FIELD TRIPS TO SCIENCE CENTERS: TEACHERS' PERSPECTIVES, ROLES, AND REFLECTIONS

A THESIS SUBMITTED TO
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ERAY ŞENTÜRK

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
SECONDARY SCIENCE AND MATHEMATICS EDUCATION

SEPTEMBER 2015

Approval of the thesis:

FIELD TRIPS TO SCIENCE CENTERS: TEACHERS' PERSPECTIVES, ROLES, AND REFLECTIONS

submitted by **ERAY ŞENTÜRK** in partial fulfilment of the requirements for the degree of **Doctor of Philosophy in Secondary Science and Mathematics Education Department**, **Middle East Technical University** by,

Prof. Dr. Gülbin Dural Ünver _____
Dean, Graduate School of **Natural and Applied Sciences**

Prof. Dr. Ömer Geban _____
Head of Department, **Secondary Science and Math. Edu.**

Assoc. Prof. Dr. Ömer Faruk Özdemir _____
Supervisor, **Secondary Science and Math. Edu. Dept., METU**

Examining Committee Members:

Prof. Dr. Fitnat Köseoğlu _____
Secondary Science and Math. Edu. Dept., Gazi University

Assoc. Prof. Dr. Ömer Faruk Özdemir _____
Secondary Science and Math. Edu. Dept., METU

Prof. Dr. Ahmet İlhan Şen _____
Secondary Science and Math. Edu. Dept., Hacettepe University

Prof. Dr. Jale Çakıroğlu _____
Elementary Education Dept., METU

Prof. Dr. Ömer Geban _____
Secondary Science and Math. Edu. Dept., METU

Date: 01.09.2015

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name : Eray ŞENTÜRK

Signature :

ABSTRACT

FIELD TRIPS TO SCIENCE CENTERS: TEACHERS' PERSPECTIVES, ROLES, AND REFLECTIONS

Şentürk, Eray

Ph.D., Department of Secondary Science and Mathematics Education

Supervisor: Assoc. Prof. Dr. Ömer Faruk Özdemir

September 2015, 240 pages

The purpose of this study was to examine (1) teachers' perspectives on field trips to informal learning environments, (2) teacher roles during a field trip to the Middle East Technical University's Science Center (METU SC), and (3) teacher reflections on the field trip to the METU SC. Two different research designs, survey (N= 153) and case study (N=74), were used in two different stages. In stage one, teacher perspectives on field trips to informal learning environments were examined by using a survey design. In stage two, case study design was conducted to investigate teacher roles during a field trip to the METU SC and their reflections on the field trip. Participants were selected from the METU SC's reservation list conveniently for survey research design and purposefully for case study research design. Data were collected through survey, observations, and semi-structured interviews. The results of the survey revealed that a great majority of teachers consider field trip visitations as highly valuable educational experiences for their students. Most of them conducted field trips to informal learning environments (ILEs) twice a year or more, and they mainly conducted

field trips to science centers. When planning a field trip to ILE, almost everything was arranged by them, and surprisingly they did not complain about this situation. "To what extent an informal learning environment will provide benefits for students" was considered as the top priority issue of teachers when planning a field trip to ILEs. Majority of the teachers also thought that students should be informed before the visit about the field trip setting, the field trip program, and the purpose of the visit. Even though most of the teachers claimed that they should supervise and facilitate the learning experiences of their students during an actual field trip, the most repetitive suggestion was getting an explainer for their students. In a similar manner, for teachers, getting feedbacks from students about the visit was more important than providing curriculum connection or making students share their experiences. The key emergent issues that currently prevent teachers from conducting more field trips to the METU SC were reported as time constraints, transportation, and science center's busy schedule.

The results of the case study revealed that teachers adopted a variety of roles during an actual field trip to the METU SC, namely Superintendent, Information Provider, Information Seeker, Facilitator, Recorder, Participator, and Indifferent. Some of these roles had also sub-roles (e.g., technical directions giver, attention stimulator, controller, requester, technical assistant, and motivator were emerged as sub-roles of the major superintendent role). In terms of the parts of the visit, the most repetitive teacher role at the welcoming and accommodation part of the visit was superintendent. While teachers mostly adopted participator role during explainer demonstration part of the visit, recorder role was mostly adopted by teachers during free exploration part of the visit. Teachers also reflected their views on gains from science center, infrastructure of science center, explainer demonstrations and personalities of explainers, exhibits, and free exploration.

The results of the study revealed that teacher perspectives on field trips need to be given special attention since their perspectives are of the important factors affecting the success of a field trip. In addition, even though teachers adopted many roles during a field trip to the METU SC, their roles generally remained passive. This must be paid attention by the educators of science centers and

teacher educators. Both pre-service and in-service teachers need to be trained to be aware of the importance of their roles in informal learning environments in terms of facilitating students' learning experiences. For that purpose, educators are required to develop specific programs where teachers are able to learn unique pedagogical strategies to be used in ILEs. Besides, ILEs like the METU SC should find a way to establish a collaboration with teachers when planning field trips. Educators and explainers of science centers should know what teachers expect from them. Teachers should also know what science centers expect from them.

Key words: informal setting, informal learning environment, free-choice setting, science museum, science center, teacher perspectives, teacher roles, teacher reflections, field trip, excursion, explainer, docent, guide.

ÖZ

BİLİM MERKEZLERİNE YAPILAN SINIF GEZİLERİ: ÖĞRETMEN BAKIŞ AÇILARI, ROLLERİ VE DÜŞÜNCELERİ

Şentürk, Eray
Doktora, Orta Öğretim Fen ve Matematik Alanları Eğitimi Bölümü
Tez Yöneticisi: Doç. Dr. Ömer Faruk Özdemir

Eylül 2015, 240 sayfa

Bu çalışmanın amacı: (1) öğretmenlerin okul dışı öğrenme ortamlarına düzenledikleri sınıf gezilerine bakış açılarını, (2) Orta Doğu Teknik Üniversitesi Bilim Merkezi'ni ziyaretleri sırasında benimsedikleri rolleri ve (3) gerçekleştirdikleri bu geziye yönelik düşüncelerini belirlemektir. Araştırmada iki farklı araştırma tasarımı, anketle tarama (N=153) ve durum çalışması (N=74), iki farklı basamakta kullanılmıştır. Birinci basamakta, öğretmenlerin okul dışı öğrenme ortamlarına düzenledikleri sınıf gezilerine bakış açıları tarama yöntemiyle araştırılmıştır. İkinci basamakta, öğretmenlerin Orta Doğu Teknik Üniversitesi Bilim Merkezi'ni ziyaretleri sırasında benimsedikleri roller ve bu geziye yönelik düşünceleri durum çalışması yöntemiyle araştırılmıştır. Çalışmaya katılan öğretmenler bilim merkezi randevu listesinden seçilmiştir. Anketle tarama için öğretmenlerden uygun olanları, durum çalışması için öğretmenler araştırmanın amacına yönelik seçilmiştir. Araştırma verileri anket, gözlemler ve yarı-yapılandırılmış görüşmelerle elde edilmiştir. Anket analizi sonucunda

öğretmenlerin büyük bir çoğunluğunun sınıf gezisi ziyaretlerini öğrencileri için eğitimsel değeri oldukça yüksek deneyimler olarak değerlendirdiği tespit edilmiştir. Öğretmenlerin birçoğunun yılda ikiden fazla okul dışı öğrenme ortamlarına sınıf gezisi düzenlediği ve genellikle ziyaretlerin bilim merkezlerine gerçekleştirildiği ifade edilmiştir. Bir sınıf gezisi planlama aşamasında ise neredeyse her şeyin öğretmenler tarafından yapıldığı ve öğretmenlerin büyük bir çoğunluğunun bu durumdan şikâyetçi olmadığı tespit edilmiştir. Okul dışı öğrenme ortamının öğrencileri için ne kadar yarar sağlayacağı bilgisinin, bir sınıf gezisi planlama aşamasında öğretmenler tarafından en fazla dikkate alınan husus olduğu belirlenmiştir. Öğretmenlerin büyük bir çoğunluğu öğrencilerin sınıf gezisi öncesinde gidilecek mekân, katılınacak program ve gezinin amacı hakkında bilgilendirilmeleri gerektiğini önermiştir. Bunun yanı sıra, öğretmenlerin birçoğu ziyaret sırasında öğrencilerini denetlemeleri ve öğrencilerin gezideki deneyimlerini kolaylaştırmaları gerektiğini önermiş olsalar da, en sık tekrarlanan önerinin öğrencilerinin bir eğitmen eşliğinde ziyareti gerçekleştirmesi gerektiği olduğu görülmüştür. Ayrıca, öğretmenler için öğrencilerden ziyaret hakkında geri bildirim almanın müfredat bağlantısı sağlamaktan ya da öğrencilerin deneyimlerini paylaşmasını sağlamaktan daha önemli olduğu tespit edilmiştir. Öğretmenler zaman yetersizliğinden, ulaşım zorluğundan ve bilim merkezinin yoğun programından dolayı ODTÜ Bilim Merkezi'ni sıklıkla ziyaret edemediklerini belirtmişlerdir.

Durum çalışması sonucunda, öğretmenlerin bilim merkezi ziyareti sırasında farklı roller benimsedikleri tespit edilmiştir. Bunlar öğretmenlerin, yönetici, bilgi sağlayıcı, bilgi arayıcı, öğrenmeyi kolaylaştırıcı, kaydedici, katılımcı ve ilgisiz rolleridir. Bu rollerin bazılarının farklı alt rollere de sahip olduğu belirlenmiştir (Örn. Talimat verici, dikkat çekici, kontrolcü, ricacı, teknik yardımcı ve güdüleyici rolleri yönetici rolünün alt rolleri olarak belirlenmiştir). Bunun yanı sıra, öğretmenlerin sınıf gezisinin farklı kısımlarında farklı roller benimsediği görülmüştür. Yönetici rolü en fazla grubun karşılanması ve yerleşimi kısmında görülürken, bilim merkezi eğitmenleri sunum ve gösterim yaparken öğretmenlerin

daha ziyade katılımcı rolünü benimsedikleri tespit edilmiştir. Serbest zamanlarda ise öğretmenler en fazla kaydedici rolünü benimsemişlerdir.

Ayrıca, öğretmenler bilim merkezinden elde ettikleri kazanımlar, bilim merkezinin alt yapısı, eğitmenler (eğitmen gösterimleri ve eğitmenlerin kişilik özellikleri), sergi üniteleri (sergi ünitelerinin tasarımları ve sürekli güncellenmeleri) ve serbest zaman hakkında düşüncelerini ifade etmişlerdir.

Sonuç olarak öğretmenlerin sınıf gezilerine bakış açısına önem verilmesi gerekmektedir, çünkü öğretmenlerin bakış açıları bir sınıf gezisinin başarısını etkileyen önemli faktörler arasında yer almaktadır. Ayrıca, öğretmenler gezileri esnasında birçok farklı rolü benimsemelerine rağmen, rollerinin genellikle pasif olduğu görülmektedir. Hem öğretmen adaylarının hem de öğretmenlerin, kendi öğrencilerinin deneyimlerini kolaylaştırması bakımından bu tip okul dışı ortamlarda benimsedikleri rollerin önemi hakkında farkındalıklarının artırılmasına ihtiyaç duyulmaktadır. Bu amaçla, hem bilim merkezi eğitimcilerinin hem de öğretmen yetiştiricilerinin, öğretmenlerin bu tip ortamlarda kullanabileceği pedagojik stratejileri öğrenebileceği mesleki gelişim programları geliştirmesi gerekmektedir. Ayrıca, ODTÜ Bilim Merkezi gibi okul dışı öğrenme ortamlarının sınıf gezisi planlanırken öğretmenlerle işbirliği yapabilecekleri etkili yollar bulması gerekmektedir. Bir sınıf gezisi düzenlenirken, okul dışı öğrenme ortamlarındaki eğitimciler ve eğitmenler öğretmenlerin kendilerinden ne beklediğini, öğretmenler de kendileri tarafından yapılması beklenenleri bilmesi gerekmektedir.

Anahtar Kelimeler: okul dışı öğrenme ortamları, informal öğrenme ortamları, bilim müzeleri, bilim merkezleri, öğretmen bakış açıları, öğretmen rolleri, öğretmen yansımaları, sınıf gezileri, rehber, eğitmen.

To My Father

ACKNOWLEDGEMENTS

Firstly and the foremost, I wish to express my deepest gratitude to my supervisor Assoc. Prof. Dr. Ömer Faruk Özdemir for his guidance, advice, criticism, encouragements, and insight throughout the research.

I would also like to express my deepest gratitude to the examining committee members, Prof. Dr. Ahmet İlhan Şen, Prof. Dr. Fitnat Köseoğlu, Prof. Dr. Jale Çakıroğlu, and Prof. Dr. Ömer Geban for their precious suggestions and comments.

Very special thanks go to the researchers listed in "References" section for their incredibly valuable articles. If I had not accessed to their articles, I would not have embarked on this journey.

I would like to thank the Rectorate of METU and the Society and Science Application and Research Center for their support. I also thank all participants of this study who helped me during data collection procedure. I would like to thank Prof. Dr. David Anderson from the University of British Columbia for his support during my crisis.

A very special thanks goes to my beloved mother, Ayşe Şentürk. The closer I came to the completion of my goal, the more she cheered me on as she has done through all my life. I also thank to my older sister Şenay Şentürk who always pray for me. I thank Prof. Dr. Safure Bulut, Prof. Dr. Fatoş Tünay Yarman Vural and Prof. Dr. Hüseyin Vural who always supported and believed in me.

I would like to thank my colleague, Semra Tahancalıo and her husband, my closest friend, Mehmet Ali Tahancalıo (MALI) who always encouraged me to complete my thesis and cheered me up while I was studying.

Last but not least, I also thank my dear friends (Abdullah Yılmaz, Assist. Prof. Dr. Ayşegül Tarkın, Assist. Prof. Dr. Betül Demirdöğen, Fatma Nur Akın, Kübra Eryurt, Assist. Prof. Dr. Sevgi Aydın, Sevgi İpekçioğlu Önal, Umut Akın, Yener Şentürk) who always supported and believed in me.

TABLE OF CONTENTS

ABSTRACT v
ÖZ viii
ACKNOWLEDGEMENTS xii
TABLE OF CONTENTS xiv
LIST OF TABLES xxi
LIST OF FIGURES xxiii
CHAPTERS 1
1. INTRODUCTION 1
1.1 Background of the Study 1
1.2 Purpose of the Study 5
1.3 Significance of the Study 6
1.4 Definitions of Important Terms 7
2. THE RELATED LITERATURE REVIEW 9
2.1 Informal Science Education/Learning/Environments 9
2.1.1 Informal science education (ISE) 10
2.1.2 Informal science learning (ISL) 10
2.1.3 Informal learning environments (ILEs) 11
2.1.3.1 Science centers as an informal learning environment 12
2.2 A Journey to Informal Learning Environments: Field Trips 13
2.3 How to Conduct a Successful Field Trip 22
2.3.1 Pre-visit factors 23
2.3.1.1 Pre-visit preparation 23
2.3.1.2 Orientation 24
2.3.1.3 Novelty 25
2.3.1.4 Prior knowledge 28
2.3.1.5 Summary 29

2.3.2 On-site factors 30
2.3.2.1 Degree of structure 30
2.3.2.2 Worksheets 31
2.3.2.3 Explainers 32
2.3.2.4 Social context of setting 34
2.3.2.5 Summary 36
2.3.3 After-visit factors 36
2.3.3.1 Follow-up (post-visit) activities 36
2.3.4 Other factors 38
2.3.5 Suggestions for teachers 39
2.3.6 Summary 41
2.4 Key Decision-Makers for Field Trips: Teachers 41
2.4.1 Teacher motivations for field trips 45
2.4.2 Teacher perspectives on field trips 48
2.4.3 Teacher roles in field trips 52
2.4.4 Teacher reflections on field trips 67
2.4.5 Summary 68
3. METHODOLOGY 69
3.1 Stage One: Survey Research Design 71
3.1.1 Sample and sampling technique 71
3.1.2 The data source: Questionnaire 72
3.1.3 The procedures for administration of the questionnaire 74
3.2 Stage Two: The Case Study Research Design 75
3.2.1 Case I 76
3.2.1.1 The selection of Case I 76
3.2.1.2 The setting: Middle East Technical University's Science Center (METU SC) 78
3.2.1.2.1 Science center program during observational data collection 79
3.2.1.2.2 Standardization of explainer demonstrations 81
3.2.1.3 Participants 82
3.2.1.4 The procedures of data collection 82

3.2.1.4.1 Direct observations 82
3.2.1.4.2 Semi-structured interviews 85
3.2.2 Case II 86
3.2.2.1 The selection of Case II 87
3.2.2.2 The setting: METU SC 87
3.2.2.3 Participants 87
3.2.2.4 The procedures of data collection 88
3.2.2.4.1 Observation checklist 88
3.2.3 Trustworthiness 89
3.2.3.1 Credibility 89
3.2.3.2 Dependability 90
3.2.3.3 Transferability 91
3.3 Ethics and Privacy 96
3.4 Assumptions 92
3.5 Limitations 93
4. ANALYSES OF DATA AND RESULTS 95
4.1 Stage I: The Analyses and Results of the Survey 95
4.1.1 Teachers' views on field trips 96
4.1.1.1 ILEs where teachers did conduct a field trip 96
4.1.1.2 Field trip venues except for ILEs teachers did bring their students 97
4.1.1.3 The number of field trips conducted by teachers throughout their teaching experience 98
4.1.1.4 The frequency of field trips conducted by teachers to ILEs 99
4.1.1.5 Teachers' perceived value of field trip visitations as educational experiences for their students 99
4.1.1.6 The distribution of responsibilities for preparation and planning of field trips to ILEs and teachers' satisfaction with this distribution of responsibilities 100
4.1.2 Teachers' planning and implementation of field trips - Influence on decision-making process 101

4.1.2.1 The issues that teachers consider when planning field trips 102
4.1.2.2 Top five priorities that teachers consider when planning field trips for their class(es) 104
4.1.2.3 The issues that should be done before, during, and after field trip visitation to maximize students' gains from field trip: Teacher suggestions 104
4.1.3 Teachers' familiarity with the METU SC 108
4.1.3.1 The level of teachers' familiarity with three ILEs 109
4.1.3.2 Teachers' perception of the METU SC compared with other two ILEs 109
4.1.4 Teacher perceptions of the major factors preventing more field trip visitation 110
4.1.4.1 The frequency of teacher visitations to the METU SC... 111
4.1.4.2 The reasons for not visiting the METU SC..... 111
4.1.4.3 Restrictions for repetitive visitations 112
4.1.5 Improving the visitation rate 112
4.1.5.1 Teachers' ratings of various proposals to increase visitation frequency to the METU SC 112
4.1.5.2 Suggestions from teachers for frequent visitations 114
4.1.6 METU SC's communications with teachers 116
4.1.6.1 The level of METU SC's communication with teachers 116
4.1.6.2 The accessibility of field trip guide 116
4.1.6.3 Suggestions from teachers for increasing the accessibility of field trip guide 116
4.1.6.4 Teachers' perceived value of field trip guide 117
4.2 Stage Two: The Analyses and Results of the Case Studies 117
4.2.1 Case-I: Teacher roles 118
4.2.1.1 Superintendent 119
4.2.1.1.1 Technical directions giver 120
4.2.1.1.2 Attention stimulator 121
4.2.1.1.3 Controller 122

4.2.1.1.4 Requester 122
4.2.1.1.5 Technical assistant 123
4.2.1.1.6 Motivator 123
4.2.1.2 Information Provider 124
4.2.1.2.1 Informing students based on prior knowledge or experiences obtained from former visitations 124
4.2.1.2.2 Informing students by reading labels 125
4.2.1.2.3 Informing students by summarizing or rephrasing what was told by explainer 125
4.2.1.2.4 Informing students by connecting their everyday life experiences to the experiences provided by exhibits and/or demonstrations 126
4.2.1.2.5 Informing students by connecting their school experiences to the experiences provided by exhibits and/or demonstrations 126
4.2.1.2.6 Informing explainers about some issues 126
4.2.1.3 Information Seeker 127
4.2.1.4 Facilitator 129
4.2.1.5 Recorder 130
4.2.1.6 Participator 131
4.2.1.6.1 Observer 131
4.2.1.6.2 Reader 132
4.2.1.6.3 Experimenter 132
4.2.1.6.4 Group member 132
4.2.1.7 Indifferent 134
4.2.1.7.1 Indifference towards what students/parents asked 134
4.2.1.7.2 Indifference towards demonstrations conducted by explainer 134
4.2.1.7.3 Indifference towards field trip in general 135
4.2.1.7.4 Indifference towards what explainer asked for ..135

4.2.1.7.5 Indifference towards explanations provided by explainer 135
4.2.1.7.6 Indifference towards participating in activities requested by explainers 136
4.2.1.8 Summary 136
4.2.2 Teacher roles in different parts of the visit 136
4.2.3 Teacher reflections on a field trip to the METU SC 139
4.2.3.1 Reflections on gains from science center 140
4.2.3.1.1 Cognitive gains 141
4.2.3.1.2 Affective gains 142
4.2.3.2 Reflections on exhibits 143
4.2.3.2.1 Design of exhibits 143
4.2.3.2.2 The need of on-going update of exhibits 143
4.2.3.3 Reflections on explainers 144
4.2.3.3.1 Explainer demonstrations 144
4.2.3.3.2 Personalities of explainers 145
4.2.3.4 Reflections on free exploration 146
4.2.3.5 Reflections on infrastructure of science center 147
4.2.3.6 Summary 148
5. DISCUSSION, IMPLICATION, AND RECOMMENDATION 149
5.1 Discussion 149
5.1.1 Teacher perspectives on field trips 149
5.1.2 Teacher roles 154
5.1.3 Teacher reflections 157
5.2 Implications and Recommendations 159
5.2.1 Implications and recommendations for teachers, teacher educators, the educators of science centers 159
5.2.2 Implications and recommendations for science centers 162
5.3 Recommendations for Further Research 164
REFERENCES 167
APPENDICES 183
A. THE REFERENCES USED IN TABLE 2 183

B. QUESTIONNAIRE 189
C. THE COVER LETTER FOR MAIL SURVEY 203
D. THE CONSENT FORM 205
E. A SNAPSHOT OF OBSERVER POSITION DURING WELCOMING OF SCHOOL GROUPS 209
F. FIELD TRIP GUIDELINE FOR EXPLAINERS 210
G. THE DEMOGRAPHIC INFORMATION OF TEACHERS OF CASE I 223
H. THE VIEW OF OBSERVER POSITION FROM THE EYES OF EXPLAINER DURING EXPLAINER DEMONSTRATION 225
I. A SNAPSHOT OF OBSERVER POSITION DURING FREE EXPLORATION 227
J. OBSERVATION CHECKLIST 229
K. ETHICAL APPROVAL TAKEN FROM METU HSEC 231
L. THE FIELD TRIP GUIDE FOR SCHOOL GROUPS.....233
M. AN EXAMPLE OF CODING THE PART OF A FIELD NOTE 235
N. TEACHER ROLES 237
CURRICULUM VITAE 239

LIST OF TABLES

TABLES

Table 1. The designs of the study 6

Table 2. Recommendations for teachers about how to conduct successful field trips to an informal learning environment 40

Table 3. During-visit strategies 64

Table 4. The components of the study 70

Table 5. Science center program during observational data collection 80

Table 6. Intra-class correlations among the ratings of two coders on seven major teacher roles 91

Table 7. The frequencies and percentages of top five venues that teachers brought their students except for ILEs 97

Table 8. Teachers' perceived value of field trip visitations as educational experiences 99

Table 9. The distribution of responsibilities for preparation and planning of field trips to ILEs 101

Table 10. The issues that teachers consider when planning field trips 103

Table 11. Teacher suggestions regarding what they should do before the actual field trips 106

Table 12. Teacher suggestions regarding what they should do during the actual field trips 107

Table 13. Teacher suggestions regarding what they should do after the actual field trips 108

Table 14. Teachers' perception of the METU SC compared with other ILEs ..110

Table 15. Teachers' suggestions to be aware of "Field Trip Guide".....117

Table 16. Examples of technical directions used by teachers in different parts of the visit 120

Table 17. Teachers' questions about different issues 128

Table 18. The frequencies of each major teacher role according to the parts of the visit 137

Table 19. The frequencies of sub-roles of the major role "Superintendent" adopted by teachers in welcoming and accommodation part of the visit 138

Table 20. The frequencies of sub-roles of the major role "Participator" adopted by teachers in explainer demonstration part of the visit 138

Table 21. The demographic information of teachers of Case I.....223

Table 22. Observation checklist.....229

LIST OF FIGURES

FIGURES

Figure 1. ILEs where teachers did conduct a field trip 97

Figure 2. The number of field trips conducted by teachers throughout their teaching experience 98

Figure 3. The frequency of teacher visitations to the METU SC 111

Figure 4. Restrictions for repetitive visitations 113

Figure 5. Suggestions from teachers for frequent visits to be made 115

Figure 6. Teacher roles 118

Figure 7. Sub-roles of superintendent role 119

Figure 8. Sub-roles of participator role 131

Figure 9. Teacher reflections on different themes 140

Figure 10. A snapshot of observer position during welcoming of school groups 209

Figure 11. The view of observer positions from the eyes of explainer during explainer demonstration 225

Figure 12. A snapshot of observer position during free exploration..... 227

Figure 13. An example of coding the part of a field note..... 235

Figure 14. Teacher roles 237

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Day by day and year by year, the gradually increasing numbers of people throughout the world visit informal learning environments such as science centers, science and technology museums, zoos, and the like. This is because these environments can effectively promote science learning, and strengthen and enrich school science (NRC, 2009; Phillips, Finkelstein, and Wever-Frerichs, 2007). Most of the visitors of informal learning environments seem to be primary and secondary students and their accompanying teachers during school trips (e.g., Anderson & Lucas, 1997; Beardsley, 1975; Lelliott, 2007; Rennie & McClafferty, 1995; Tal, Bamberger, & Morag, 2005).

Visit to informal learning environments organized by teachers for an educational purpose can be described as field trip. The available literature suggests that field trips have a positive impact on cognitive (Anderson, 1999; Anderson & Lucas, 1997; Bamberger & Tal, 2006; Beiers & McRobbie, 1992; Eshach, 2007; Flexer & Borun, 1984; Gottfried, 1980; Miglietta, Belmonte, & Boero, 2008; Orion & Hofstein, 1994; Stronck, 1983; Tuckey, 1992a), social, and affective outcomes (Braund & Reiss, 2006b; Finson & Enochs, 1987; Meredith, Fortner, & Mullins, 1997; Orion & Hofstein, 1994; Rickinson et al., 2004; Wellington, 1990) which explains why teachers conduct field trips to such environments. The long-term effects of field trips on cognitive outcomes, such as science learning (Miglietta et al., 2008; Balling & Falk, 1980; Bamberger & Tal, 2008b), memories of specific content and social contexts (e.g., milking a cow on the first-grade trip to the farm

that was recalled by an eight-grade student) (Falk, 1983b; Falk & Dierking, 1997) as well as affective outcomes such as attitude towards science and interest in science (Jarvis & Pell, 2002, 2005) were well-documented in the literature. Even the effects of field trips on career choices were reported (Canadian Association of Science Centres [CASC], 2008; Salmi, 2003). Nonetheless, to most of teachers, the term "field trip" generally implies a daunting task involving extra time and effort (Scribner-MacLean & Kennedy, 2007; Rebar, 2009; Rebar & Enochs, 2010; Storksdieck, 2001). As a result, field trips are still underused as learning experiences (Dewitt & Storksdieck, 2008; Storksdieck, Werner, & Kaul, 2006) even though it is recommended as a way to teach science and make inquiry (NRC, 1996, 2000).

Falk and Dierking (1992) suggest that any visitor's experiences are shaped by his/her personal background (e.g., prior knowledge, experiences, skills, motivations, and desire to learn) and interactions with their social (social interactions with people) and physical (created by the exhibits and their surroundings) environments. For successful field trips, therefore, teachers should know how to integrate these three contexts (personal, social, and physical) into a coherent field trip experience (Rennie & McClafferty, 1995). In fact, the available literature offered many suggestions for teachers about how to conduct successful field trips to informal learning environments (see Table 2). The learning potential of the entire field trip experience is affected by a good number of factors (Beardsley, 1975; Dewitt & Storksdieck, 2008) such as students' familiarity with the setting and prior knowledge, the degree of structure (guided vs. unguided) and social aspects of the visit (e.g., working in pairs vs. individual). In addition, Rennie and McClafferty (1995) claimed that many of these factors are under the direct control of teachers who thus have an impact on students' possible gains from visits to informal settings. Nonetheless, the current teacher practice on field trips does not seem to reflect the desired one. "On most field trips, the students are put into buses early in the morning, driven to a rather novel setting, led through some activities by a stranger, put back on the bus, and returned at the end of the day." (Falk & Balling, 1982, p.22). Furthermore, several researchers showed that

teachers may not explicitly define their goals for their field trips (Cox-Petersen, Marsh, Kisiel, & Melber, 2003; Cox-Petersen & Pfaffinger, 1998; Griffin, 2004; Griffin & Symington, 1997; Kisiel, 2003b; Ramey-Gassert, Walberg III, & Walberg, 1994; Tal et al., 2005), unable to connect the experience to the classroom curriculum, and rarely organize or conduct pre-visit activities (Griffin & Symington, 1997; Ramey-Gassert et al., 1994; Tal et al., 2005). As a reason for the current undesired teacher practice on field trips, Griffin (1994) argued that teachers' perspectives, perceptions, values or motivations for field trips have a direct impact on their field trip practice no matter of what they are recommended or offered. In this respect, the first aim of this work was to investigate teachers' perspectives on a field trip to an informal science learning setting, which was the Middle East Technical University's Science Center (METU SC).

