of being built on this unique school model, there are other activities represented behalf of community services, such as: Science Museum, The Colors of the Science Activity, Astronomy Nights and Criminology Week etc.

According to interview results, approximately 12.000 students have visited Science Museum and The Colors of the Science Event first held in 2009. To this event, 140 teachers attended throughout Istanbul, all the meal and the transportation were served for free. Daily Schedule started in the morning, as a part of the event a current scientific topic opened for discussing in the conference with a special guest, later in the afternoon there had been some practical workshops for the attendees.

The findings suggested that the social responsibility approach has taken place in school curriculum. For instance, every student has been given a chance for processing and carrying a social responsibility project. In this context students make kermes, revenues of which had helped an elementary school to built its computer laboratory and another school for restoring the rest rooms. Within this context, the School Principal stated

“... for instance students organized charity fairs last years, they raised funds by selling local food they brought and refurbished the toilet of a primary school. They also constructed a computer lab for another primary school. We encourage children for such things as much as we can. They also had an activity with Mor Çatı women’s organization, they supported that NGO. We have organized 10 to 12 fairs for charity purposes to collect funds to support institutions, neighboring schools and people.”  
(SP)

Additionally, the first student stated

“...we take education from this school, one of the main aims is to make our country a better place to live, to contribute to its welfare. This aim is something continuously given to us at school. Here we are not only raised as good scientists, but also as people who will push forward this society one more step. We are asked even today to realize some social responsibility projects. For instance we organize charity fairs, we give support to various schools with the funds we raise during those organizations...”

According to interview results, the core idea behind social responsibility activities of the School and the foundation is teaching future generations the importance of taking responsibility toward the society and contribute to the development of the society as a whole.

#### **4.1.2. Managerial Innovations**

The findings suggested that BSTHS has various innovative managerial practices. The interview results showed that the processes of organizational learning and knowledge creation can be seen in managerial processes of the BSTHS. Moreover, the team working is a critical component for their management approach.

The School principal mentioned about the principles of the differences and the advantages that put the School on very unique and innovative position. He stated that:

“...the features make us different than rest of the educational organizations, those features, the specialties are first we do the self criticism we make connection very wide and open with each employee whose working with us, and we take issues to find a way to make solutions from them, we do this as a team, as a creative and open to the new and better ways. Therefore we developed into a new perspective to make our skills grow with breakthrough ideas. Sharing, and be open to the developments of the future, those are our key specialties...” (SP)

Head of Math Department stated that “the source of innovativeness is to grow more on a higher educational level each year, the truth of the choice that have been

made by the students, and the sustainability of the specialties and skills, so we can see all those turn into advantages to make a more qualified education area with the competitive.”

In this section, the innovative management approach and applications of BSTHS were explained by means of strategic management, learning organization, networking, corporate culture, diffusion of innovation and Blue Ribbon Award.

#### *4.1.2.1. Strategic Management*

The findings suggested that the main strategy of the BSTHS is to develop qualified human resource for science. Within this context, the vision of school has been defined as: “To educate young people who has vision to contribute to the universal science of our country among global technology leaders with International standards of scientific study and education of the future direction of technology.”

The interview results suggested that according to the vision, the goals have been set right after the process of doing SWOT analysis under the leadership of the general manager in the establishment period and those goals are frequently controlled and updated by management.

#### *4.1.2.2. Learning Organization*

Interviews with the administrators and teachers show that Bahçeşehir Science and Technology College established itself as a learning organization. First of all establishment of the School as an alternative science and technology high school has been a result of a learning process. Presented model is in line with developments in the contemporary world, and with the needs of the country.



Beyond that, interview results imply that education institutions from all around the modern world are being continuously followed and that on-the-job training of the teachers is given much importance.

All the education and science exhibitions are supported for visiting to reach the desired level and knowledge of teachers. Administrators and teachers stated that teachers have to improve themselves continuously because of the high profile students enrolled to the School. For instance the second biology teacher said the following about the School's teachers: "They are just like the students, the science school students, they are trying to make a difference. Everyone is conscious about this fact: I must not be static. If I am static then I must not work in this school..."

Additionally, math teacher and another biology teacher stated that: "certainly we are in a learning organization, because otherwise not possible" and "institutions as being different, as a teacher you are also making a difference..."

Physics teacher also stated that teamwork and sharing is very important in this process, and said, "We are really very participative in general sense. When someone needs something, someone else responds quickly, even he/she doesn't say a word."

Head of Science Department argued that despite of the English education is continued in Turkey for years, textbooks according to the curriculum, are not written. She stated that teachers and lecture notes, which were written over time and laboratory manuals, are gathered and improved by the time and they were made into textbooks in Bahçeşehir Colleges. These books are still in the preparatory phase and in 2010 will be printed in Bahçeşehir Publications.

She also mentioned that school library books and periodicals for teachers are taken regularly and teachers have to develop themselves at every opportunity, they work

hard and develop their course content consistently. The School's model and student profile has made it mandatory.

The interview results suggested that team work, participatory management approach and institutions sharing of knowledge are extremely caring and possibilities of the characteristics of schools are created and over time this approach has given very positive results and has created its own output. Science Museum, both for administrators and teachers, as well as for students has been a real learning process. Starting from this experience, the School has launched a new initiative to set up a Children's Museum.

Finally the General Manager made the following evaluation regarding the reason behind the learning quality of the organization:

“I think the reason is our being able to self-criticize, to be in an open communication with everyone and to question open heartedly some issues during our routine meetings in which everybody attends as a team. Our skills such as creativeness, innovativeness, in other words ability to think from different perspectives are well developed. Sharing, in other words our beings open to development, our being personally open to development... I think those are our key characteristics.” (GM)

#### *4.1.2.3. Corporate Culture*

Interviews conducted with the participants indicate that the BSTHS developed a corporate culture. Teamwork, open door policy, participatory management approach, continuous development and innovativeness are basic aspects of the dynamics of that corporate culture. The General Manager explained that approach as follows:

“It is a must that you have a corporate culture in order to generate innovative ideas. You must have a suitable environment for that culture. In other words, such ideas cannot be flourished easily in every institution, and are not considered positively when flourished. As a matter of fact our organization at large, i.e. Bahçeşehir Uğur Education Institutions are innovative. Therefore it is not surprising that such ideas flourish here. In that sense we adopted a participatory management approach at all levels with all our employees. We do encourage and support all our employees to produce new ideas, continuously, that is to say every teacher working here knows

very well that in order to be a good Bahçeşehir College employee or Bahçeşehir Uğur Education Institutions employee they have to be innovative, different, always generating new ideas. They all know that they have to.” (GM)

#### *4.1.2.4. Networking*

Interviews show that BSTHS established well-defined systematic relations with various national and international institutions and organizations. Those relations have a critical importance regarding the development, sustainability and diffusion of the School model.

First of all, the research results demonstrate that the internal network among Uğur Education Institutions had an utmost importance regarding the sustainability of the established innovative model. There is a continuous communication among Bahçeşehir Colleges and Uğur Private Teaching Institutions all around Turkey, an aspect that helps the promotion and visibility of the School, providing the teacher needs etc. The Bahçeşehir University is essential in the application of the model.

Science High Schools in Turkey continue their teaching activities without cooperation with a university even though it is a requirement by regulation. But at the BSTHS’s model, universities and private sector cooperation is required. In this regard the General Manager of the School as expressed in the following school model and that of the original and the new power of this highly depends on cooperation:

“...in this condition there’s a necessity of collaboration. The current science high schools can provide their programs without featuring a university. But it is not possible to do so in Bahçeşehir Science and Technology High School, we take the students by choosing them, all of them have the scholarship, so we cooperate with business world, we made them to believe this dream and this project, the students have the chance to get full scholarship by support of them...” (GM)

The findings suggested that in this cooperation the private sector organizations support the financial issues on domestic and international visits of the

students, to make opportunities for internship, developing the projects and building school laboratories. For example the Genetic Laboratory of the School has been established by support of German Hospital, in the procurement of computers and computer labs for students with the creation of Casper, Intel, Cisco, etc. provide the necessary support.

And finally, Science Board members of the School are international and competent persons in their fields. The Board Members are Stevens Institute of Technology from the USA, President and Dean of the Faculty of Technology at the Kent State University from the USA, President of the South Korea Myongji University, served a Turkish professor at the Montana State University Physics, Vice President at the Bahçeşehir University, Bahçeşehir University General Secretary and Director of Technology Development Center at the Bahçeşehir University. Such a Science Board, established to be an indicator of international relations and the network, as well as visits to these countries and facilitate their visit to the laboratory also has a feature.

#### *4.1.2.5. Diffusion of Innovations*

Research findings point to the fact that the model established by the BSTHS, and its innovative environment, created a positive influence both inside and outside the School. In a sense, that positive influence can be considered to be diffusion of innovativeness.

In spite of its short past (of four years), the School is now most preferred school in SBS (Assessment Test), among all science high schools. According to the interview results the reason behind that is the School's success and opportunities. That result lead to the becoming of the School model a prominent example. School

Principal stated that some private schools in Istanbul started a similar initiative and got in touch with the BSTHS for this end. He explained their support to those schools as follows:

“... Institutions that achieved a certain level come to us. We show them around the School. We answer their questions about our programs. If they request addresses, we help them getting appointments with them, we direct them to those people...” (SP)

Similarly, the Science Museum also has emerged as an innovative product, therefore various municipalities and schools have started their preparations for setting up such a museum.

This diffusion effect is not only the outward looking; it shows itself within the School. For example, the efforts of creating a children's museum is about to be concluded in school by the science museum experience. On the other hand, this experience encourages and motivates both teachers and students to innovation. This school biology teacher described as followed below: “It is something in between teacher-student and manager triangle. Not only teachers, students also in the business of science museum which has brought me a very innovative approach.”

These practices have a significant effect on the students. Science Museum holds a critical importance to create their own innovation capacity and new projects to be represented. They have already focused on future work that will be done in the country's science and technology system will contribute to the work to do, based on the museum experience, success in the international platform and also the effects of courses taken by the Bahçeşehir University faculty members.

#### *4.1.2.6. Blue Ribbon Award*

In addition to these managerial characteristics, the School got the Blue Ribbon Award. This is for the success of the School in managerial processes and

applications. The Blue Ribbon Lighthouse School Award is a recognition program for schools in USA designed by Blue Ribbon Schools of Excellence, Inc.

During interviews with the School administrators and teachers, they told that having been awarded Blue Ribbon is a sign that the School model is considered within international standards, which in turn helps sustaining the very standards that constituted the justification for the grant of that award.

Bahçeşehir Colleges is the first international school, which is awarded this award.

This can be considered as an accreditation process for the School. This award proves that the School managerially performs at the level equivalent schools abroad.

Schools are identified and selected for this award based on achievement of excellent performance in following nine major categories of the Blueprint for Excellence:

Student focus and support, school organization and culture, challenging standards and curriculum, active teaching and learning, technology integration, professional community, leadership and educational vitality, school, family and community partnerships and indicators of success.

The findings suggested that that the critical and distinctive characteristics of Bahçeşehir Colleges, which observed in the evaluation, process can be listed as:

Individual based teaching model (KÖS), AKORD: Smart Measurement and Evaluation System, Bahçeşehir TV, technology usage, Science Museum, Class-Mate Mobile School Computer, effective language teaching, successes in national and international platforms, mentor teachers, classrooms and laboratories, social responsibility projects and voluntariness, cultural and social development activities, continuous teacher trainings and safety in school environment.

### 4.1.3. Science Museum

The findings suggested that Bahçeşehir Science Museum is a very important example as being an innovative rapprochement of the School. The Bahçeşehir Science Museum is unique initiative. Because it has been created by student and teachers in school building and there is no another science museum like this in the world.

Interview results suggest that the Museum is highly valued by everyone at the School. They take that experience as the most important sign of the innovative aspect of their school. During the interview conducted with the first biology teacher, he expressed that as follows:

“That is something going on inside the teacher-student-administrator triangle. Not only the teacher, nor the administrator, but the student is also in the game... the Science Museum is also in the game. All helped me to adopt an innovative approach. Why? Look, let’s say we are producing an object for our school, everyone have a finger in that object. Can you imagine, let’s say you are a student and have a share in such a formation. Tomorrow that student will grow up, occupy a position somewhere and will say ‘I have not only studied, I have not only read books, not only prepared to the exams, I physically made this and that at that corner of that building of my school and I did it.’ When he/she will become a high level manager for instance, I believe that will contribute his/her standing much. According to me, you cannot give such things to the student via books.” (B1)

The museum has several tools and workstations aiming students to explore the scientific world. Students can test and learn several facts of science and physics at the interactive stations and research labs. There is also a Planetarium, sky observation station, and a 3-D movie theater for scientific educational films.

The interview results suggested that Science Museum is also a tool for inquiry based science education so that the student projects are exhibited in science museum. The third student interviewee explained that with the following words:

“Our teachers assign us projects. Our projects are exhibited in our Science Museum. For instance I made a mathematics project last year, you must have already seen the Science Museum. That is in fact a museum based on ideas and projects of students. My last year’s project will be exhibited at the Science Museum this year for example. It has been built completely with the labor of the students. Perhaps you

have seen a planetarium there. At the very beginning we had built it using cardboards. We had cut triangles, glued them, made a dummy...” (S3)

Most importantly, the BSTHS earns money from this initiative by consultancy to municipality and other private schools to establish their own science museum. In this consultancy process, students are working and present their experiences. The School principle stated that:

“We made in Beşiktaş, in Karşıyaka. There are a couple of more projects. I think they are also discussing with Diyarbakır, in the past they discussed with the Samsun Municipality as well. We do nothing outside school; we get all our incomes here. But since we have several schools, we have some small companies providing logistics to those schools. We have a company called Bahçeşehir Construction for instance. That company started to take care of such works. However the fund is completely ours, for we do the consulting job... Now we are constructing a new museum based on the experience we got from the Science Museum. We are building a Children’s Museum in our primary education section.” (SP)

As a result, this museum is very important for managers, teachers and especially for students as a new products which is created by themselves as well as it encourages them for new projects and successes.

## **4.2. Conditions Enabling Innovations in Bahçeşehir Science and Technology High School**

In this section, the findings on the managerial characteristics enabled innovations at the School are presented.

### **4.2.1. Vision and Mission of the School**

Research findings indicate that the founders find a change in the education systems compulsory for scientific and technological change. Here is a fragment from the School brochure related to this argument:

“Fast scientific and technological developments of our age affect the society and education systems just like the economic system. Today information and technology became the key to societal and economic development. It is not enough for societies



only to follow and adopt new technological developments. Societal and economical developments oblige the production of new technologies in a country. Bahçeşehir Science and Technology College aims at raising young people who will be the engine of our country in science and technology. Young people who will receive an education from our school will step into today's highest science and technology environment, equipped to shape the future... One of our biggest aims is to produce an example to existing science high schools, with our innovative education program and system..."

BSTHS's vision is defined as: "To educate young people who has vision to contribute to the universal science of our country among global technology leaders with international standards of scientific study and education of the future direction of technology."

Interviews and observations at the School show that this approach haven't remained on the paper but successfully applied, and internalized by the administrators, teachers, even students. This can be observed in the descriptions of the student interviewees of their school. They described their school within the frame of the School vision and strategies. For example the first student interviewee described that as follows:

"They do things in science, but in theory, then it turns out to be beneficial only in a limited manner as long as you cannot translate it to technology. And for instance you want to contribute to your country, producing a brand new technology using current scientific theory will be more beneficial to your country... Our school gives both science as a base and technology that comes afterwards which is far more important... For example I study Physics, and I would like to pursue my further studies in the area of Applied Physics. In the name of producing new technologies. Our high school gives both of them: Scientific base and following steps..." (S1)

Additionally, the findings suggested that the innovative vision and mission are manifested in the culture of the School. The success of the School is not considered as individual success but as an institutional success. The development of this culture is not only related to BSTHS, as being Bahçeşehir Education Foundations there is 40 year old history has been taken seriously and the other foundation schools that spread across the country. The School principal summarized his approaches below:

“... to create more innovative ideas there needs to be a proper institution culture for that... So Bahçeşehir Education Foundations are already indicating that innovation. It is not surprising to have those radical ideas in here. We encourage and support our employee for creating new ideas, you have to be innovative if you want to join Uğur Education Foundations...” (SP)

Teachers feel belongingness for this foundation and they expressed their satisfaction with these foundations. Third mathematics teacher interviewee stated the following:

“None of the Schools I worked for in the past was as visible in the media as Bahçeşehir. Besides, those were also important schools of Istanbul that had proved themselves with their achievements. However Bahçeşehir established itself with its achievements and difference. That is a school that proved its individuality. You can conceive what I say as advertisement. But I don't think so. I am very happy being working in this school.” (M3)

And also second chemistry teacher said that everybody does something to create a product or an idea and not forcibly, just sincerely, and she added that all of those leave a positive impact on her.

#### **4.2.2. Leadership**

The findings suggested that BSTHS, 40 years old background lays on the educational experience or a new product with a more accurate expression can be regarded as a new educational organization. Beside school administration and other factors, school's founders take an important place for this innovative organization to arise. The interviews show the leadership qualities of the founder whom can be regarded as a true educational entrepreneur. For example, Head of the Science Department express it as followed below:

“...Innovation comes from our founder. In fact, this is a matter of nature and the Founder has the appropriate personality. He follows the developments and also wants to contribute to country. He is so motivated into that ... if you listen to him, you feel motivated and excited. Therefore, our team believes in him. The projects that we have done are useful for Turkey, we also make big movements for education...” (HS)

This approach emerges exactly same way with the teachers, managers and the students who have been interviewed in school. For example the second biology teacher interviewee expressed her opinion about the founder as the source of innovativeness of the School as follows:

“BSTHS is an innovative school. First of all its name and its student profile make it different. More importantly, its curriculum is different. What the students do, opportunities given them... All of them come from the founder of the School, having a different point of view...” (B2)

The first chemistry teacher interviewee summarized the characteristics of the founder of the School as a leader as follows:

“We are talking about a private sector institution and its founder is a person who invested every single penny he won to education... he is in constant investigation, thus being open to innovation comes from this fact, he is very keen to investigate new things, and when he finds something out and if he finds that meaningful, he is very quick in implementing, and making people implement it. I, as an educator always felt the lack of it, he also feels the same; as a matter of fact he also has a professional background in the area of education, so does his wife. I think that he found out ways of doing better things via his investments in education...” (C1)

Teachers and students also made extremely positive statements during interviews regarding not only the founder but also the General Manager, School Principal and head of departments. Teachers stated that they basically work in close contact with head of departments, and solve their problems with their help.

According to the interview results, team members regard head of departments as good team leaders. Teachers stated in that context that head of departments identify problems and expectations correctly, take the initiative when necessary, and they did not have any troubles in solving problems and communication in general. Moreover, teachers think that all school administrators are well equipped, qualified people, and that they perform their duties very well. In addition to that, many teachers said that their leaders are very effective in defining duties and responsibilities as well as the expectations. The first mathematics teacher interviewee, when asked about

leadership said the following: “They know very well what they want and they identify that very clearly.” (M1)

The findings suggested that the principal is perceived as a role model. In the use of ICT, communication and guidance to students shows school's understanding of an appropriate model and the main purpose is to establish a democratic and participatory environment in the School. The second chemistry teachers stated that:

“Principal said that they could be helpful on providing the teachers’ web-blog in case of they would like it to be changed. The attitudes of those issues are extremely evolving. They say; you can do it if you would like to and we can improve you on those” rather than saying; “don’t you know?” (C2)

Besides findings also indicate that the founder, General Manager and School Principal were are very influential on students as well. It was observed that the main reason for this positive approach was open and intimate communication environment. Interviewees expressed that during interviews as well. The fourth student interviewee stated the following:

“... when I first came here to see the School, Barış showed me around, then we went to Teacher Tolga’s office, he was then our Assistant Manager. He explained the School to me, I’ve listened to his very words about what they wanted to give to students. Then we came across Teacher Sinem on the way. Barış kissed her, Teacher Sinem is like, how should I say, maybe it’s going to sound a bit classic, but she acted as if he was his son. There is such a system here. And our teachers are like that... one cannot know everything. One cannot follow daily events every day. Let’s say we are sitting at the classroom, something happens, we ask our teacher: ‘Have you heard about that?’... Maybe he/she haven’t read, nor heard, says, ‘Is it so?’ and listens to you. They don’t deny things like that. They investigate, look if it really happened or not. In the next class, he/she says, ‘Yes you’re right, there is such a thing, and the logic is like this and that.’ They give you a right to speak. The attitude is not like ‘you can’t know anything, I am the teacher, I know better than you do.’” (S4)

#### *4.2.2.1. Participative Leadership*

Interview results with members of top management suggest that the leadership at the School adopted a participatory management approach. Meetings with teachers and students regularly, sharing information related to the performance

of the School as well as personal information, and giving feedback and suggestions are elements of the participatory leadership. The General Manager's approach on this subject follows below:

“...I deliberately tried to do something is to be participative. My biggest goal for everyone to create a working environment can be peaceful and I think I can achieve it. To encourage innovation ... We are trying to create a learning institution ... The most important thing is a participatory management...” (GM)

The middle manager implements a different decision making process. For example, when hiring teachers they make the first interviews with teachers then decisions are forwarded to top management. Teachers who have been hired are potentially the ones accepted by heads of departments. Department heads receive comments and suggestions of teachers at the weekly meetings, and emerging problems and their solutions are transmitted to the top management in the case of necessity or in weekly meetings. Particularly the inclusion of students on various decision making process is remarkable.

Science Museum is a product as a result of students' involvement for processes. The principal of the School summarize his approaches below:

“...Therefore this year, students who have lived in places they are given a set of speech rights. Just as we have done in the heads of departments, deputy director of itself and we also have meetings with our students from time to time. For example if there is going to be something get shopped for school, like a outside company will advertise... we integrate many students as possible in it, so that how our museum came up...” (SP)

Students have a highly specific place on introducing the School. They take an active role on helping the visitors such as parents or students to visit Science museum and the School. Interviewed students indicated that participative management is a very positive influence after they visit the Science Museum and they are extremely effective on choosing the School. Finally, the students take an

important role on presentation and sales of the Science museum. The third student interviewee expressed the importance of that practice for them as follows:

“When I came first to the School, Barış accompanied me. It is important to hear things from students themselves; as a matter of fact students live in this environment. That’s why our school makes presentations every year; they organize demo programs to encourage newcomers to prefer our school. And students take part in those organizations.” (S3)

Another example for student participation is seen in menu choices for lunch and dinner. School administration has created a board with students and they send the menu, which is chosen by refectory to the board, after they make some changes, and in the final menu, comes up.

About the questions on participative leadership, the interviewees gave another example on this practice, i.e. computer usage of students. The fourth student interviewee summarized it as follows:

“Last year we were allowed to use our laptops at certain hours, sometimes we couldn’t finish our homework and couldn’t play. This year we went to our teachers and said we were not happy with that. As a matter of fact, our two friends took the initiative. They drafted an agreement covering our rights to use the computers during study hours and afterwards (until bed time), they wanted to establish a system. We had meetings on that, and now this system will be implemented.” (S4)

#### *4.2.2.2. Monitoring and Responding to External Environment*

The findings showed that the most important feature of the School management of BSTHS is to follow the developments in the world, figuring the needs of the country and create an accurate model of those to provide the sustainability in its innovative practices. In the beginning the main goal was to establish a science high school which could be similar with others but that developed to new goals after they’ve seen the other different models in developed countries.

The School principal stated that the concept of innovation contains new trends and developments in the technology of education. Those are followed to be

integrated new techniques of lecturing studies and represent to the students. The interview results suggested that the founders and school administrators frequently visit developed countries and different educational institutions in these countries. Also they've visited the other similar Science High Schools across Turkey. The main idea based on Jefferson High School for Science and Technology in USA. The interviewees stated that this model was adopted considering the conditions of the country. The General Manager summarized their approach as follows:

“Now when we look at 2000's, at the science world of the 2000's, what were the interests of scientists, what were their expectations, what were the knowledge and skills they needed... today science high school programs do not prepare students to the science world. Therefore we said we have to take the conditions of our country into account, we said this program must be changed. Our school is innovative in that sense; it is suitable to today's conditions, demands... We, as a private school were the ones who took first steps towards this end.” (GM)

As stated in the managerial innovations above, the School has created its own network to establish and maintain the model. Above all, there's Bahçeşehir Educational Institutions including the Schools, personalized courses, universities and the foundations in this network. In addition, the country's private sector and relevant international institutions and organizations are also available. The presence of Bahçeşehir Educational Institutions is extremely important to developing the School model, university's active support and consulting and training services of the foundation. The School's widespread network is also maintains a very critical position to find qualified teachers and keep the recognition across the country.