Another issue related to field trip is the kind of roles teachers adopt during a field trip. There is a common view that teachers play a pivotal role in learning experiences of students throughout a field trip to informal settings such in the case of any formal setting (Cox-Petersen & Pfaffinger, 1998; Finson & Enochs, 1987; Stronck, 1983). Indeed, teachers can adopt a variety of roles during their teaching at school or conducting a visit to a science center. While some teachers may act as facilitators because they feel they help their students construct their own knowledge and experiences, some others may act like a maestro to organize students' learning experiences. However, teachers were seemed to have a general tendency. Their roles during a field trip to informal learning environments mostly seemed to be passive. Most of the teachers in the studies were engaged primarily in the technical aspect of the visit. They followed explainers of the informal settings, and solely helped explainers primarily with maintaining order and discipline such as organizing students, keeping students quiet, and watching students' behaviors. A few number of teachers actively engaged in the facilitation of student learning experiences (e.g., linking guide's explanations and/or subjects offered by museums to students' prior knowledge and/or the subjects being covered at the school) (e.g., Faria & Chagas, 2013; Griffin, 1994; Griffin & Symington, 1997; Tal et al., 2005; Tal & Morag, 2007). In addition, some

researchers have preferred to generate teacher roles by categorizing these teacher behaviors. For instance, Tal and Steiner (2006) identified three distinct type of teacher roles, which were (1) *involved teachers* whose behaviors include asking questions, asking explainer to elaborate, recommending ideas, helping their students in the activities, and making connections between the experience and the curriculum; (2) *traditional teachers* whose behaviors include keeping students on task and providing explainers with administrative help; (3) *passive teachers* whose behaviors include irrelevant activities such as grading tests, reading a newspaper, leaving students and going elsewhere. Correspondingly, Cox-Petersen and Pfaffinger (1998) generated for distinct roles, which were explainer, initiator (both were considered as facilitator of hands-on experiences), manager, and observer. Overall, the available literature showed that there were a few studies exploring teacher roles during a visit to informal learning environments concluding that teachers generally adopt passive roles during a visitation. Furthermore, the researchers generally preferred to report teacher's specific behaviors during a visit rather than categorizing them into the meaningful categories referring to distinct roles, whereas identification of teacher roles is of great importance since the roles adopted by teachers can lead to positive or negative results in terms of student learning experiences (Cox-Petersen & Pfaffinger, 1998; Finson & Enochs, 1987; Stronck, 1983). Cox-Petersen and Pfaffinger (1998) clearly demonstrated that students whose teachers gave them guidance experienced a greater variety of activities than students whose teachers did not. In this respect, the second aim of this work was to investigate the kind of roles teachers adopt during a field trip to the METU SC.

Beside teachers' perspectives on and roles in a field trip, their reflections on the trip might have important implications for improving students' learning experiences. Nonetheless, the focus of teacher reflections seemed to be limited to how they decide on the success or failure of a field trip (Anderson et al., 2006; Kisiel, 2005), and teachers generally determined the success of field trip by student enjoyment and other emotional or affective criteria (Anderson et al., 2006). Even Anderson et al. (2006) reported that the success of field trip "is

oftentimes humorously summarized as bringing all students back alive and healthy" (p.380). Similarly, if students exhibited good behavior, asked high quality questions, showed positive experience, increased their motivation and interest, or demonstrated new knowledge, the field trip was also considered to be successful by teachers (Kisiel, 2005). In addition to these reflections on the determination of the success of field trips, teachers also highlighted their concerns about their field trips such as too much lecturing, lack of connection between the concepts offered by setting and students' prior knowledge, insufficient time for free exploration, and irrelevant movies (Tal et al., 2005). Overall, the available literature includes only a limited number of studies exploring teacher reflections on a field trip visit to informal learning environments, and teachers generally report how they decide on whether their field trips are successful. However, teacher reflections about the field trip can play a pivotal role in the operation of informal learning environments. By considering different reflections (e.g., about the pros and cons of the visit, exhibits, explainers or the structure of the visit), informal learning environments might be better able to serve teachers and increase their level of field trip participation that in turn influence students' learning experiences from field trips. In this respect, the third aim of this work was to investigate teachers' reflections on different dimensions of a field trip to the METU SC.

1.2 Purpose of the Study

The main aim of the study was to explore: (1) teachers' perspectives on field trips to informal learning environments that includes teachers' views about field trips in general, influence on decision making process of teachers when planning and implementing field trips, teachers' familiarity with the METU SC, teachers' perceptions of the major factors preventing more field trip visitation, and teachers' assessments of proposals offered by the METU SC like pre- and post-visit activities to increase their visitation frequency, (2) their roles during a field trip to the METU SC that include all verbal and non-verbal interactions of teachers with students, explainers, colleagues, parents, and exhibits as well as their specific behaviors, and (3) their reflections on a field trip to the METU SC that include

teachers' reflections on the general impression of the visit, exhibits, explainer, and the implementation of free exploration. More precisely, the researcher aimed to answer the following research questions in two stages (Table 1):

Table 1

The designs of the study

Study Setting: METU SC			
	Stage I	Survey	RQ1: What are teachers' perspectives on conducting field trips to a science center or other similar informal learning environments?
	Stage II	Case I	RQ2: What kind of roles do teachers adopt for themselves during a field trip to the METU SC?
			RQ3: What are teachers' reflections on a field trip to the METU SC?
		Case II	RQ4: What kind of roles do teachers mostly adopt for themselves in different parts of the visit to the METU SC?

1.3 Significance of the Study

Classroom teaching, practical laboratory works, and field trips to informal science learning environments can be considered as three pivotal activities of science education (Michie, 1998). The potential influences of field trips on students' cognitive (e.g., facts and concepts) and affective (e.g., attitudes and interest) gains were well documented in the literature. When considering the types of visitor, it was clearly seen that most of the visitors of informal learning environments consist of primary and secondary students and their accompanying teachers (e.g., Anderson & Lucas, 1997; Beardsley, 1975; Lelliott, 2007; Rennie and McClafferty, 1995; Tal et al., 2005). In fact, teachers are the key decision-makers for conducting field trips, and the findings of other researchers briefly reviewed in Section 1.1 clearly demonstrate that their perspectives on, roles in and reflections on a field trip directly or indirectly influence their students' learning experiences. Even though the available literature makes us gain insight about teacher perspectives on field trips to informal learning environments, little is known about the kind of roles teachers adopt or the details of their reflections on a field trip.

In addition, even though all informal settings intend to promote science learning, each informal setting is unique in terms of their programs (e.g., guided or unguided visit), opportunities (e.g., providing free exploration time), visitor types, and the like. In this respect, teachers' perspectives on, roles in, or reflections on a field trip may also be shaped by the operation of these unique settings. The structure of the visit, the presence/absence of explainers, the number of students accepted per session, the culture and the like may change the nature of the field trips implemented by teachers. As a result, it seemed worthwhile to investigate teachers' field trip practice on a science center to better understand what the perspectives of teachers on field trips, which roles adopted by teachers during field trips, and what reflections were made by teachers. Overall, the obtained information gains advantage for not only teacher educators, school administrators but also informal science settings by assisting them to meet the needs of teachers conducting field trips. Thus, informal settings might be better able to serve teachers and increase the levels of field trip participation.

1.4 Definitions of Important Terms

Field trip: A visit to informal learning environments organized by teachers for an educational purpose.

Informal learning environments: The places that include everyday experiences (e.g., gardening, walking in the park, watching a sunset), designed settings (e.g., science museums/centers, zoos, aquariums), and programs (e.g., youth, adult, community, and after-school) where an individual has free choice of what, when, how and with whom to learn (Griffin, 1998; Falk & Dierking, 2000; National Research Council [NRC], 2009).

***Science Center*:** An informal setting in which visitors are connected with science, given curiosity, wonder, encouragement, and firsthand experience by allowing them to touch, play, and interact with the exhibits (Association of Science-Technology Centers [ASTC], n.d.; Quin, 1990).

Exhibit: One stand-alone component of an exhibition that is exhibited to visitors in an informal learning environment such as science museums/centers that visitors are able to interact with, manipulate, or observe (Anderson, 1999).

Explainer: A research assistant working at METU Science Center who is responsible for accompanying school groups throughout their visitations from the welcoming to the end of the visit including implementation of a wide variety of science demonstrations.

Teachers' perspectives: Teachers' self-reports in response to field trip survey which includes their purposes, preparations, responsibilities, expectations, and decision making processes about how they plan and implement a field trip to an informal setting.

Teacher role: Teacher role is a comprehensive pattern of behaviors of teachers during a field trip to the METU Science Center.

Teachers' reflections: Teachers' verbal reports in response to a semi-structured interview about how they valued and perceived the visit to the METU Science Center.

CHAPTER 2

THE RELATED LITERATURE REVIEW

In this chapter, field trips in general, teacher motivations for field trips, their perspectives on, roles in, and reflections on field trips were reviewed. As discussed in Chapter One, this research has arisen out of the lack of understanding of field trips through the eyes of teachers. To provide a further elaboration about how this research has emerged, this chapter first focused on informal science education, informal science learning, and informal learning environments. Then, a brief information about the science centers including its definition and its impact on science learning was provided. Second, field trips in terms of their contributions to learning science in informal environments were reviewed. Third, field trips were reviewed in terms of how they can be conducted successfully and the factors should be considered by teachers. Forth, the literature providing suggestions for teachers to make them conduct successful field trips are reviewed. Finally, the literature focusing on field trips through the eyes of teachers considering their perspectives on, roles in, and reflections on field trips to an informal learning environment were reviewed, which in turn generated the focus of this research.

2.1 Informal Science Education/Learning/Environments

Human beings learn science from several different types of sources, in a range of settings, and for a diversity of reasons (Hofstein & Rosenfeld, 1996). Learning is an ongoing process of active engagement with experience across the life span, from infancy to late adulthood that occurs in everywhere. It is generally described as a change in knowledge and understanding, capabilities and skills, ways of

thinking (values, beliefs, feelings, and attitudes), and/or ways of acting (behaviors) (Krishnamurthi & Rennie, 2011). It is not something done to individuals, but something that individuals themselves do. Although learning takes place in everywhere, it is broadly categorized as formal (that takes place in schools, colleges, and universities) and informal learning (that occurs in anywhere outside the school) (Krishnamurthi & Rennie, 2011), which were assumed as two complementary contexts for science learning (Hofstein & Rosenfeld, 1996).

2.1.1 Informal science education (ISE)

As a matter of fact informal science education is all about learning science that occurs in informal (out-of-school, free-choice) environments (settings, contexts) (McCallie et. al., 2009). It can be generally defined as science learning experiences in informal environments people have throughout their lifetimes (National Research Council [NRC], 2009; Falk, Storksdieck, & Dierking, 2007). These experiences, which happens in outside formal school settings, can be gained through a broad range of activities such as visiting designed settings such as science museums, zoos, aquariums, botanical gardens, parks, nature centers; watching/listening science programs; exploring a science topic in libraries; playing a virtual or augmented reality game; participating in everyday life experiences like gardening, hiking or fishing; or participating family discussions about science at home (Brisson et. al., 2010; McCallie et. al., 2009; NRC, 2009).

2.1.2 Informal science learning (ISL)

Even though the same learning processes occurs in both formal and informal learning environments, these settings may possess some qualitative differences. Wellington (1990), listed some differences between characteristics of formal and informal learning as follows “voluntary vs. compulsory attendance, unstructured vs. structured, learner-centered vs. teacher-centered, unsequenced vs. sequenced” (p.126). Nonetheless, Hofstein and Rosenfeld (1996) criticized this distinction by claiming that when informal learning is compared with formal learning, it can be recognized that field trips to informal learning environments can also be

compulsory, structured or sequenced. For that reason alone, they adopted a hybrid definition of informal learning including formal and informal learning proposed by Crane, Nicholson, and Chen (1994). “Informal learning refers to activities that occur outside the school setting, are not developed primarily for school use, are not developed to be part of an ongoing school curriculum, and are characterized by voluntary as opposed to mandatory participation as part of a credited school experience. Informal learning experiences may be structured to meet a stated set of objectives and may influence attitudes, convey information, and/or change behavior.” (p.90). According to Institute for Learning Innovation (2007), the term “informal science learning” is limited. It was reported that the separation of the settings from the definition of learning occurring in these settings are critical because of the fact that “many classrooms can be considered informal environments or contain informal elements and that not all experiences in informal science institutions are self-directed or free-choice” (p.4). As a result, the institute acknowledged the term “learning science in informal environments (LSIE)” rather than “informal science learning (ISL)”, and this type of learning are predominantly characterized as personal, voluntary, ongoing, non-linear, learner-directed, contextually relevant, collaborative, open-ended, guided chiefly by learner’s intrinsic curiosity, needs, interests, and with a high degree of choice over what, when, how, and with whom to learn (Griffin, 1998; Falk & Dierking, 2000). In addition, these experiences are believed to create a sense of desire to learn more, in turn science learning can be personally relevant and worth doing (NRC, 2009).

2.1.3 Informal learning environments (ILEs)

Even though the number of studies directed towards the informal science education has increased exponentially day by day, it can be clearly seen that few compilations of the related literature have been performed. In 2009, the National Research Council (NRC) published a comprehensive report entitled “Learning Science in Informal Environments: People, Places, and Pursuits” including a synthesis of more than 2,000 studies regarding science learning in informal environments. According to this report, informal science education takes place in

informal learning environments, and informal learning environments can be broadly defined as places that include *everyday experiences* (e.g., gardening, walking in the park, watching a sunset), *designed settings* (e.g., science museums, zoos, aquariums, botanical gardens, parks, nature centers, planetariums), and *programs* (e.g., youth, adult, community, and after-school). These environments are accessible to all learners of all ages, cultural and socio economic backgrounds, and abilities (NRC, 2009).

The overwhelming majority of interest groups devoted themselves to informal learning agree with the notion that free-choice (informal) learning environments contribute to people's understanding of science. Concurring with this idea, Falk and Dierking (2010) emphasized the importance of informal learning environments by stating, "School is not where most Americans learn most of their science" (p.486). In their articles, they discuss the results of some studies reporting the contribution of these environments to people's science learning, understanding of science, curiosity, interest in science, social interaction, and science inquiry skills. Perhaps the most important environment for science learning is science museum/centers.

2.1.3.1 Science centers as an informal learning environment

Science centers can be defined as places where visitors are connected with science, given curiosity, wonder, encouragement, and firsthand experience (ASTC). One of the most distinguished characteristic of science centers is their ability to mix learning and entertainment together (Weitze, 2003) by allowing visitors to touch, play, and interact with the exhibits (Quin, 1990). A comprehensive review of the related literature indicated that science museums/centers have positive impacts on different variables as provided below:

- learning science (European Network of Science Centres and Museums [ECSITE], 2008; Falk & Needham, 2011; Garnett, 2001; Hooper-Greenhill et al., 2005; NRC, 2009; Rennie & McClafferty, 1995; Watson, Dodd, & Jones, 2007),

- understanding science (Anderson, Lucas, Ginns, & Dierking, 2000; Ertaş, Şen, & Parmasızoğlu, 2011; Falk & Needham, 2011; Hooper-Greenhill et al., 2005; Kılıç & Şen, 2014; Pompea & Hawkins, 2002),
- motivation to learn about science (Ramey-Gassert et al., 1994; Watson et al., 2007; Wellington, 1990),
- science-related career choices (Garnett, 2001; NRC, 2009; Salmi, 2003),
- interest in science (Bozdoğan & Yalçın, 2006, 2009; Pompea & Hawkins, 2002; Wellington, 1990),
- scientific literacy (Pompea & Hawkins, 2002; Wellington, 1990),
- psychomotor skills (e.g. dexterity, manipulative skill, hand-eye coordination) (Wellington, 1990), and
- attitudes towards science (ECSITE, 2008; Falk & Needham, 2011; Garnett, 2001; Hooper-Greenhill et al., 2005; Jarvis & Pell, 2002, 2005; Kılıç & Şen, 2014; NRC, 2009; Ramey-Gassert et al., 1994; Rennie & McClafferty, 1995; Rix & McSorley, 1999; Russell, 1990; Şentürk & Özdemir, 2014; Wellington, 1990).

Even though informal environments can effectively promote science learning and strengthen and enrich school science (NRC, 2009; Phillips et al., 2007), science centers as informal learning environments are still underutilized by schools and colleges, especially in science education in Turkey. Braund and Reiss (2006a) asserted that students might be engaged in school science when it is associated with science activities presented by out-of-school environments such as science museums. Therefore, it is important to conduct field trips to such places.

2.2 A Journey to Informal Learning Environments: Field Trips

The concept that out-of-school environments can improve education is not new. Long time ago, Johann Comenius's (1592 – 1670) ideas of "authentic curriculum" as well as the French philosopher Jean-Jacques Rousseau's advice on teaching by referring learning outside the classroom (as cited in Braund & Reiss, 2004, p.3-4). In 1917, Twiss stated that "in spite of all difficulties, therefore, it ought, in any school, to be possible to have in every subject some field observation in which a

considerable portion of the class can participate" (p.145). Similarly, Dewey (1938) indicated the importance of field trips by claiming that all authentic education comes through experience. Furthermore, humans are social creatures and sociocultural view on learning, generally referring to Vygotsky (1986), highlighted the importance of social interactions thorough which students gain new and more complex knowledge via facilitated experiences provided by their more capable peers or teachers. As Falk and Dierking (2000) claimed that if we do not know the answer we want to know about, we ask for help, read about it. In this respect, field trips to out-of-school environments can provide such precious affective and social learning opportunities as well as cognitive ones.

Field trip can be defined as "a trip arranged by the school and undertaken for educational purposes, in which the students go to places where the materials of instruction may be observed and studied directly in their functional setting" (Krepel & Duvall, 1981, p.8). According to Rebar and Enochs (2010), field trips can be defined "as any educational activity that teachers guide or direct in a setting outside the classroom" (p.112). In the simplest form, field trip can be described as a trip to outside of the school organized by teachers for the educational purposes. As a matter of fact when considering types of visitors, it can be seen that most of the visitors to informal settings, especially to science centers in Turkey, are the students from primary and secondary schools who attend as members of class groups participating in school field trips conducted by teachers as mentioned in other international studies (e.g., Anderson & Lucas, 1997; Beardsley, 1975; Lelliott, 2007; Rennie and McClafferty, 1995; Tal, Bamberger, & Morag, 2005). Nonetheless, to most of teachers, the term "field trip" often implies a daunting task involving extra time and effort (Scribner-MacLean & Kennedy, 2007; Rebar & Enochs, 2010). As a result, field trips still are often underused as learning experiences (Beardsley, 1975; Dewitt & Storksdieck, 2008; Storksdieck et al., 2006), even though field trip is recommended as a way to teach science and perform inquiry (NRC, 1996, 2000). Whereas numerous rigorous studies suggested that they have a positive impact on both cognitive, social and affective outcomes emphasizing why teachers conduct field trips to out-of-school

environments. Not only the potential cognitive benefits of field trips such as facts and concepts learning (Anderson, 1999; Anderson & Lucas, 1997; Bamberger & Tal, 2006; Beiers & McRobbie, 1992; Eshach, 2007; Flexer & Borun, 1984; Gottfried, 1980; Miglietta et al., 2008; Orion & Hofstein, 1994; Stronck, 1983; Tuckey, 1992a) but also social and affective benefits of field trips (Braund & Reiss, 2006b; Finson & Enochs, 1987; Meredith et al., 1997; Orion & Hofstein, 1994; Rickinson et al., 2004; Wellington, 1990) were well-documented. The long-term effects of such trips regarding cognitive outcomes such as science learning (Miglietta et al., 2008; Balling & Falk, 1980; Bamberger & Tal, 2008b), memories of specific content and social contexts (Falk, 1983b; Falk & Dierking, 1997) as well as affective outcomes such as attitude towards science and interest in science (Jarvis & Pell, 2002, 2005) were also well-documented. Even the effects of field trips on career choices were reported (CASC, 2008; Salmi, 2003).

In a study conducted by Finson and Enochs (1987), the effect of field trip to a museum on students' (N=194 with Grades 6 through 8) cognitive and affective learning was investigated. Their findings revealed that students who visited the science and technology museum developed more positive attitudes toward science-technology-society than those who did not visit. Furthermore, students whose teachers made efforts to plan structured activities before, during, and after (or combinations of these) the field trip obtained higher scores than their counterparts whose teachers had not planned any such activities. In a similar way, Flexer and Borun (1984) compared the affective and cognitive outcomes of 416 fifth and sixth graders -randomly assigned to four conditions, which were control, exhibit only, lesson only, and exhibit followed by lesson- resulted from a class trip to Franklin Institute Science Museum. Their findings showed that students who visited science museum obtained significantly higher scores on science achievement test than those who did not visit. Correspondingly, the studies conducted by Anderson et al. (2000) as well as Beiers and McRobbie (1992) provided evidence for the impact of various interactive exhibits on students' understanding of the scientific principles underlying different concepts such as the electricity, magnetism and the sound concept. In a study conducted by Tuckey

(1992a), students (N=153, aged between 8 and 12 from 6 schools which were randomly selected) remembered many things they had seen (e.g., exhibit names, things that they found out from their visit, to some degree of understanding of the principles involved in the exhibit), and some of them were able to draw the locations of the exhibits at Satrosphere -Scotland's first interactive science centre- on a map accurately. To provide evidence for science learning during a field trip, Orion and Hofstein (1994) investigated the factors that might affect the ability of students to learn during a 1-day geologic field trip in a natural environment. The sample consisted of 296 students in Grades 9 through 11 in Israel. Data were collected from three different sources (student, teacher, and outside observers) in three stages both quantitatively and qualitatively. By means of observations and questionnaires, they tried to determine: (1) the nature of student learning during field trip, (2) students' attitudes towards field trip, (3) changes in students' knowledge and attitudes after the field trip. Their findings suggested that there are two major factors ("field trip quality" and "novelty space") controlling the educational effectiveness of field trip. While the field trip quality refers to its structure, learning materials, teaching methods, and the ability to direct learning to a concrete interaction with the environment, the novelty space refers to 'prefield' variables, which are *cognitive* (the fieldwork concepts and skills that students are required to handle during the field trip), *psychological* (the fieldwork task and activities, i.e. the students' previous experiences with the outdoor settings as a social adventurous event rather than a learning activity), and *geographical* (the fieldwork setting reflecting the acquaintance of the students with the fieldwork setting). The results of the study supported to conclude that the changes in knowledge and attitudes of students were significantly higher than their counterparts' whose novelty space was not reduced before the field trip by means of a 10-hour preparation unit designed to make them familiar with content, setting, and procedural information. Correspondingly, Stronck (1983) compared the effects of a highly structured tour with a less structured tour on students' attitudes and learning during a field trip to the Natural History Gallery of the British Columbia Provincial Museum in Victoria, Canada. The sample of his study consisted of 816 students (622 with guided tours and 194 with unguided

tours) in Grades 5, 6, and 7. The results of the study revealed that students have significantly greater cognitive learning when they participate in a more structured tour led by a museum docent (explainer); however, have more positive attitudes when they participate in a less structured tour led by their classroom teacher. However, Shortland (1987) criticized class excursions to informal learning environments in terms of science learning, and he claimed that science learning does not occur in informal learning environments by stating that "when education and entertainment are brought under the same roof, education seems to be the loser" (p.213). Conversely, Wellington (1990) argued that students do not just play and entertain during their field trips, they can also learn. To provide evidence for his claim, he filmed a video entitled "Hands-on science: It's fun but do they learn?" in 1989 summer. The major aim of this video was to investigate different perspectives on the centers by filming visitors in action and by interviewing a wide range of students, teachers, docents, parents, and other adult visitors. The conducted interviews pointed out that science centers make some contributions to science learning of students. He also claimed that playing and entertaining do not seem to be downsides; on the contrary, they are seen as virtues resulting in educating future scientists. Furthermore, he emphasized that field trips to informal learning environments such as science centers make contributions to the development of motivation and interest in science and technology which cannot be underestimated. Likewise, work by Murray and Reiss (2005) demonstrated that one alternative - "Going on a science trip or excursion"- of the eleven alternatives was rated by students as the most enjoyable way of learning science. Eshach (2007) backed this result by summarizing the research literature and concluding that "children enjoy going on scientific field trips. They are aware that they are expected to learn from the trip, and that it should not be a "fun day", but rather a day where they enjoyably learn science" (p.177). Similarly, by reviewing the researches on outdoor learning, Rickinson et al. (2004) concluded that field trips can influence young people's: (1) "attitudes, beliefs, self-perception - examples of outcomes include independence, confidence, self-esteem, locus of control, self-efficacy, personal effectiveness, and coping strategies; (2) interpersonal and social skills – such as social effectiveness, communication skills, group cohesion and

team work" (p.32). Braund and Reiss (2006b) highlighted the utilization of field trips due to the fact that science introduced in out-of-school environments is more authentic and may be recognized by students as having more pertinence. Gottfried's (1980) study seems to support this idea. In his study, Gottfried investigated children's behavior and learning on field trips and teachers' use of field trip in the curriculum. He developed a questionnaire based on his participatory observations lasting 6 months during field trips to the Lawrance Hall of Science and then administered the questionnaire to the participating field trip groups a week before their visit. During one hour visit to Biolab located in Lawrance Hall, observations were conducted to get information about focal individual's choice of exhibits, length of stay at each exhibit, and degree of engagement. After the visit, he administered another questionnaire to compare the responses to the questionnaires with actual observations during the field trips. About two weeks after the visit, students were requested to draw a map of the Biolab as far as they can recall by labelling as many things as possible. On the day after the map drawing, the students participated in a peer teaching session at their school with another group of students who did not visit the Lawrance Hall. The results of the study supported to conclude that students discovered a broad range of facts and concepts and a number of skills during their field trip experience. A total of 320 different "discoveries" (e.g., "Snakes put their tongues out to smell" – Animal Behaviour Category; "The tarantula has eight eyes." – Animal Anatomy Category; "How to listen to an animal's heart." –How to… Category; "My heart is slower than the rabbit's." –About Myself Category; "What biology is." – Miscellaneous Category) were listed on the 400 questionnaires completed. Additionally, peer teaching sessions revealed that students could benefit from the knowledge they obtained during field trip experience. From another point of view, "peer teaching" can be evaluated as follow-up activities which reinforce students' own knowledge and understandings gained from field trip experiences.

In addition to some anecdotal evidence (e.g., Braund and Reiss, 2004), some studies were also demonstrated that field trips have the potential to influence students' future career choices. In a study conducted by Salmi (2003), a survey

taken among 1.019 first and second year Helsinki university students confirmed that informal learning environments such as science centers have a positive effect in their academic career choices. In a similar way, the Strategic Counsel (2008) conducted an online survey and found that more than 90 % of Canadian university students reported that visits to science centers increased their interest in science and technology as well as in pursuing academic science career (CASC, 2008).

Evidence of longer-term outcomes was also found in a study of a class trip to the National Museum of Science, Technology and Space in Israel (Bamberger & Tal, 2008b). One visit of eight graders from a Kibbutz school was randomly selected from the schools that had already scheduled their visit to the science museum. The major sample consisted of three class groups, and each group was exposed to a guided tour of the exhibition, participation of an inquiry activity in the laboratories, and view of an IMAX movie respectively. During guide tour, each group visited three halls, namely mirrors, darkness, and aviation. The guide's explanation took about 10-15 minutes in each hall and free exploration time was about 15-20 minutes for each hall. During the laboratory time, students were involved in a small group activity that aimed to identify "a criminal" according to given clues. At last, students watched an IMAX movie regarding the Big Bang and the formation of galaxies. Although pre-trip measures of knowledge or understanding were not used, interviews with eight grade students (n=21) sixteen months after the visit revealed that the students recalled facts and details of the experience, such as names of exhibits, activities in which they had participated at the museum, and guides' explanations. Students also pointed out that they felt they had learned from the visit, and that social interactions like peer interactions were a valued part of their experience. In the study of Miglietta et al. (2008), a 33-item questionnaire regarding sharks and their behaviors was administered to 537 students (121 primary, 149 middle and 267 secondary school students) at 3 different times. The first implementation took place on students' arrival on the Basking Shark Hall in Marine Biology Museum located in Porto Cesareo. The second implementation took place immediately after the didactic experience on site, and final implementation took place after 3 months in the classrooms of

participating students. The results of the study demonstrated that the acquired knowledge through didactic experience about sharks were strong in the short term, however, decreased with time. In addition, students' prior knowledge did not significantly increase from primary to middle school level. Nonetheless, retention was greater for middle school students. The study suggested the long-term impact of a visit to science learning environment. Likewise, Falk and Dierking (1997) investigated the long term impact of field trips in terms of the effects of the social, physical, and personal contexts of subjects, and the subsequent understandings based on their past field trip experiences. Their sample consisted of 128 subjects (34 4th graders, 48 8th graders, 46 adults). The subjects were interviewed about their recollections of school field trips conducted in the early years of their elementary education by means of many questions such as whether they could recall a school field trip they went in their first, second, or third grade; where they went; with whom they went; what grade they were in at the time; how they got there; things they remembered from their field trip experiences; and whether they had subsequently thought about their field trip experiences in other contexts. Falk and Dierking found that almost all of the subjects (96%) were able to recall one or more things learned during their field trips even after very long period. Seventy-nine percent (79%) of the subjects could provide comprehensive answers to all the questions asked, and the majority of their recollections (58%) were related to content/subject matter; thirty-seven percent (37%) related to physical setting features; twenty-seven percent (27%) related to feelings; twenty percent (20%) related to social context. Falk and Dierking's study clearly demonstrated the longer-term impact of field trip experiences, and social, physical, and personal contexts are obviously important in the transformation of knowledge. Furthermore, the study supports the idea that the past field trip experiences provide a basis for the development of new understandings at a later time. Also, Falk and Dierking's study supported the assertion proposed by Wellington (1990) that visitor's experiences may reappear after weeks, months, even years later in other contexts or experiences that may finally lead to the development of new or profound understandings.

Concerning affective learning, works by Jarvis and Pell (2002, 2005) demonstrated the long-term effect of a field trip on students' attitudes towards science and science enthusiasm. In both studies, they investigated the impact of space centre experiences on students' attitude towards science and space. Their samples for both studies consisted of 655 and 300 (Year 6, aged 10-11 years) students, respectively. The results of these studies demonstrated that 20 to 25 percent of students, mostly girls, felt a raised desire to become scientist. They were also more enthusiastic about pursuing the study of science in their future careers and this enthusiasm sustained for several months. Nonetheless, although students who already interested in science and pursuing a science career in advance of the visit sustained this interest and science enthusiasm expressed, other students' declined. Thus, it appears that field trips can have the potential to influence on students' affective learning, but perhaps not on all students. Teacher activities have also an impact on students' affective learning. Teachers who supported their students during the visit by interacting, leading, showing them some interest, and conducting pre-visit and follow-up activities had students with more positive attitudes, even after two months.

In summary, numerous comprehensive studies suggest that school field trips to informal learning environments have positive impacts on cognitive (e.g., facts and concepts), affective (e.g., attitudes, interest), and social learning (e.g., peer teaching) of students emphasizing why teachers conduct field trips to out-of-school environments. Nonetheless, even though the related literature clearly demonstrated that the field trips to informal environments have a positive impact on students' cognitive, affective and social outcomes, Dewitt and Storksdieck (2008), concurring with Braund and Reiss (2004) and Rennie and McClafferty (1996), claimed that affective and social outcomes such as increased interest, attitudes towards science, motivation, and curiosity may be more logical to expect from school field trips than cognitive outcomes such as the learning of facts and concepts due to the short-term nature of most field trip experiences. Furthermore, in the lights of the researches in the literature, not all but well-designed field trips have the potential to enrich and strengthen students' science learning or awareness on the level of cognitive or affective (Anderson, Kisiel, & Storksdieck, 2006).

Nonetheless, the question still keeps its validity: “How can a successful field trip to an informal learning environment be conducted by teachers?”.

2.3 How to Conduct a Successful Field Trip

Day by day, the gradually increasing number of people throughout the world visit out-of-school learning environments such as science centers, science and technology museums, zoos, libraries, botanic gardens, arboretums, nature centers, open-air museums, and the like. Nonetheless, most of the visitors of these settings seems to be consisted of primary and secondary students and their teachers participating in field trips. Falk and Dierking (1992) suggested that any visitor’s experience are shaped by his/her personal background (e.g., prior knowledge, experiences, skills, motivations, and desire to learn) and interactions with their social (social interactions with people) and physical (created by the exhibits and their surroundings) environments. For that reason alone, for successful field trips, teachers should know how to integrate these three contexts (personal, social, and physical) into a coherent field trip experience (Rennie & McClafferty, 1995). However, “on most field trips, the students are put into busses early in the morning, driven to a rather novel setting, led through some activities by a stranger, put back on the bus, and returned at the end of the day.” (Falk and Balling, 1982, p.22). This situation is also valid in Turkey due to the fact that an overwhelming majority of teachers may conduct a field trip once a year with their students. In addition, a school field trip generally starts with a technical preparation and ends with a conversation about the field trip experience. However, the learning potential of the entire field trip experience is affected by a good many of factors (Beardsley, 1975; Dewitt & Storksdieck, 2008). The following section tried to shed light on factors influencing the entire field trip experiences, which in turn affects students’ learning in terms of three phases, which are pre-visit, on-site, and after-visit.

2.3.1 Pre-visit factors

2.3.1.1 Pre-visit preparation

No one denies that the pre-visit preparation is an integral part of the field trip to informal learning environments. Numerous studies also demonstrated that pre-visit preparation have the potential to affect students' learning. For instance, Orion and Hofstein's (1994) study revealed that students who attended to a 10-hour preparation unit designed to familiar them with content, setting, and procedure information in advance of a one-day geology field trip surpassed their counterparts who attended to the same field trip with no special preparation in terms of changes in their knowledge and attitudes. Likewise, Gennaro (1981) investigated the effect of pre-visit instructional material on student learning for a museum field trip by teaching related concepts and ideas in the classroom prior to the field trip with a sample of 10 eight-grade earth science classes (randomly assigned 5 experimental, 5 control). The final sample were 56 students in the control group and 49 students in the experimental group. The seven-day experimental period includes: (1) implementing pre-test to the both groups, (2) implementing treatment, which lasted 4 days, (3) field trip to the Omnitheatre to view 'Genesis' by both groups, and (5) implementing the post-test to the both groups that was the same as the pre-test. The treatment was conducted by graduate students who were certified earth science teachers. The treatment included study sheets, demonstrations, and hands-on experiences focusing on the concepts and ideas provided by the film of 'Genesis' focusing on the theory of Big Bang and plate tectonics. While the experimental group received the treatment, the control group received no relevant material before the museum trip. The tests consisted of 50 multiple-choice items. Six items were determined to be factual; 26, comprehension; 18, analytic and synthetic according to the Bloom's Taxonomy. The results of the study revealed that students in the experimental group were able to answer 7.7 more questions on the post-test that represent fifteen percent (15%) of the test. As a result, Gennaro concluded that the use of pre-visit instructional material is valuable. Similarly, Melton, Feldman, and Mason (1936) compared a 15- and 30-minute lectures prior to the museum tour and found that a 15-minute

lecture was more effective. They concluded that "… children of the sixth, seventh, and eighth grades learn more when they spend the usual introductory lecture time in further direct contact with the museum exhibits. On the other hand, the fifth grade children need a short introductory lecture (15-minutes)…) (p.47).

2.3.1.2 Orientation

Another significant factor affecting students' cognitive learning of concepts and principles regarding exhibits is orientation of students to the physical features of the setting prior to visitation. For instance, Anderson and Lucas (1997) investigated whether there is a significant impact of pre-orientation to the physical environment of a science museum on students' cognitive learning outcomes. The study was conducted in the 'Queensland Sciencentre' with a sample of 75 upper secondary students (29 girls and 46 boys), who randomly assigned to experimental and control groups. While students in experimental group attended to a forty-minute pre-orientation program designed to decline the novelty of the science museum for them, students in control group viewed a forty-minute video about the opening of the National Science and Technology Centre in Canberra. The pre-orientation program implemented by the Education Officer from the Sciencentre three days before the visit that include physical location of the building, arrival procedures, Sciencentre's history, floor plan, schedule of activities and location. Even though it seems to include everything about the trip, students were not shown any details of individual exhibits. During visitation, without requiring completing any tasks such as worksheets, both groups spent almost two hours in the Sciencentre, with 30 minutes assigned for one of the two galleries, about 15 minutes for Science Shop, and a 30-minute presentation by staff of the museum. To determine cognitive learning outcomes, the researchers developed a test related to nineteen of the exhibits in the Sciencentre. The test involved 21 questions, 19 of which had two parts. In the first part, it was intended to understand whether students had a correct understanding of scientific content illustrated by the exhibit, and in the second part, it was intended to understand whether the scientific content was familiar to the student before visitation. The results of the study suggested that when the pre-orientation and prior visitation

combined moderately, a greater decrease in novelty and a more marked increase in cognitive learning outcomes would be obtained. Correspondingly, Delaney (1967) explored the effectiveness of the teachers' introduction in implementing a science field trip. Six seventh grade science and social studies classes (30 students in each and the half of them were selected as experimental; the rest were selected as control groups) comprised the sample of the study. Brookhaven National Laboratory in Upton, Long Island was selected as study site. The experimental groups were exposed to forty-minute orientation one day before the field trip, and this introduction was composed of a lecture including information about what students will likely experience, outcomes that students will be expected to gain from the field trip experience, a teacher presentation including colored slides taken during last year's trip to the same site, listening a tape recording which consisted of students' observations who visited to same site last year, and distributing brochures and map of the site. The control group were just told that they would be taking the field trip, and routine classwork continued. The day following the trip, all students were asked to complete an objective-type test consisting of 25 multiple choice items regarding field trip experience. The result of the study indicated that students who were sufficiently oriented to a projected field trip benefit more than their counterparts who were not.

2.3.1.3 Novelty

Bitgood (1989) claimed that teachers' familiarity with the field trip site (e.g., knowing the informal site's program, how to help site's explainers, and the details of site's agenda) has a significant impact on the outcome of the field trip. According to John Breukelman, field trip must be sufficiently introduced: "Before the trip starts, the leader should explain to the group just what the trip is for, what its objectives are and what is likely to be seen" (as cited in Delaney, 1967, p.474). "For many students, the museum's physical layout and conceptual organization is unfamiliar. The museum often appears a confusing place; a place filled with so much that is new that it often becomes overwhelming and incomprehensible and sometimes overstimulating" (Sakofs, 1984, p.136). In fact, unfamiliarity with a setting and its contents is most likely resulted in inflating curiosity. If you go to

somewhere you never seen before, you are unquestionably curious about it referring to the high level of perceived novelty. This is most likely valid for the most of students brought to an informal setting by their teachers during field trips (Falk & Balling, 1982). Despite the fact that it seems to be desired thing at the beginning, Kubota and Olstad (1991) study clearly showed that the high level of perceived novelty students experienced detrimentally influence intended cognitive learning in informal settings, especially at the very beginning of a visit. In their study, Kubota and Olstad (1991) examined and measured the effect of exploratory behavior on cognitive learning where novelty was considered as a possible link between exploratory behavior and cognitive learning. Their sample consisted of 64 6th graders (32 male, 32 female) from public schools in Seattle. These students were randomly assigned to one of two groups -control and experimental. In advance of the visit day, both groups participated in a different 15-minute slide/tape program which was categorized as (1) the novelty-reducing treatment for experimental group, (2) the placebo treatment for control group. While the novelty-reducing treatment included a slide/tape presentation consisting of slides about the Pacific Science Centre's one area -namely Science Playground- covering questions and comments, orienting remarks about the setting, and "how to" remarks generating manipulative skills that students would have learned during actual field trip. The placebo treatment included a different slide/tape presentation consisting of slides about the Pacific Science Centre's another area covering its history, objects exhibited in it. On the following day, both groups participated in an actual field trip to Pacific Science Centre's Science Playground. During their visitations, all students were videotaped during their 30-minute period of the visit to determine their on-task exploratory behaviors. When they returned to their schools, they were asked to complete cognitive post-test. The results of the study clearly suggested that novelty-reducing preparation results in boosted on-task exploration with greater cognitive learning, especially for boys. In a similar way, Falk (1983a) explored the novelty effects on student behavior during a field trip. The study was conducted with a sample of 320 (a subsample of over 2500) fourth- and fifth-graders (8-10 years old) visiting National Museum of Natural History (NMNH), New Delhi, India during winter 1982. The most of the

students had not previously visited the NMNH; only 22% of them were second time visitors. All students were exposed to the same lecture and discussion by a teacher while seated in front of predetermined exhibits; but the order of exposure to an exhibit differed: the half within the first ten minutes of their tour, and the other half after forty-five minutes of their tour. Participating in teacher/exhibit was considered as "on-task" behavior while all other loci of attention were considered as "off-task" behavior. The results of the study disclosed that children's behaviors were affected by the length of time they spent in the museum. Particularly, students who are exposed to an exhibit after 40-50 minutes seemed more attentive to an exhibit than students who are exposed to an exhibit within the first 10 minutes. Second time visitors (22% of students) showed a significantly lower percent of 'off-task' behaviors. Falk (1983a) claimed that growing familiarity with the new setting as well as repeat visits to the same setting may result in reduction anxiety or environmental curiosity. Hence, students are more attentive to an exhibit. He suggested that either through pre-visit materials or through on-site orientation may lead to significant increases in field trip learning. Additionally, studies conducted by Falk and his colleagues (e.g., Falk, Martin and Balling, 1978; Balling and Falk, 1980; Martin, Falk, Balling, 1981; Falk and Balling, 1982) evidently demonstrated that the novelty of the setting has a notable impact on students' cognitive learning. Extremely novel settings negatively influence concept learning. As a result, the researchers suggest that the educational potential of field trips can be maximized by placing students in a setting of appropriate novelty –neither very much nor too little. At this point, Ballentyne and Packer (2002) highlighted the balance between novelty and familiarity since they found that "students who had not visited the particular site before were looking forward to their visit more than those who had ($p<0.001$)" (p.221). Orion and Hofstein (1994) called attention to another point regarding novelty of the setting. They argued that students should be prepared for novelty not only cognitively but also geographically and psychologically. Furthermore, they suggested that while the cognitive novelty can be lessened directly by many concrete activities such as working with materials that students will meet in the field trip and simulation of phenomena and processes via practical works, the

geographic and psychological novelties can be lessened through some activities in the classroom indirectly such as showing slides, films, working with maps, providing detailed information about the field trip including purpose, learning method, number of learning stations, length of time, expected weather conditions, expected difficulties along the route and so on. Besides familiarizing students with the informal setting, researches have emphasized the importance of sharing instructional objectives with students to help them focus on intended learning activities (e.g., Koran & Baker, 1979).

2.3.1.4 Prior knowledge

One of the other important factor influencing students' learning is their prior knowledge and experiences (Falk, 2001; Falk & Dierking, 1992, 2000). Hein (1998) highlighted the impact of prior knowledge and experiences on learning by stating that "…in order to incorporate new ideas, new concepts, new knowledge, we need to be able to associate what we are intended to learn with what we already know" (p.157). A review on learning in interactive environments conducted by Roschelle (1995) revealed that new learning and understanding requires building upon prior knowledge. The result of the discussions with students in Tuckey's study (1992a) recommended that if they have known or some understandings of the concept being covered by an exhibit, they learn better from that exhibit. In other words, students' learning from an exhibit is affected by their prior knowledge and experiences (Anderson, 1999; Anderson et al., 2000; Beiers & McRobbie, 1992). Beiers and McRobbie's (1992) study clearly demonstrated that the changes in students' knowledge and understanding of science concepts (e.g., the production of sound and the transmission of sound) through a visit to Queensland Sciencentre was mainly depended upon the level of prior knowledge that students had. Nonetheless, offering an activity or exhibit being appropriate to each students' prior knowledge and experiences seems to be daunting task for any informal learning environment. For that reason alone, teachers are the key persons to mediate such experiences during a field trip. They are required to be familiar with their students' prior knowledge and experiences and facilitate the learning process (Dewitt & Storksdieck, 2008). Anderson and

his colleagues (2006) suggested that by conducting pre-visit activities, teachers can provide prior knowledge and experiences that can help students' understanding of the new concepts that will be covered at field trip site. The related literature also demonstrated other possible personal factors influencing visitors' gains such as interest, motivations, and agendas (Ellenbogen, 2002; Falk & Adelman, 2003). Nonetheless, conducting a field trip by considering each students' personal factors such as agendas and interests would be reasonably challenging for any teacher (Dewitt & Storksdieck, 2008).

2.3.1.5 Summary

The related literature recommends that

1. Teachers can use pre-visit lessons or pre-tour lectures regarding the subjects provided by informal setting during the actual field trip to increase students' cognitive as well as affective learning (Gennaro, 1981; Melton et al., 1936; Orion & Hofstein, 1994).
2. Orienting students to the physical features of an informal setting such as science museum and science center prior to visitation can contribute to the students' cognitive learning of concepts and principles associated with the exhibits (Anderson & Lucas, 1997; Delaney, 1967).
3. The novelty of field trip setting can impact the effectiveness of field trips as learning experiences. It can mitigate students' conceptual and probable affective learning if novelty of the setting is either very much or too little altogether (Balling & Falk, 1980; Falk, Martin & Balling, 1978; Falk & Balling, 1982; Martin, Falk, & Balling, 1981). Furthermore, orientation to the setting prior to or during field trip as well as novelty-reducing preparation can reduce this undesired impact (Anderson & Lucas, 1997; Falk, 1983a; Kubota & Olstad, 1991; Orion & Hofstein, 1994).
4. The changes in students' knowledge and understanding of science concepts can mainly depend upon the level of prior knowledge that students had. Teachers are required to be familiar with their students' prior knowledge and experiences and facilitate the learning process (Dewitt &

Storksdieck, 2008). By conducting pre-visit activities, they can provide prior knowledge and experiences that can help students' understanding of the new concepts that will be covered at field trip site (Anderson et al., 2006).

2.3.2 On-site factors

2.3.2.1 Degree of structure

To improve the effectiveness of field trips on students' gains, field trips seem to provide a moderate amount of structure including both some kind of structured task and direction and some choice and control in exploration of exhibits (Bitgood, 1989; Bamberger & Tal, 2007; Falk & Dierking, 1992; Gilbert & Priest, 1997; Mullins, 1998; Price & Hein, 1991; Rennie & McClafferty, 1995; Storksdieck, 2006; Stronck, 1983). For instance, Bamberger and Tal (2007) investigated the effectiveness of a field trip experience in terms of levels of choice. They selected four museums for the study site (one zoological center, two natural history museums, and one science museums). Their sample consisted of about 750 students in 29 classes, in grades four to eight with an age range from 9,5 to 14,5, and all classes were guided by explainers of the museums to some extent. The methods for data collection were (1) *observations* – focusing on the guiding, students' actions and interactions with their classmates, teachers, and explainers, (2) semi structured interviews (n=41 students in grades six to eight) in classes one day after the field trip – focusing on students' perceptions of the field trip experiences, content's connection to students' life, and how the visit was connected to students' prior knowledge and school curriculum, (3) museum worksheets – focusing on to what level of choice the museum provide and how the visit was connected to students' prior knowledge and school curriculum. The results of the study suggested that the visits allowed "limited choice" where students were given some kind of structured task and direction as well as some choice and control in exploration of exhibits were more appropriate than "no choice" referring to highly structured or "free-choice" referring to unstructured

visits. The visits allowed "limited choice" seemed to enhance deeper involvement in the learning process, scaffold subject learning, enable control, and encourage satisfying social interactions.

2.3.2.2 Worksheets

Although the international literature showed that on-site activities can include a diversity of experiences such as lectures, demonstrations, tours, audio-visual presentations (including planetarium shows), tours are the most common type of field trip experience that are generally supported by worksheets. As a matter of fact, it is common to see students in informal learning settings who are doing some kind of written assignments as a part of their visit (Kisiel, 2007) by providing worksheets covering various topics for interested visitors and school groups (Krombaβ & Harms, 2008). Nonetheless, some researchers found that worksheets can increase students' cognitive learning if they are not used as a tool for behavior management, but they result in less positive attitudes (Stronck, 1983). Some others found that the use of worksheets with many detailed questions regarding contents instead of concepts blocks students' learning (Kisiel, 2003a, 2006d; McManus, 1985), and also they lessen the role of teachers as facilitator (Bailey, 1999). Price and Hein (1991) argued that worksheets block students' learning by impeding actual observation, and preventing students from designing their own questions to ask. A primary school teacher in Lucas's (2000) study backed this argument by stating that "… I refused to spoil a good visit, a good hands-on visit, with worksheets and pieces of papers and filling-in…" (p.533). Likewise, students interviewed in Griffin's (1994, 1998) studies also reported that worksheets prevented them from engaging in the exhibits. Nonetheless, after enrolling in a program where students prepared their own questions about the topic being covered in class prior to visitation, and were permitted to choose what they explored at within particular exhibitions, students' comments about the visit changed. One student said "This was different because the other [excursions] were more plain educational, where this one was more fun, although it was educational, but it was also fun and you could do things that you liked doing and not walking around, just" (p.170). Similarly, Kisiel (2003a) examined the "worksheet

experience" in an urban natural history museum to comprehend deeply how it promotes or limits the entire student experience during a field trip. Kisiel's study apparently showed that teachers believed that learning wouldn't occur without worksheets since they considered them as a way to keep students focused and on task. Students and many teachers also believed that worksheets during field trip are needed for learning (Griffin, 1994; Kisiel, 2003a). The reason behind this might be that worksheets help to attract attention of students on specific objects (Price & Hein, 1991) and let them study at their own pace (McManus, 1985). In fact, Kisiel (2003a) argued that if worksheets are properly developed, they might help teacher improve the quality of learning in informal settings as well as classroom learning. Put differently, Krombaβ and Harms (2008) claimed that worksheets help to shape a museum visit in addition to being basis for follow-up course work. According to them, the worksheets are one of the most important materials to achieve the goals of educational activities. Likewise, Mortensen and Smart (2007) investigated how a worksheet should be to support science learning during a field trip. To achieve this goal, they developed a set of design criteria for worksheets. Worksheets based on these criteria aiming to encourage free-choice exploration of curriculum-related topics were determined to increase both number and diversity of students' content-related conversations during a field trip. Overall, it could be inferred that worksheets, either supplied by the informal settings or generated by the teachers, give signals to students about the distinctive features of the exhibits and make students learning better about particular exhibit objectives (Kisiel, 2003a).

2.3.2.3 Explainers

Even though the programs offered by informal settings seem to be different, in Turkey school field trips to informal settings as being in Israel (Tal et al., 2005) have been generally conducted with an accompanied explainer. Even without an explainer at informal learning environments, students seem to learn a great amount during their free exploration. However, the question of whether or not an explainer should be available during field trip is still inconclusive even though the presence of explainers also seems to be important factor on factual learning

(Stronck, 1983). For instance, Antonio Gomes da Costa (2005), from the head of Education Department of Ciencia Viva Science Centre, Lisbon, criticized the guided visits by connecting the reason of why explainers exist to the notion that visitors merely learn if we teach them. He also argued that the behavior of "explaining" is opposite to the nature of interactive exhibits due to the fact that these exhibits were created to promote people's engagement with science, and explaining ruins the essence of interaction. In another aspect, Stronck (1983) investigated the effects of a highly structured tour guided by explainers versus a less structured tour guided by teachers on 5^{th} (N = 306), 6^{th} (N = 216), and 7^{th} (N = 262) graders' learning and attitudes who had a tour of the new natural history exhibit, "Living Land-Living Sea" at the British Columbia Provincial Museum in Victoria, Canada. While explainer guided tours limited to nine students per explainer included a highly organized lesson plan about coast and sea, teacher guided tours were conducted by students' own teachers and tended to include relatively little structure. In addition, while twenty-three groups (N = 622) had guided tours, eight groups (N = 194) had teacher guided tours. Each student was given a 10-item attitude questionnaire based on semantic differentials before and after the tour. A 10-item multiple-choice test of knowledge after the tour was also administered to students. The results revealed that the students on the explainer guided tours performed higher on the test of knowledge than those on the teacher-guided tours. Nonetheless, the students on the teacher-guided tours disclosed more positive attitudes than those on explainer-guided tours. In the final analysis, while explainer-guided tours is superior to the teacher-guided tours to learn about things in the museum, less structured tour guided by teachers produced more positive attitudes toward the museum than explainer-guided tours. However, according to Price and Hein (1991) and Sakofs (1984), the presence of explainers is important because trained explainers try to help students ask questions, think deeper, and make connections between the object being viewed and their knowledge by starting a conversation rather than direct them to the desired answers.

2.3.2.4 Social context of setting

Some studies called attention to the social context to support the learning on the level of cognitive and affective from the field trip experiences (Anderson, 2003; Birney, 1988; Gilbert & Priest, 1997; Rennie, 1994) due to the fact that social interaction can also be an important characteristic of school field trip experiences (Falk & Dierking, 1992, 2000). For instance, work by Birney (1988) demonstrated that students emphasized the importance of sharing information and experiences with their companions. Similarly, work by Anderson (2003) clearly demonstrated that the most dominant and vivid recollections of fifty participants' experiences from visitations (World Expo 86 hosted in Vancouver, Canada in 1986 and World Expo 88 hosted in Brisbane, Australia in 1986) were their social interactions within the social contexts (e.g., conversations they had, sharing experiences, having a dinner at restaurant or café on the site, walking together). Likewise, Gilbert and Priest's (1997) study clearly showed that the interactions among students themselves and accompanying adults mediated by verbal discourse during a visit to the Science Museum, London, played a key role in the social construction of knowledge. Correspondingly, Gottfried's dissertation (1979) indicated that the expectation of both students and teachers from a museum were its provision of social interaction among them. Students in Gottfried's study approached exhibits, seldom read or observed graphic cards. They generally preferred to interact with one another. Peer instruction seemed to be the type of interaction on the field trip. Furthermore, students who were not triumphant in school were often successful in tutoring their classmates during field trip indicating the importance of social context (as cited in Linn, 1983, p.123). From another point of view, Braund and Reiss (2004) strongly believed that informal learning environments thanks to their social contexts explain science in new and exciting ways even though many studies reported that science is considered to be boring, hard to learn, and impractical by students (Barmby, Kind, & Jones, 2008; Lyons, 2006). In fact, students like any type of field trips to informal learning environments (Falk & Dierking, 1997) involving social context which motivated and encouraged social interaction (Carlisle, 1985). For instance, Gottfried's

(1980) study clearly demonstrated how social interaction like peer teaching is important to consolidate field trip experience. In a similar way, Carlisle's (1985) study evidently demonstrated that the majority of students shared their experiences with other friends by taking a role of explainer during their field trips that could plausibly contribute to learning. Carlisle (1985) investigated the typical behaviors of fifth grade students during their visitation to the Canadian Arts, Sciences and Technology Centre's exhibit "The Extended 'i.'" Throughout two calendar months, thirty fifth graders (15 boys and 15 girls) were observed by three trained volunteer observers during ten visits to the exhibit. The students had some fifty-five minutes to explore the exhibits. Observations including each exhibit visited; the time spent at each exhibit; size of the group at each exhibit; comments made by or to the child at each exhibit; and the level of interaction achieved at each exhibit were recorded as field notes. Three levels of interaction were identified and defined as follows: (Level 1) Child approaches the exhibit without touching it or its parts; (Level 2) Child approaches the exhibit and touches it or its parts but does not complete the whole purpose of the exhibit; (Level 3) Child approaches the exhibit, touches it, and completes the intention of the exhibit. It is clearly seen that two basic responses to the exhibit were "wandering around" and "engaging with the exhibits". However, Carlisle (1985) summarized the typical behaviors of these children as the following: "The children approached an exhibit, looked, went on, or waited and/or participated. Few reads the graphics on the exhibits. Most of them worked by trial and error, imitated what others was doing, or were "instructed" by friends." (p.30) that highlights the importance of social interaction as well as social context which motivated and encouraged social interaction. About 280 students in Griffin and Symington's study (1997) reported that they enjoyed working with, and talking to their peers. They prefer moving as a group, talking to/with their peers, and working together.

2.3.2.5 Summary

The related literature recommends that

1. Give students "limited choice" where they were given some kind of structured task and direction as well as some choice and control in exploration of exhibits (Bitgood, 1989; Bamberger & Tal, 2007; Falk & Dierking, 1992; Gilbert & Priest, 1997; Mullins, 1998; Price & Hein, 1991; Rennie & McClafferty, 1995; Storksdieck, 2006; Stronck, 1983). "Limited choice" can enhance deeper involvement in the learning process, scaffold subject learning, enable control, and encourage satisfying social interactions (Bamberger & Tal, 2007).
2. If the worksheets are considered to be used during actual field trip, they should emphasize concepts rather than a wide survey of the content, and they should include questions that prompt students to interact with the exhibits and permit them some degree of choice in their responses (Kisiel, 2003a; Kisiel, 2007).
3. While structured tours may produce factual learning, unstructured tours may create more enthusiasm and interest in the subject matter. For that reason alone, these components can be involved in a field trip for supreme impact (Stronck, 1983).
4. Students like any type of field trips to informal learning environments (Falk & Dierking, 1997) involving social context which motivates, encourages social interaction (Carlisle, 1985). For that reason alone, encourage social interactions, even while using worksheets (Bamberger & Tal, 2007; Carlisle, 1985), and provide students with working in pairs or small groups (Braund, 2004; Cox-Petersen & Pfaffinger, 1998).

2.3.3 After-visit factors

2.3.3.1 Follow-up (post-visit) activities

Another factor that have the potential to enrich field trip experiences is post-visit activities. In 1980, Gottfried's results suggest that "peer teaching" can be

evaluated as follow-up activities which allowed students to reinforce their own knowledge and understandings gained from field trip experiences. Correspondingly, Finson and Enochs's (1987) study indicated that students whose teachers made efforts to plan structured activities before, during, and after (or combinations of these) the field trip develop more positive attitudes than their counterparts whose teachers had not planned any such activities. Likewise, Anderson (1999) in his dissertation found that follow-up activities connected to field trip experience resulted in students' construction and reconstruction of knowledge regarding science concepts represented in field trip experience. Similarly, Anderson et al. (2000) investigated the construction of knowledge about electricity and magnetism by 11- and 12- year old students, which resulted from a field trip to Sciencentre (The Queensland Museum, Brisbane, Australia) and follow-up activities were conducted in the classroom. Their sample consisted of twenty-eight Year 7 students (15 girls, 13 boys) from a state primary school, Brisbane, Australia. The study included three phases, which were *pre-visit* – referring to the investigation of students' prior knowledge about electricity and magnetism; *Sciencentre visit* – including pre-visit preparation, actual visit, and a brief follow-up session; *post-visit* – referring to several practical activities linked to the exhibits about electricity and magnetism. The pre-visit started with teaching how to draw a concept map, ended with students' construction of their own concept maps about electricity and magnetism, and as a result of examining these concept maps as well as discussions with teacher, twelve students were selected for more intensive study. Four to five days after their first completion of concept maps about electricity and magnetism, each of these students were interviewed about their knowledge on the same subjects for about 25 minutes. One day before the visit, all students were exposed to a 30-minute introduction presentation about Sciencentre including its layout, exhibits to be encountered, and the schedule of activities. During Sciencentre visit, students were let to explore the galleries of sound and mechanics for about 40 minutes on their own, then the galleries of electricity and magnetism for about 30 minutes, and then they completed the visit by participating in a 30-minute Sciencentre's staff presentation about the electricity and magnetism in general as well as the phenomena covered

by exhibits. The day after the visit, students were asked to complete the concept map as in pre-visit. After two or three days after the completion of concept maps, students who were selected for interview (n=12) were interviewed for about 25 minutes, and let to reconstruct their own concept maps during the interviews. One week after the visit, students participated in two different activities. During the first activity students worked in pairs with a review of their Sciencentre visit including the selection of two of six target exhibits that they found interesting, the description of their involvement with these exhibits, the provision of an explanation of how these exhibits worked. The second activity focused on engaging students in open-ended practical experiments about the induction and electromagnetism, which had clear similarities to two of the Sciencentre exhibits. One day after the post-visit activities, students were asked to complete their third and fourth concept maps regarding these activities. Finally, each of the twelve students was interviewed one to four days after their completion of concept maps. The findings clearly demonstrated that a Sciencentre visit and follow-up activities resulted in changes in students' knowledge about electricity and magnetism in a positive way. Put differently, Braund and Reiss (2006a, 2006b) claimed that school laboratories as well as teacher-enabled discussions among students in their science classes as follow-up activities can both complement and extend what were gained by students at informal learning environments. As claimed by Anderson et al. (2006), while pre-visit activities provide prior knowledge that can help in the understanding of experiences at the field trip site, post-visit activities reinforce new connections and provide additional cues for subsequent experiences.

2.3.4 Other factors

There are many other possible factors that should be considered for a successful field trip experience such as size of the group, duration of field trip, number of staff/teachers accompanying students, grade level of students, and time allowed for unstructured wandering (Bitgood, 1989). Students agendas referring to motivations (why do they participate in a field trip?) and strategies (how much are they aware of the opportunities provided by informal site?) may also have an

impact on their visitations in terms of how, what, and how much they can learn (Falk & Dierking, 1992; Falk, Moussouri, & Coulson, 1998).

The factors explored in the related literature demonstrated that field trip experience is affected by many of factors such as students' familiarity with the setting, their prior knowledge, the degree of structure as well as social aspect of the visit, and the like. Besides, as claimed by Rennie and McClafferty (1995), a good many of these factors are under the direct control of teachers. Thus, it can be argued that teachers also have an impact on their class visits to informal settings, which in turn, on their students' learning experiences. As a result, several suggestions were provided for teachers in the literature to improve their field trip practice.