Private sector contributions to the School are very much indeed which participate in this network. Research findings retain that this collaboration helped the School in two dimensions. First, the School is able to follow the conditions and needs of the private sector, and thus sustain the motivation towards an institutional structure that will equip the School and its students with up-to-date information,

thanks to these collaborations. On the other hand, the private sector is a source of finance and information. Keeping the School's infrastructure up-to-date and funding some part of student scholarships is possible thanks to that source. In addition to that, required facilities for student internships and projects can be found easily from the private sector.

#### *4.2.2.3. Qualifications*

The findings suggested that another theme in behind innovativeness of the School is related to the qualifications of the founders and administrators. More importantly, research findings retain that school founders have a 40 years experience in the education area, and show that the implemented model is based on a substantial experience and work due to the fact that among founders were academic staff of Bahçeşehir University Engineering Faculty.

All of the administrators are extremely competent people with required work experience in their fields. The most prominent characteristic is that they are graduates of top universities. The General Manager holds a PhD degree in educational administration, while the School principal and head of the science department also have graduate degrees. They all are highly competent in foreign languages and even the general manager and principal's university educations studied on English.

In the meantime, it is found out that the mastery of the School Principal in Information Technologies and other technical areas was extremely important regarding teachers and students. Besides, in other examples from other parts of the world, school administrators are expected to have a technical background.



Finally, the findings indicate that personal networks of the School founders and all school administrators including the head of departments has a critical importance in the implementation of the School model. With these relationships can be helped on development of the School and the implementing. For instance, the general manager can manage the relationships with Bahçeşehir University and other organizations by lay on his academic background. School principal is in a close relationship with private sector organizations. On the other hand Mathematics Department Chair is an active member of the Association of Mathematicians and he can cooperate with academics from Middle East Technical University and the members of the associations for students' projects.

#### *4.2.2.4. Relations with Employees and Students*

There is a very comfortable environment available on communication and relationships at the School. All teachers talk about founders and managers with respect and affection. Also administrators mention about a clear communication, the importance of teamwork and fair and democratic efforts to create an environment in every opportunity. School principal has expressed it as follows below:

“... They keep doors open; this is what I think most importantly. You don't have to take appointments, it is open to everyone who works in the foundation but also but there is a certain hierarchical order ... In this sense, there is a corporate culture.” (SP)

Head of Mathematics Department's assessment that is related to administrators as follows below:

“...first of all my managers are respectful. They are communicative and empathized, and believe in institutionalization truthfully. They are friendly, sensitive to expectations and solution focused people. They are aware of our needs and they clearly state what they want to us...” (HM)

Department heads and teachers share the same office. And this can be observed as a positive influence to make process on relationships. School principal's office is also located nearby the classes and not isolated. Students and teachers are extremely comfortable on communicating with School Principal. Refectories and rest rooms are not separated for students or teachers. Everyone is using public space. Teachers and administrators will queue up in the refectory.

According to interview results, teachers think that managers are highly qualified and able to identify issues and goals properly. Physics teacher interviewee told that the administrators were extremely open in those relations; that they frankly discussed with the teachers in case of not fulfilling the targets and expectations. Whereas the second biology teacher interviewee expressed his opinion about the abundance of communication channels at the School as follows: "The communication environment is pretty relaxed. I do understand what they mean, and vice versa, and that makes me feel comfortable..."

The fourth mathematics teacher interviewee summarized their relaxed working environment as follows:

"I observe a big enthusiasm and motivation among teachers as well. Everyone performs his/her job with love. Generally one of the biggest sources of unhappiness among teachers is conditions, etc, way of doing things in the environment we work. As far as I observed here until now, teachers are not having a negative attitude regarding working conditions. People here are not obliged to struggle to establish suitable conditions to perform his/her jobs comfortably. There are some facilitating mechanisms for that..." (M4)

Teachers and the managers are closely in care of the students as they are boarding students at last. Mentor teachers who have been called for intern teachers stay with the students in the dormitories. Other teachers and administrators are able to accommodate students in their homes at weekends. Especially School Principal is

extremely dedicated himself on this issue. Students' education and needs are in interested for almost 24 hours.

### **4.2.3. Innovations in Human Resources Management**

#### *4.2.3.1. Teachers Trainings*

The findings suggested that the most noteworthy issue on the human resource management is related to in-service training. In-service training opportunities are provided to all of the teachers. These opportunities are frequent and cover various topics at first the teacher who is recruited to the position, takes courses for education system, which contains how to training starts to get different titles and preparation to the specific particular person terminology. Those courses are delivered by the Bahçeşehir University, Innovative Education Research Center which runs under the Bahçeşehir Education Foundation as well as international consultants. Also people with competence within the organization also organize courses in-house trainings.

General Manager summarized their approaches follows below:

“...we are doing a lot of in service training... in our school culture; sharing knowledge, producing the project, open communication, being open and honest, being able to accept criticism and constructive criticism are strong pieces have been sensed. Professional development is highly important...” (GM)

School administrators state that they will respond if teachers request trainings. Teachers also stated that they are involved with almost every training like they did not get participate in any training until they work here. Beside practices in school other trainings can be taken such as current issues, facing the outside needs, and follow the daily topics. And two of those are given below:

For the first Genetic Course which will be given to the BSTHS students, 3 Biology Teachers have taken theoretical and laboratory implementation lessons from TÜBİTAK Marmara Research Center Genetic Engineering and Biotechnology

Institute in September. The researchers of the institution will also give seminars for students about latest issues of biotechnology in 2010.

In December 2009, administrators and teachers participated to a seminar which was given Prof. Dr. Norman G. Lederman who is chair of Department of Mathematics and Science Education in Illinois Institute. This seminar was about 'scientific inquiry' and 'action research'.

#### *4.2.3.2. Recruitment and Performance Evaluation*

Interview results suggest that practices of staff recruitment and performance evaluation are currently at development stage due to the fact that BSTHS is a new school. For example the number of teachers working at the School is low, since the number of students is low and some of the teachers interviewed are relatively new teachers. It turned out from the interview results that a group of teachers was laid off last year on the grounds that they could not comply with the School model.

Similarly the School Principal stated that they preferred to work with a younger group of academicians in courses given by the Bahçeşehir University academic staff due to some problems occurred previous years.

An essential finding is that the choice of the head of departments is critical in recruitment of new teachers. Head of departments are supported by high level administration in forming their teams. Head of Science Department gave the following information about this matter:

"We conduct in-depth interviews when we'll recruit a new teacher. They are taken to classes to experience the class environment, we conduct interviews in English, as well as in Turkish, and the references are also important, whose name they gave as reference, whose name not... all of those are taken into consideration. We talk to the references they provide us with their job application, but also to the ones they didn't provide, from the Schools they worked in the past. Of course they must have a certain experience, it is certainly important which schools they worked for in the past... The reason that majority of the teachers are new, is the School being in an

enlargement process, and in the establishment process of its staff. In fact there is not a big circulation at the School. BSTHS is new and unfortunately it is really hard to find competent teachers who can teach in a science and technology high school. Therefore we mostly have circulation at the end of the first year of the teacher. That can be considered as a threshold, because his/her compliance with the corporate culture, and his/her academic competence, relations with the students, all of those are revealed out when you live with them. You cannot foresee some things during interviews, they become generally known at the end of the first year. In other words, the teacher stays with us when he/she crosses that one-year threshold, if there is no some serious problems, otherwise the institution lays him/her off at the end of the first year.” (HS)

On the other hand, there is not yet a systematic approach for the performance evaluation of the BSTHS staff. School Principal said the following regarding this issue:

“We couldn’t establish such a system. We are currently discussing that. We will adopt a system for performance evaluation; our head office is working on it. Of course those are needs arising with the enlargement. I do believe that such a system would contribute. For instance if we consider wages, it is important that the employees would know on which base their wages are set. It is their right to know that. I believe that would give a sense of justice, also motivating...” (SP)

And finally, all Bahçeşehir Educational Institutions, high schools and private classrooms are important resources for responding to teachers’ needs. On the other hand, subject of teachers is extremely important for the BSTHS management that contains the issues being able to support the student profile and maintain established model. Both administrators and teachers agree on the problems that this model needs to be established with very qualified teachers. The School principal expressed his thoughts on especially the difficulties for finding teachers who able to prepare students for Science Olympics are very rare. And main reason for teacher training in the country, he added.

#### *4.2.3.3. Teacher Profile*

The management of BSTHS and all the interviewed teachers are expressed that the gold key is the teacher as a feature of BSTHS’s innovative educational

applications and more specifically as a model. In this regard the General Manager's approach is summarized as follows below:

“...I think the critical shareholder is teachers at schools. To establish a school with dreams as big as, unless you have a good teacher, the teachers in it is not proper, you cannot do anything. To bring the best students, to prepare the best course program, it is teachers who will conduct... BSTHS teacher produces something who has this kind of ability like thinking, questioning, responsible, I will add altruistic, because you have to work overtime...” (GM)

Head of Department of Mathematics stated that “BSTHS now is a brand” and accordingly, she said that they work with a group of teachers who graduated from prestigious universities. She argued that the general characteristics of teachers are being likely to improve himself and work constantly, using of the technology, internalized the School's goals and aims.

Results are identified after the researcher interviewed with teachers and the impressions follows that all the teachers are happy to be working with BSTHS and they live a professional satisfaction there. First of all, managers and teachers had helped and cooperated during this research and they were all polite and friendly. The physics teacher statements illustrate causes of satisfaction of the teachers:

“I see great enthusiasm and demand in teachers. Everyone loves their work cause we know that conditions of teachers are usually the biggest reason for unhappiness; it has to be on the right way to work out the things. Here, attitudes of teachers are not negative on these matters. No one has to fight for good work place because it has been already the best place for a teacher. There are mechanisms that facilitate a team.” (P1)

Principal's statement summarizes development of teachers of the School:

“...any of our teachers or any of our students can also be other institutions' students automatically. They can use the infrastructure, certification programs which also can go as a full scholarship. There is school for leadership, and school for politics, management systems, and there are management-related courses as well. In request, I transport teachers and students through private shuttles... In addition, there are special discounts to the teachers who want to apply master's or doctorate in Bahçeşehir...” (SP)

In summary, the positive working conditions and the opportunities provided to the teachers of BSTHS can be listed as: (1) Students highly qualified and success-oriented, (2) Developments of classrooms and lab conditions, (3) Provided in-service training, (4) Assistant course materials, software, books, (5) The positive atmosphere and communication environment on admin-teacher and teacher-teacher and teacher-student relationships, (6) Notes and opinions taken for course hours, attention on needs, (7) Each teacher provided a working desk and computer, (8) Team work and fair distribution of work, (9) Co-teachers and mentors for supporting each branch's teacher, and (10) Being a part of this great success and a recognized educational institution as a teacher, an institution which maintains 150 private classrooms with 20 schools and universities.

#### **4.2.4. Students**

BSTHS's student profile observed and seemed highly compatible with goals and objectives of the School. Therefore school administration has been defined that large extents of students come to the School that has been suitable to this approach. In the last two years Bahçeşehir Science and Technology High School is the first science high school that has been chosen by the students who has scored the highest test results. Students continue their education that who are from different provinces of Turkey and both related with lower and middle-income groups and 95% of students are boarding in dormitories.

According to the evaluation of administrators and teachers, BSTHS students have a thoughtful, questioning and developed sense of social responsibility, they can produce new ideas and projects, they are highly self-confident, they follow developments in technology and be a user of it, they are, unlike other private school

students, respectful and serious concerns about future, they aware of the value of the opportunities they have and who have the concern of losing these, they are intelligent, disciplined, having work habits and who enjoy that, they knows well the value of time management, their social aspects highly developed, they come from very different cities and from cultural diversity, they can force teacher for the benefit of course content and use of technology and finally they are respectful and happy individuals.

Administrators and teachers reported that there is a serious and fast development have been experienced by those students right after they come to the School as being as boarding students. There is a critical importance of the School that effected students on development and social responsibility from different social aspects in particularly. According to the respondents what makes BSTHS innovative are the students. The School's physics teacher summarizes it as followed: "... Students are incredibly innovative, they don't like many things of yours..." (P1)

Also principal's comment on students is:

"...Many of them have goals; and school's goals overlap with the most of it... Bahçeşehir Science and Technology High School students are different kids, at first they were different as well, and in the time being they become more different in the conditions of being as a team here..." (SP)

School curricula are being implemented quite heavy, beside that all the students joining various social activities, there are both students who study for the Science Olympics as well as who work on projects. So far there has been no student who quit or failed the School. According to reviews of the science department they use time management very well and they all are very intelligent beings to do so.