2.3.5 Suggestions for teachers

Without doubt, a school field trip to informal settings seems to be daunting task. A good many of factors can potentially affect on the quality of field trip experiences. To improve the effectiveness of field trip experience, Cox-Petersen and Melber (2001) suggested students' exploration of setting's web site as a first step. By using a device, teachers can take images of and record students throughout the entire field trip. After the field trip, teachers can distribute these media so that students can create their own field trip stories and present orally or in writing. In another aspect, Rennie and McClafferty (1995) suggested that teachers should link visits to the school curriculum in ways which complement and enrich learning activities at school. They should offer guidelines for achieving enjoyable visits and advancement of student participation and learning in science. They should be aware of that student backgrounds, and social and physical environments must be regarded in all phases of a field trip (planning, implementing, and follow-up). Like Cox-Petersen and Melber (2001) and Rennie and McClafferty (1995), many researchers offered suggestions concerning what and when teachers do from the beginning to the end of a field trip, and even after the field trip to maximize the effectiveness of field trip experiences. Table 2 represented the collection of suggestions for teachers throughout a field trip.

Table 2

Recommendations for teachers about how to conduct successful field trips to an informal learning environment

GENERAL	Field trip experiences are best placed early in a given curriculum[41] Connect field trip experiences to the school curriculum in each phase of an entire field trip (before, during, and after) for better retention [10, 23, 27, 38]
PRE-VISIT	Determine the purpose of the field trip first, then plan the informal setting [10, 31, 43, 46] If you chose an informal setting, consider how it supports your agenda [30] Visit the field trip setting before the actual trip and coordinate with staff on safety, logistics, expectations and learning [2, 12, 31, 37, 46] or visit the setting website or talk to someone who has been before [10, 12] Consider students' prior knowledge [1, 4, 8, 20, 21, 38], interests, motivations, and agendas in planning your field trip as much as possible [15, 18, 20, 21] Use pre-visit lessons/orientations designed to familiar students • ***with content*** specifically related to informal setting's topics [24, 39, 41, 46] • ***setting*** including physical location of the setting, arrival procedures, setting's history, floor plan [3, 9, 14, 16, 31, 35, 41, 46] • ***and procedure*** including purpose, timetable and regulations, schedule of activities and location, what students will likely experience, outcomes that students will be expected to gain [9, 14, 31, 41, 46] During pre-visit lessons/orientations, introduce moderate novelty neither too much nor too little to reduce novelty of new settings not only cognitively [5, 19, 22, 36] but also geographically and psychologically [41]
DURING VISIT	Focus on particular exhibits instead of seeing it all [7, 31, 33, 46] Connect students' prior knowledge and experiences to the experiences provided by informal settings [17, 38] Give students 'limited choice' including both some kind of structured task and direction and some choice and control in exploration of exhibits [6, 20, 25, 38, 40, 42, 43, 44, 45] If you use worksheets, emphasize concepts rather than a wide survey of the content, and prefer questions that prompt students to interact with the exhibits and permit them some degree of choice in their responses [29, 34] Encourage social interactions, even while using worksheets [6, 11, 28, 47] Provide students with working in pairs or small groups [10, 13, 32, 43]
AFTER VISIT	Use follow-up activities connected to the field trip experience [1, 31, 33] like peer-teaching [10, 26] or practical activities [4, 10] (not replicate what students did at the informal setting), or debriefing [46] (ask students about overall impressions, any challenges they faced, the activities they did), or poster presentations [10], or presentations via a software in order that students share field trip memories [12]

Note. Adapted from Rebar, B. M., & Enochs, L. G. (2010). Integrating environmental education field trip pedagogy into science teacher preparation. In A. M. Bodzin, B. S. Klein, & S. Weaver (Eds.), The Inclusion of Environmental Education in Science Teacher Education (p. 117). Springer Science+Business Media. doi:10.1007/978-90-481-9222-9
The references used in this table were provided in Appendix A.

2.3.6 Summary

All in all, students' preparation for a school field trip to an informal learning environment have the potential to influence on their possible gains from that experience, and each component of such preparation is a factor such as reducing the novelty, orienting of them to the physical features of setting, considering their prior knowledge, providing worksheets, explainers, semi-structured visit, social interaction, and follow-up activities. As claimed by Anderson et al. (2006), students gain most from a field trip experience when they are exposed to pre-visit activities in parallel with curriculum, actively take part in on-site activities, and when the experiences obtained during field trip is reinforced with follow-up activities. However, an overwhelming majority of teachers may conduct a field trip to out-school environments once a year with their students (Cox-Petersen & Melber, 2001) apparently due to the exhibits, live animals, or Planetarium shows that they have never seen before, yet they may not visit again if they do not see other probable assets for their students and/or themselves (Youker, 2002). Concurring with this claim, Garcia (2012) argued that many schools merely visit these settings, if they do not fit with their academic goals. If informal environments can strengthen and enrich the formal education of students (NRC, 2009; Phillips et al., 2007), then why aren't more teachers utilizing these informal environments for both their students as well as themselves by conducting field trips?

2.4 Key Decision-Makers for Field Trips: Teachers

In spite of their potential benefits, the number of field trips to informal settings conducted by teachers has appeared to decline due to the limited school funding, the fears about potential injuries or teachers' fears about being sued by parents or school administrations (Stradeski, 2011) as well as lack of time, support, and supervision, heavy curriculum, the pressures of routine tests and student evaluations, and a requirement for teachers and school administrators to justify that field trips satisfy the curricular requirements (Anderson et al., 2006; Schatz,

2004). There are also many possible obstacles and barriers encountered by teachers when organizing and conducting field trips to informal designed settings such as science museums and centers. For instance, Anderson and Zhang (2003a) explored barriers and obstacles encountered by K-7 teachers when organizing and conducting field trips to museums in Greater Vancouver. The study included both quantitative and qualitative methods. Ninety-three K-7 teachers from ten different school districts of the Greater Vancouver Regional District (GVRD), namely Vancouver, Richmond, and Surrey were surveyed at their schools by means of a 23-item questionnaire. The findings emerged from questionnaire were used to the development of a focus group interview protocol. The focus group discussions were administered to two cohorts containing about 6 teachers in each. Teachers' selection was based on their questionnaire responses that more fully enlightened central issues about filed trips. The results of the study disclosed that curriculum-fit, perceived value of the experience, venue entry cost, amount of enjoyment, and transportation cost were top five issues determined by teachers when they consider in organizing and conducting filed trips. Similarly, in a study conducted by Michie (1998), transportation, money, large class sizes, time, effort, and insufficient choice of field trip settings were reported to be seen as obstacles to taking more field trips by most teachers. Likewise, Anderson et al. (2006) reported that while transportation cost was identified as being most problematic issue in Los Angeles case, cost of entry was most probably to be a barrier in Vancouver case. In Freiburg case, the cost of the transportation as well as entry were not considered as obstacles due to the fact that students were generally able to use public transportation, and entry costs were subsidized. In both Los Angeles and Freiburg cases, teachers considered time as a constraint. Teachers claimed that the requirements of curriculum did not permit them to allocate sufficient time to prepare pre- and post- visit activities for a successful field trip. Testing schedules, tight curriculums, and lack of teaching materials were determined as reasons for time limitations. Unlike previous studies, some teachers in Yu's (2005) study reported the reason of the lack of preparation prior to visitation as that they had scheduled more than one place to see in a day. Even though teachers are aware of the fact that visiting a science museum with a large group of students

results in some problems (e.g., difficulty in control, limitation of space, insufficient explainers), some factors (e.g., administrative details, responsibility and discipline) enforce them to travel with a large group. It was even reported that some schools had to make this type of field trip because it was a required policy. In fact, why teachers prefer to visit the museum with a large group of students instead of one class was resulted from several issues such as (1) distance between the school and museum, (2) having full responsibility, (3) administrative procedures and other practical details, and (4) safety considerations.

In her dissertation, Youker (2002) presented a fine picture of potential obstacles and barriers referring to why many teachers may often not conduct field trips to informal settings (p.20-21). By extending this picture, potential obstacles and barriers can be summarized as follows:

1. Logistics

- The coordination and cost of the transportation (Anderson & Zhang, 2003a; The Association for Supervision and Curriculum Development [ASCD], 2010; Kaspar, 1998; Lessow, 1990; Michie, 1998; Orion, 1993; Schatz, 2004),
- venues' entry costs (Anderson & Zhang, 2003a),
- concerns about safety/security (Michie, 1998; Orion, 1993; Rickinson et al., 2004),
- potential student misbehavior (Lessow, 1990) and large class sizes (Michie, 1998; Lessow, 1990),
- curricular requirements (Rickinson et al., 2004),
- lack of curriculum-fit (Anderson & Zhang, 2003a; Kisiel, 2005).

2. External support system

- a lack of assistance from administrators who see the field trip as a day off (ASCD, 2010; Michie, 1998; Mullins, 1998) or disruptions to the normal school program (ASCD, 2010; Hofstein & Rosenfeld, 1996),

- a lack of assistance from other teachers who are comfortless with novel experiences and going outside of the classroom (Michie, 1998; Mullins, 1998).

3. Personal motivation

- fear of failure (Mullins, 1998),
- lack of confidence in teaching outdoors (Orion, 1993; Rickinson et al., 2004, Yaakobi, 1981);
- lack of effort and time (Anderson et al., 2006; Lessow, 1990; Michie, 1998; Mullins, 1998; Rickinson et al., 2004; Schatz, 2004);
- poor interest (Mullins, 1998), and
- lack of awareness of and positive experiences with informal settings (Michie, 1998; Orion, 1993).

4. Availability of resources

- insufficient choice of informal settings (Michie, 1998; Orion, 1993),
- lack of curriculum material regarding outdoor activity (Orion, 1993).

Schatz (2004) claimed that it can be so difficult to attract school groups to visit science centers due to three reasons, which are school needs (state standards, school district policies, teacher needs), science center goals (appreciation of science, wide range of concepts, inquiry-based learning), and financial constraints (entrance fees, busing costs, competing experiences). In addition, many teachers may agree with the notion asserted by Martin Braund in Swift's (2010) article that when you take a class out to a science field trip, the class is likely not just missing the science time, it's missing math, literature, or something else. Perhaps other teachers may say: *Hey, wait a minute! I appreciate your effort to organize such an activity but students are going to miss essential learning time in my subjects which in turn affect their exam results*. All of these reasons deprive students of rich, amusing, and memorable experiences that change their point of views about science as well as world, improve their self-confidence, and provide them desire

to learn more (Stradeski, 2011), whereas teachers are required to understand the possible contributions of school field trips on cognitive, affective, and social learning of students. They are also required to understand the necessity of planning, participation, and student reflection to maximize the potential learning experiences from a field trip (Behrendt & Franklin, 2014). Nonetheless, the current teacher practice does not seem to reflect the desired one. Griffin (1994) argued that available suggestions for teachers are not known or not heeded by an overwhelming majority of teachers. This may be resulted from teachers' own perspectives regarding visits. Their perspectives, perceptions, values or motivations for field trip have a direct impact on their field trip practice no matter of what they are recommended or offered. The truth is that teachers have a great diversity of motivations concerning their visits to an informal designed setting.

2.4.1 Teacher motivations for field trips

Falk et al.'s study (1998) responded to the question "why do people go museums?". The researchers identified six categories for the motivations of museumgoers that were place, education, life cycle, social event, entertainment, and practical issues. However, the motivations of education and entertainment appeared to be superior to the others. As a result, people preferred going to museums in order to not only have fun but also gain knowledge. The review of the related literature clearly demonstrated that teachers have also a great variety of motivations regarding field trips. For instance, Storksdieck et al.'s (2006) study on University Circle Incorporated's (UCI) Linking Education and Discovery (LEAD) field trip program suggest that teachers have a diversity of purposes for their field trip experiences, and these goals varied from providing affective experiences for their students (e.g., creating memorable experiences, motivating and inspiring students, providing pleasure and enjoyment), to reinforcing content knowledge of students, and to expanding their students' general knowledge and perspectives. Moreover, it seemed that the affective learning goals are slightly more important than related learning outcomes based on chiefly curricular ties for teachers. Correspondingly, the results of the study conducted by Storksdieck (2001)

regarding the objectives for the planetarium visit revealed that there are many reasons why teachers had visited the planetarium, which are a part of school outing (Nine teachers out of twenty-nine teachers), introducing students to alternative settings for learning (Three teachers), personal interest in the topic of the show (Four teachers), providing more effective teaching (Seven teachers) and curricular overlap (Five teachers), increasing student motivation (Four teachers), and adding credibility to the subject matter by making use of alternative instructor (Three teachers). In a similar fashion, the results of the teacher questionnaires in Faria and Chagas's (2013) study showed that teachers have a variety of reasons why they bring their students to the aquarium such as (1) increase awareness about aqua life, (2) provide real world observation, (3) to strengthen and extend content knowledge, (4) advance a variety of learning methods and scientific culture, and (5) increase interest in natural sciences and research. Similarly, Mosabala's (2009) study indicated that teachers have a wide variety of purposes for their visiting such as entertainment, edutainment (education and entertainment), curriculum-fit, interactivity, career selection, and school tradition referring to regular class activity. Likewise, Cox-Petersen and Pfaffinger's (1998) study revealed that the primary reason of the visitation for teachers was to provide students with the opportunity where they manipulate objects and enjoy the experience at the Discovery center. Correspondingly, Tal and Steiner's (2006) findings obtained from sixty teacher interviews showed that teachers have six main motives for visiting the museum which are (1) providing a chance for having personal experience and conducting experiments that cannot be replicated in school, (2) providing curriculum connection, (3) providing enrichment in science, (4) exposing to scientific environment, (5) providing high-level teaching, and (6) bolstering social interactions in the classroom. Likewise, in Kisiel's (2005) study, eight teacher motivations for field trips were identified. Even though these teacher motivations were not prioritized, teachers are conducting filed trips for connecting with the classroom curriculum, providing a general learning experience, encouraging lifelong learning, enhancing interest and motivation, providing exposure to new experiences, providing a change in setting or routine, enjoyment, and meeting school expectations.

In some studies, teachers gave "enrichment" in general for the main reason of their visits even though they seemed not to have a specific one. For instance, Tal et al. (2005) study revealed that the majority of the teachers provided general answers to the purpose of their visit such as "enrichment", "learning about animals", even though they did not provide a specific purpose for their visits. Comparatively, in a study of Tuckey (1992a), teachers gave enrichment of the curriculum as their primary reason for visiting, but none had made any special preparation or had linked the visit to any particular topic that children were studying. Likewise, in Gottfried's (1980) study, a majority (62%) of teachers whose classes participated in the study viewed also the science center field trip as an "enrichment" activity. However, they did not plan preparatory or follow-up activities for the field trip. Rather, the field trip was seen as a "change of pace" for students, exposure to new ideas and surroundings with the hopes of promoting better interaction between class members. These teachers perceived the field trip's value to be a social experience and not an explicit "science lesson". Thirty-eight percent of the teachers used the field trip as an introduction to a course of study (e.g., biology, animals, and science experiments), and although they did not prepare the children before the trip, they did conduct a number of follow-up activities. Approximately, thirty percent of the teachers mentioned that they felt that their students were not being exposed to enough science at school and they therefore took their students on field trips to Lawrance Hall to increase their exposure.

When the studies conducted in present-day were reviewed, it can be seen that todays' teachers' reasons for their visits did not quite differ from the teachers' in the past. For instance, the purpose of the work conducted by Michie (1995) was to evaluate the programs offered by the Channel Island Field Study Centre (CIFSC) in 1989 and 1991 in terms of teachers' perceptions. Data were collected through questionnaires including thirteen questions (in 1989) and fourteen questions (in 1991) covering a variety of areas of interest. Forty-nine (in 1989) and seventy-five (in 1991) questionnaires were distributed to the teachers who visited the field center in the previous two years. While twenty-four questionnaires were received

in the 1989 evaluation, thirty-one were received in the 1991 evaluation. The results of the study revealed that teachers had a variety of reasons for the visit. The majority of them consider their visit as a part of their general classwork. While a few of them considered the visit as an introduction to a topic, a few considered it as a conclusion. In the following years, Michie (1998) found that teachers mainly took field trips to give students hands-on, real life experiences which they could not have in the classroom or the laboratory. Furthermore, he tried to determine how teachers' attitudes towards field trips may have been shaped by their past experiences, and his result revealed that the major component affecting their willingness to take filed trips was their past successful experiences on field trips, chiefly as teachers but also as students.

2.4.2 Teacher perspectives on field trips

According to Cambridge Dictionaries Online, perspective means "a particular way of considering something". According to Oxford Dictionaries, it means "a view or prospect". In the simplest form, perspective can be defined as the way we think about something. In fact, our perspective is created by our knowledge and experiences including our thoughts, feelings, beliefs and the like that in turn influence our actions. Indeed, teachers' perspectives regarding field trips have also a direct impact on their field trip practice. For instance, in his study, Michie (1998) interviewed 28 secondary science teachers to explore the influences on them to plan and carry out field trips. Michie (1998) found some variation in teachers' understanding about the usefulness of field trips. Most of the teachers realized the cognitive gains related to the trips. Many teachers realized affective gains as well. Furthermore, as teachers progressed in their teaching practices, they described that they became more successful in taking field trips. Also, teachers' thoughts differed with respect to the resources provided by informal settings to help them prepare their trips. Even though many teachers became self-sufficient in preparing for the trips on their own, the others want to see more help from informal settings. Similarly, the results of focus group discussions in Anderson and Zhang's (2003a) study showed that teachers ask for field trip site-produced

document in print that was unambiguous and reachable and, more crucially, indicating the connections to school-based curriculum. They also request a contact person, who is easily accessible while planning field trip. Another finding of the study revealed that most of the teachers (90%) viewed that field trips provided highly precious educational experiences for their students. In addition, even though the top issue was reported as curriculum-fit by teachers when they consider in organizing and conducting filed trips, it was not referred to the integration of field trip experiences with school-based curriculum. The prime issue of curriculum-fit appeared to be unavoidably associated with the need to secure the legitimacy of the trip for administrative authority. Regarding the division of responsibility, most of the teachers claimed that it was the combined responsibility of the field trip site and teacher to provide the planning of on-site experiences. One-third of the teachers claimed that it was the responsibility of the museum to provide the planning of on-site experiences. Another one-third claimed that it was a field trip site's responsibility for the provision of follow-up activities. Nonetheless, more than one-third argued that they were dissatisfied with the distribution of responsibilities. Also, teachers strongly believed that the provision of pre-visit activities is more important and desirable than follow-up activities by field trip venue. In addition, teachers were reported that overall success of field trips is affected by: (1) effective pre-planning/pre-lessons, (2) appropriate curriculum fit, (3) engaging/hands-on experiences for students, (4) sufficient parent volunteers/drivers/easy transportation. In the following years, Anderson and his colleagues (2006) provided a new perspective on the data that previously collected and reported (Anderson & Zhang, 2003a; Kisiel, 2005; Storksdieck, 2001, 2004), and reexamined the results from a larger perspective that is associated with teachers' perspectives on field trips. The results of the study clearly showed that there are three areas of commonality in teacher perceptions, which were (1) field trip worth and learning experiences, (2) logistics and other obstacles, (3) the importance and paradox of curriculum fit. Even though field trip seemed to be considered as a day off from school, in all studies, teachers perceived field trips as highly valuable educational experiences for their students. Teachers also felt that field trip experience should fit effectively with the

school curriculum. In fact, in both the Los Angeles and Vancouver cases, curriculum fit was an important consideration for conducting a field trip to an informal setting. However, the meaning of curriculum fit varied from activities which integrated the field trip experience into the current unit, to a general review of a topic which had already covered in classroom. The researchers claimed that teachers obtained legitimacy for their field trip by showing that it would fit the curriculum. In addition, in both the Vancouver and Los Angeles cases, teachers claimed that access to and/or implementation of pre-visit activities was generally more important to achieve a successful field trip than post-visit activities. On the other hand, in Freiburg case, the majority of teachers during interviews claimed that they conducted some sort of follow-up activities more than pre-visit activities even though they recommended that pre-visit activities are more important than follow-up activities to achieve a successful field trip. However, only about one-third students could describe follow-up activities. In a similar manner, Storksdieck (2001) investigated how teachers approach to visit in informal settings. He conducted twenty-nine structured, half-standardized phone interviews with teachers, who visited the Richard-Fehrenbach-Planetarium in Freiburg, Germany about one year ago. During interviews, he asked mostly open ended questions that covered all aspects of the visit (e.g., motivation to participate, preparation beforehand, activities during and after the visit, information received from the site, expectations from the planetarium show, show impact, visit context). The results of the study indicated a paradox in terms of preparation and integration. While nine teachers claimed that they made a connection with classroom unit, most of them argued that they did not make any preparations due to the lack of time and curriculum-fit, yet almost all teachers recommended that the content preparation must be done before conducting field trips. Regarding content preparation, while one teacher suggested that student expectations for the content as well as the setting must be set, another one suggested that students' prior knowledge and attitudes must be investigated. All teachers suggested that follow-up activities (e.g., clarification of remaining questions, repetition, and improved retention) must also be done. Nonetheless, only three teachers claimed that follow-up activities should include an investigation of students' feelings, or

impressions about the visit. To prepare activities before and after the visit, three teachers recommended contacting the informal setting for the detailed information about the activity offered by site. In his final analysis, Storksdieck (2001) argued that teachers can count on materials provided by out-of-school environments. Likewise, Kisiel (2005) characterized field trips from teachers' perspectives. His leading question was that "why do they conduct field trips to museum?". Even though his methodology was descriptive in nature, he used both qualitative and quantitative methods. His survey included closed- and open-ended questions for determining teacher motivations for school field trips regarding why they arrange field trips. He selected 400 upper elementary grade teachers randomly from more than 1000 teachers in the Los Angeles area. The survey was distributed via e-mail. However, only 86 teachers (22%) responded. Additionally, 29 surveys were obtained from randomly selected teachers participating in a local science-teaching workshop and teachers volunteered to participate in observational phase of the study. His final sample size was 115 teachers. Furthermore, additional 10 upper elementary grade teachers agreed to participate were selected for in-depth studies from the Natural History Museum's reservation list. Kisiel's study included two phases. While the first phase included survey, the second phase included in-depth studies. In-depth studies involved three stages: (1) pre-visit interviews with the teachers by using the same questions in mailed survey; (2) observations of teachers and students during their filed trips; (3) follow-up interviews with the teachers at their schools or by phone. In the second phase of the study ten teachers were interviewed and observed during their field trip to the National History Museum to better understand their motivations and strategies. By means of observations and interviews, some field trip motivations were clarified. For instance, curriculum connection was meant to be integration with a curriculum unit, review a curriculum unit, or introduce a curriculum unit. Label-reading was also considered as curriculum connection for reinforcing vocabulary and language use. Another field trip motivation, expose to new experiences, was directly related to teachers' strong memories of their school field trips. For all of these teachers, helping their students experience the world around them was a significant field trip motivation. Furthermore, teachers' motivation regarding 'lifelong learning'

was directly associated with students' willingness to come back to museum with their parents. Kisiel's study showed that field trip experience is hugely formed by the teacher's motivations (agenda). In addition, there is an increased likelihood that students will share, or accept the teacher's agenda for the field trip. In addition, in-depth studies showed that teachers' motivations differ from those of others including administrators, other teachers within the school, museum docents/staff, or the museum itself. Tight curriculum, time constraints, and district/state mandate testing program prevented teachers from implementing both pre- and follow-up visit activities. Field trip timing, choosing the site, financial needs, or collaboration with other teachers was also considered as barriers. The limited docent/staff and student interaction was also not congruent with the teacher's agenda. In conclusion, teachers have a great variety of perspectives regarding their visits that in turn affect their roles in field trips.

2.4.3 Teacher roles in field trips

There is a common view that teachers play a crucial role in students' learning experiences throughout a field trip to informal settings. In our daily life, teachers, like anyone else, fulfil many roles. Indeed, teachers can perform a variety of roles during their teaching at school, planning a field trip to an informal setting, or conducting a visit to a science center. Some teachers may be considered as facilitators because they feel that they should help their students to do something more easily or find the answer to a problem by discussing things and suggesting ways of doing things during visit. Other may be considered as maestro because they organize the entire field trip from its beginning to the end. These roles adopted by teachers can lead to positive results or negative consequences in terms of student learning experiences (Cox-Petersen & Pfaffinger, 1998). For instance, in 1994, Griffin investigated whether students and teachers are learning through the experiences provided by informal science settings. To determine this, she conducted 114 interviews with teachers and students from 13 different schools over a three month period. School groups visited two science learning settings, which are the CSIRO Science Education Centre and the Australian Natural

History Museum. The groups including two to four students were randomly selected from classes of Year 5 to 10 students. Teachers and students were observed during their visitations to these institutions. Interviews questions focused on the purpose, expectations, preparation and follow-up activities related to the visit. All teachers were interviewed during and within two weeks of the field trip. Concerning preparation, the results of the study revealed that very little preparation was done for the field trips, and it was mostly organizational, and the visit to museum was considered as a day out activity. Even though the topic of the visit was studied at schools previously or studied during the visit, the connection of the visit to the topic being studied at school was not established for students. Considering the actual observation of students and accompanying teachers during visits, the results demonstrated that teachers did generally stand back and not participate in the learning activities at all, even though they seems to be involved (e.g., watching the group). In addition, most of the teachers had a strong belief that 'just looking around' should not be considered as learning. Students would not learn anything unless they answer the questions in the worksheets. With some exceptions, most of the teachers had claimed that they would do something; however, there was very little done. What was done by teachers seemed to be collecting and marking the worksheets. Furthermore, the attitudes of teachers and students were matched. If teachers had clear purpose for their visitation and positive attitude to the field trip, the students reflected similar attitudes. Nonetheless, the study generally revealed that teachers have a general pattern such as unclear purposes, lack of variation in learning activities, lack of preparation, and no connection with classwork. Similarly, Griffin and Symington (1997) explored the teacher practices who conducted field trips to one of the two museums in Sydney, Australia. The sample consisted of 12 school groups, including 29 teachers and 735 students in 30 classes ranging from years 5 to 10. Schools were randomly chosen from those that had already made their bookings for one of these museums on days when one of the researcher was available to collect data. Data were collected through observations of school groups as they visited the museums and interviews with individual teachers (n=29) and small groups of students (in size from two to five, totaling about 280 students) before,

during, and two to three weeks after their visitations to the museums. Considering the purpose of the visit, the results demonstrated that just half of the teachers' responses referred to the students' content and skills learning. Most of the teachers had not any clear goals for their visitations. Filling out worksheets seemed to be the fundamental goal for almost all teachers. In addition, students' attitudes toward field trips seemed to be reflecting their teachers' ones. If the teacher had a clear goal and enthusiastic about the visit, the students had as well. Concerning pre-visit preparation, the results showed that teachers had very little preparation and they were often related to organizational activities such as distributing worksheets on the day before visit, telling students where they are going to, reminding to to bring parents' permission slip, and the cost of the visit. Furthermore, most visits were poorly connected to subjects being covered at school. Most of the teachers felt that they had little role in implementation of the visit. Regarding follow-up activities, most of the teachers said that they would conduct follow-up activities in some way; however, this often referred to collecting and marking the students' worksheets. The subjects covered in the museums were often not connected to the classroom ones. Considering teacher behaviors during visit, the results illustrated that teachers had a variety of behaviors. Some of them actively engaged in learning activities with small groups of students; some of them worked quite specifically and exclusively with one or two small groups of students and ignored the rest; some of them just watched the groups, primarily for behavior; others stood back, not attended in any activities at all. On many occasions, teachers sat down even though they did not let that happen for their students. The study concluded that teachers used primarily task-oriented teaching practices (e.g., completing worksheets) and strategies (not let students to watch videos in the galleries, to conduct hands-on activities, or to sit down for a while for making them complete their worksheets). The researchers argued that the reason of using task-oriented strategies can be attributed to many factors (e.g., the fear of losing students, risking the reputation of their school, the probability of being asked questions that they may not answer, not having backup plan as they have at school). In another study, Cox-Petersen and Pfaffinger (1998) explored teacher roles before (How did they prepare their students for a field trip

to Discovery Center of Natural History Museum of Los Angeles County?), during (How did they interact with their students during the field trip?), and after the field trip (How did they plan to follow up the field trip?). Their sample consisted of eleven teachers as well as their accompanied students from nine second grade classes and two third grade classes with an age range from seven to nine years. The researchers adopted a naturalistic qualitative method to investigate teacher roles by means of their interactions with their students. The verbal and non-verbal interactions between them were noted and recorded as field notes from the moment they entered the center until they left the center. After each observation period, the researchers conducted interviews as informal conversations with teachers, and all interviews were audio-taped and noted for proper documentation. Concerning pre-visit preparation, the results showed that none of the teachers conducted specific pre-visit activities. The reasons provided for not conducting any pre-activities were that teachers did not want to distort students' visit or wanted their students to have experiences when they saw it instead of providing prior knowledge via pre-visit activities. Other reasons included time constraints and not having any information about the Discovery center. In addition, although each one of these eleven teachers stated that they would conduct some follow-up activities, they were not specific about these activities. The most repeated activities reported were discussion and journal or story writing. Only one teacher reported that she wanted to enquire deeper into topics presented in the Discovery center when they returned to school. Considering teacher roles, all teachers reported that they saw themselves in different roles during their visitations. Even though most of them reported that they should ensure students learn and participate in hands-on experiences, just half of them displayed such behaviors. While two of them indicated that they should enjoy the visit with their students by accompanying and exploring with them, only one teacher perceived her role as facilitator of learning by asking students open-ended questions to make them think. As a matter of fact this teacher was observed asking open-ended questions; however, she never elaborated her questions in detail when students gave answers. In addition, from teacher observation data, the researchers generated four distinct roles that teachers adopted: explainer, initiator (both were considered as facilitator

of hands-on experiences), manager, and observer. Regarding teacher and student behaviors, half of the teachers mostly observed and managed students' behaviors, and the students of these teachers level of interaction with the hand-on exhibits was low. The other half of the teachers mostly initiated hands-on experiences by avoiding managing and observing students' behaviors, and the students of these teachers were involved in a greater variety of exhibits for longer lengths of time. In short, students whose teachers gave them guidance engaged in a greater variety of activities than students whose teachers did not. Based on their results, Cox-Petersen and Pfaffinger (1998) recommended that teachers should accompany their students by taking a facilitator role rather than an authoritarian role and let them stay in areas for longer periods of time to explore hands-on exhibits throughout their visitation to an informal learning environment. In a similar manner, Lucas (2000) tried to better understand some teachers' readiness and conduct of visits to the Queensland Sciencentre, Australia. Her sample consisted of one primary school teacher (Ms. Meg Norton) and her Year 7 class consisting of 28 boys. She adopted a naturalistic inquiry for her study. She conducted interviews and observations before, during, and after the visit to Sciencentre. In the first phase, she interviewed with Ms. Norton (about 1 hour) and six students (about 10 minutes for each), and she observed the last science lesson at the school before the visit. The semi-structured interview included questions attempting to gain insight about teacher functions (e.g., teacher's preparation for the visit including pre- and post-visit lessons, her approach to teaching science, vision about the role that she adopt during actual visit). In the second phase, class visit to Sciencentre was videotaped, and the teacher was equipped by a microphone. Five days after the visit, the follow-up lesson was observed, and the teacher and six students were interviewed at their school. Concerning pre-visit lesson, it was reported that the teacher nearly did not waste her time for explaining logistics (except for dress and deportment), the layouts of Sciencentre building, or what are in there. Also, she did not distributed any worksheets and other paraphernalia to be used by students during the actual visit. Instead, the teacher discussed about the types of learning method, encouraged students for the visit, and requested peer instruction during visit. Her goal for the visit was clear, and her agenda was to

help students extend their knowledge about science and technology, and have fun while doing so. Upon arrival, the class participated in explainers' demonstrations of the Sciencentre for about 30 minutes, and then students in small groups accompanied by a parent were let free to explore other galleries at Sciencentre for about 90 minutes. During the visit, it was reported that the teacher spent a great deal of time (1) to focus her boys' attention to exhibits' labels, (2) to facilitate her boys' learning experiences (by helping them to understand how exhibits run or making a connection between exhibits and real life applications), (3) to promote peer instruction (by encouraging them to explain the goal or working process of a particular exhibit to her or their peers). Ms. Norton consider her role as an accompanying teacher who asked many types of questions to link the experiences at Sciencentre with everyday ones. Regarding follow-up activities, Ms. Norton has had a chance to conduct a follow-up lesson regarding Sciencentre visit after 5 days. She asked for students (1) to rate the visit on a scale of 1 to 10, (2) to make a list of the exhibits as many as they remember in a minute, (3) to discuss the most interested exhibits and why these exhibits interested them, (4) to complete a worksheet involving a drawing of an exhibit that interested them, (5) to write a sentence about what the selected exhibit demonstrated, and (6) to make a connection between real life and the chosen exhibits. Likewise, Tal et al. (2005) focused on the roles and perceptions of teachers who visited four informal settings (museum, natural history center, and zoological and botanical gardens) with their classes in Israel. In their study, 40 classes were observed from the moment that school bus entered the one of these settings' parking lots. Furthermore, the semi-structured interviews lasted about 15-20 min were conducted with twenty-six teachers either at the end of the visit or by phone at the following evening. All observations were videotaped by two researcher of the study, and all collected data were inductively analyzed. The results of the study revealed that the majority of the teachers

(1) did not take an active role in organizing and preparing the museum visit. Only a few of them reported that they planned the visit aligned with the school curriculum.