Effective presentation techniques are given to the students and these courses taken very seriously. In interviews with students, they commented on the remarkable contributions they have experienced. They don't have any problems to express



themselves. They fully adopted the School's aims and objectives so they represent school very well and they clearly tell what all that means to them. School management evaluated the students for promoting the School. Science Museum presentation and the guidance run by students. Two of the students interviewed stated the following regarding the communication skills they earned from the School:

“For example we have a drama club, we learned there how does it feel telling something from a slightly high level, from the stage, we learned what it meant to speak from a platform. We learned how does it feel telling something in front of 350 people. We had been assigned important duties during the founding process of the Science Museum. We had a beautiful experiment, a superconductor experiment. Our astronomy teacher was making that experiment. I talked to them, I said teacher I want to make that experiment once. 30 to 35 students attend in one go of that experiment. I decided to make once during one of the tours of the Science Museum. And I made and explained that experiment during our tour to İzmir, at the opening of the Science Museum of the Karşıyaka Municipality. There was an audience of 1000 people at that opening...” (S2)

and,

“We take a course on effective presentations, a one term course, but I learned a lot. I didn't have such skills when I first came to this school, to be honest I was a student who preferred remaining at the back, who didn't like making presentations. I learned how to make a presentation in front of a big audience thanks to this course, without boring listeners.” (S3)

#### **4.2.5. Financial Resources**

Interviews with top management members and teachers suggested that maintaining education practices at BSTHS requires serious resources. Bahçeşehir BSTHS is a project that requires serious resource requirements. All students have full scholarship, dormitory conditions, performed for students' academic and social development activities, excursions, activities, etc. All of these costs are extremely high. In practice the costs of current students and the School's infrastructure needs are supported by various private sector organizations and individuals. School Principal gave the following information about the expenses they had to make:

“We take overall 24 students, we had started with 48 at the beginning but couldn't sustain that amount. For we could not find the support we expected... the cost of a single student is quite high, about 35 to 40 thousand TL. We are a big institution, but if you sum up all of the costs, it turns out to be quite high. Therefore we decided to carry on with 24 students from the second year on.” (SP)

During the interviews with the administrators, it came out that due to the economic crisis and low level of financial supports, they experienced some financial difficulties and had to cut some expenses such as international travels. Research findings show that collaboration between the private sector and university has a vital importance for the BSTHS model.

Additionally, BSTHS converted its self-initiated Science Museum to a funding source for the School. The revenue comes from the support to other schools and various municipalities to establish new museum are fully transferred to the School and it is used for scholarships.

#### **4.2.6. Technological Resources**

Interviews and observations indicate that one of the most important aspects of the BSTHS model is its technologic infrastructure. It has been observed that smart boards used in all classrooms and laboratories; software and other education materials given to teachers and students and Bahçeşehir TV and 17 laboratory carried BSTHS to a totally different level compared to its counterparts.

More importantly, the findings suggested that the technological infrastructures of all school facilities are used and are being developed. Administrators and teachers are aware of using technology in education is the only way to make a difference with today's students and in today's modern world. All of the qualifications and motivation of students are aware of the opportunities of technology using and also beyond that they are already using these technologies.

During the creation of the museum, Bahçeşehir students' awareness of this has played a critical role.

As an educational tool, smart boards at school with all the facilities are used.

The first chemistry teacher summarized this with following words:

“We can spread the technology throughout educational approach; this means you can get the students into the center. Then these tools are innovative... For example, in government schools also have the technological tools, users, too. But they use them again in classic, conventional training methods. For example, smart boards can be used as a projection screen in many schools. We have a very good use of that sense in our school; I think we use all of the capabilities of smart boards. For example, in science courses are designed that smart board technology will be the part of it...”  
(C1)

#### *4.2.6.1. Laboratory Infrastructure*

According to the research findings, one of the most unique and innovative aspects of the BSTHS as an education institution focused on science and technology education, was the laboratory infrastructure of the School which is effectively used. Laboratory infrastructure necessary for the extra-curricular courses given by the academic staff of the Bahçeşehir University, as well as for the ones given under the Ministry of National Education Curriculum, have been built at the School. Interview results show that laboratories are used effectively. School Principal stated the importance of the presence of school labs as follows:

“Our second big difference is our labs. In order to be given properly that extra-curricular courses requires a suitable environment. First of all proper physical conditions is a must. In other words, we needed different labs. Today science high schools only have physics, chemistry and biology labs. However we had to build different labs, other than these three areas, in order to be able to give a proper education. First of all those labs give our students an R&D culture, at such an early age.” (SP1)

The School Principal gave the following information about how these labs have been built during the founding process of the School as a result of throughout researches and investigations:

“A quite big group of academic staff consisting of the Dean of the Engineering Faculty and instructors have worked together during preliminary works for establishing this model and deciding which labs would be taken into the model. There were two schools from the USA that we took as a model. Education program directors of the Thomas Jefferson Science and Technology Colleges gave a big support to us. They shared a good amount of information with us, such as their current education program, course syllabuses, labs, projects, type of collaborations with the business world... And they also shared their personal experiences with us. For instance they said, ‘Don’t built this lab, we did it but it proved as a dead investment, it turned out a rarely attended lab, and its costs were very high, instead, you can go for a collaboration with a company that can provide you type of works that can be conducted in that lab, take the children to the premises of that company,’ etc. They shared what they learned in that application, they conveyed us...” (SP)

In addition, all precautions for the safety of students and teachers have been taken in these laboratories. The laboratories and their properties are given below:

*Mechatronics / Robotics Laboratory:* Students within the context of mechatronics course, autonomous robots that can do before they are designed, then they made their software applications and write a laboratory that is. Each students coming to 12th class has to do a project that robot production implementation before graduates.

*Electrical / Electronic Laboratory:* This is the laboratory that students learn basic concepts of electrical and electronic components and implement various projects in it.

*Physics Laboratory:* This is the laboratory that physics courses in accordance with the experimental program applications and projects can be done.

*Chemistry Laboratory:* This is the laboratory that chemistry courses in accordance with the experimental program applications and projects can be done.

*Biology Laboratory:* This is the laboratory that designed for biology course and includes a microscope for each student and teacher which is connected to a projector.

*Hyper class-Computer Laboratory:* This is the laboratory that is done general-purpose computer applications, computer-aided instruction and computer courses in it.

*Computer Networks Laboratory:* This is the laboratory that is done network applications, determined the privilege level TCP / IP addresses and local network and the operating system, are learned to establish and 'ethical hacker' and 'system manager' and assumed the role of the applications by the students.

*Software Laboratory:* Is a laboratory for students that they have the flexibility to develop software and all the facilities is provided.

*Computer Hardware Laboratory:* Students can make application for computer equipment, is a laboratory containing 26 computer hardware parts and supplies that may occur.

*.Net Laboratory:* .Net platform has been established for students to learn and develop in order to provide the software platform.

*Genetics Laboratory:* Laboratory has been established in 2009 to make applications for the genetics course.

*Mathematics Laboratory:* Laboratory has been established to support various mathematical software.

*Research Laboratory:* 24 hours a day, which is open to students working laboratory is used for special projects. Physics, chemistry, electrical and electronic lab equipment thanks to the fundamental problem in the students own personal research and science in preparation for the Science Olympics in the laboratory shall pursue.

#### **4.2.7. Physical Infrastructure**

##### *4.2.7.1. School Building and Dormitories*

BSTHS is located in Bahçeşehir in İstanbul province. Bahçeşehir Region is a settlement area, which is a definitely safe environment that has been granted several awards in the area of “Satellite City” in contests organized by the European Union.

The School is located at the old building in Bahçeşehir University campus. It is atypical regarding its architectural aspects compared to other primary and secondary schools. Classes and laboratories are well lit, comfortable and equipped with necessary technological infrastructure. The School being located in a public housing area is a safe place, isolated from the city of Istanbul. 95 % of the students accommodate in dormitories just next to the School. The dormitory consists of triplex housing units where students have an opportunity to live in rooms for 2 to 4 people. Sometimes teachers also stay at the dormitories and conduct projects and other activities with the students during off-school times. That vicinity also gives an opportunity to students benefit from the School library and laboratories on a 24-hours basis. In addition, other needs of students such as laundry, ironing and dormitory cleaning are fulfilled by caretakers responsible of the dormitory. Teachers are given special function rooms. Each teacher has a desk and computer.

Furnishings of principal and teachers' rooms are extremely simple and functional. Especially the principal room is open all the time and the students can enter the room and communicate easily, but in a respectful manner.

BSTHS and Bahçeşehir College give educational services in the same building. Although different programs are being implemented, the benefits provided by the physical proximity of students are used by entering public classes, the social responsibility projects, club activities, and various cultural activities. Interviewed students, administrators and teachers are expressed that nested structure is extremely helpful for students' social development. 95% of the students are male in BSTHS and this combination eliminates a dominant sexist environment. Students can do dance, prepare play and folklore events together. The first student interviewee stated the positive aspects of the location of two different schools in one building as follows:

“I think diversity is always good, getting various thoughts together, creating a synthesis... We have such a situation here. Perhaps they are encouraging us in the social arena, none of us were social people when we first came to this school. I think they have a share in our socialization. And maybe we are encouraging them about science. There is a mutual flow of thoughts. Of course that is important too.” (S1)

#### **4.2.8. Social Interaction**

During interviews, observations and visits at the School the researcher observed that the social environment of the School is extremely positive. Relations between administrators-teachers, teachers-teachers, teachers-students and administrators-students at the School seem to be relaxed, based mutual respect.

Administrators stated that their main target is raising students not only well qualified academically but also socially. Head of Science Department said the following in this topic:

“We highly encourage students to artistic activities. We have teachers here for all branches, or we hire teachers on part-time basis. For instance drama teacher is hired on freelance basis. Science and Technology College students produced an incredibly good piece of theater. It was really professional; I wish you’d have seen it. Before, their artistic side was weak, our school acquired that to them, I wouldn’t try to be modest in this matter...” (HS)

All administrators and teachers stated that BSTHS students were respectful children perceiving life different than other private school children. Main reason for this difference is said to be the majority of them being from small towns, provinces, and coming from mid to low income group families. Yet, children who are somehow asocial, having troubles to get in communication with people at the beginning, turn into children who can express themselves comfortably thanks to the fact of living in a boarding school. Students themselves made similar comments and stated that they were provided with an extremely relaxed communication environment at school, that they were always asked about their opinions. Second student expressed this fact as follows:

“Our school principal had praised our two friends in that meeting. Moreover he encouraged all of us to make the same thing. He said, ‘If you also have a logical idea, if you see some faults in the functioning of the School and if you have a logical idea towards the solution of that problem, prepare a project for me, just like your friends, if it is correct and applicable I would surely apply it, I’d make what you want.’ He said exactly that.” (S2)

Moreover the School Principal told the following regarding the “mentor teacher practice” that they have been considering for the social interaction with the students:

"...we have a system called mentor teacher... but they are just sisters and brothers rather than being mentoring. They go out; dining places with students ... This type of activities is abundant... Students are invited to breakfast at our home; with teachers in the cafeteria are cooked pizza..." (SP)

And finally, the visitors who are the candidate students for BSTHS and their parents, were showed around school by students and one of the interviewed students stated that this application was the most important reason to select to BSTHS for her and her parents.

It has also been observed that the social communication among teachers as well as between teachers and administrators was positive. Head of Mathematics Department said the following regarding this:

"There is comfort, sincere, not too close to a dialog based on mutual respect and love in our environment. In this way, an environment that increases our capacity for cooperation and partners do business. " (HM)

Teachers said that they didn't have any problem with meeting with the administrators and that all their needs are fulfilled. All teachers interviewed agree that their work environment is intimate and participative. On the other hand, according to the interview results there are more activities regarding social interaction aiming at students.



### **4.3. Summary of the Findings**

Research findings showed that the BSTHS administrators were aware of the concept of innovation, and beyond that, school administrators conceived BSTHS as an innovative application within the Turkish Education System. According to interview results with school administrators and teachers, the source of this innovativeness was first of all the leadership and visionary attitude of the school founders.

According to school administrators, the motivation lying behind that innovative approach is the need of the Turkish Education System for new and contemporary practices in the area of education and for raising the human resources necessary for the science and technology system in order to Turkey can take a place in the contemporary world. It was found out from the interview results with the teachers that the leadership quality of the school founders; their desire to make a difference as an education institution and competition conditions produced that innovative approach.