(2) were passive during the visit. They followed the museum guide, and solely helped the guides. The help were primarily related to maintaining order and discipline such as organizing students, keeping students quiet, and watching students' behaviors. About 5 to 7 teachers were actively engaged in enacting the program, and initiated or facilitated some of activities.
(3) did not make a proper pre-preparation (e.g., planning and selection of learning activities) in school for the museum visit. They only reported that they informed students about the technical issues such as clothing, food, and visit hours.
(4) reported that they are not going to conduct follow-up activities.

Furthermore, a few patterns of teacher behaviors were observed during the museum visits, which were (1) "helping and talking to small groups of students"; (2) "looking at the exhibit with a few students"; (3) "quietly standing behind"; (4) "chatting with the chaperones"; (5) "chatting outside the building" (p.926). In their final analysis, the researchers argued that the adoption of passive roles by teachers might be resulted from the fact that they consider the visit as a fun experience rather than a well-prepared educational experience. The researchers also claimed that the presence of guide may also lead the vast majority of teachers not to take an active role. Similarly, Faria and Chagas (2013) investigated both teachers and students' roles in and perspectives on a field trip to an aquarium, namely the Vasco da Gama Aquarium, Lisbon, Portugal. A typical guided visit lasting about one hour included a group visit to the live exhibition and the visualization of a small multimedia presentation focusing on the theme of the visit. The researchers observed 39 guided class visits to determine the interactions among students, teachers and guides, their specific behaviors, and the operation of the visit. In addition, the researchers distributed a questionnaire to teachers and students to disclose their perceptions of the guided visit at the end of their visit. 145 teachers and 191 students completed the questionnaire. Furthermore, additional eleven teachers who participated in a guided visit before were surveyed online to gain deeper understanding about their ideas regarding school visit. According to online questionnaires (n=11) all teachers stated that "science

museums should function as a complement to school learning, instead of overlapping scientific knowledge or being independent" (p.12). Furthermore, all teachers preferred the guided visits, and the main reason for this preference seemed to be related to the idea that museum explainers have more profound knowledge about the concepts involved in the exhibitions; thus they promote deeper learning than teachers can, keep students more focused on and interested in visits. Considering pre-preparation, all teachers mentioned that they conduct pre-visit activities in some way. Informing students about what would be provided by the setting, discussing about the expectations of students from the visit (n=2), explaining the purpose of the visit (n=1), preparing a worksheet to complete during actual visit (n=1) were reported as pre-visit preparations that they performed. Only one teacher reported that she generally get prepared for the field trip with their students (discussing about what they would like to know, what they ought to observe and so on). Regarding follow-up activities, teachers reported that they conducted several follow-up activities such as presentation (e.g., poster, photography, and drawings), debate, and report. Only one teacher reported that she generally discusses with their students about what they have learned from the field trip, what they still would like to know, and what would be the further step to learn more. Overall, the results demonstrated that these eleven teachers have limited preparation and follow-up activities that would support the visit. Concerning the structure of the visit, the results of the study demonstrated that all class visits were guided and lecture-oriented. The interactions between students and teachers were limited, and when the interaction took place, it was only for the disciplinary reasons. In most cases, teachers preferred to talk to each other, watch exhibits other than the exhibits observed by the group. Only one teacher was observed asking questions (e.g., what are you observing?), or making connections between the subject provided by the aquarium and the one already studied in science class. In general, teachers seemed to play a passive role during the guided visit, and the researchers claimed that the reason of this result was due to guided visit. This type of visit provides very little choice for both teachers and students, limited interactions among students, teachers, and even the aquarium resources. These results were consisted with the findings of the study conducted by Cox-

Petersen et al. (2003), in which approximate 30 class visits in Grades 2 through 8 were observed, and 30 teachers and 85 students were interviewed to determine how a guided field trip operates at a natural history museum. The results of the study demonstrated that guided visits were organized in a didactic way, guide-focused, and lecture-oriented allowing minimal interaction among students, teachers, guides, chaperones, and resources provided by the museum (e.g., exhibits). In a similar manner, Mosabala (2009) in her Ms. Thesis investigated five teachers' field trip experiences to one of four museums, which were Scibono Discovery Centre, HartTAO, Johannesburg Planetarium, and Adler Museum in South Africa. The data was collected through observation of teachers throughout the entire filed trip and interviews with teachers before and after the visit. The observations of teachers during their field trip disclosed that teachers' interactions were either learner-oriented (e.g., discussion of the exhibits or conducting an activity altogether) or behavior-oriented referring to the control of behavior. However, some teachers showed no interaction with their students. Instead, they interacted with their colleagues. The findings regarding teachers' preparation indicated that while some teachers preparation referred directly to task-oriented preparation (e.g. he completion of worksheets), the others' preparation referred directly to learning-oriented preparation (e.g., preparation conducted on the topic being covered and/or the field trip site). Nonetheless, one teacher's preparation was not directly about the visit. Concerning follow-up activities, it can be seen that teachers conducted either task-oriented (e.g., the completion of worksheet or handing in worksheets) or learner-oriented (e.g., connecting field trip experience to classroom discussion of the topic or using field trip experiences in assignments or projects) follow-up activities.

The aim of the study conducted by Tal and Steiner (2006) is to understand how teachers and museum staff members can work together to carry out a successful field trip to an informal science learning setting, which was the Science Education Center of the Israel National Museum of Science, Technology, and Space. Forty-two coordinators who did not visit the museum before were interviewed prior to

the visit. Furthermore, one hundred and two teachers were subjected to a variety of data collection methods as follows:

(1) Focused observations (N=42, 30 class visits),
(2) Interviews (N=60) - Interviews were semi-structured and followed a written protocol. The purpose of the interviews was to determine whether any preparation including planning, activities, and the like took place as well as teacher roles before and during the visitation,
(3) and museum's feedback sheets (N=84) including technical and educational questions as well as questions regarding any aspect of the day.

The results of focused observations revealed that teachers' behaviors have a great variation such as asking questions, calling for attention, asking to elaborate, making comments, helping students in the experiments, moving between groups of students, and being busy with personal matters. By considering these variations, the researchers have combined them into three types of teacher behaviors: (1) involved teachers whose behaviors include asking questions, asking the docent to elaborate, recommending ideas, helping their students in the activities, and making connections between the experience and the curriculum; (2) teachers following tradition whose behaviors include keeping students on task and providing docents with administrative help; (3) passive teachers whose behaviors include irrelevant activities such as grading tests, reading newspaper, leaving students and going elsewhere.

The mediation offered by guide and teacher was also explored. For example, Tal and Morag (2007) tried to understand the process of learning in an informal setting by evaluating the characteristics of the guided visit, type of guides'/students' questions, presentation of scientific ideas/terms and mediation offered by guides and teachers. Their study involved four informal settings (museum, natural history center, and zoological and botanical gardens). They randomly selected 42 classes (approximate ten to each setting), and the grade levels of students were ranged from Year 3 to Year 11. All class visits were

accompanied by a school teacher and one or two guides at the settings. During data collection, they used observations, and then these observations were inductively analyzed. In addition to other results, the study revealed that there are three main patterns of mediation:

1) *Guide's initiatives* referring to mostly technical directions for maintaining order and discipline,
2) *Teachers' initiatives* referring to teachers' facilitation of the learning experiences in the settings, (e.g., helping students to complete their worksheets and connecting concepts to the ones covered in class),
3) *No mediation* referring that neither guide nor teacher facilitated the learning experiences of students.

Unfortunately, in only five or six out of 42 class visits, teachers actively engaged in facilitating student learning experiences (e.g., linking guide's explanations and/or subjects offered by museums to students' prior knowledge and/or the subjects being covered at the school). Quite surprisingly, the researchers did not observe any intentional attempt by guides to invite teachers to be more involved in the activities. Furthermore, even though teachers can play a key role in facilitation of student learning experiences (e.g., by providing discussion, collaboration, and cooperation), most of the teachers in the study are engaged primarily in the technical aspect of the visit. The findings also revealed that teachers are more inclined to inform students of their behavioral and learning expectations than to orient them on the field trip goal, experience, and environment. Besides, teachers are inclined to provide younger students with more orientation than middle school students. Instead of lecturing on the field trip subject matter, collecting worksheet or testing students on the material, teachers preferred conducting discussions or question/answer sessions for follow-up. The researchers claimed that teachers are possibly underutilized during field trip, they can not only be behavior monitors but also active facilitators.

The strategies used by teachers during a field trip to an informal designed setting were also investigated. For instance, Kisiel (2006b) tried to understand how

teachers perceive and deal with different learning environments and behave in these settings by asking two research questions: (1) *what strategies do upper elementary teachers report using during their field trips to a museum or similar institution?*, (2) *to what extent are these strategies related to observed field trip practices in an actual setting such as a natural history museum?*. The researcher adopted both quantitative and qualitative methods. His study consisted of two phases. The first phase (Phase I) included a survey consisting of open- and closed-ended questions as well as demographic-type questions to detect teacher instructional strategies for a successful school field trip. The second phase (Phase II) included in-depth studies involving three stages: (1) interviews with the teachers by using the same questions in survey before they come to Natural History Museum; (2) observations of teachers and students during their filed trips; (3) interviews with the teachers at the school site or by phone after their visits. He selected 400 upper elementary grade teachers randomly from over 1000 teachers in the Los Angeles area. The survey was distributed via e-mail. Furthermore, additional teachers were randomly selected from teachers participating in a local teaching conference. His final sample size was 115 teachers. Furthermore, additional 10 teachers were selected for in-depth studies from the Natural History Museum reservation list. The survey results demonstrated that ninety-two percent of teachers described pre-visit strategies completed before the visit, and sixty-nine percent of teachers described some sort of instructional strategies they might use during the visit. In fact, Kisiel (2006b) identified three categories of during-visit strategies with sub-categories (see Table 3): (1) the structured and unstructured student engagement strategies; (2) student supervision; (3) event documentation. Also, 42% of teachers were reported that they use some structured student engagement strategies, mostly information-seeking strategies such as using worksheets. Kisiel (2006b) suggested that theachers' responses such as "probably", "would try to" points out some tentativeness of using this strategy. As a result of his observations and interviews, he provided a more detailed picture of these strategies. Under the structured student engagement strategies, information-seeking strategies included worksheets and other students-writing activities such as taking notes and sketching artefacts.

Table 3

During-visit strategies

<table>
<tr><td rowspan="4">Student Engagement Strategies</td><td rowspan="3">The structured student engagement strategies</td><td rowspan="2">Information-Seeking Strategies</td><td>Completing worksheets</td></tr>
<tr><td>Taking notes</td></tr>
<tr><td rowspan="2">Information-Receiving Strategies</td><td>Sketching artefacts</td></tr>
<tr><td>Guide tours</td></tr>
<tr><td>The unstructured student engagement strategies</td><td colspan="2">Staff presentations</td></tr>
<tr><td>Discussing, sharing, asking and answering questions, pointing out items of interest, reflecting, facilitating, and guiding.</td><td colspan="2"></td></tr>
<tr><td>Student Supervision</td><td colspan="3">Student grouping, chaperone guidance, keeping track of both students and time, other references to student behavior.</td></tr>
<tr><td>Event Documentation</td><td colspan="3">Taking photos and recording videos during visit.</td></tr>
</table>

The role of teacher was described as facilitator for completing the worksheet experience. Information-receiving strategies included guide tours as well as museum staff presentations. However, he highlighted that the mediated experience provided by docents changed enormously from one group to another. He also argued that the educational value of this experience seemed to be influenced by two significant factors, students' involvement level and the museum staffs' ability to meet students' needs. During the interviews, one of the teachers said that "having experts to explain what's in the exhibits would be nice" (p.440) referring a thought which may result in the adoption of a passive role by teacher. The "interpretation" was another strategy used by many teachers. Teachers, based on their prior knowledge or information provided by exhibits' labels, interpreted the meaning of an exhibit or object. Another strategy used by many teachers was "connecting" referring helping students make a connection between what the exhibit and object tells and classroom curriculum. Another strategy was "facilitation" referring the contribution of teachers to meaning making process by

providing comments or posing open-ended questions. However, the result of a teacher's observation indicated that the facilitation strategy is replaced by interpretation one over the time due to fatigue and limited time. The deliberate and complementary label reading were also considered as strategies. In deliberate label reading, teachers promoted a student to read aloud to other classroom mates. If necessary, teachers helped students by using the interpretation or facilitation strategy. In complementary label reading, teachers asked students to read and find the answer to a question regarding an exhibit or object. As classes moved from hall to hall, teachers generally used some sort of orientation and advance organizers such as making use of museum signage, reading the name of the hall, asking questions, and encouraging responses before entering the hall. Furthermore, many of the teachers let students free to explore exhibits or objects on their own. Even though some student read the labels, most did not. For that reason alone, Kisiel (2006b) claimed that the overall effectiveness of free exploration seems to be dependent on teacher discipline characteristics as well as student field trip experience. Considering student supervision strategy, two significant factors: "keeping track" and "refocussing" were reported. While keeping track strategy referred to teachers' attempts to sustain students' awareness in the novel informal setting, refocusing strategy referred to repeating rules, directions and learning objectives. Even though Kisiel (2006b) provided a good picture of the strategies used by many teachers during a visit to informal learning site, he was aware that most of the strategies were overlapped. In fact, the strategies used for student engagement such as using worksheets, advance organizers, teachers' interpretation, even staffs' presentations might also have provided some supervision. Although event documentation strategy through photographs or cameras was used by teachers to document their experiences at the museum, some other purposes were revealed. One of the teacher used this strategy to promote student interest and family conversation. In addition, this teacher mentioned that she prevent students from the distraction with cameras by offering herself as photographer for them. As a result, Kisiel (2006b) suggested that event documentation strategy may not only be used to create a classroom scrapbook, but

also to facilitate student interest and conversation. Overall, Kisiel's (2006b) study suggested that teachers use a wide range of strategies during field trips.

One study in the related literature was different from the previous studies in terms of two issues: (1) school field trips were conducted by travel agents, and (2) students visited the museum with large groups (over 100 students). The purpose of Yu's (2005) study was to investigate the perceptions of teachers who visit to National Science and Technology Museum (NSTM) in Kaohsiung, Taiwan with large group of students. He interviewed with thirty teachers (24 elementary, 4 junior high, 2 senior high school) during the study, and the interview questions involved school information, interviewee information, and eight semi-structured (including closed- and open-ended) questions. In addition, the visiting varied from one to six hours. In detail, elementary school groups visited the NSTM for a longer time than junior and senior high school groups. The results of the study were reported in terms of eight interview questions. Twelve out of thirty teachers said that they hired travel agencies to plan and conduct field trip for them. Unlike the other studies (Anderson & Zhang, 2003; Hannon & Randolph, 1999), this study's data suggested to conclude that curriculum fit and cost were not essential considerations for the visitation. Not surprisingly, most of the teachers did not feel that they were responsible for providing worksheets or helping students to prepare prior to their visitation. Some teachers still prefer explainer to do their jobs for them, particularly those whose domain is not associated with science. Furthermore, fourteen out of thirty teachers felt that visiting time was not sufficient. Most of them claimed at least 4 hours were needed to visit museum. In addition, even though the majority of teachers claimed that they accompanied their students during visit or participated in the activities, none of them mentioned that they facilitated the experiences of students. For that reason alone, the researcher suggested that observation studies are needed to find out what teachers actually do during visitation. Concerning the satisfaction with students' learning, it was clearly seen that teachers considerably depended on explainers to help students learn in the museum.

2.4.4 Teacher reflections on field trips

Although the available literature seems to be limited, several studies focused on the reflections made by teachers regarding field trips. For instance, in his dissertation, Gottfried (1979) reported that even though teachers consider field trips as learning and social experiences, they feel privileged if all their students get on the bus on time, and if all the accompanying parents are impressed by the setting (as cited in Linn, 1983, p.123). Similarly, even though most of the teachers in Anderson et al.'s (2006) study highlighted the importance of curriculum fit, they rated the success of field trip in terms of student enjoyment and other emotional or affective criteria. Even humorously, the researchers claimed that the success of field trip is often judged as "bringing all students back alive and healthy" (p.380). In a similar manner, in Kisiel's (2005) study, teachers' responses to the question regarding how they determine whether a fieldtrip was successful were categorized as follows. When students show positive experience (61%), demonstrate new knowledge (41%), connect to classroom curriculum in class (23%), increase their motivation and interest (17%), exhibit good student behavior (17%), ask high quality and high number of questions (8%). Besides, five percent out of 115 teachers claimed that if no one gets lost or hurt, the field trip is meaning to be successful. Likewise, Tal and Steiner's (2006) research results of teacher feedback sheets designed by museum personnel to help in enhancing subsequent learning activities was categorized into four main dimensions as technical issues (18%), students' enjoyment (40%), pedagogy (17%), and content (25%). Interestingly, while teachers from elementary schools were addressing the aspect of the visit, they did not directly connected to the learning activity. Nevertheless, more than half of teachers from secondary schools addressed the contents as well as the methods used by docents in evaluating the learning activity. In another research conducted by Tal, Bamberger, and Morag's (2005) an overwhelming majority of teachers referred to the type of learning (e.g., concrete experiences, constructivist learning, enrichment), contents, and methods used by guides to reinforce learning. Many of them also reported that students had enjoyed as well. The teachers also highlighted a few concerns, which were too

much lecturing, lack of connection between the concepts offered by setting and students' prior knowledge, insufficient time for free-exploration, and irrelevant movies.

2.4.5 Summary

Even though teachers' behaviors (e.g., asking questions, calling for attention, asking to elaborate, making comments, helping students in the experiments, moving between groups of students, being busy with personal matters) and strategies (student engagement, supervision, and event documentation strategies) during a field trip have a great diversity, the available literature showed that there was a few teacher roles during a field trip such as explainer, initiator, manager, and observer, and many teachers were not aware of the significance of the roles they adopted for the success of a field trip to informal designed settings. Furthermore, some general patterns were emerged from the review of literature such as not having a clear purpose of visit, lack of variation in learning activities, lack of preparation, no connection to classwork, and unaware of their roles in forming their students' experiences. In addition, as the reasons for these insufficiencies, teachers generally blame the tight curriculum, time constraints, school administrations, and informal sites. Even though the available literature provides insight about the teacher's perspectives on, roles in, and reflections on field trips to informal learning environments, it seems to be limited, and many results differed from one another in terms of country, teachers' teaching grade level, the structure of the visit (e.g., guided or unguided), and the implementation of visit (e.g., by teachers or travel agency). For that reason alone, it seems worthwhile to investigate teachers' perspectives on, roles in, and reflections on a field trip to an informal setting such as science center to better understand what the perspectives of teachers on field trips, which roles adopted by teachers when they organize and conduct field trips, and what reflections were made by teachers.

CHAPTER 3

METHODOLOGY

Thomas (2011) stated that "designing research is like designing anything else – you start with a purpose and then plan how to achieve it" (p.26). The purpose of the study was to describe

(1) teachers' perspectives on field trips to informal learning environments,
(2) and their roles in and reflections on a field trip to an informal learning environment, which was Middle East Technical University's Science Center (METU SC).

A key focus of the study was the kind of roles teachers adopt for themselves during a field trip to the METU SC, and variation of these roles during different parts of the visitation such as welcoming and accommodation, explainer demonstration, and free exploration. This investigation focused on teachers' interactions with students, explainers, colleagues/parents, and exhibits in addition to their specific behaviors in different parts of the science center visit. The nature of the research questions required two different research designs, survey and case study design in two different stages. In stage one, the researcher investigated teacher perspectives on field trips to informal learning environments by using a survey design. In stage two, the case study design was conducted to investigate teacher roles in and their reflections on a field trip to the METU SC. The Table 4 summarizes the methodological structure of the study.

Table 4

The components of the study

Context	Design		Research Questions	Sampling	Data Sources	Evidence
Study Setting: METU SC	Stage One	Survey	RQ1: What are teachers' perspectives on field trips to a science center or other similar informal learning settings?	All primary, middle and high school teachers (n=252) on the reservation list of the fall semester of 2012, the fall and spring semesters of 2013, and the spring semester of 2014 comprised for the sample of the study.	Survey	Frequencies were calculated to identify which responses and emerging categorizations were most common.
	Stage Two	Case I	RQ2: What kind of roles do teachers adopt for themselves during a field trip to the METU SC?	Twenty-five teachers having different school types and teaching grade levels that were selected purposively from the METU SC's reservation list of the spring semester of 2013 comprised the participants of direct observation.	Observation	Teacher behaviors were examined using a process of open coding, and emerging roles were identified.
			RQ3: What are teachers' reflections on a field trip to the METU SC?	Twelve teachers out of twenty-five teachers that were agreed to participate and observed in the initial step of stage two comprised the participants of the semi-structured interviews.	Interview	Responses were examined using a process of open coding, and recurring themes were identified.
		Case II	RQ4: What kind of roles do teachers mostly adopt for themselves in different parts of the visit to the METU SC?	Forty-nine teachers that were purposively selected from METU SC's reservation list of the spring semester of 2014 comprised the participants of direct observation through checklist.	Observation Checklist	Frequencies were calculated to identify most common teacher behaviors and roles.

In the following sections, the designs of the study and the methods used in both designs were described. The first stage focused on survey design including sample and sampling technique, the data source -questionnaire- used for data collection, and the procedures used for administration of the questionnaire. In a similar fashion, the second stage focused on case study design including the selection of cases, the description of the study site (METU SC), participants, the procedures of data collection (direct observations, interviews, and observation checklists), and trustworthiness. Ethics and privacy issues, assumptions, and limitations of the study were also addressed in the last section.

3.1 Stage One: Survey Research Design

The purpose of conducting a survey study was to describe the teachers' perspectives on field trips to informal learning environments, who plan to conduct a field trip to the METU SC. To achieve this goal, a cross-sectional survey was adopted. The data were collected from the sample between the fall semester of the 2012-2013 academic year and the spring semester of 2014-2015 academic year.

3.1.1 Sample and sampling technique

To determine sample, the METU SC's reservation list was used. The list includes information about teacher name, school/group name and address, school type, grade level/age interval, the number of students/participants, and related contact person's e-mail address and phone number. At first, the target population of the study was determined as "all teachers who plan to visit the METU SC" because they are potential visitors of the METU SC. However, the accessible population was delimited to all primary (1^{st} through 4^{th} grades), middle (5^{th} through 8^{th} grades), and high school (9^{th} through 12^{th} grades) teachers who plan to conduct a field trip to the METU SC with their students between the fall semester of the 2012-2013 academic year and the spring semester of 2014-2015 academic year. Overall, 252 teachers comprised the accessible population. The sample and the accessible population was the same. Nonetheless, the size of the sample was not

as large as expected because of several reasons. The major reason was that mostly the same teachers conduct visits to the METU SC with different classes. The other reasons listed below were related to some events took place in the METU's main campus which were discouraged teachers to conduct a visit to the METU SC located in the main campus.

- Taksim-Gezi Park protests,
- protests against 1071 Malazgirt Boulevard (The Bridge Issue), and
- protests against former Prime Minister who came to main campus for watching Turkish Satellite Göktürk-2 launch.

3.1.2 The data source: Questionnaire

A field trip survey was mostly adapted from two questionnaires, developed by Anderson and Zhang (2003b) and Kisiel (2005). While the first three items were adapted from Kisiel (2005), the rest of the items except for 8th were adapted from Anderson and Zhang (2003b). The item numbered 8 was generated by the researcher, which was "What do you think should be done to maximize students' gains from a field trip experience before, during, and after a field trip?"
The translation of combined survey into Turkish and then again into English were done by both research assistants working at different departments of METU such as Basic English, Science Education, Physics Education (n=11) and science education doctorate candidates in different English-speaking countries (n=6). For each of the survey items the most repeated translation was chosen to comprise the final version of the items in the survey. When the translation process was done, the final version of the questions in the questionnaire were checked whether they overlap or conflict with the original questions by six experts from the Faculty of Education at METU (n=5) and Hacettepe University (n=1). The questionnaire was revised according to experts' suggestions and it was piloted with a small sample (n=10) whose demographic characteristics were similar to those of the actual population of the study. According to the feedbacks from the respondents of pilot study, all ambiguities, poorly worded or unclear questions, unclear choices, and the level of clearness of instructions were revised. The final version of the survey

was checked again by the same experts for translation validity. After all, the final version of the questionnaire to be administered was comprised (see Appendix B).

The final version of the survey questionnaire focused on six themes with twenty items, which were

- teachers' views about field trips to informal learning environments (Q1, Q2, Q3, Q4, Q7, Q9, and Q10)
- teachers' planning and implementation of field trips (Q5, Q6, and Q8)
- teachers' familiarity with the METU SC (Q11 and Q15)
- teachers' perceptions of the major factors preventing more field trip visitation (Q12, Q13, and Q14)
- improving visitation rate to the METU SC (Q19 and Q20), and
- METU SC's communication with teachers (Q16, Q17, and Q18).

The questionnaire included two types of items, selection (that teachers selected a choice from a set of possible choices) and supply (that teachers provided their own answers to particular question). In other words, types of questions ranged from multiple-choice to open-ended. Follow-up (contingency) questions were also included in the questionnaire. Some example items from the questionnaire were presented as follows:

Q2: Have you ever conducted a field trip to somewhere except for informal learning environments?

☐ No ☐ Yes

If your answer is "YES", where did you bring your students?

Q3: Altogether, approximately how many class field trips to informal learning environments have you conducted throughout your teaching career?

- ☐ None
- ☐ 1-2
- ☐ 3-5
- ☐ 6-10
- ☐ 11-20
- ☐ Over 20

Q14: What are the most dominant factors that prevent you from making field trip visits to the METU SC more often than you do?

In addition to these twenty questions, demographic information about teachers, which were gender, faculty graduated, degree, the level of participation in formal and in-service training, location of school (in or out of Ankara), type of school including whether it is private or public, teaching level, the existence of science laboratory in school, the use of science laboratory in school, subject area graduated vs. current subject area, and teaching experience were collected through using the participant information sheet attached to the end of the survey.

3.1.3 The procedures for administration of the questionnaire

The questionnaire was sent to each teacher in the sample (n=252) through e-mail one week before their visitations to the METU SC, with a request that she/he complete and return the questionnaire within one week at the latest. The e-mails included:

- the cover letter in the main body of the e-mail (see Appendix C),
- the survey questionnaire in the attachment, and
- the consent form in the attachment, which included the information about the purpose of the study, their selection process, their responsibilities as participants, risks and benefits, and confidentiality (see Appendix D).

Nonetheless, the researcher did not get a signed consent form; instead, he adopted an "implied consent". Thomas (2011) stated that "with implied consent, you tell participants about the research, and assume that they give their consent unless they tell you to the contrary." (p.70). To get implied consent, the researcher wrote a phrase in the body of the e-mail sent to the teachers as "I shall assume that you have read the consent form, been acknowledged about the research, and participated in the study voluntarily when you sent your completed questionnaire". Furthermore, all teachers were reminded to complete their questionnaires within one-week interval (max. five times) to increase response rate. Overall, one-hundred fifty-three teachers (60.7%) completed the survey. While six of them (3.9%) returned the questionnaire within the first week, the rest of them (96.1%) returned the questionnaires from one week to five weeks after their visitations to the METU SC. In addition, while twenty-six of them (10.3%) rejected to complete the questionnaire, the remains (n=73, 29%) did not inform the researcher whether they would participate in the study even though the researcher asked for a return more than once via e-mail. Overall, the nonresponse rate for the survey was 39.3%. For that reason alone, the sample may not be a true representation of the accessible population from which the sample was selected because if teachers who did not complete the questionnaire had responded, their responses would be different from the others who completed the questionnaire (Fraenkel et al., 2011).

3.2 Stage Two: The Case Study Research Design

Thomas (2011) stated that "case studies are analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems which are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame – an object – within which the study is conducted and which the case illuminates and explicates." (p.23). Furthermore, he argued that the major purpose of the case study is to understand the details of what is happening. Concurring with these arguments, the researcher adopted the case study design because the stage two

was undertaken within the context of a science center and the nature of the research questions restated below clearly required a case study.

(1) What kind of roles do teachers adopt for themselves during a field trip to the METU SC?
(2) What are teacher reflections on a field trip to the METU SC?
(3) What kind of roles do teachers mostly adopt for themselves in different parts of the visit to the METU SC?

To respond to the research questions, the researcher identified two cases. While Case I was used to respond to the first and second research questions, Case II was used to respond to the third research question. In the following section, these cases were described.

3.2.1 Case I

Case I consisted of the METU SC including exhibits, explainers, and thirty-two teachers selected purposefully. Case 1 was used to investigate the roles adopted by teachers during a visit to the science center and their reflections on the visit. The following sections describes the case, its selection process and setting (METU SC) including science center program during data collection, explainers, and standardization of explainer demonstrations. The demographic information of participants and the procedures of data collection were also described.

3.2.1.1 The selection of Case I

To respond to the research questions, the Middle East Technical University's Science Center was chosen as the setting of Case I because of the following reasons:

- it is easily accessible to the researcher,
- its program for school groups are carefully designed by research assistants (also doctoral candidates) who have science backgrounds,
- the implementations of these programs are standardized for school groups to make them be exposed to nearly the same field trip experience,

- unlike other science centers in Ankara, the duration of field trips for school groups about 90 minutes - is the most appropriate to investigate teachers roles,
- and finally the school field trips to the METU SC are neither guided tour nor free exploration completely. Instead, the combination of both guidance and free exploration is offered for school groups that may cause teachers to adopt different roles during an entire visit.

In addition to selecting the setting, participants were purposively selected for Case I. Merriam (2009) stated that "purposeful sampling is based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned" (p.77). Similarly, Patton (2002) claimed that "the logic and power of purposeful sampling lies in selecting *information-rich* cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term *purposeful* sampling" (p.230). Therefore, thirty-two teachers were selected purposefully from the METU SC's reservation list of the spring semester of 2013 according to their gender, subject areas, types of school, and student grade levels to maximize a diversity of characteristics. This selection, however, was a daunting task. First, the reservation list of 2013 was opened and reviewed to determine the number of teachers who were planning to visit the science center during the spring semester of 2013. Seventy-two teachers' names were located from the reservation list. Then, the selection process began based on some criteria. First, the teachers were categorized in terms of their gender. Because only six teachers out of seventy-two were male, the researcher automatically included all male teachers in the study regardless of their school types, subject areas or their student grade levels. Then, types of schools including whether they are private or public were considered (e.g., Science high school, Anatolian high school, Anatolian medical vocational high school, Anatolian vocational and technical high school, primary, and middle school). Then, these school types were categorized in terms of grade levels and teacher subject areas like physics, chemistry, natural sciences. Then some combinations of these

variables were considered to maximize the variation of teacher characteristics. Finally, thirty-two teachers with a maximum variation in terms of gender, subject areas, school types, and student grade levels were selected purposefully from the METU SC's reservation list of the spring semester of 2013. Thus, Case I was defined as the METU SC, its exhibits and explainers, and thirty-two teachers who were planning to conduct a field trip to the METU SC with their students.

3.2.1.2 The setting: Middle East Technical University's Science Center (METU SC)

METU SC came into existence around 2005 and served as a part of Society and Science Application and Research Center. Today the center is operated by a chief, eight administrative board members, one research coordinator, four research assistants, three technical staff, and one other staff who is responsible for the economic issues. The research assistants are doctoral candidates in different departments (science education, physics education, micro and nanotechnology) of METU, and all have science education backgrounds. In addition to their other duties, three of four research assistants are responsible for welcoming of school groups, conducting demonstrations for school groups, and accompanying with school groups throughout their visitation to the science center.
At first, METU SC performed its activities in a small building. In 2007, a new building called Unidentified Flying Object (UFO) was constructed by the supports of State Planning Organization (SPO) and Rectorate of METU. It serves everybody from all ages, cultures, educational levels, backgrounds with free of charge. However, the METU SC has been visited mostly by school groups. Especially, upper elementary (4^{th} grade), middle (between 5^{th} and 8^{th} grades), and high schools (between 9^{th} and 12^{th} grades), not only from Ankara but also from other cities, can benefit from the METU SC with a scheduled programming. METU SC has been successful in attracting approximately 20.000 students and their accompanied teachers per year.

In addition to providing three sessions in a day (09.30, 11.00, and 14.00), the METU SC enables visitors to use "pick and choose" option; if visitors are not

attracted by an exhibit, then they can freely move on to another. Today, the METU SC presents fifty-two interactive exhibits. Most of them are related to physics; a few of them are related to biology and mathematics. Three research assistants working at the science center over five years have been carrying out the development and optimization of these exhibits. The exhibits demonstrating the relevance of science to daily life were classified with respect to the underlying scientific concepts such as mechanics, electricity, magnetism, optics, and waves. This classification eases understanding of the scientific concepts and of their relations to one another. Workshops, activities, and science shows on stage conducted by accompanied research assistants called explainers constitute the essence of the METU SC's programs. Besides, METU SC offers mobile exhibits that are sent out to school halls, local community centers, other science centers, and shopping malls. Furthermore, in outreach projects conducted by the METU SC, twenty-five interactive exhibits are taken to the poor regions of Turkey where they may not be available in any science laboratories or science centers.

3.2.1.2.1 Science center program during observational data collection

Each month the METU SC provides different activities for their visitors such as science show, planetarium, and workshop. Nonetheless, all teachers were exposed to "science show" program even though the inclusions of science shows were different from one another during data collection period (see Table 5). When school groups came to the METU SC, they were welcomed at the entry of the science center (see Appendix E), let go inside, and requested to sit on cushions (teachers were also asked to sit wherever they want, but they were generally directed to sit on a cushion with the color of blue by explainer to make observers conduct their observations more comfortably), and then explainer introduced himself/herself. After that, explainer tried to generate comfortable rapport that generally begins with a social language sentence such as "How are you?", "Your first came here?", "What career do you want to pursue?" To make the observer(s) identify the teacher that will be observed, explainer also asked "who is/are the responsible for the group?", "Dear teacher(s), can you introduce yourself?, your subject area(s)?, the grade level of students?" and so on.

Table 5

Science center program during observational data collection

Months	Themes	Exhibits Demonstrated by Explainers
DECEMBER	Mechanic	Different Weight on Other Planets Newton's Cradle Popper Toy Pascal Syringe
MARCH	Sound and Waves	Thunder Drum (The nature of sound) Sound in a Vacuum Sound Waves (Longitudinal vs. Transverse) Pitch of the Sound (He + SF_6)
APRIL	Electricity and Magnetism	Van de Graaff Generator Simple Electric Circuit Magnets Mysterious Current: Eddy
MAY	Light and Optics	Aftereffect Motion Concave and Convex Mirrors Biconcave and Biconvex Lenses Total Internal Reflection and Fiber Optics

Note. The observational data were collected during the fall semester of 2012 and the spring semester of 2013 for Case I and the spring semester of 2014 for Case II.

Then explainer informed all students and teacher(s) about the sequence of the science center program referring to the parts of the visit (what are we going to do today and when?). After that, they were given a demonstration of exhibits called as science show. In science show programs, students were informed about four exhibits such as Van de Graaff generator with an explainer's interactive demonstrations. During explainer demonstrations, the explainer flashed out some of the important and interesting aspects of the exhibits, and s/he generally tried to create discussions, to do more listening than talking, not to make editorial comments, and not to pressure on students to catch answers. These demonstrations lasted from twenty to thirty minutes depending on the number of questions asked by students/teachers or teachers' specific requests (e.g. repeating demonstration with more students). After explainer demonstrations, students were let free to make their own observations and experiments throughout sixty minutes

on average. During free explorations, the explainers walked through the students to help them engage in exhibits and/or answer their questions about the particular exhibits. Throughout visitations, students were guided by one of the two explainers and they were not required to complete any form such as worksheets.

3.2.1.2.2 Standardization of explainer demonstrations

Even though explainer's characteristics (e.g., the tone of voice and its intensity, their habitual speaking speed, their use of the body language like jest and mimics, and gender) cannot be standardized, field trip guidelines were developed to make all school groups to be exposed to nearly the same field trip experience (see Appendix F for an example). These guidelines (instruction) included:

(1) the duration of parts of the visit,
(2) the order of demonstration of exhibits,
(3) specific knowledge about the particular exhibit that will be given,
(4) how to make transition between exhibits being demonstrated,
(5) what and when to ask questions,
(6) how to engage students/teachers in activities, and
(7) how to respond to the possible questions raised by students/teachers during explainer demonstration.

In addition, how the explainers will behave and what they will do during free exploration were defined in the guidelines. To determine whether the explainers stick to the guideline, some observations (n=8) were conducted during the fall term of 2012-2013 academic year. Throughout all observations, both explainers mostly stuck to the protocol (93.5%), even though questions raised by students/teachers or teacher requests were not same (e.g., one teacher asked explainer to tell students pulley system, lever, and center of mass during free exploration). Nonetheless, the order of demonstration of exhibits, the amount of knowledge given about the particular exhibit, the transitions between exhibits being demonstrated, the number of questions, also the questions themselves, or

the behaviors of explainers during free exploration unless otherwise required were the same.

3.2.1.3 Participants

The participants of the Case I were twenty-five teachers who gave their permissions regarding their observational data to be used in the study anonymously. These teachers were selected purposively from the science center's reservation list of the spring semester of 2013 according to their gender, subject areas, school types, and student grade levels to maximize the diversity. Details about teacher characteristics were provided in Appendix G. When teacher gender were considered, it could be seen that while 92% of teacher were female, only 8% of teachers were male. Furthermore, the most of the teachers' teaching experience (68%) were more than ten years. While some of them (4%) had less than five years teaching experience, some of them (28%) had teaching experience between five and ten years. Almost half of the teachers (48%) were natural sciences teachers. The others were physics (20%), classroom (16%), psychological counselling and guidance (12%), and chemistry teachers (4%).

3.2.1.4 The procedures of data collection

Direct observations by taking detailed field notes and semi-structured interviews were used to respond to the related research questions. The following section described the data sources and collection processes.

3.2.1.4.1 Direct observations

To respond to the related research question, "What kind of roles do teachers adopt for themselves during a field trip to the METU SC?", a naturalistic observation was adopted. The focus of observations was "holistic view of the activity or characteristic being observed and all of its elements sought" (Fraenkel et al., 2011, p.447). In fact, observations made it possible to record teachers' behaviors within the context of science center visit as they were happening. Before conducting major observations, the observers (the researcher and a doctoral

candidate in science education) were conducted pilot observations on five middle and five high school teachers to practice and improve observation skills. After these observations, the observers discussed and compared their observations, and decided what they will focus on, what they will give more attention to, how they will take field-notes more accurately, and how they close to teachers without disturbing them to record what they are saying during free exploration. When they were ready and felt competent, major direct observations were conducted from the welcoming to the end of the visit of school groups. Thirty-two teachers were passively observed by the researcher mainly, who took the role of unobtrusive participant observer (onlooker), with particular attention to teachers' interactions with students, colleagues, parents, explainers, and exhibits including specific behaviors throughout the METU SC visit during the fall term of 2012 and the spring term of 2012-2013 academic year. Nonetheless, the observational data recorded by observers inevitably to some extent reflect the biases and viewpoints of the observers. The observers' ideas or characteristics may also bias what they really see during observations (Fraenkel et al., 2011). To handle observer bias (to increase data reliability), some observations (7 out of 32) were conducted by both observers at the same time. After these observations, they worked in a team so that they could check their observations against each other's. They reviewed their field notes line-by-line and check them against each other's, and there were almost never inconsistencies between their notes. The only inconsistencies were in wording, not in the observed teacher behaviors. In a similar fashion, it is expected that the presence of an observer which is called "observer effect" may also have a great impact on the behavior of teachers being observed. To handle this situation, Fraenkel et al. (2011) proposed that the observer spend some time with teachers who will be observed before starting to record observations so that teachers get accustomed to observer's presence and go about their usual activities. Nonetheless, the observations conducted in the METU SC did not possess such an interference due to the nature of the study. For that reason alone, in the current study, the nonparticipant observation technique was adopted; all teachers were observed covertly. The observer(s) observed the activities of teachers in the science center throughout the field trip without in any way participating in those

activities, and the observer(s) just acted like *hanging around* in the science center during visitation of school groups because teachers would most probably behave very differently if they had known they were being observed. As a result, teachers did not know that they were being observed by the observer(s). In addition, no explanations were given to any of teachers before the observations. During observations, the observer(s) sat behind the teachers from the beginning to the end of the explainer demonstrations (see Appendix H). During free exploration time, observer(s) was (were) generally positioned himself/herself in a place which was very close to the teachers being observed to hear what s/he was talking (see Appendix I). The observer(s) adopted paper-based recording by taking field notes throughout the entire visit (i.e., *welcoming and accommodation*, *explainer demonstration*, and *free exploration)* and recorded all verbal and non-verbal interactions as well as specific behaviors of teachers in as much detail as possible. Durations of observation were about seventy-three minutes on average (M=73.74, SD=10.53, with a maximum of one-hundred minutes and a minimum of fifty minutes). At the end of the visit one of the observers informed the teacher about the purpose of the study, that s/he was observed during his/her visitation and why the observer observed him/her covertly. Then, they were requested to give permission for using his/her observational data in the study anonymously. Upon his/her acceptance, his/her demographic information (e.g., subject area, teaching experience, the grade level/s of students, and the school type including whether it is private or public) were also requested. The data of teachers (n=25) who gave their permissions regarding their observational data to be used in the study were included in the study. The others' data whose permissions were not granted were destroyed in front of the relevant teachers. Overall, the researcher passively observed twenty-five teachers during their visitations to the METU SC, and both observers passively observed five of these teachers at the same time. Furthermore, the teachers who gave their permissions regarding their observational data to be used anonymously in the study were asked to participate in semi-structured interview part of the study that will be conducted by telephone within one week after their visits. While twelve teachers agreed to participate and informed the researcher about what day(s) and time they will be available to be interviewed, the

rest of them rejected to participate. Overall, these twelve-teachers were included in semi-structured interview part of the study.

3.2.1.4.2 Semi-structured interviews

Since we cannot observe feelings and thoughts (Fraenkel et al., 2011), we have to ask people questions about what we really want to learn. deMarrais (2004) defined an interview as "a process in which a researcher and participant engage in a conversation focused on questions related to a research study" (p.55). In fact, the main purpose of the interview is to find out what is and on participant's mind (Patton, 2002). That is why the researcher conducted semi-structured interviews to find out teachers' reflections on a field trip to the METU SC. Before conducting major interviews, the researcher piloted the interview questions with a colleague (working at science center over five years) and a friend (a doctoral candidate in physics education). The aim of the pilot interviews was to test the clarity of questions as well as practicing and refining the interview techniques of the researcher. After that, the questions were modified based on the feedbacks and discussions with one expert from the Faculty of Education of METU. Then, another pilot interview with two familiar teachers who visited METU SC within the month of December, 2012 was conducted. After this pilot study, the questions were revised and some of them were deleted because they did not contribute further understanding of teachers' reflections on the visit. The final semi-structured interviews included five open-ended questions including probes, and the question types were opinion (or values) questions aiming at finding out what teachers think about exhibits, field trip in general, guide offered by explainers (Fraenkel et al., 2011) as presented in the following:

1. What are your general impressions about the visit to the METU SC?
2. Considering all aspects of your visit to the METU SC, what were the pros of the visit?
3. Considering all aspects of your visit to the METU SC, what were the cons of the visit?
4. How were the exhibits?

5. How was the guide?
   Probes: Tell me more, you mentioned that … can you give me an example, anything else, what do you mean that?

The researcher tried to establish a comfortable rapport with the teachers to encourage them reveal what they really have in their minds related to the visit. In all interviews, the researcher tried to use teachers' names, and begin with warm and welcoming language such as "How are you?, How was your day?, How is everything?" In addition, the researcher informed all teachers about the purpose of interview, confidentiality, and right to terminate interview at any time during the interview. During interviews, the researcher generally tried to do more listening than talking, adopt a listener role as a receiver rather than a critic, prevent himself from making editorial comments, and not to pressure on teachers to catch core ideas. In addition, he generally asked a question by using probes when necessary, get an answer, summarize the key points, evaluate the answer, and record the answer or asked another similar question (Fraenkel et al, 2011). All teachers were asked the same questions in the same order. Twelve teachers who agreed to participate were interviewed by telephone within one week after their visits, between 21 April and 29 May 2013 except for one teacher who was interviewed by telephone on December 26, 2012. All interviews were audio-recorded by means of phone application "Androrec" with the consent of participants. In addition, the researcher took notes during interviews to ask follow-up questions if needed. The interviews lasted between fifteen minutes and twenty-four minutes, relying on the extent to which teachers responded to questions.

3.2.2 Case II

Case II was consisted of the METU SC including its exhibits and explainers and sixty-two teachers selected purposefully. Case II was used to investigate teacher roles in different parts of the visit to the METU SC.

3.2.2.1 The selection of Case II

To respond to the third research question "What kind of roles do teachers adopt for themselves in different parts of the visit to the science center?", METU SC's reservation list was again used to select a sample. At first, all primary, middle, and high school teachers were selected from the reservation list of the spring semester of 2014, and all sixty-two teachers on the reservation list determined as the sample of Case II. Thus, Case II consisted of the METU SC including its exhibits and explainers and sixty-two teachers selected purposefully.

3.2.2.2 The Setting: METU SC

METU SC described in Section 3.2.1.2 was also used as the setting of Case II. Science center program administered to school groups, the demonstrations offered to school groups performed by explainers, and field trip guidelines were also same.

3.2.2.3 Participants

Forty-nine teachers who gave their permissions regarding their observational data to be used in the study anonymously became the participants of Case II. These teachers were selected purposefully from the science center's reservation list of the spring term of 2014 according to their gender, school types, and student grades to maximize a diversity of teacher characteristics. The demographic information of teachers were as follows:

As it was expected from the Case I, female teachers (87.8%) also outnumbered male teachers (12.2%) in Case II. Similarly, the most of the schools regardless of their grade levels were public (77.6%). In terms of teacher subject areas, while 53.1% of teachers were natural sciences teachers, 14.3% of them were classroom teachers. The others had different subject areas like physics (12.2%), technology and design (6.1%), history (4.1%), guidance (2%), chemistry (2%), biology (2%), physical education (2%), mathematics (2%). Teachers' teaching experience had also some varieties (e.g., less than five years (4.1%), between five and ten years

(34.7%), and more than ten years (61.2%)). Student grades had also great varieties. Beside single grades such as 4th (14.3%), 5th (12.3%), 6th (10.2%), 7th (16.3%), 8th (6.1%), 9th (8.2%), and 10th (4.1), some of the teachers preferred to bring students with different grades together (28.4%) (e.g., 10th, 11th, and 12th graders).

3.2.2.4 The procedures of data collection

Case II was examined through observation checklist. The following section described this data source and its implementation.

3.2.2.4.1 Observation checklist

During major observations on Case I, the observer(s) had taken field notes and recorded verbal and nonverbal interactions of teachers, and described all or most of the behaviors of teachers throughout the field trip to the METU SC. After the analyses of these observational data, the researcher identified teachers' specific roles and sub-roles adopted during the visit. Based upon these findings, the researcher developed an observation checklist including a set of teacher roles and sub-roles (coding scheme) to be used in further observations related to the research question, "What kind of roles do teachers mostly adopt for themselves in different parts of the visit to the METU SC?" (see Appendix J). The developed observation checklist was shown to other observer to validate whether the generated teacher roles and sub-roles are meaningful. They discussed and changed wording of some teacher roles and the categorization of some sub-roles. In addition, the observers discussed the procedure of data collection through checklist before the administration, and they decided that if they observe a teacher behavior, which is not on the checklist, they would note it. Similarly, if they are doubtful about the category of observed teacher behavior, they would also note it. When they were ready, sixty-two teachers were passively observed by the researcher mainly, who took the role of unobtrusive participant observer, with particular attention to teachers' interactions with students, explainers, parents, colleagues, and exhibits including specific behaviors throughout the METU SC

visit during the spring term of 2013-2014 academic year. To increase data reliability, some observations (8 out of 62) were conducted by the researcher and another observer who is a doctoral candidate in science education (see Section 3.2.3.2 for the results). All teachers were observed covertly (e.g., acted like *hanging around* in science center during visitation of school groups) because teachers would most probably behave very differently if they had known they were being observed. At the end of the visit, to take teacher permission for using the collected data and to take some information about teacher (e.g., subject area, teaching experience, the grade level/s of students, and the school type including whether it is private or public), one of the observers informed teacher about the purpose of the study, that s/he was observed during his/her visitation, and also why the observer observed him/her covertly. The data of teachers (n=49) who gave their permissions regarding their data to be used in the study anonymously were included in the study. The others' data whose permissions were not granted were destroyed in front of the relevant teachers. Overall, the researcher passively observed forty-nine teachers during their visitations to the METU SC according to the parts of visitation (welcoming and accommodation, explainer demonstration, and free exploration) through checklist, and both observers passively observed eight of these teachers at the same time.

3.2.3 Trustworthiness

Regardless of the type of research, the researchers need to convince readers, practitioners, and other researchers that their conclusions "make sense" (Merriam, 2009). To achieve this goal, the following sections focused on different considerations that the researcher took into account related to the trustworthiness of the current study.

3.2.3.1 Credibility

To provide credibility of the study, peer examination strategy was used (Merriam, 2009). The researcher asked a colleague (a doctoral candidate in Science Education Department of METU) and an expert in Physics Education Department

of METU to review some of the raw data and assess whether the findings are plausible based on the data.

To enhance the credibility of the research, Patton (2002) suggested that "credibility of researcher, which is dependent of training, experience, track, record, status, and presentation of self" (p.552) and "philosophical belief in the value of qualitative inquiry, that is, a fundamental appreciation of naturalistic inquiry, qualitative methods, inductive analysis, purposeful sampling, and holistic thinking" (p.553) should also be reported. Prior to conduct this research, I have taken a qualitative research course. During this course, I have read four distinguished qualitative research textbooks to understand the underpinnings of this field even though it does not mean that I learned everything about qualitative researches. Yet, at least, it made me gain a perspective about naturalistic approach. In addition, I have been working at the METU SC since 2007 as both researcher and explainer. I have been serving about seven thousands students with different grades and their accompanied teachers per year. Furthermore, I have been conducting both quantitative and qualitative researches granted at the METU SC since 2010 that improved my experience regarding different aspects of research methodologies such as how to select appropriate design, ask appropriate questions, and collect and analyze data. Similarly, discussion with colleagues and experts about my research in every single step help me gain a great experience.

3.2.3.2 Dependability

In this study, all interviews were done by the researcher, and all participants were asked the same questions in the same order. In addition, all interviews were systematically recorded and transcribed. Furthermore, to provide dependability of the study, peer examination strategy was also used (Merriam, 2009). The researcher asked a colleague (a doctoral candidate in Science Education Department of METU) and an expert in Physics Education Department of METU to review some of the raw data and the results based on these data and assess whether the results are consistent with the data collected. In addition, inter-rater reliability was also considered. Hallgren (2012) claimed that one of the most

commonly used statistics for assessing Inter-Rater Reliability (Observer Agreement) is the intra-class correlation (ICC). He also claimed that ICC is appropriate for studies where a subset of participants is rated by two or more observers and the rest are rated by one of the observers. When this is the case, he argued that the researcher should report many parameters such as model and effect whether raters randomly sampled for each subject (one-way random) or same raters across subjects (two-way mixed), type of agreement like absolute agreement or consistency, and the unit of analysis (single- or average-measures units). Therefore, for the Case II in stage two of the current study, the inter-rater reliability was assessed using a two-way mixed, consistency, and single-measures ICC to assess the degree that observers provided in their ratings of behaviors across teachers. The resulting ICC was equal to 0.998, demonstrating that observers had a high degree of agreement and suggesting teacher behaviors were rated similarly across observers (see Table 6).

Table 6

Intra-class correlations among the ratings of two coders on seven major teacher roles

	ICC*
TOTAL	.998
Superintendent	.983
Information Giver	.993
Information Seeker	1.000
Facilitator	1.000
Recorder	.963
Participator	.977
Indifferent	1.000

Note. * Intra-class correlation coefficients
$p < .001$

3.2.3.3 Transferability

To enhance transferability, the researcher provided detailed description of the setting, of participants of the study, as well as of the findings with evidence in the form of quotes from participant interviews and field notes. In addition, the researcher gave careful attention to the selection of participants. Maximum

variation in the sample in terms of participants' characteristics were provided as suggested by Merriam (2009).

3.3 Ethics and privacy

Ethical approval for the current study was obtained from "Human Subjects Ethics Committee of Middle East Technical University" (METU HSEC) in 2012 (see Appendix K). By using number codes, confidentiality for teachers was maintained at all times. All teachers participated in the study were acknowledged that all data (e.g., data files, transcripts, and completed questionnaires) collected from them through surveys, observations, observation checklists, and interviews were kept in a locked cabinet in the head office of Society and Science Research and Application Center, and their data may be seen by reviewers of journals or dissertation supervisory committee members in addition to the researcher for inspection. Correspondingly, data transferred into SPSS (Statistical Package for Social Sciences) software were protected by a 32-digit strong password. Since none of the teachers' identity in this dissertation can be identified, privacy requirements were also met.

3.4 Assumptions

The following assumptions were used for this study:

(1) In this study, a questionnaire for survey was used, and the researcher assumed that all teachers understood the meaning of the statements and were sincere in their responses.
(2) Teachers and students' behaviors while the observer(s) was/were observing them were not significantly different from those if the observer(s) was/were not present during their visit to the METU SC.
(3) There were no interactions between the teachers participating in this study during the completion of the questionnaires.

3.5 Limitations

The setting, the METU SC, and methodology adopted placed certain limitations. The possible limitations were as follows:

(1) The study was limited to the period between December 2012 and May 2014.
(2) This study was limited to only one visit lasted about seventy-three minutes to the METU SC.
(3) Teachers' behaviors during visit may be affected by the survey sent one week before their visitations to the METU SC.
(4) Since explainer's characteristics, jest and mimics and the like cannot be standardized, explainer behaviors may have affected teachers' behaviors during visit to the science center.

CHAPTER 4

ANALYSES OF DATA AND RESULTS

This chapter was divided into two stages to present the analyses of data and the results. In the first stage, the analyses of the teachers' responses to the survey and the results were presented. In the second stage, the analyses of data collected from the cases and the related results were presented.

4.1 Stage 1: The Analyses and Results of the Survey

The key objectives of conducting the survey were to understand teachers' perspectives on field trips to informal learning environments (ILEs) as well as the determinants and barriers faced by teachers when they were planning and implementing field trips to the METU Science Centre. The available data were analyzed by using IBM SPSS 19 (Statistical Package for Social Sciences) in terms of descriptive statistics. Before running the analyses, the data were controlled to identify the erroneous entries. Minimum-maximum values and scores that were not in the range of possible values were checked and corrected for multiple choice questions. Then, frequencies were calculated to identify which categories are most repetitive. Similarly, teachers' responses to the open-ended questions were coded and tabulated to categorize their perspectives on field trips.

In the current study, one-hundred fifty-three teachers (60.7%) completed the questionnaire. While 28.8% of teachers were male, 71.2% of them were female. In addition, most of teachers' (62%) teaching experiences were more than ten years, 19% of the teachers' were between five and ten years and other 19% of the teachers' were less than five years. In terms of teachers' subject areas, over a half of teachers (60.1%) reported that their current teaching subject areas were related

to natural sciences, 36% of them reported that their teaching subject areas were related to social sciences. Only 3.9% of them reported that they were not teaching currently due to their administration duties. In terms of location of schools, most of teachers (83%) were from schools in central Ankara whereas 3.9% of them were from schools in outlying counties of Ankara such as Kızılcıhamam, Beypazarı, Polatlı, and Nallıhan. In addition, 13.1% of teachers were from schools out of Ankara.

4.1.1 Teachers' views on field trips

In this section, teachers' responses to the questions of 1, 2, 3, 4, 7, 9 and 10 in the survey were analyzed to generate answers to two basic questions: "What are teachers' views regarding the places where they conduct field trips, the value of field trips and to what degree/level do they want to take involvement in planning?"

4.1.1.1 ILEs where teachers did conduct a field trip

By question 1, it was tried to determine ILEs where teachers did conduct a field trip. The results showed that teachers did conduct field trips to a variety of ILEs (see Figure 1). In detail, 95.4% of teachers reported that they chiefly conducted field trips to science centers. A majority of teachers (68%) reported that they also visited cultural and historical museums. Zoos (32%), Observatories (28.1%), and Science Parks (26.1%) were also reported as the most visited places by teachers respectively. Furthermore, many other ILEs or activities where teachers conducted a visitation were also reported as Aquariums (22.2%), Open air museums (20.3%), Art museums (18.3%), Plants like organic agricultural farms, dump sites, water treatment plants (13.7%), Scientific exhibitions like Cern, Body Worlds, Leonardo da Vinci, Van Gogh (11.8%), Child Museums (11.1%), Scientific activities like seminars, conferences, science feasts (3.9%), Arboretums (2%), and Libraries (2%). Only one teacher reported that she never brought her students to an informal learning environment.

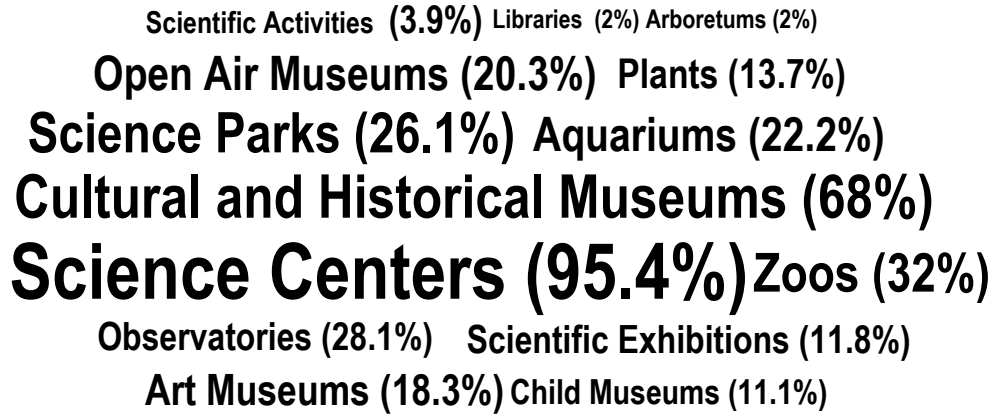


Figure 1. ILEs where teachers did conduct a field trip

4.1.1.2 Field trip venues except for ILEs teachers did bring their students

By Question 2, it was attempted to determine any venues except for ILEs that teachers did bring their students. The results clearly showed that while more than half of teachers (58.2%) conducted field trips with their students to some venues other than ILEs, 41.8% of them did bring their students to nowhere except for ILEs. Table 7 shows the frequencies and percentages of top five field trip venues except for ILEs respectively that teachers have brought their students.