During the interviews, participants showed the following as the source of the innovativeness of the school: Administrative practices, the individual based learning model, a participatory administration understanding, open door policies of the administrators, effective usage of communication technologies in both education and learning, and administrative processes, and application of Blue Ribbon standards. In addition to these, school administrators and teachers emphasized another aspect, which is the fact that Bahçeşehir Education Institutions are learning institutions. In that context, interviewees pointed out the importance given to the in-house training

of teachers and to being effectively updated about the new practices in education in developed countries.

During the interviews all participants showed the school curriculum as one of the most important innovative practices. School administrators stated that the source of their curriculum is similar international education institutions that they are collaborating and the Bahçeşehir University. School administrators also said that they have been collaborating with a couple of national and international institutions since the foundation of the BSTHS, such as the Bahçeşehir University, similar Science and Technology Colleges from the US and various private sector institutions. Interviewees stated that new courses in the curriculum are being given mainly by the Bahçeşehir University academic staff members; that various private sector institutions give financial support for the student expenditures and created internship opportunities, as well as giving support to the construction and updating of the school infrastructure.

During the interviews the administrators stated that people working as a teacher at the BSTHS are selected based on certain criteria, are continuously observed and given in-house training which is a very important issue for them. At this point school administrators and teachers pointed out that not every teacher can teach at the BSTHS because of the student profile of the school. In all interviews it was said that the teachers of those high profile and high capacity students should themselves be capable of continuously self-developing, of following latest innovations and of using technology in education and learning processes.

Another important finding of the interviews was the participatory administration approach of the BSTHS administration. The most important finding in that context was the Science Museum that was created within a process in which the

students have also been included. Besides being a product of the participatory administrative approach of the school the Science Museum is an innovative product of an innovative education institution.

Additionally, according to the administrators, teachers and students, the laboratories and classes that were designed in accordance with the school curriculum and program were considered to be most distinguished quality of the school. Interview results showed that this infrastructure was constructed based on the fundamental aim of the school, taking other contemporary examples into account.

BSTHS' student profile appears to be another result of the innovative approach of the school. During the interviews the administrators and teachers said that their students have a different profile compared to other private schools; that they basically come from low and middle income families, who are very clever, successful students having targets in their minds. Administrators, teachers and students share the view that the school gives a very important support to students in their social development and self-expression ability.

It can be concluded from the interviews with the students that the BSTHS can fulfill the students' expectations. In spite of the intense and heavy curriculum of the school, the students during the interviews haven't mentioned any problems with that. Most important findings of the interviews with the students were that the students can express themselves without any problem; that their opinions are taken by the school administrators and teachers when necessary and that the school administration provided them necessary conditions for self-realization in academic and social senses. Other important findings of the interviews with the students are the fact that the students have internalized the fundamental aim and vision of the school and that they are utterly aware of the opportunities presented to them. Four student

interviewees were people who had targets, who could express themselves very comfortably. The co-existence of the BSTHS and Bahçeşehir College in the same building is regarded as a big advantage in the development of their social skills. According to the students, the school infrastructure and the effective usage of technology in education and learning processes are two other superior qualities of the school.

## CHAPTER 5

### DISCUSSION AND CONCLUSIONS

This section presents a discussion on the findings, reflections upon the results, along with the recommendations for future research on innovation in education.

#### 5.1. Discussion

##### 5.1.1. School as an Innovative Organization

In last two decades the developed countries have been in a rapid transition phase from an industrial economy to a knowledge economy (Drucker, 1993). The knowledge economy is based on “the production and distribution of knowledge and information, rather than the production and distribution of the things” (Drucker, 1993, p. 182). Many scholars emphasized the importance of creativity and innovation in the knowledge economy. For example, Florida (2002; cited in OECD, 2008) refers to today’s economy as a creative economy and in the new growth theory perspective. Cortright (2001) argued that the creativity and idea generation are central to today’s economy.

In this perspective, need of change in institutions in general is applicable to all institutions in the education system. Innovation has become *sine qua non* factor for the Schools that adapt quickly to changing conditions and will train human

resources suitable for new conditions. In other words, in order to reach the innovative science and technology system, the education system at school level also need to be innovative.

In Turkey, in last two decades, various activities have been carried out for changing the education system under the names of “restructuring”, “educational reforms” or “development” in order to respond to societal needs. However, all these activities and developments could not end up with widespread and effective results because of the teacher profile, examination oriented school models and insufficient and ineffective in-service trainings. First of all the examination system within the Turkish Education System, designed with the aim of selecting students, totally dominates the education environment. Level of success of education at school and society at large is now almost totally assessed based on examination results; thus all education and learning activities have started to be carried based on the so-called examination system. Whereas works done towards improvement and reforms have not been integrated into the education system as a whole but remain secondary concern eclectically.

Compliance between the country’s science and technology policies and education policies is a must; however, that basically remains on paper in Turkey, which puts an obstacle in front of raising human resources supply of the country. More importantly, existing structure and understanding result in presenting good education opportunities to a relatively little group of students and to deteriorate equal opportunity in education. For example, private schools have structural-functional flexibility to carry out more innovative and qualified educational applications thanks to their financial power and more flexible administrative structures. This is a serious blow to equal opportunity in education. If we consider this issue from science and

technology education perspective, we can say that both teachers' education and physical infrastructure of the School definitely need a good amount of financial resource. However state schools, including science high schools highly lack necessary laboratories and technological infrastructure. Beyond that, present teacher profile is not qualified enough. Even the primary and secondary education institutions that are considered to be good in Turkey, became to be assessed based on their successes in examinations.

The reason to take BSTHS as a case study in this thesis is that it is model producing quality in secondary education level within the Turkish Education System. In addition to that, this school accommodates dynamics of an innovative organization, a learning and self-developing institution that carries education activities with external institutions.

The most striking point here is that the founders of that school had correctly determined the human resource need of the contemporary world and of Turkey, and managed to establish necessary organizational and physical infrastructure for this end. These basic qualities make the School as an alternative model.

The sources of innovation in BSTHS are considered as Drucker (1985) defines the internal and external factors that draw attention. Drucker (1985, p. 35) defined seven specific sources of innovation or seven circumstances from which innovation emerges in an organization. Four of them are internal sources and these are: (1) "The unexpected" such as unexpected success, unexpected failure, unexpected outside event, (2) Incongruity, (3) Innovation based on process need, and (4) Changes in industry structure or market structure that catches everyone unaware.

And the external sources are: (1) Demographics, (2) Changes in

perception mood and meaning and (3) “New knowledge”, both scientific and unscientific.

Seen from this framework, BSTHS’s model was born with these conditions which maintain the country's current science and technology education in secondary education level of the day that unable to adapt to our conditions and even in non-compliance. In other words, the point where the current science high schools are from an innovative school model has enforced.

In a four-years period, the School's innovative applications and related processes emerged from inside. For example Science Museum was not designed as an emerging model at the beginning but over time it became innovation arising from itself.

Beyond that, School's student profile extremely affects all processes at School, shaping many things from decision-making processes, textbooks and teaching techniques to the teacher selection. External innovation sources, such as the "new knowledge" and “changes in perception mood and meaning” the reasons put forward are the direct model.

This study shows that the various managerial resources are innovation sources and dynamics at the Bahçeşehir BSTHS. These are leadership, to create an alternative teaching and learning environment, to be a learning organization, networking, student qualifications and diversity and diffusion of innovation.

### **5.1.2. Leadership**

Leadership has long been a major research area of interest among social scientists especially who are interested in organizational and political dimensions. It is not an easy concept to define and there are different approaches to study it. In this



study, the researcher analyzed the leadership according to the new leadership approach in the context of transformational leadership. Alimo-Metcalfe & Alban-Metcalfe (2001; cited from Clegg, 2006, p. 452) argued that there are nine transformational leadership factors, which are genuine concern for other, empowers and develops potential, integrity, being trustworthy, honest and open, accessibility and approachability, clarifies boundaries, involves others in decisions, encourages critical and strategic thinking, inspirational networker and promoter, decisiveness, determination, self-confidence and political sensitivity and skills.

In the context of BSTHS, transformational leadership can certainly be said to have extremely positive influences on the innovativeness of an organization. Main reason for such a positive influence is the ability to create an environment and conditions suitable for the flourishing of change and innovation in an organization, and beyond that, the ability to establish the organization itself by recognizing the conditions and needs of the surrounding environment. In that sense BSTHS has a model established upon evaluating current conditions and determining deficiencies and needs in the area of science and technology education of the country.

The School has been founded on a well-defined strategy and vision, and the model has been developed by evaluating surrounding relations with the University, Uğur Private Teaching Institutions, as well as other national and international institutes and institutions. Moreover, the leadership approach at the School provides opportunities and necessary conditions to improve that innovative education institution and to realize the innovative potential of everyone at the School from administrators to students. General Manager, Principal and even Head of Departments are equipped with authorizations and responsibilities to manage the School. They can take the initiative when necessary. Teachers are provided with

necessary conditions to develop themselves, and the students are incorporated within decision-making processes.

It is extremely easy to reach to the General Manager and the School Principal. Regular meetings and established professional and social relationships facilitate this proximity. A democratic working environment is created in the School thanks to that proximity. All administrative authority and responsibilities given democratically to people who can take an initiative when necessary, and that aspect can clearly be observed at all levels. Administrators clearly define and state responsibilities of teachers; in turn teachers can openly express their expectations.

In this study teachers and students are asked their views about leadership. In this context, it is observed that the School leadership is perceived innovator among teachers and students, as well as providing necessary conditions of innovation to them.

Finally, leadership at all levels of the School prioritizes cooperation across units within the organization and with external organizations. Leadership is also effective in creating and managing networks. The innovative potential of this school created via alliances and networks is realized in various projects and practical trainings.

### **5.1.3. Creating Alternative Teaching and Learning Environment**

The term “alternative education” means different approaches to teaching and learning other than mainstream education with a special, often innovative curriculum and flexible program of study which is based on to a large extent on the individual student’s interests and needs (Raywid, 1988). By the 1990s, the standard model of schooling has started to be discussed in the context of knowledge based economies

and various alternative school models have been founded such as Charter Schools in the United States and Canada, the Foundation schools in England. Moreover, many teaching practices have been developed such as project-based and cooperative learning, independent learning, (OECD, 2008).

BSTHS adopted an alternative educational model within the Turkish Education System. The innovativeness was also related to the curriculum implemented, the laboratory infrastructure, innovative administrative processes and collaborations with the science and technology education. The School, in order to be accredited by the Blue Ribbon criteria, applied Person-oriented Instructional Model and AKORD harmonize, according to the needs of each student's characteristics and thus forming a related educational process.

Entirely new curriculum is applied in accordance with the School's vision. This relationship and cooperation with a university curriculum implementation is also required.

Information and communication technologies open up new possibilities for effective learning and innovative teaching methods. For example, ICT reduces the need for physical proximity in cognitive activities such as distance education and ICT enhances possibilities for creative interaction in real or virtual classroom settings (Shapiro et al., 2007).

In this study, the importance of ICT was observed in the management procedures of Bahçeşehir Science and Technology High School's, as well as in its training and education practices. Especially ICT awareness is extremely high at the School administration level. One of the most important criteria in selection of teachers is their effective use of computer technology. Smart-boards are used in all

school facilities from classrooms to laboratories. Newly created curriculum and laboratory infrastructure are largely ICT oriented.

KÖS and AKORD web-based applications and distance education opportunities are evaluated with Bahçeşehir TV. Individual based learning model is based on identifying individual differences in students' ways of learning and on planning the learning process based on those differences. According to this model, students' individual learning ways are determined by a test developed by the Director of Bahçeşehir Creative Learning Center. This model suggests that people are more interested in learning when they know their own way of learning, and thus become more conscious learners. This model provides very important opportunities to teachers and parents in understanding students and creating necessary conditions for a suitable education environment. However, the current structure of Turkish Education System which is based on examination uniforms all students regarding learning and success, and kills diversity, thus creativity by undermining individual differences and variations.

Another learning tool used in the individual based learning model is Smart Assessment and Learning Support System developed by the Bahçeşehir Uğur Education Institutions. That is a web-based system aiming at identifying lack of concepts or existing errors of students within their learning processes, and correcting those learning difficulties. And finally, technological base of the individual based learning model is Bahçeşehir TV. Students have an opportunity to revise and appropriate what they've learned anywhere and anytime.

In the context of science and technology education, laboratory infrastructure and extra-curricular courses given by the Bahçeşehir University constitute most important pillars of this school model. Students who take extra-curricular courses in

various areas of science and technology are canalized in their decisions on further academic carrier. Those extra-curricular technology courses are mainly related to Information Technologies, in other words students get information about every aspect of that technology. And the laboratories provide an environment for the application of theoretical issues given during the courses, which results in a more effective learning process. Science Museum is a final product of this approach and application.

Finally, travel opportunities given to BSTHS students to laboratories in the country and abroad, to visit research institutes and join fairs. This opportunity has a raising students' awareness about science and technology. Besides, internship schemes realized at the premises of various private sector institutions to determine students' professional orientations support this approach.

All together it can be concluded that this alternative science and technology education model is constructed upon the following question: "What kind of a scientist we must raise?" and the founders' answer to that question is, "a scientist not only good and academically qualified but also a social person who is successful in communication and self-expression and aware of the world's and country's needs." Within this context students, besides history of science and technology, presentation techniques, entrepreneurship etc, have to participate in at least one social responsibility project during their education life at that school. Moreover students are provided with an environment with all kinds of social and cultural activities.

As a result, education and learning environment provided for BSTHS students has a structure that support awareness and creativity, and that helps revealing their skills and capacities out.

#### **5.1.4. Bahçeşehir Science and Technology High School as a Learning Organization**

Innovative organizations take steps towards building cultures, which promote learning (Senge, 1990). Nonaka & Takeuchi (1995) argued that organizational learning is concerned with the processes used to capture and to convert tacit knowledge into explicit knowledge. Moreover, a learning organization promotes innovation by empowering its people by creating free space for learning and these learning focused enterprises encourage collaboration, promote inquiry, and create continuous learning opportunities for their employees (Lam, 2002).

If knowledge and information are constantly changing and evolving in the life of an organization, learning ability is critically important. If an institution remains static and could not adopt itself to changing conditions, the system is doomed to remain outside. In the case of BSTHS, characteristics of a learning organization as mentioned in literature can clearly be observed. First of all, BSTHS is the result of a learning process. The effort of establishing a science high school which is equivalent to other science high schools, turned out to be an alternative science and technology school.

School management places emphasis to teacher trainings and technology usage for the development and sustainability of school model. Because of highly qualified students profile, continuous learning and development is required for teachers.

Today, when we consider the young generation's relationship with the technology and more importantly with information technologies, standard education models and teaching techniques cannot meet the educational needs of young

generations. Constant changes in society challenges the School as an organization to be more flexible and adaptive to changes.

#### **5.1.5. Networking**

The term networking refers to systematic establishment and use of internal and external links as communication, interaction and co-ordination between people, teams or organizations in order to improve performance (OECD, 2003). Fagerberg et al. (2005, p. 79) argued that “networks contribute significantly to the innovative capabilities of firms by exposing them to novel sources of ideas, enabling fast access to resources and enhancing the transfer of knowledge”.

Today the use of network structures is increasing as a source of knowledge, as a source of effectiveness in teaching and learning processes and as a source of innovation.

Recently, in Europe, the US and Australia, different forms of network have been created in order to provide comprehensive cover to meet every aspect of teaching and support staff requirements within educational establishments. However in Turkey, there are still no corporate network structures for teaching and learning. But, BSTHS partially has its own networks with Bahçeşehir University, Bahçeşehir Schools, Uğur Private Classrooms, Bahçeşehir Education Foundation and other various private sector organizations. BSTHS is in constant communication with various international education institutions and the establishment of these alliances for developing and maintaining the School model has been extremely effective.

Digital media networks have created structures in science and technology related areas abroad, however those networks are not yet developed in Turkey. Teachers and students in Turkey, more specifically due to the fact that they are not

fluent in English as a common foreign language, have basically a language barrier in using that digital information-sharing environment.

#### **5.1.6. Student Qualifications and Diversity**

One of the highly distinctive characteristics of BSTHS is its student profile. That is a profile consisting of students who are focused on science and technology topics; who are very successful academically; who have not any problems with time management, and are self-confident persons whose social aspects are reinforced also by the School. The fact that students come from cities all around Turkey and live at school dormitory and that 95% of them being children of mid to low income family groups, effect students' expectations and future plans positively regarding the School model. Therefore it can be said that the School attracts a student profile that complies with the established model and raises its own innovators. Those students, given that they directly contributed to the establishment of the Science Museum and created their original software and regularly participate in social responsibility projects, are "students oriented towards innovation" rather than "educated students". As a result the model applied in BSTHS puts the student to the center.

#### **5.1.7. Diffusion of Innovation**

BSTHS is supported by the Ministry of Education as a pilot project to be adopted as an alternative model of science and technology education venture. If four-year achievements are taken into consideration, the High School emerged as a unique example in the current Turkish National Education system. According to school administrators, two private schools are currently considering establishing a science



and technology high school. These new initiatives will also accept students with %100 scholarships and will implement a similar curriculum.

Additionally, two new science museums have been established under the consultancy of BSTHS. Moreover, these innovative applications affect the School itself by means of administrators, teachers and students; for example, currently a Child Museum is being established by the Bahçeşehir High School.

## **5.2. Recommendations Further Studies**

This study is one of the first attempts to study innovation at secondary level in Turkey. As a result, the study serves a guide for future studies to analyze the dynamics of innovation in education in wider contexts. This study only touches the edge of the larger topic of innovation in science and technology schooling in secondary level education. The dynamics of innovation suggested by this study may surely exist in the areas of different levels of education outside science and technology high schools. As well, there are endless opportunities for additional study of science and technology high schools, such as the difference in innovative dynamics between private and public schools.

There are ample opportunities for in-depth studies. This qualitative project engaged only school leaders, science and mathematics teachers and only four students, not other teachers, founders or shareholders. Each of these constituencies might well provide insights complementing and enriching the data uncovered here. As well, this study is restricted to one school. A comparative study with private and public science high schools may be valuable in revealing organizational differences in how innovation takes place.

While the researcher decided to conduct a qualitative study, a quantitative

study dealing with the same topic could afford the opportunity to broaden the study in a manageable fashion. There is need to investigate innovation in quantitative approach.

### **5.3. Implications**

Today, production relations, power relations and social relations and structural transformation are observed consistently. This transformation could also be observed in educational institutions, training and teaching methods, content and format of educational materials. Moreover, this transformation is changing the meaning of knowledge and is creating a new culture.

In today's contemporary societies, productivity and competitiveness are processes, which govern the knowledge society. Productivity stems from the innovation and competitiveness stems from the flexibility. Therefore, companies, regions, countries and economic units of all types are being restructured to incorporate innovativeness and flexibility. Education systems and schools themselves are not likely to be independent from this transformation.

We have to distinguish concepts of education and skills. Technological and organizational changes may render obsolete skills easily. Education is a process of people that work for a labor data redefining the ability to continually obtain necessary qualifications and the qualifications to win the resources accessible. Findings of this study point to the achievements of the BSTHS founded as an alternative to the existing science high schools in a relatively short time such as four years, and to the necessity and need of innovative education models. The fact that the BSTHS emerged within a self-learning process and realized this learning process within a national and international network, are the main factors that made it original

and innovative. Bahçeşehir Education Institutions from its private teaching institutions to its university, function within a big network at national level, in addition, they got the support of the private sector. Some international institutions played a very important role in the formation of the School model and its sustainability.

Another important factor is that successful and talented students from mid to low income groups are granted non-refundable 100% scholarships and thus a privileged and very important investment on education is made. The established infrastructure, the designed curriculum and the collaboration with the university make an example to new science and technology high schools to be established in future in Turkey.

The findings of this study also show that the leadership emerged remarkably at the BSTHS as an important factor supporting innovation. This study found out that the founders of the School are people who have a vision and their support to this innovative model and their manifesting a different approach to education that is conflicting at times with the present structure of the Turkish National Education system, are worth to analyze. One of the main findings of this study is the fact that the School adopted an educational approach that really puts the student at the center. Students are involved in the decision-making processes thanks to the participatory management approach of the School administration and to the right management of this process. One of the innovative products of this approach is the Science Museum, which is an important example to similar institutions.

The present structure of the Turkish Education System is examination-oriented, a system ignoring personal characteristics of individual students, thus overlooking creativity and diversity, which are the most important elements of

innovation. The individual based teaching program applied in all Bahçeşehir schools is a system that helps the students' individual differences and talents be realized, and beyond that, canalize students, teachers and parents according to those differences.

Finally, another important innovative quality of the BSTHS is its effective usage of technology in education and teaching processes. Moreover, communication technologies play a very important role in school administration and selection of teachers.

It is a must that above mentioned technologies would be effectively used in all education institutions in the Turkish Education System. In addition to that, formation of networks in the virtual world in Turkey, just like in examples abroad, is necessary regarding the share of information and experiences. Such networks will form the basis of a widespread communication among school administrators and teachers, as well as increasing share of information, experiences and best education practices.

As result, today, the School must be managed by effective and innovative leadership and must use the national and international network structures to improve itself. Moreover, the School must turn into an innovative learning organization by means of effective usage of ICT in order to create an innovative society and innovative generations. At this point the education system as a whole needs a systematic education reform and what it means to perform in an Schumpeterian way called "mental destruction".

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## Appendix A: Interview Protocols

### Administrators' Interview Protocol

Merhaba,

Ben Zehra Pekşen. TÜBİTAK Marmara Araştırma Merkezi Gen Mühendisliği ve Biyoteknoloji Enstitüsü'nde başuzman olarak çalışmaktayım. Enstitüde, ISO 9001:2000 Kalite Yönetim Sistemi, ISO 14001 Çevre Yönetim Sistemi ve OHSAS 18001 İş Sağlığı ve Güvenliği Sistemi'nin kurulması ve sürdürülmesi faaliyetlerinin yanı sıra eğitim sorumlusu olarak çalışmalarımı sürdürmekteyim. Enstitü Bilim ve Toplum etkinlikleri kapsamında biyoloji öğretmenlerine yönelik olarak 2009 yılından itibaren verilmeye başlanacak "Biyoteknoloji ve Yaşam Bilimleri" eğitimi tasarımı gerçekleştirirdim.

Bu görüşmeyi Orta Doğu Teknik Üniversitesi Eğitim Fakültesi Eğitim Bilimleri Bölümü'nde yaptığım ve danışmanlığımı Yrd. Doç. Dr. Yaşar Kondakçı'nın yaptığı yüksek lisans tez çalışmam kapsamında yapmaktayım. Bu çalışmanın amacı alanında kendine özgü örnek kurum olan Bahçeşehir Bilim ve Teknoloji Lisesi'nin idari ve akademik işleyişini yenilikçilik (innovation) kavramı çerçevesinde nitel bir incelemesini yapmaktır.

**Başlığı "Innovativeness as a managerial process in the context of science teaching: A case study on Bahçeşehir Science and Technology High School (Yönetimsel bir süreç olarak fen bilimlerinde yenilikçilik: Bahçeşehir Bilim ve Teknoloji Lisesi üzerine bir örnek olay incelesi)"** olan bu çalışmanın temel amacı Bahçeşehir Fen ve Teknoloji Lisesi'nin yönetim anlayışını ve organizasyonel yapısını inovasyon kapsamında incelemektir. Çalışmanın kapsamı 'bilim eğitimi' uygulamaları ile sınırlandırılmış olup okul yönetiminin ve öğretmenlerinin değerlendirmeleri kapsamında okulun "yenilikçi" yapısının ortaya çıkarılması ve incelenmesi planlanmaktadır. Yapılacak mülakatlar gözlemler ve belge incelemeleri ile desteklenecektir.

Bu görüşme için gönüllü olduğunuz takdirde, kimliğiniz ve bize sağladığımız bilgi kimseyle paylaşılmayacaktır. Bu görüşmeyi katıldığınız sırada görüşme mekanında yöneticileriniz, çalışma arkadaşlarınız veya öğrencileriniz bulunmayacaktır. Bu görüşme, katılanlara zarar getirebilecek psikolojik ya da fiziksel bir iş içermemektedir. Görüşmenin, katılanlara kendi bakış açıları ve çalıştıkları kurum hakkındaki düşünceleri ile ilgili bir eğitim araştırmasına katılmış olmaları dışında sağladığı bir yarar yoktur. Fakat sonuçlarının çalışmakta oldukları okula ve genel olarak Türkiye'deki bilim ve teknoloji eğitimine yararlı etki yapması beklenmektedir. Bu katkı aşağıda başlıklar halinde özetlenmiştir:

- Ülkemizde ilk kez , Organizasyonel yenilik (inovasyon) konusu bir orta öğretim kurumunda incelenecektir.
- Bahçeşehir Fen ve Teknoloji Lisesi'nin henüz çok yeni ve bir "ilk" olarak tasarlanmış yapısı organizasyonel anlamında incelenecektir.
- Özgün ve atipik bir okul olarak Bahçeşehir ve Fen Teknoloji Lisesi ile ilgili olarak bir ön çalışma yapılmış olacak ve modelin geliştirilmesine katkıda bulunulacaktır.
- Çalışmanın sonuçları bir en iyi örnek (best practice) olarak paylaşılabilir.