Table 7

The frequencies and percentages of top five venues that teachers brought their students except for ILEs

	n	%
Picnic	34	22.2
Theatre	28	18.3
Cinema	26	17.0
City & Country Outing	26	17.0
School visits	18	11.8
Total	89	58.2

As it can be seen in Table 7, 58.2% of all teachers brought their students to picnic (22.2%), theatre (18.3%), cinema (17%), city and country outing (17%), and

schools like universities, high schools, or sister schools (11.8%). Beside top 5 field trip venues except for ILEs, teachers also reported other ones where they brought their students such as recreational areas (10.5%), care houses (3.9%), book expo (3.3%), parents' working places (2.6%), and arbor (planting) (2.0%).

4.1.1.3 The number of field trips conducted by teachers throughout their teaching experience

By question 3, it was tried to determine the number of field trips conducted by teachers throughout their teaching experience. The results showed that one-third of the teachers (33.3%) conducted field trips to ILEs more than twenty (see Figure 2). Furthermore, while 22.2% of teachers reported that they conducted between six and ten field trips, 19% of them reported that they conducted between eleven and twenty field trips throughout their teaching experience. In addition, 24.8% of teachers reported that they conducted between one and five field trips. Only one teacher (0.7%) reported that she never conducted a field trip to an ILE.

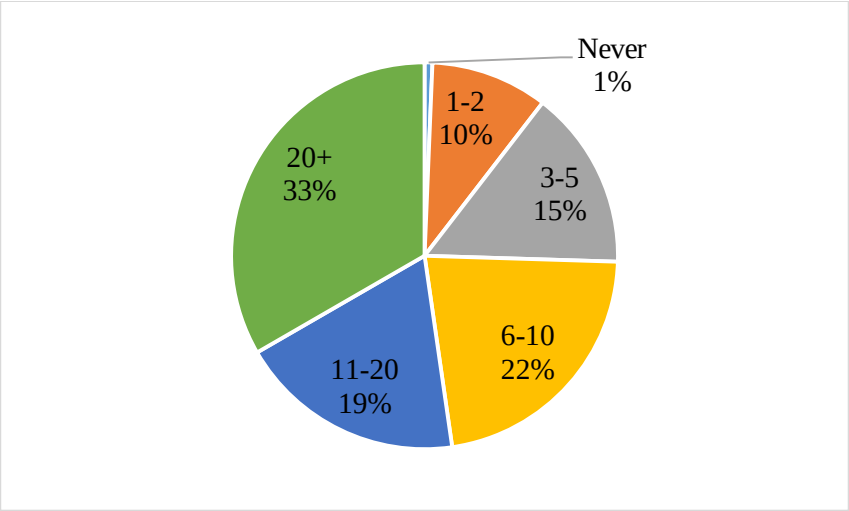


Figure 2. The number of field trips conducted by teachers throughout their teaching experience

4.1.1.4 The frequency of field trips conducted by teachers to ILEs

By question 4, it was tried to determine the frequency of field trips conducted by teachers to ILEs. The results revealed that almost half of the teachers (45.8%) conduct field trips to ILEs more than twice a year. While 26.8% of them claimed that they conduct field trips twice a year, 11.8% of them claimed that they conduct field trips once a year. In addition, 15% of them claimed that they conduct field trips once every 2-3 years. Only one teacher reported that she never conducted field trip to an ILE.

4.1.1.5 Teachers' perceived value of field trip visitations as educational experiences for their students

By question 7, it was attempted to determine teachers' perceived value of field trip visitations as educational experiences for their students. The results revealed that 83.7% of teachers considered field trip visitations as being high or very high in value as educational experiences for their students. Table 8 showed the frequencies and percentages of teachers' perceived value of field trip visitations as educational experiences.

Table 8

Teachers' perceived value of field trip visitations as educational experiences

	n	%
Educational value is very low	8	5.2
Educational value is low	4	2.6
Educational value is moderate	13	8.5
Educational value is high	58	37.9
Educational value is very high	70	45.8
Total	153	100.0

Note. M=4.16, SD=1.05
Mean rating is equivalent to average rating. Standard Deviation is an indication of the closeness of the responses to the mean.

4.1.1.6 The distribution of responsibilities for preparation and planning of field trips to ILEs and teachers' satisfaction with this distribution of responsibilities

By question 9, it was tried to determine the distribution of responsibilities for preparation and planning of field trips to ILEs. Ten different issues were provided and asked teachers for mark the valid choices for their own case such as myself, other teachers, school administration, and field trip setting. Teachers were able to mark one or more possible choices for each issue. As a result, beside four choices provided, teachers marked different combinations of these choices. Overall, fifteen choices were emerged. Nonetheless, the researcher deliberately reported the frequencies and percentages of top three choices marked by teachers instead of giving frequencies and percentages of these fifteen choices (see Table 9). Table 9 clearly shows that almost everything regarding preparation and planning of field trip was made by teachers except for getting Ministry of National Education's permission and arrangement of transportation. These two issues were mostly reported to have made by school administration. Furthermore, through follow-up question, it was tried to determine teachers' satisfaction with this distribution of responsibilities. The results revealed surprisingly that while 73.9% of all teachers were satisfied with the distribution of responsibilities, 26.1% of them reported that they were dissatisfied with the current distribution of responsibilities. According to the teachers' opinions, while the identification of ILE to visit (19 out of 40 teachers, 47.5%), the assessment of educational value and curriculum-fit of ILE (32.5%), organizing field trip (30%), the identification of pre-visit (45%), and post-visit activities (45%) should be the responsibility of teachers, getting internal school (60%), parental (72.5%), and MONE's permissions (85%) as well as the arrangement of transportation (77.5%) and the collecting of its cost (67.5%) should be the responsibility of school administration.

Table 9

The distribution of responsibilities for preparation and planning of field trips to ILEs

	1		2		3		4		5		6	
	n	%	n	%	n	%	n	%	n	%	n	%
Identification of informal setting	86	**56.2**	8	5.2	5	3.3	-	-	27	17.6	10	6.5
Assessment of educational value and curriculum-fit of field trip setting	69	**45.1**	11	7.2	13	8.5	2	1.3	39	25.5	7	4.6
Internal school permissions	60	**39.2**	3	2	52	34	1	.7	17	11.1	9	5.9
Parental permissions	78	**51**	7	4.6	43	28.1	-	-	12	7.8	8	5.2
MONE's permission	14	9.2	5	3.3	126	**82.4**	-	-	1	.7	5	3.3
Arrangement of transportation	38	24.8	7	4.6	84	**54.9**	1	.7	5	3.3	10	6.5
Collecting of transportation cost	81	**52.9**	12	7.8	36	23.5	1	.7	18	11.8	3	2
Organizing field trip	77	**50.3**	7	4.6	15	9.8	4	2.6	25	16.3	8	5.2
Identification of pre-visit activities	92	**60.1**	7	4.6	5	3.3	3	2	34	22.2	2	1.3
Identification of post-visit activities	96	**62.7**	8	5.2	6	3.9	1	.7	35	22.9	2	1.3

Note. 1 refers to myself, 2 refers to other teachers, 3 refers to school administration, 4 refers to field trip setting, 5 refers to myself and other teachers, 6 refers to myself and school administration. Bold numbers refer the highest percentages.

4.1.2 Teachers' planning and implementation of field trips – Influence on decision-making process

In this section, teachers' responses regarding the questions of 5, 6, and 8 in the survey were reported. Responses were analyzed to answer three basic questions: "What do teachers consider in planning and implementing field-trips, that really

makes a difference?, what factors do teachers consider when planning field trips for their classes, and to what degree do these factors influence the decision making process?"

4.1.2.1 The issues that teachers consider when planning field trips

By question 5, it was tried to determine the issues that teachers consider when planning field trips. A list of seventeen issues was provided and let teachers add other issues they consider when planning field trips. Table 10 clearly showed that teachers consider all issues listed when planning a field trip to ILEs. In detail, the most cited issues were identified to be

- (#1) to what extent the setting will provide benefits for students (95.4%),
- (#2) getting required permissions (89.5%),
- (#3) amount of enjoyment that students will have at the setting (88.9%),
- (#4) how to best incorporate and capitalize on experiences back in classroom (88.9%), and
- (#5) availability of the setting at the time teacher desires to visit (82.4%).

Furthermore, beside these seventeen issues listed, very few teachers reported other issues that they consider when planning a field trip, which were related to

(1) *transportation such as*

- secure transportation vehicles (2.6%),
- bus availability (1.3%),
- experienced drivers (0.7%),
- students' seating arrangement in vehicles (0.7%),
- bus service contract for the transportation of students (0.7%),
- weather and road conditions (0.7%),

(2) *ILE such as*

- the level of social interaction provided by ILE (discussion, cooperation, collaboration etc.) (2.6%),
- ILE's impact on students' scientific awareness (2%)

Table 10

The issues that teachers consider when planning field trips

	n	%
To what extent the setting will provide benefits for students	146	95.4
Getting required permissions	137	89.5
Amount of enjoyment that students will have at the setting	136	88.9
How to best incorporate and capitalize on experiences back in the classroom	136	88.9
Availability of setting at the time you desire to visit	126	82.4
Curriculum appropriateness of the setting	120	78.4
Distance of informal setting	119	77.8
Time available within the school year/school curriculum	115	75.2
The subject matter knowledge of explainer and his/her communication with students	114	74.5
Transportation costs	104	68.0
The degree to which the setting will provide benefits for you	100	65.4
Entry cost of informal setting	99	64.7
Difficulties/ amount of work/effort required to organize field trip	65	42.5
Your personal familiarity with the field trip setting	52	34.0
Your willingness to see the setting	47	30.7
Parental involvement and parental preference for choice of informal setting to visit	47	30.7
Issues of legalities/ protection from litigation	36	23.5

- the level of ILE's opportunities (whether it provides learning by doing) (2%)
- ILE's security (2%),
- ILE's appropriateness to the grade level (1.3%),
- ILE's impact on students' future career choice (1.3%)

- the level of ILE's up-to-dateness (0.7%),
- whether ILE visit are fully described including allocated time, science demonstrations that will be conduct etc. (0.7%),
- the amount of care provided by ILE (0.7%),

(3) conditions for the visitation such as

- sufficient number of participated students (1.3%),
- not having seen by students before (0.7%),
- school administration support (0.7%),
- whether parents and children possess the culture of trip (0.7%),
- absence of nutritional problems among students (0.7%).

4.1.2.2 Top five priorities that teachers consider when planning field trips for their class(es)

Question 6 required teachers to select top five issues from a list of 17 that they may consider when planning field trips for their class(es) as well as different issues they suggested. The results demonstrated that the most important issue that teachers consider when planning field trip is the level of students' utilization of ILE during visitation. 45.1% of all teachers reported that they first consider to what extent the setting will provide benefits for students. Other issues raised by the teachers were as follows: the amount of enjoyment that students will have at the setting (19.6%), how to best incorporate and capitalize on experiences back in the classroom (19%), the subject matter knowledge of explainer and his/her communication with students (15%), the degree to which the field trip visitation will fit their school-based curriculum (11.8%).

4.1.2.3 The issues that should be done before, during, and after field trip visitation to maximize students' gains from field trip: Teacher suggestions

Question 8 required teachers to reflect their opinions on what they should do before, during, and after an actual field trip to an informal learning environment to

maximize students' gains from the field trip. According to the responses, most of the teachers thought that students should be informed before the visit about the field trip setting (66.94%), the field trip program (47.11%), and the purpose of the visit (40.50%) (see Table 11). The results regarding what they should do during the actual visit clearly illustrated that teacher should provide supervision in some way (102%) such as reminding students about the rules to be obeyed and also provide an environment where students are able to ask questions freely (15%) and participate in activities actively (10%). Nonetheless, the most repetitive suggestion from teachers was that teachers should make sure that all students are instructed by an explainer (33%) (see Table 12). In the second rank, teachers suggested that all students should be reminded about the expectations from them, purpose of the visit, rules to be obeyed, and visitation duration (22%). Besides, the results regarding what they should do after the visit showed that teachers should get feedbacks from students through discussion about what the pros and cons of the field trip were (55.96%), what they gained from field trip experience (52.29%), and what the most interesting exhibit was (44.95%). Providing curriculum-connection (17.43%) as well as making students share their experiences via report about what they have learnt (12.84%) also reported by teachers as most repetitive suggestions respectively (see Table 13).

Table 11

Teacher suggestions regarding what they should do before the actual field trips

Informing Students about the Field Trip (239.68%)

Teachers should inform students about

- the field trip setting (where they will visit, what they will see?) (66.94%) **#1**
- the field trip program (e.g., the inclusion of field trip, activities, time spent) (47.11%) **#2**
- the purpose of the visit (40.50%) **#3**
- the rules they are expected to obey (29.75%) **#4**
- what they are expected to gain from field trip experience (28.93%) **#5**
- the technical issues (e.g., clothing, food & beverage, weather conditions, distance, cost) (26.45%)

Increasing Student Readiness (30.58%)

Teachers should increase students' readiness by making them

- explore the field trip setting through its website (12.40%),
- explore the subject matter offered by the setting (11.57%),
- prepare questions regarding the subject matter offered by the setting (4.13%),
- prepare an introduction presentation of the setting (2.48%).

Increasing Teacher Readiness (19.84%)

Teachers should increase their readiness about the setting through

- exploring its website (9.92%),
- contacting with the staff of the setting (5.79%),
- exploring it before the actual visit (4.13%).

Making a Plan (55.38%)

Teachers should

- consider students' interest and willingness for the visit (16.53%),
- make plans related to technical issues such as transportation, clothing, lunch, determination of the number of teachers, the distribution of responsibilities, getting relevant permissions, sharing emergency phone numbers (9.09%),
- check curriculum-fit of the setting (7.44%),
- consider students' thoughts and suggestions for the visit location (4.96%),
- check age/grade level appropriateness of the setting (4.13%),
- prepare worksheets and open-ended questions that students will complete/investigate during their visitations (4.13%),
- specific goals for the visit (2.48%),
- set students' expectations from the visit (2.48%).
- plan the visits before the term begins and write them on annual plan (2.48%),
- conduct field trip after the related unit was taught at school (0.83%),
- plan the visit with the staff of the settings (0.83%).

Conducting Pre-Visit Activities (10.74%)

Teachers should conduct pre-visit activities for providing prior knowledge by

- lecturing about the subject matter provided by the setting (4.13%),
- pre-testing to evaluate what students know about the subject matter offered by the setting (4.13%),
- repeating topics taught previously that are related to the topics offered by the setting (2.48%).

Note. No responses (n=32, 20.92%) were excluded, and the percentages were calculated by considering one-hundred twenty-one teachers. Some teachers provided multiple responses to the question. #1, #2, and #3 refers to dominant suggestions.

Table 12

Teacher suggestions regarding what they should do during the actual field trips

Providing Supervision (102%)

Teachers should provide supervision by making sure that all students

- are instructed by an explainer (33%) **#1**,
- are reminded about the expectations from them, purpose of the visit, rules to be obeyed, visitation duration (22%) **#2**,
- take notes (12%) **#4**,
- are watched and given directions to maintain order and discipline (8%),
- interact with the exhibits (7%),
- complete their worksheets (5%),
- read the explanations on the labels of exhibits (5%),
- take photos (3%),
- are assigned to small groups and accompanied with a sufficient number of teachers (3%).
- are assigned to small groups and accompanied with a sufficient number of explainers (2%),
- complete their observation forms (1%),
- listen to explainer (1%),

Facilitating the Learning Experiences (49%)

Teachers should facilitate the learning experiences of students by providing

- an environment where students are able to
    - ask questions in their minds (15%) **#3**,
    - participate in activities actively (10%) **#5**,
    - interact with the exhibits on their own and with their teachers (6%),
    - have equal opportunities (2%).
- curriculum-connections (5%),
- hands-on experiences (4%),
- everyday life connections (3%),
- peer-teaching (2%),
- open-ended questions (2%),

Getting Student Attention (13%)

Teachers should

- attract students' attention to particular exhibits/demonstrations (9%),
- direct students' attention to explainer (4%).

Providing Encouragement (2%)

Teachers should encourage their students to

- talk with the explainer (1%),
- interact with the exhibits (1%).

Note. No responses (n=53, 34.64%) were excluded, and the percentages were calculated by considering one-hundred teachers. Some teachers provided multiple responses to the question. #1, #2, and #3 refers to dominant suggestions.

Table 13

Teacher suggestions regarding what they should do after the actual field trips

Getting Feedbacks (153.20%)

Teachers should get feedback from students through discussion about

- what the pros and cons of the field trip were (55.96%) **#1**,
- what they gained from field trip experience (52.29%) **#2**,
- what the most interesting exhibit was (44.95%) **#3**.

Making Students Share Their Experiences (36.69%)

Teachers should make students share their experiences regarding field trips through

- making them prepare
  - a report about what they have learnt (12.84%) **#5**,
  - a booklet, essay, or presentation (11.01%),
  - a school bulletin board decorated with photos, brochures, posters (5.50%).
- making them share their experience with friends, teachers as well as parents, who did not participate in field trip (7.34%).

Providing Curriculum Connection (17.43%)

Teachers should connect field trip experiences to the school curriculum (17.43%) **#4**.

Conducting Post-Tests (11.01%)

Teachers should conduct post-tests to determine whether students have gained knowledge about subject matter(s) offered by informal setting (11.01%).

Conducting Follow-up Activities (9.17%),

Teachers should conduct follow-up activities, which let students

- use the knowledge and experiences gained from field trip (6.42%),
- develop materials (1.83%),
- conduct and share their researches about an interesting topic/exhibit/demonstration regarding field trip (0.92%).

Note. No responses (n=44, 28.76%) were excluded, and the percentages were calculated by considering one-hundred nine teachers. Some teachers provided multiple responses to the question. #1, #2, and #3 refers to dominant suggestions.

4.1.3 Teachers' familiarity with the METU SC

In this section, teachers' responses regarding the questions of 11 and 15 in the survey were analyzed to answer two basic questions: "How familiar are the teachers with METU Science Centre versus other similar settings?, What are the teachers' perceptions of a) the METU Science Centre's brand and image; b) the METU Science Centre as an attraction; and c) METU Science Centre as a resource for all things related to science?"

4.1.3.1 The level of teachers' familiarity with three ILEs

Question 11 required teachers to mark one of the three choices such as very, a little, and none referring to the level of their familiarity with three ILEs. The results illustrated that teachers' familiarity with the METU Science Centre (64.1%) was more than the other two ILEs: Feza Gürsey Science Centre (51%) and MTA (Mineral Research & Exploration General Directorate) Energy Park (31.4%). Correspondingly, teachers' unfamiliarity with the METU SC (5.2%) was lower than the other two, Feza Gürsey Science Centre (19%) and MTA Energy Park (41.2%).

4.1.3.2 Teachers' perception of the METU SC compared with other two ILEs

Question 15 required teachers to compare the METU SC with others in terms of several statements (see Table 14). According to the results, most of the teachers consider the METU SC, when it is compared with other ILEs,

(1) as a more appropriate place for curriculum fit (87.6%),
(2) as a better resource for scientific issues (85%),
(3) as a more enjoyable place for their students (84.3%),
(4) as a better place where their students can engage in activities actively (81.1%),
(5) as a better field trip destination that parents also agreed to have students attend (79.1%),
(6) as a better resource that they can utilize in many different ways (78.4%),
(7) as a better field trip destination to visit as an end-of-year reward (63.4%).

Table 14

Teachers' perception of the METU SC compared with other ILEs

	More than worse		Worse		Almost same		Better		More than better	
	n	%	n	%	n	%	n	%	n	%
An enjoyable place for my students	-	-	2	1.3	16	10.5	46	30.1	83	54.2
A good resource for scientific issues	-	-	-	-	17	11.1	41	26.8	89	58.2
An appropriate place for curriculum	-	-	-	-	13	8.5	49	32	85	55.6
A field trip destination to visit as an end-of-year reward	2	1.3	8	5.2	40	26.1	34	22.2	63	41.2
A good resource that I can utilize in many different ways	-	-	4	2.6	23	15	43	28.1	77	50.3
A place where my students are able to actively engage in activities	1	0.7	2	1.3	20	13.1	31	20.3	93	60.8
A field trip destination that parents also agreed to have students attend	2	1.3	4	2.6	20	13.1	31	20.3	90	58.8

Note. Seventeen teachers (11.1%) reported that they never came to visit METU SC up to now. Nonetheless, while eleven of them (7.2%) did respond to the questions of 15 and 16, that was not expected, six of them (3.9%) did not respond. This may be resulted from the time that teachers have completed the survey: before they visit the METU SC (3.9%) or after their visitation for the first time (7.2%).

4.1.4 Teacher perceptions of the major factors preventing more field trip visitation

In this section, teachers' responses regarding the questions of 12, 13 and 14 in the survey were analyzed to answer one basic question: "What are the major factors that prevent teachers from visiting the METU Science Centre with their classes?"

4.1.4.1 The frequency of teacher visitations to the METU SC

Question 12 required teachers to report the frequency of their visitations to the METU SC. The results disclosed that 51.6% of all teachers visited the METU SC with their students once or more than once in last year (see Figure 3). In addition, 20.3% of them claimed that they visited the METU SC once in last 2 years. While 17% of them reported that they visited the METU SC in last 5 years, 11.1% of them claimed that they never visited the METU SC up to now.

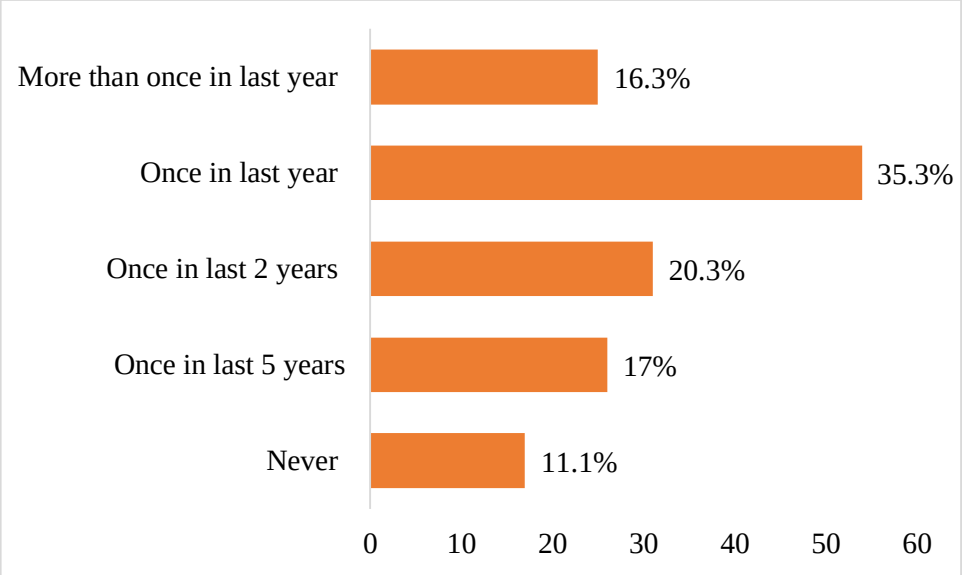


Figure 3. The frequency of teacher visitations to the METU SC

4.1.4.2 The reasons for not visiting the METU SC

Question 13, a follow-up question, required teachers (n=17) to report why they did not bring their students to the METU SC up to now. The reasons for not visiting the METU SC up to now that reported by teachers were

- no awareness of its existence (52.9%),
- distance (23.5%),
- no awareness of its offers for school groups (17.7%),
- difficulties in organization (permissions, transportation, required effort and time etc.) (5.9%),
- site's busy schedule (5.9%).

Interestingly, four teachers reported distance as the reason for not visiting the science center were from schools in central Ankara.

4.1.4.3 Restrictions for repetitive visitations

Question 14 required teachers to report restrictions that prevent them from making more field trips to the METU SC. The results demonstrated that there were many restrictions for frequent visits to be made by teachers. Most of the restrictions reported by teachers were related to logistics (84%) or science center itself (33.6%). Some other restrictions were related to the Ministry of National Education's legislation (5.6%) and personal unwillingness (38.4%) (see Figure 4). The most cited restriction for frequent visits to be made by teachers was time constraints (34.4%). Transportation (20.8%) and science center's busy schedule (16%) were reported as next dominant factors preventing teachers from making more field trips to the METU SC respectively.

4.1.5 Improving the visitation rate

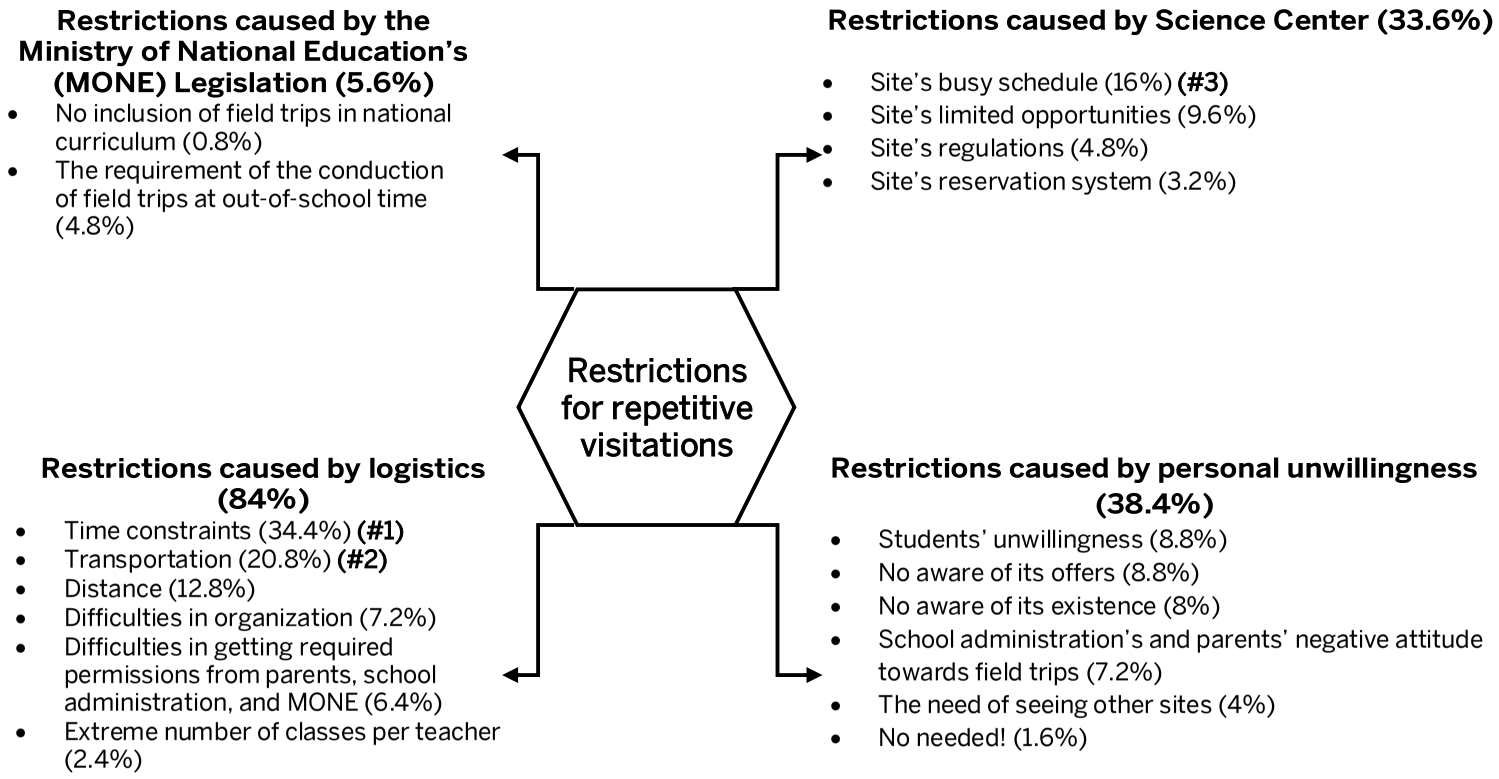
In this section, teachers' responses regarding the questions of 19 and 20 in the survey were analyzed to answer two basic questions: "What kinds of things could the METU Science Centre do to increase the rate of visitation from schools?" and "what are teachers' assessments of proposals by the METU Science Centre?"

4.1.5.1 Teachers' ratings of various proposals to increase visitation frequency to the METU SC

Question 19 asked for teachers to rate each one of the five proposals trying to increase their visitation frequency. A great majority of teachers claimed that their visitation frequency will increase if the proposals in the following are provided:

(1) preparing activity packages, which will be conducted in-classrooms after visit (92.8%),

(2) preparing activity packages, which will be conducted in-classrooms before visit (92.1%),



Note. Twenty-five teachers (16.3%) reported that there were no obstacles for frequent visitations. Also, they claimed they are implementing field trips as much as possible. Furthermore, no responses (n=3, 2%) were excluded, and the percentages were calculated by considering one-hundred twenty-five teachers (81.7%).

Figure 4. Restrictions for repetitive visitations

(1) making a connection between the activities provided by the METU SC and school-based curriculum (90.2%),
(2) sending field trip guide to teachers at the beginning of each term by collecting of teachers' e-mail addresses (90.1%),
(3) sending "introduction presentation of the METU SC" to teachers (89.6%).