Çalışma kapsamında yapılacak görüşme 25 ana sorudan oluşmakta ve yaklaşık 80 dakikalık bir zaman alacağı varsayılmaktadır.

Çalışmanın her hangi bir anında sorularınızı sorabilirsiniz. Eğer gönüllü olmaya karar vermeden önce öğrenmek istedikleriniz varsa lütfen sormaktan çekinmeyin. Bu çalışmada yer almadıkça, yer aldığınız halde herhangi bir anda yarım bırakılmak ve cevaplamaktan rahatsız olduğunuz soruları atlamak hakkına her zaman sahipsiniz. Eğer bu görüşmeye katılmak için gönüllü olursanız, kişisel bilgileriniz mümkün olan en gizli şekilde korunacaktır. Sadece benim ve tez hocamın bu bilgilere erişebilme hakkı vardır ve hiç bir şekilde diğer kişilerle paylaşılmayacaktır.

Bu form biri sizin kendinize ait kayıtlarınız için, diğeri de araştırma için olmak üzere iki adet hazırlanmıştır. Adınız ve imzanız, size gönüllü olmak isteyip istemediğinizi sorduğumuz için, yalnızca bu iki kopya formun üzerinde yer alacaktır. Bir kopyası ileride sizinle bağlantı kurabilmemiz için bana ait olup, diğeri kopyası ise size aittir ve o kopyayı sizden istemeyeceğiz.

Sağlayacağınız bilgi hakkında bu belgenin sonunda ayrı bir bölüm vardır. Lütfen araştırma ekibine o bölüm için de gönüllü olup olmadığınızı bilgisini veriniz.

Eğer ileride bu çalışma hakkında daha çok soru sormak isterseniz lütfen aşağıdaki iletişim yollarından birini kullanarak bana ulaşınız (tercihinize bağlı olarak isim belirtmeyebilirsiniz):

Zehra Pekşen

Tel: 533 470 29 72

Tel: 262 677 3353 (iş)

e-mail: [zehra.peksen@mam.gov.tr](mailto:zehra.peksen@mam.gov.tr)

Eğer bu çalışma için gönüllü olmak istiyorsanız lütfen aşağıda verilen yere adınızı, soyadınızı ve tarihi yazıp imzalayınız. Lütfen aşağıdaki iletişim yollarından tercih ettiğiniz birinin bilgisini veriniz.

Teşekkürler.

Ad, Soyad: \_\_\_\_\_ İmza : \_\_\_\_\_

Tarih : \_\_\_\_\_

Tercih ettiğiniz iletişim yolu bilgisi:

Tlf: \_\_\_\_\_ (Ofis) \_\_\_\_\_ (Cep)

Elektronik posta: \_\_\_\_\_

## Teachers' Interview Protocol

Merhaba,

Ben Zehra Pekşen. TÜBİTAK Marmara Araştırma Merkezi Gen Mühendisliği ve Biyoteknoloji Enstitüsü'nde başuzman olarak çalışmaktayım. Enstitüde, ISO 9001:2000 Kalite Yönetim Sistemi, ISO 14001 Çevre Yönetim Sistemi ve OHSAS 18001 İş Sağlığı ve Güvenliği Sistemi'nin kurulması ve sürdürülmesi faaliyetlerinin yanı sıra eğitim sorumlusu olarak çalışmalarımı sürdürmekteyim. Enstitü Bilim ve Toplum etkinlikleri kapsamında biyoloji öğretmenlerine yönelik olarak 2009 yılından itibaren verilmeye başlanacak "Biyoteknoloji ve Yaşam Bilimleri" eğitimi tasarımı gerçekleştirirdim.

Bu görüşmeyi Orta Doğu Teknik Üniversitesi Eğitim Fakültesi Eğitim Bilimleri Bölümü'nde yaptığım ve danışmanlığımı Yrd. Doç. Dr. Yaşar Kondakçı'nın yaptığı yüksek lisans tez çalışmam kapsamında yapmaktayım. Bu çalışmanın amacı alanında kendine özgü örnek kurum olan Bahçeşehir Bilim ve Teknoloji Lisesi'nin idari ve akademik işleyişini yenilikçilik (innovation) kavramı çerçevesinde nitel bir incelemesini yapmaktır.

Başlığı "**Innovativeness as a managerial process in the context of science teaching: A case study on Bahçeşehir Science and Technology High School (Yönetimsel bir süreç olarak fen bilimlerinde yenilikçilik: Bahçeşehir Bilim ve Teknoloji Lisesi üzerine bir örnek olay incelesi)**" olan bu çalışmanın temel amacı Bahçeşehir Fen ve Teknoloji Lisesi'nin yönetim anlayışını ve organizasyonel yapısını inovasyon kapsamında incelemektir. Çalışmanın kapsamı 'bilim eğitimi' uygulamaları ile sınırlandırılmış olup okul yönetiminin ve öğretmenlerinin değerlendirmeleri kapsamında okulun "yenilikçi" yapısının ortaya çıkarılması ve incelenmesi planlanmaktadır. Yapılacak mülakatlar gözlemler ve belge incelemeleri ile desteklenecektir.

Bu görüşme için gönüllü olduğunuz takdirde, kimliğiniz ve bize sağladığınız bilgi kimseyle paylaşılmayacaktır. Bu görüşmeyi katıldığınız sırada görüşme mekanında yöneticileriniz, çalışma arkadaşlarınız veya öğrencileriniz bulunmayacaktır. Bu görüşme, katılanlara zarar getirebilecek psikolojik ya da fiziksel bir iş içermemektedir. Görüşmenin, katılanlara kendi bakış açıları ve çalıştıkları kurum hakkındaki düşünceleri ile ilgili bir eğitim araştırmasına katılmış olmaları dışında sağladığı bir yarar yoktur. Fakat sonuçlarının çalışmakta oldukları okula ve genel olarak Türkiye'deki bilim ve teknoloji eğitimine yararlı etki yapması beklenmektedir.

Çalışma kapsamında yapılacak görüşme 22 ana sorudan oluşmakta ve yaklaşık 75 dakikalık bir zaman alacağı varsayılmaktadır.

Çalışmanın her hangi bir anında sorularınızı sorabilirsiniz. Eğer gönüllü olmaya karar vermeden önce öğrenmek istedikleriniz varsa lütfen sormaktan çekinmeyin. Bu çalışmada yer almamak, yer aldığınız halde herhangi bir anda yarım bırakmak ve cevaplamaktan rahatsız olduğunuz soruları atlamak hakkına her zaman sahiptir. Eğer bu görüşmeye katılmak için gönüllü olursanız, kişisel bilgileriniz mümkün olan en gizli şekilde korunacaktır. Sadece benim ve tez hocamın bu bilgilere erişebilme hakkı vardır ve hiç bir şekilde diğer kişilerle paylaşılmayacaktır.

Bu form biri sizin kendinize ait kayıtlarınız için, diğeri de araştırma için olmak üzere iki adet hazırlanmıştır. Adınız ve imzanız, size gönüllü olmak isteyip istemediğinizi sorduğumuz için, yalnızca bu iki kopya formun üzerinde yer alacaktır. Bir kopyası ilerde sizinle bağlantı kurabilmemiz için bana ait olup, diğeri kopyası ise size aittir ve o kopyayı sizden istemeyeceğiz.

Sağlayacağınız bilgi hakkında bu belgenin sonunda ayrı bir bölüm vardır. Lütfen araştırma ekibine o bölüm için de gönüllü olup olmadığınızı bilgisini veriniz.

Eğer ilerde bu çalışma hakkında daha çok soru sormak isterseniz lütfen aşağıdaki iletişim yollarından birini kullanarak bana ulaşınız (tercihinize bağlı olarak isim belirtmeyebilirsiniz):

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Teşekkürler.

Ad, Soyad: \_\_\_\_\_

İmza : \_\_\_\_\_

Tarih : \_\_\_\_\_

Tercih ettiğiniz iletişim yolu bilgisi:

Tlf: \_\_\_\_\_ (Ofis) \_\_\_\_\_ (Cep)

Elektronik posta: \_\_\_\_\_

## Students' Interview Protocol

Merhaba,

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Çalışma kapsamında yapılacak görüşme 9 ana sorudan oluşmakta ve yaklaşık 40 dakikalık bir zaman alacağı varsayılmaktadır.

Çalışmanın her hangi bir anında sorularınızı sorabilirsiniz. Eğer gönüllü olmaya karar vermeden önce öğrenmek istedikleriniz varsa lütfen sormaktan çekinmeyin. Bu çalışmada yer almamak, yer aldığınız halde herhangi bir anda yarım bırakmak ve cevaplamaktan rahatsız olduğunuz soruları atlamak hakkına her zaman sahipsiniz. Eğer bu görüşmeye katılmak için gönüllü olursanız, kişisel bilgileriniz mümkün olan en gizli şekilde korunacaktır. Sadece benim ve tez hocamın bu bilgilere erişebilme hakkı vardır ve hiç bir şekilde diğer kişilerle paylaşılmayacaktır.

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Teřekkrler.

Ad, Soyad: \_\_\_\_\_

İmza : \_\_\_\_\_

Tarih : \_\_\_\_\_

Tercih ettięiniz iletiřim yolu bilgisi:

Tlf: \_\_\_\_\_ (Ofis) \_\_\_\_\_ (Cep)

Elektronik posta: \_\_\_\_\_

## Appendix B: Interview Forms

### FOR ADMINISTRATORS

1. Yenilikçilik (innovasyon) kavramından ne anlıyorsunuz?
2. BBTL'deki yenilikçiliğin kaynağı sizce nedir?
  - a. Sizi diğer kurumlardan/rakiplerinizden farklı kılan özellikleriniz nelerdir?
3. Sizi yenilikçiliğe yönelten etkenler nelerdir?
4. Yenilikçi uygulamalarınız ne gibi yönetsel uygulamaları zorunlu kılmıştır (TQM, MIS, stratejik planlama)
5. Yenilikçilik için benimsediğiniz yönetim stratejileriniz nelerdir?
6. Liderlik anlayışınızı nasıl tanımlarsınız? (öğretmenlere: liderinizin tutum ve davranışını nasıl tanımlarsınız? Kurumunuzdaki liderlikle ilgili düşünceleriniz nelerdir?)
7. Kurumunuzda uygulanan müfredatın özellikleri nelerdir?
  - a. Müfredatta ne tür yenilikler sunulmaktadır?
  - b. Diğer müfredatlardan nasıl ayrılmaktadır?
  - c. Bu müfredata nasıl karar verildi?
8. BBT lisesinin paydaşlarıyla (Üniversiteler, MEB, kamu kurumları, toplum) ilişkilerini anlatır mısınız?
  - a. Sizce bu ilişkilerin BBTL'de yenilikçiliğe katkısı nedir?
  - b. Paydaşlarınız yenilikçi yaklaşım/uygulamalarınızı nasıl karşılamaktadır?
9. Eğitimde yenilikçilik size nasıl yaygınlaştırılabilir?
10. Öğrencilerin genel özellikleri nedir?
  - a. Öğrenci seçimi nasıl olmaktadır?
11. Öğretmenlerin genel özellikleri nedir?
  - a. Öğretmen seçimi nasıl olmaktadır?
12. Diğer çalışanların özellikleri nedir?
  - a. Çalışan seçimi nasıl olmaktadır?
13. Kurumunuzdaki ödül/ceza/kontrol mekanizmaları nelerdir?
  - a. Bu mekanizmaların yenilikçiliğe katkısı nedir?
14. Kurumunuzdaki sosyal etkileşim nasıldır?
  - a. Kurumunuzdaki sosyal etkileşimin yenilikçiliğe katkısı nedir?
15. Kurumunuzda profesyonel etkileşimi nasıl tanımlarsınız?
  - a. Kurumunuzda takım çalışmasına ne derece yer veriliyor?
  - b. Takım çalışmasının yenilikçiliğe katkısı sizce ne düzeyde olmaktadır?
16. Kurumunuzda bilgi paylaşımı nasıldır?
  - a. Bilgi paylaşımı için ne tür mekanizmalar işletilmektedir?
  - b. Sizce kurumunuzdaki bilgi paylaşımının yenilikçiliğe katkısı nedir?
17. Kurumunuzda iletişim sizce nasıldır?
  - a. İletişim ne tür kanallarda işletilmektedir?
  - b. Yenilikçiliğe katkısı nedir?
18. Çalışanlarınızı yenilikçiliğe yönelik olarak nasıl motive ediyorsunuz?
  - a. Çalışanlarınıza eşdeğer diğer kurumlardan farklı olarak ne tür imkanlar sunuyorsunuz? (Öğretmenler için "nasıl motive ediliyorsunuz?...size diğer kurumlardan farklı olarak ne sunuyor?)



19. Yenilikçilik çalışmalarınızda risk almayı ne ölçüde zorunlu kılıyor?
  - a. Risk yönetimi anlayışınızı tanımlar mısınız?
20. Belirlenen hedeflerin gerçekleştirilememesine karşı yaklaşımınız nasıldır (öğretmenler için, hedeflerin gerçekleştirilememesine karşı yöneticinizin tutumu nasıldır?)
21. BBTL'deki yenilikleri kamu ve özel kurumlarla paylaşıyor musunuz?
  - a. Kimlerle paylaşıyorsunuz?
  - b. Neden paylaşıyorsunuz?
22. Kurumunuzu öğrenen bir örgüt olarak tanımlar mısınız?
  - a. Kurumsal öğrenmeyi kurumunuzda mümkün kılan özellikler nelerdir?
23. Karar alma süreçlerinizde çalışanların, öğrencilerin ve diğer paydaşların (örnek, veliler) katılımı ne derecede olmaktadır?
  - a. Paydaşlarınızın katılımı yenilikçiliğini nasıl etkiliyor?
24. Kurumsal ve sizin (lider) bireysel olarak sahip olduğunuz ortaklıklar ve ağların yenilikçiliğine katkısı ne düzeyde olmaktadır?
25. Yenilikçiliği sürdürmek için ihtiyaç duyduğunuz kaynaklar, stratejiler nelerdir?

### **FOR TEACHERS**

1. Yenilikçilik (innovasyon) kavramından ne anlıyorsunuz?
2. BBTL'deki yenilikçiliğin kaynağı sizce nedir?
  - a. Sizi diğer kurumlardan/rakiplerinizden farklı kılan özellikleriniz nelerdir?
3. Sizi yenilikçiliğe yönelten etkenler nelerdir?
4. Yenilikçi uygulamalarınız ne gibi yönetsel uygulamaları zorunlu kılmıştır (TQM, MIS, stratejik planlama)
5. Yenilikçilik için benimsediğiniz yönetim stratejileriniz nelerdir?
6. Yöneticilerinizin tutum ve davranışını nasıl tanımlarsınız? Kurumunuzdaki liderlikle ilgili düşünceleriniz nelerdir?
7. Kurumunuzda uygulanan müfredatın özellikleri nelerdir?
  - a. Müfredatta ne tür yenilikler sunulmaktadır?
  - b. Diğer müfredatlardan nasıl ayrılmaktadır?
  - c. Bu müfredata nasıl karar verildi?
8. BBT lisesinin paydaşlarıyla (Üniversiteler, MEB, kamu kurumları, toplum) ilişkilerini anlatır mısınız?
  - a. Sizce bu ilişkilerin BBTL'de yenilikçiliğe katkısı nedir?
  - b. Paydaşlarınız yenilikçi yaklaşım/uygulamalarınızı nasıl karşılamaktadır?
9. Eğitimde yenilikçilik size nasıl yaygınlaştırılabilir?
10. Öğrencilerin genel özellikleri nedir?
11. Öğretmenlerin genel özellikleri nedir?
  - a. Öğretmen seçimi nasıl olmaktadır?
12. Diğer çalışanların özellikleri nedir?
  - a. Çalışan seçimi nasıl olmaktadır?
13. Kurumunuzdaki ödül/ceza/kontrol mekanizmaları nelerdir?
  - a. Bu mekanizmaların yenilikçiliğe katkısı nedir?

14. Kurumunuzdaki sosyal etkileşim nasıldır?
  - a. Kurumunuzdaki sosyal etkileşimin yenilikçiliğe katkısı nedir?
15. Kurumunuzda profesyonel etkileşimi nasıl tanımlarsınız?
  - a. Kurumunuzda takım çalışmasına ne derece yer veriliyor?
  - b. Takım çalışmasının yenilikçiliğe katkısı sizce ne düzeyde olmaktadır?
16. Kurumunuzda bilgi paylaşımı nasıldır?
  - a. Bilgi paylaşımı için ne tür mekanizmalar işletilmektedir?
  - b. Sizce kurumunuzdaki bilgi paylaşımının yenilikçiliğe katkısı nedir?
17. Kurumunuzda iletişim sizce nasıldır?
  - a. İletişim ne tür kanallarda işletilmektedir?
  - b. Yenilikçiliğe katkısı nedir?
18. Yenilikçiliğe yönelik olarak nasıl motive ediliyorsunuz?
19. Belirlenen hedeflerin gerçekleştirilememesine karşı yöneticilerinizin tutumu nasıldır?
20. BBTL'deki yenilikleri kamu ve özel kurumlarla paylaşıyor musunuz?
  - a. Kimlerle paylaşıyorsunuz?
  - b. Neden paylaşıyorsunuz?
21. Kurumunuzu öğrenen bir örgüt olarak tanımlar mısınız?
  - a. Kurumsal öğrenmeyi kurumunuzda mümkün kılan özellikler nelerdir?
22. Karar alma süreçlerinizde çalışanların, öğrencilerin ve diğer paydaşların (örnek, veliler) katılımı ne derecede olmaktadır?
  - a. Paydaşlarımızın katılımı yenilikçiliğini nasıl etkiliyor?

### **FOR STUDENTS**

1. Neden Bahçeşehir Fen ve Teknoloji Lisesi'nde okuyorsunuz? Bu okulu seçmenizin nedeni nedir? Şu anda memnun musun?
2. Bahçeşehir Koleji ve Bahçeşehir Fen ve Teknoloji Lisesi'in birarada olması avantaj mı?
3. Bu okulun sizce diğer okullardan bir farkı var mı? Varsa bu farkı nedir?
4. Bahçeşehir Fen ve Teknoloji Lisesi'nden mezun olduktan sonra, ne yapmayı planlıyorsunuz? Okumak istediğiniz alana karar verdiniz mi? Bu karar da Bahçeşehir Fen ve Teknoloji Lisesi'nin etkisi nedir?
5. Okulunuzdaki iyi eğitim ve öğretim uygulamaları nedir? Teknoloji kullanımı, nasıl? Bunu nasıl değerlendiriyorsunuz?
6. Okul yönetimi ile ilişkiniz nasıl? Onlarla sorunlarınızı paylaşmak konusunda bir sorun yaşıyor musunuz?
7. Öğretmenleriniz ile iletişiminiz nasıl? Sizlerin görüşleri alınıyor mu?
8. Müfredat dışı dersler hakkında ne düşünüyorsunuz? Size katkısı nedir? Bu program sizi zorluyor mu?
9. Siz burada ne tür değerler veriliyor? Burada kazandığınız değerler neler?

## Appendix C: Permission of METU's Human Subjects Ethics Committee



1956  
Orta Doğu Teknik Üniversitesi  
Middle East Technical University  
Fen Bilimleri Enstitüsü  
Graduate School of  
Natural and Applied Sciences  
06531 Ankara, Türkiye  
Phone: +90 (312) 2102292  
Fax: +90 (312) 2107959  
www.fbe.metu.edu.tr

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21 Nisan 2010

Gönderilen: Yrd.Doç.Dr. Yaşar Kondakçı

Eğitim Bilimleri Bölümü

Gönderen : Prof. Dr. Canan Özgen

IAK Başkan Yardımcısı

İlgi : Etik Onayı


“Yönetmelik Bir Süreç Olarak Fen Bilimlerinde Yenilikçilik: Bahçeşehir Bilim ve Teknoloji Lisesi Üzerine Bir Örnek Olay İncelemesi” başlığı ile yürüttüğünüz çalışmanız “İnsan Araştırmaları Etik Komitesi” tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

Uygundur

21/04/2010

  
Prof.Dr. Canan ÖZGEN  
Uygulamalı Etik Araştırma Merkezi  
(UEAM) Başkanı  
ODTÜ 06531 ANKARA

**Appendix D: Bahçeşehir Science Technology High School Weekly Lesson Plans for 4 Years.**

Mayıs 2006-2584

Millî Eğitim Bakanlığı Tebliğler Dergisi

419

**ÖZEL BAHÇEŞEHİR FEN VE TEKNOLOJİ LİSESİ  
HAFTALIK DERS ÇİZELGESİ**

DERS KATEGORİLERİ	DERSLER	HAZIRLIK	9. SINIF	10. SINIF	11. SINIF	12. SINIF
ORTAK DERSLER	TÜRKÇE	4	-	-	-	-
	DİL VE ANLATIM	-	2	2	2	2
	TÜRK EDEBİYATI	-	3	3	3	3
	DİN KÜLTÜRÜ VE AHLAK BİLGİSİ	-	1	1	1	1
	TARİH	-	2	2	-	-
	T.C. İNKILAP TARİHİ VE ATATÜRKÇÜLÜK	-	-	-	2	-
	COĞRAFYA	-	2	2	-	-
	MATEMATİK	2	5	-	-	-
	GEOMETRİ	-	2	-	-	-
	FİZİK	1	2	-	-	-
	KİMYA	1	2	-	-	-
	BİYOLOJİ	1	2	-	-	-
	SAGLIK BİLGİSİ	-	-	2	-	-
	FELSEFE	-	-	-	2	-
	YABANCI DİL	23	8	3	3	3
	BEDEN EĞİTİMİ	2	2	-	-	-
	MİLLÎ GÜVENLİK BİLGİSİ	-	-	1	-	-
	TRAFİK VE İLK YARDIM	-	-	-	1	-
	TOPLAM	34	33	16	14	9
	ALAN DERSLERİ	MATEMATİK	-	-	4	4
GEOMETRİ		-	-	2	2	2
FİZİK		-	-	4	4	4
KİMYA		-	-	4	4	4
BİYOLOJİ		-	-	4	4	4
ANALİTİK GEOMETRİ		-	-	-	-	2
BİLGİ VE İLETİŞİM TEKNOLOJİLERİNE GİRİŞ		-	2	2	-	-
BİLGİSAYAR BİLİMLERİNE GİRİŞ		-	1	1	-	-
VB.NET İLE PROGRAMLAMA		-	-	2	-	-
MEKATRONİK SİSTEMLERİ		-	-	-	2	2
JAVA İLE PROGRAMLAMA		-	-	-	2	-
BİLGİSAYAR AĞLARI		-	-	-	-	2
WEB PROGRAMLAMA		-	-	-	-	2
TOPLAM	-	3	23	22	26	
SEÇMELİ DERSLER	RESİM (1-2) - MÜZİK (1-2)					
	TARİH (2) - COĞRAFYA (2)					
	PSİKOLOJİ (2) - SOSYOLOJİ (2) - MANTIK (2)					
	MÜHENDİSLİK VE TEKNOLOJİNİN TEMELLERİ (2)					
	GENETİK BİLİMİNE GİRİŞ (2)					
	BİLGİ KURAMI (1)					
	ASTRONOMİ VE UZAY BİLİMLERİ (2)					
	PROJE HAZIRLAMA (2)					
	DEMOKRASİ VE İNSAN HAKLARI (1)					
	SOSYAL ETKİNLİK (2)					
	BİLGİSAYAR DESTEKLİ ÇİZİM (2)					
	BİLİM VE VE TEKNOLOJİ SEMİNERİ (1)					
	GİRİŞİMCİLİK (1)					
	BİLGİ TOPLUMUNA GİRİŞ (1)					
İSTATİSTİK (2)						
Alınabilecek Ders Saati Sayısı		1	3	4	3	4
REHBERLİK		1	1	1	1	1
TOPLAM DERS SAATI		36	40	40	40	40

**Not:**

1. Yılı sonu başarı ortalaması ile başarılı sayılmayacak ders Dil ve Anlatım dersi.
2. Seçmeli derslerin kategorisinde yer alan derslerin, ders saatleri parantez içerisinde belirtilmiştir.
3. Çizelgede yer alan derslerde, Ağustos 2005 tarih ve 2575 sayılı Tebliğler Dergisinde yayımlanan " MEB Ortaöğretim Kurumları Haftalık Ders Çizelgelerinde Yer Alan Derslerin Uygulanışına Yönelik Açıklamalar" doğrultusunda uygulama yapılır.