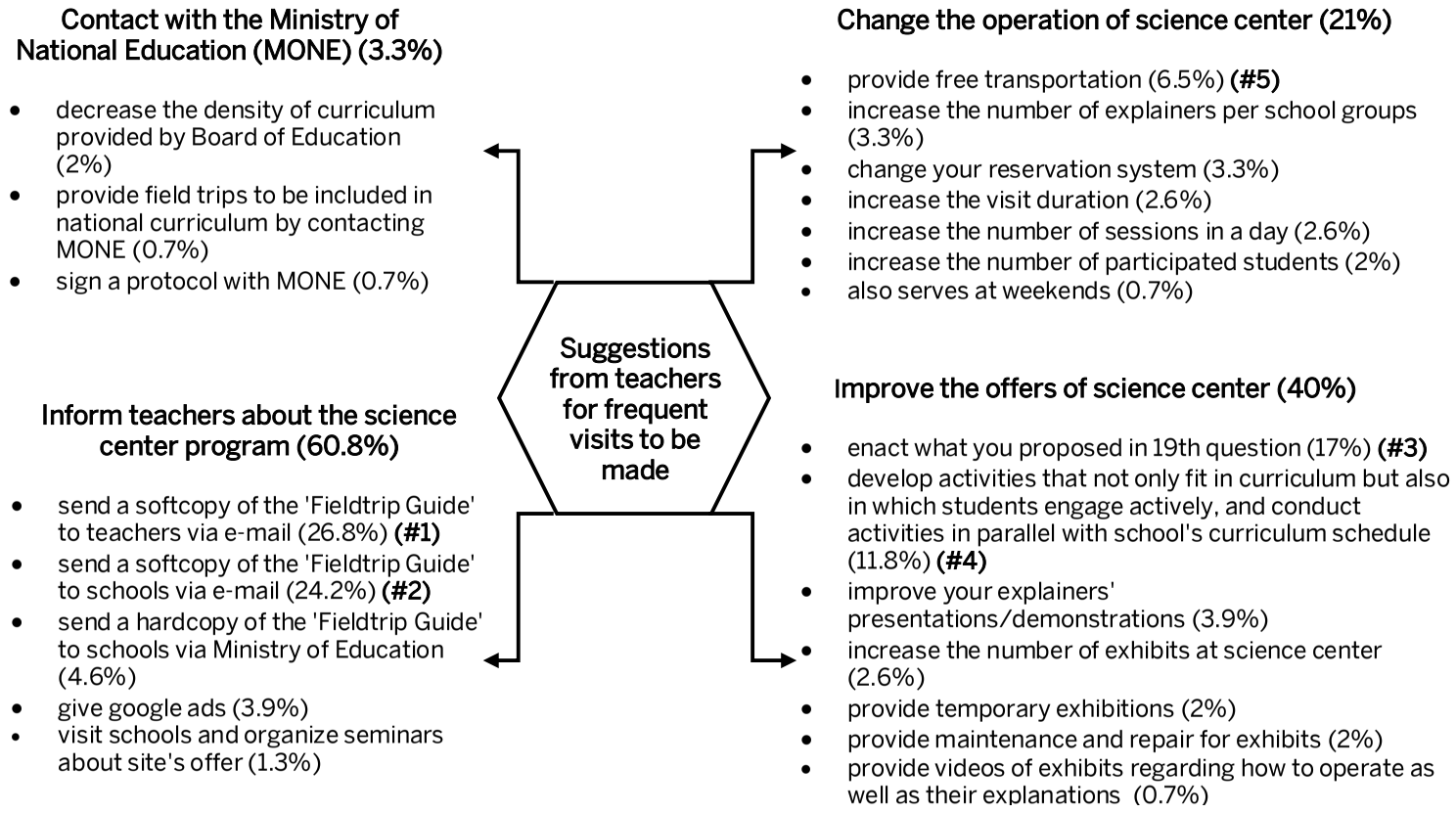
4.1.5.2 Suggestions from teachers for frequent visitations

Question 20 required teachers to make suggestions to science center regarding what the METU SC can do to make them conduct more field trips to the METU SC. Even though 20.3% of all teachers suggested that science center should continue what it has been doing, other teachers provided several suggestions, which were grouped into four main categories as

(1) informing teachers about the science center program (60.8%),
(2) improving the offers of science center (40%),
(3) changing the operation of science center (21%), and
(4) contacting with the Ministry of National Education (MONE) (3.3%) (see Figure 5).

Furthermore, most cited suggestions were emerged to be

(1) sending a softcopy of "Field Trip Guide" to teachers via e-mail (26.8%),
(2) sending a softcopy of "Field Trip Guide" to schools via e-mail (24.2%),
(3) enacting what you proposed in 19th question (17%),
(4) developing activities that not only fit in curriculum but also in which students engage actively, and conducting activities in parallel with school's curriculum schedule (11.8%),
(5) providing free transportation (6.5%).



Note. Thirty-one teachers (20.3%) suggested that science center should continue what it has been doing. No responses (n=9, 5.9%) were excluded, and the percentages were calculated by considering one-hundred thirteen teachers (73.8%). Some teachers provided multiple responses to the question. #1, #2 etc. refers to the top suggestions for frequent visits to be made.

Figure 5. Suggestions from teachers for frequent visits to be made

4.1.6 METU SC's communications with teachers

In this section, teachers' responses regarding the questions of 16, 17 and 18 in the survey were analyzed to answer one basic question: "What are the best ways to communicate with teachers regarding the METU Science Centre program updates and new initiatives?"

4.1.6.1 The level of METU SC's communication with teachers

By question 16, it was tried to determine how well the METU SC communicates and keep teachers informed. 76.5% of all teachers claimed that METU SC's communication with teachers was better than other ILEs. While 13.7% of them reported that METU SC's communication with them compared with other like ILEs was almost same, 5.9% of them claimed that it was worse than other ILEs. 3.9% of the teachers who never came to the METU SC did not respond.

4.1.6.2 The accessibility of field trip guide

Question 17 asked whether teachers had accessed the "Field Trip Guide" provided by the METU SC in the last 12 months (see Appendix L) The results were quite surprising. Even though the METU Science Center published a field trip guide for teachers in the first week of September and February months, teachers' responses clearly uncovered that almost half of the teachers (45.7%) were not aware of such a guide to be published for themselves. Even if they were aware of such a guide, they (15.7%) could not access to it. Only 38.6% of teachers reported that they could access to the field trip guide.

4.1.6.3 Suggestions from teachers for increasing the accessibility of field trip guide

In the follow-up question, teachers who were not aware of such a guide were required to make suggestions about what the METU SC can make to keep them informed. Most of the teachers suggested that the field trip guide should deliver to them in somehow (see Table 15).

Table 15

Teachers' suggestions to be aware of "Field Trip Guide"

	n	%
Send a softcopy of the 'Fieldtrip Guide' to teachers via e-mail	34	63
Send a softcopy of the 'Fieldtrip Guide' to schools via e-mail	31	57.4
Send a hardcopy of the 'Fieldtrip Guide' to schools via Ministry of National Education	16	26.6
Communicate with teachers via phone	3	5.6
Communicate with trip club teachers via phone	2	3.7
Send the program details to teachers via text messaging monthly	2	3.7
Communicate with school administrations via phone	1	1.9
Keep the website working	1	1.9

Note. Sixteen out of seventy teachers did not respond. The percentages were calculated by considering fifty-four teachers who responded. Some teachers provided multiple responses to the question.

4.1.6.4 Teachers' perceived value of field trip guide

Question 18 required teachers to rate the "Field Trip Guide" published for them (see Appendix L). 96.6% of fifty-nine teachers who accessed to field trip guide claimed that the field trip guide is beneficial when planning field trip to the METU SC. However, while one teacher reported that it is not beneficial, another one reported that it does not make a difference.

4.2 Stage Two: The Analyses and Results of the Case Studies

In this section, the analyses and results of two case studies, Case I and Case II were reported. While the analyses and results of Case I were related to teacher roles in and their reflections on a visit to the METU SC, the analyses and results of Case II were focused on teachers roles in different parts of a visit to the METU SC.

4.2.1 Case-I: Teacher roles

To determine the kind of roles teacher adopt for themselves during a field trip to the METU SC, direct observations were conducted on twenty-five teachers who agreed to participate in the study. All teachers' interactions and specific behaviors were recorded by taking field notes in as much detail as possible. At first, the field notes taken for each observed teacher were rigorously reviewed line-by-line and analyzed to determine the specific teacher behaviors. Then, each teacher behavior was labeled with the most appropriate code (Thomas, 2006) (see Appendix M). Repeating specific teacher behaviors within and across the observations on teachers were categorized into specific teacher roles (Auberbach & Silverstein, 2003; Boeije, 2002). The emergent roles were categorized as *Superintendent, Information Provider, Information Seeker, Facilitator, Recorder, Participator, and Indifferent* (see Figure 6).

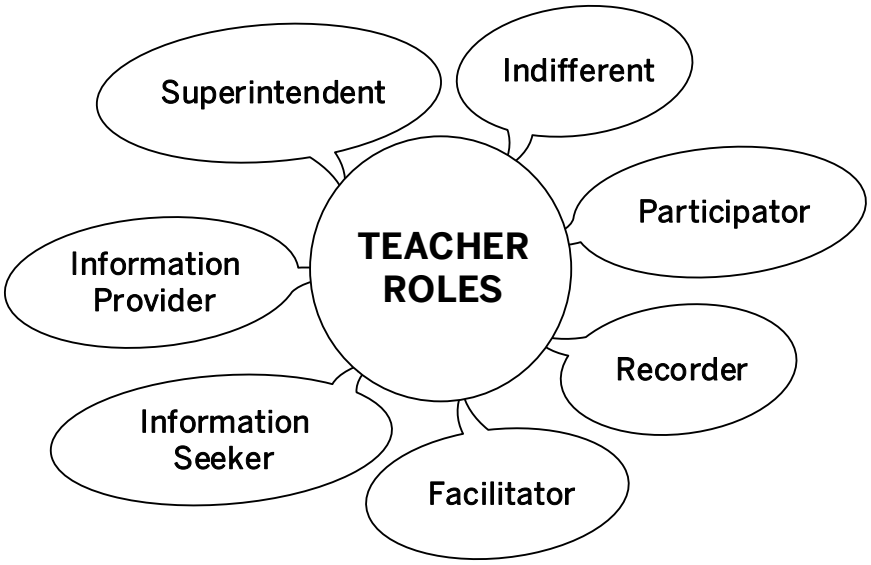


Figure 6. Teacher roles

Teachers did not have a unique role throughout the whole visit- they switched their roles from one part of the visit to another. Nevertheless, the purpose of the analysis on Case I was to define the emerging roles. The variation of the roles on different part of the visit will be analyzed on Case II. It is also worth to note that even though several roles were emerged, the researcher is aware of the fact that

some of them may overlap at some point. However, each role has distinct characteristics as will be elaborated in the following sections.

4.2.1.1 Superintendent

Superintendent is generally defined as a person who manages an activity or organization. In this study, the role of superintendent was attributed to the teachers who use her/his authority to keep track of duration of visitation, to make students interact with exhibits, and manage and control student behaviors. Besides, when the researcher examined teachers' superintended roles in details several variations were emerged which were categorized into some sub-roles such as *(1) technical directions giver, (2) attention stimulator, (3) controller, (4) requester, (5) technical assistant, and (6) motivator* (see Figure 7). The following sections were presented to elaborate these sub-roles adopted by teachers.

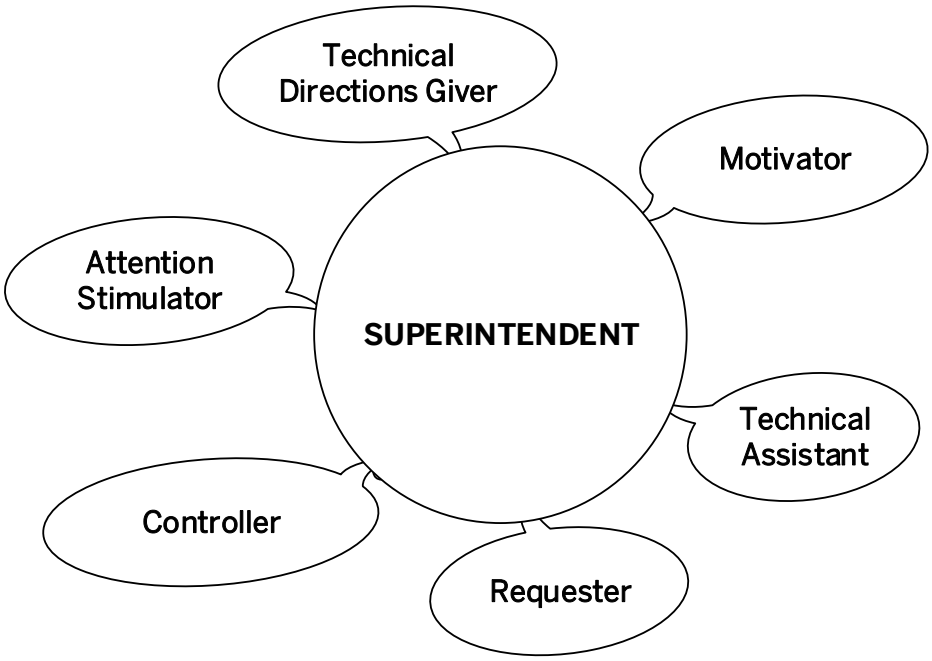


Figure 7. Sub-roles of superintendent role

4.2.1.1.1 Technical directions giver

Some of the observed teachers were coded as "Technical Directions Giver" because these teachers have used technical directions to maintain order and discipline. Table 16 shows the examples of technical directions used by teachers.

Table 16

Examples of technical directions used by teachers in different parts of the visit

Welcoming and accommodation	**Explainer demonstration**	**Free exploration**
Line up!	Hush!	Read labels!
Use ladders to go downstairs!	Shshsh…!	First, read labels and then try exhibits!
Sit over here!	Shut up!	Try that experiment!
Sit over there!	Be quiet!	Try exhibits without breaking and ruining them!
Sit where you sat!	Children, listen!	Just press the button!
Sit side to side!	Listen carefully!	Do not try same things constantly!
Sit down on cushions!	Just listen to explainer!	Just wander middle and upper floors, not lower one!
Sit down without stepping on cushions!	Back to front and listen!	Go upstairs!
Shshssh…!	Do not speak without raising your hand!	Do not look at camera!
Be quiet!	Switch off your mobile phones!	Do not step on cushions!
Hush!		Get around!
Shshsh, whom I am speaking to!		Do not forget to take your stuffs!
Listen quietly!		Line up in front of the building!
Listen to explainer carefully!		
Listen to what is being told quietly!		
Listen without speaking!		

Additionally, teachers' approaches seemed to be different while they were giving directions to their students. In some exceptions, teachers also used derogatory approach while they were giving directions to their students. The following examples represent direct quotations from teachers using a derogatory approach.

…, where are you going? Sit over here! If you continue behaving like this, I will bring you nowhere. [Welcoming and accommodation, 002][1]

Don't make me crazy! Just do what was told to you. Sit over there! [Welcoming and accommodation, 019]

Why are you yelling at?; I absolutely do not want to hear your voices during activity; do not speak without getting permission and raising your hand. [Welcoming and accommodation, 020]

Shut up your mouths! If you speak once again, you will be punished. [Explainer demonstration, 002]

…, don't say stupid things!, Give logical and reasonable answers! [Explainer demonstration, 011]

…, be serious! [Explainer demonstration, 014]

…, don't give ridiculous answers! [Explainer demonstration, 020]

4.2.1.1.2 Attention stimulator

Some of the observed teachers were coded as "Attention Stimulator" because these teachers have directed their students' attention to particular things. The following examples represent direct quotations from teachers.

We had seen energy forms in our previous lectures, do you remember?; Are you listening? It is important!; Do you remember we had seen the same experiment in MTA Museum. [Explainer demonstration, 001]

Listen carefully; these are important! We are going to cover this topic in a next few days. [Explainer demonstration, 002]

You notice that a sound is formed while the spring is being vibrated, don't you? [Explainer demonstration, 003]

Look at air molecules more closely! You notice they swing back and forth, don't you? [Explainer demonstration, 004]

You are going to be impressed by the forthcoming exhibit. Are you ready to see it? [Explainer demonstration, 006]

[1] [X, Y] X refers to the part of the visit; Y refers to teacher code.

> Listen carefully! I'm pretty sure that you would find at least one experiment attracting your interest. [Explainer demonstration, 007]

> You will see very amazing experiments. [Explainer demonstration, 022]

Some of the observed teachers have tried to get students' attention to make them try the exhibits by stating that

> Do you remember that I taught the pulley system in the last weeks? Here you are, try this! [Free exploration, 004]

> Aha, according to claim herein, you can see hundreds of reflections of yourself in every direction. [Free exploration, 020]

4.2.1.1.3 Controller

Some of the observed teachers were coded as "Controller" because these teachers have high level of control on their students' activities. Sometimes they stood behind their students and watched them while they were interacting with the exhibits. Sometimes they just sat and watched their students' behaviors. Additionally, sometimes these teachers interfered with their students by giving technical directions or informing them about the expectations. For example, one of the teacher [002] sat and watched what her students were doing during free exploration part of the visit. After a period of time, she reminded her students that they are expected not to run and try exhibits calmly. Another one of the teacher [005] stated, "Dear friends, explore the exhibits by reading their labels that are located in middle and upper floors. I do not want you to ramble or wander just for pleasure. We have about 30 minutes to explore."

4.2.1.1.4 Requester

Some of the observed teachers were coded as "Requester" because these teachers have requested some actions from explainers, students, parents or colleagues. For instance, one of the teachers asked one student for taking photos of his friends who went on stage to participate in the activity, besides, asked explainer to repeat demonstration with more students [Explainer demonstration, 005]. Another one asked explainer to sing a popular song "Ankara'nın Bağları" while he was

inhaling Helium [Explainer demonstration, 008]. Another one asked explainer to tell them the exhibit of vortex during free exploration [006]. Furthermore, even though the behaviors of this type of teacher seems to overlap the ones of technical direction givers in some cases, the word "please" has been considered as separator. The following examples represent direct quotations from teachers.

> Please sit on the cushions by using stairs without stepping on them [Welcoming and accommodation, 005].
>
> Listen well and ask good questions please [Welcoming and accommodation, 014].
>
> Please do not raise your hands when explainer is speaking. I want you ask your questions at that time when her speech is finished [Explainer demonstration, 013].
>
> All I am asking for is that you try exhibits by reading their labels [Free exploration, 002]

4.2.1.1.5 Technical assistant

Some of the observed teachers were coded as "Technical Assistant" because these teachers actively engaged in helping students or explainers during different parts of the visitation. For instance, some teachers accommodated their students where they should sit at the welcoming and accommodation part of the visit or helped explainers in selecting volunteer students to flow the program sequence tried to be conducted. Furthermore, most of the teachers have assisted their students in operating the exhibits.

4.2.1.1.6 Motivator

Some of the observed teachers were coded as "Motivator" because they tried to motivate students to participate in activities, discussions, or to interact with exhibits. Teachers adopted this role exhibited two different approaches while they were motivating their students. Some of them used "encouragement" while some others used "praise". For instance, to make students participate in the activity and discussion, or try exhibits, teachers stated that

> C'mon, you can do this. Stand up and try! [Explainer demonstration, 005]
>
> C'mon, try to answer to the questions wrongly or rightly. [Explainer demonstration, 006]
>
> This is a nice opportunity. C'mon …, you can do this. [Explainer demonstration, 011]

While one teacher praised her student for solving a puzzle during free exploration time by stating that "Well done to my talented boy" [002], another one encouraged her student for the same success by stating "…, I noticed you have been trying this tangram since ten minutes. But as you see, finally you solved that by yourself" [005].

4.2.1.2. Information Provider

Some of the observed teachers were coded as "Information Provider" because they took a role of giving information to students and/or explainers about different issues during different parts of visitation. However, while teachers informing their students, the form of providing information changed from one situation to other. Teachers informed their students about a particular exhibits/demonstrations (1) *based on their knowledge or experiences obtained from former visitations or* (2) *by reading labels, sometimes* (3) *by summarizing or rephrasing what was told by explainers,* (4) *by connecting their everyday life or (5) school experiences to the experiences provided by exhibits or demonstrations.* In the following sections, different ways of providing information were exemplified.

4.2.1.2.1 Informing students based on prior knowledge or experiences obtained from former visitations

Some teachers (e.g. 003) have informed their students about the exhibits based on their prior knowledge or experiences obtained from former visitations. The following situation represents an example for this category.

> A student approached to his mother and they tried an exhibit, but they could not. As a result, they asked for teacher's help.

Teacher: While you are eating, you put your dish onto the table, don't you?

Student: Yes, I do.

Teacher: If you bring it closer to the edge of the table, even closer, what will eventually happen?

Student: It will fall.

Teacher: Definitely, this exhibit shows us the same thing.

Teacher: Suppose that we draw a line on the plate as if the plate is divided into two equal parts. If this line goes beyond the edge of the table, it will fall. If it does not, it will not. Here we see the same thing. [Teacher showed what she told by using a notebook and pen and said to the parent you can try this experiment by putting a pillow and similar objects under the table.]

Student: Thank you.

4.2.1.2.2 Informing students by reading labels

Some teachers have informed their students and/or their colleagues about what particular exhibits tell them by reading the labels. They generally explained underlying concepts to students and/or to other teachers by reading related exhibit labels.

4.2.1.2.3 Informing students by summarizing or rephrasing what was told by explainer

Some teachers have summarized what was told by explainers. For instance, after an explainer's demonstration regarding plain mirror, one teacher [022] stated that "How awesome it is. That is to say that when we send a light beam to a plain mirror at any angle, the angle of incidence will equal to the angle of reflection." Which was actually the summary of what the explainer was just told. Some teachers have paraphrased what was told by explainer. For example, after explainer demonstration regarding sound pitch, one teacher [003] stated that "Then we expect that the heavier the gas is, the much deeper the sound is." Which is the paraphrased form of what the explainer just told.

4.2.1.2.4 Informing students by connecting their everyday life experiences to the experiences provided by exhibits and/or demonstrations

Some teachers have tried to connect students' everyday life experiences to the experiences provided by exhibits and/or demonstrations. For instance, after explainer demonstration regarding different types of mirrors, a teacher [020] tried to connect these types of mirrors to the ones used in cars by stating that

> Our cars have many mirrors at their different points. For instance, it has an inside mirror, two side mirrors, and two headlights. If we want to get an image as what we see, we should use a plain mirror like an inside mirror in our cars. If we want to get an image providing wider view, we should use convex mirrors like side mirrors in our cars. If we want to focus light, we should use concave mirrors like in our cars' headlamps.

4.2.1.2.5 Informing students by connecting their school experiences to the experiences provided by exhibits and/or demonstrations

Some teachers have tried to connect students' school experiences to the experiences provided by exhibits and/or demonstrations. For instance, during explainer demonstration regarding "Popper Toy", a teacher [001] tried to explain to the students by stating that

> Popper toy works like springs we have covered recently. I mean if you let a compressed spring free, you will notice that it jumps to the point which is farther away than the place where you start to compress it. Here we see the same thing as well.

4.2.1.2.6 Informing explainers about some issues

Teachers' do not only informed their students but also informed explainers about several issues. In some cases, after the explainer's introduction about the topics that they will cover (the flow of program that will be conducted etc.), some of the teachers (e.g., 013) informed explainer about that their students have not learned about the day's topic yet. In addition, teachers informed explainers about *the current curriculum implementations, physics lectures at school, visit in general,*

and regulations of *Ministry of National Education*. The following quotations exemplifies how teachers informed explainers on different issues.

> It was an amazing demonstration. I wish we could have same applications at our schools. As you know, according to current implementation of curriculum, we cannot teach a topic completely. Either related formulas are not given or topic is cut short, and we are forced to say: 'Well, more is presented next year.' [Free exploration, 001]

> Unfortunately, most of our students hate physics, and I think this situation may be resulted from their physics teacher. According to students' reports delivered to us, their physics teacher generally uses the blackboard and makes them write everything on the blackboard at the end of the lecture. Even one student claimed that sometimes he never looks back, and most of them reported that they hate such an application regarding teaching physics, whereas presentation implemented here seems to be loved by them. Students want to be more active, to participate in activities, to do things on their own… [Free exploration, 009]

> We conduct this leverage exhibit by using a ruler and a rubber, whereas the system we see here is so simple. I wish schools had these simple systems … We do have nothing in our laboratories, even simple materials. As a result, we come to here to make students try something. [Free exploration, 013]

> … They [field trips] always wear me out, and there are tons of works to do. Ministry of National Education requires a million of things for conducting a field trip. At first, permissions: parents' permission, school administration's permission, permission of Ministry of National Education and then logistics issues: arranging a bus for transportation, collecting money from students for transportation or entrance fees, plotting a route for destination, writing a field trip report and more … If I do not think it is beneficial, I will never engage in this work, but students enjoy. As a result, I am organizing a field trip to a maximum of twice a year. [Free exploration, 011]

4.2.1.3 Information Seeker

Some of the observed teachers were coded as "Information Seeker" because these teachers have tried to get information by asking questions to explainers. Furthermore, when the researcher investigated teachers' questions, he could

categorize them into four different issues such as about the demonstrations, about the visit in general, about the supply of materials, about the scientific explanation. The following Table 17 represents teachers' questions about different issues:

Table 17

Teachers' questions about different issues

Teachers' questions about	**Examples**
the demonstrations	• Are you conducting these demonstrations in schools? [Free exploration, 018] • Do you follow any websites to develop these demonstrations or shows? [Free exploration, 022] • Is there any demonstration that we can also perform in our forthcoming Science Fair?; Can you suggest some demonstrations that will be used in Science Fair? [Free exploration, 024] • Is there any website in Turkish about authentic science demonstrations we can explore? [Free exploration, 020]
the visit in general	• What topics will be covered today? [Welcoming and accommodation, 006] • Will we be let to explore other exhibits at the center? If so, when? [Explainer demonstration, 004] • What are we gonna do next? [Free exploration, 008] • What are the rules we have to obey here? [Free exploration, 016] • What will happen if my students break down or ruin exhibits during free time? [Free exploration, 014]
the supply of materials	• Where can I get that exhibit [climbing cone] and the materials you used in demonstrations? [Free exploration, 006] • Where can I get these mirrors and lenses?, Where can I get this fog machine and its liquid?, Is there any online store in Turkey to buy them? If so, how much money do they cost approximately? [Free exploration, 015]
the scientific explanation	• Are there any differences between lightnings that occurred between two clouds, or between a cloud and the surface of Earth? [Explainer demonstration, 006]; How can a magnet gain its magnetic properties? I mean, why do some materials such as iron, nickel, cobalt exhibit magnetic property, some materials do not? [Free exploration, 011]; what did you mean by SF_6? [Explainer demonstration, 007]

4.2.1.4 Facilitator

The role, coded as facilitator, was attributed to the teachers who help a student or a group of students doing something more easily or finding an answer to problems through discussions or suggestions. As a matter of fact that very few teachers could be identified as facilitators. These teachers have tried to help students understand exhibits more easily, or find answers of their questions by discussing and suggesting ways of doing things. For instance, the following conversation took place between a group of 9th graders and their physics teacher [006] during free exploration about the exhibit of climbing cone:

> *Teacher:* If you drop an object, it falls. However, this cone is climbing by itself. How can it be?
>
> *Students:* It may has magnet inside of it.
>
> *Teacher:* Do you mind if I take your hairclip? If it has magnet, I expect the hairclip should be pulled by it. [Teacher has selected one student and asked her to show everyone whether there is an interaction between climbing cone and hair clip. The student approximated the hairclip to the cone]. Is there any interaction between them?
>
> *Students:* None.
>
> *Teacher:* What can it be else? Make good observation.
>
> *Students:* Its climbing may be resulted from its shape.
>
> *Teacher:* But how? What does its shape provide?
>
> *Students:* Its climbing.
>
> *Teacher:* Still, how?
>
> *Students:* No response.
>
> *Teacher:* What is the reason of the fall of an object?
>
> *Students:* Gravity.
>
> *Teacher:* Where does the force of gravity appear to act on an object?

Students: Center of mass.

Teacher: You're right. Well, where is the center of mass of this climbing cone?

Students: Exact middle.

Teacher: Is there anyone to show me the center of mass of it?

[At the beginning, most of the students tried to show the center of mass. However, only one student showed the correct location of it.]

Teacher: Ok. Now look at it again. Is there any change in the height of the center of mass from the ground when it is being pushed down?

Students: It's raising.

Teacher: The gravity acts on the center of mass, doesn't it? Then?

Students: [One of the student said that] the gravity does what it expected to do. Dropping the height of the center of mass.

Teacher: Exactly. Is there anything else you have noticed? Is there really a change in its height?

[A few students tried and noticed that there was not any change in the height of the object.]

Students: [One of them said that] I got it. In fact, the height of the object is not changing when it's being pushed down. Just the height of the center of mass is changing. I mean it is raising when it is being pushed down. The gravity does its duty – dropping the center of mass.

Teacher: Exactly. A good observation. As you see, it is important to make a good observation. Please try other exhibits by making careful observations.

4.2.1.5 Recorder

Some of the teachers were coded as "Recorder" because these teachers seem to be focused on recording the part of the visit (e.g., explainer demonstration) or entire visit by using cameras. In addition, these teachers took photos of students, exhibits and their labels, and science center building.

4.2.1.6 Participator

Some of the observed teachers were mainly coded as "Participator" because these teachers seemed to participate in field trip in some way. When the teachers' behaviors were analyzed in detail, different forms of teachers' participation were emerged such as *Observer, Reader, Experimenter, and Group Member* (see Figure 8). In the following sections, the emerging sub-roles adopted by teachers were elaborated.

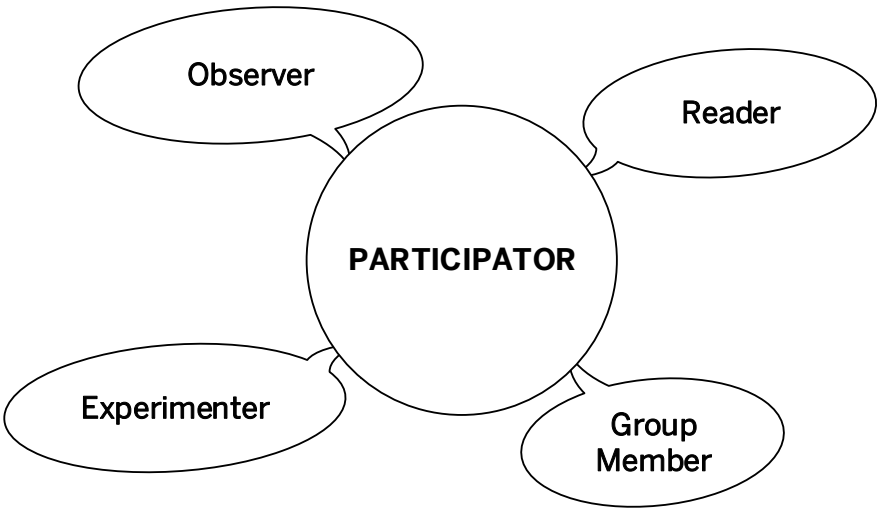


Figure 8. Sub-roles of participator role

4.2.1.6.1 Observer

The role, observer, was attributed to the teachers who attend to a workshop, a demonstration or a like activities during the visit to listen and watch but not to take a part in it. All observed teachers fitted into this category during explainer demonstrations. Each of all observed teachers generally sat on the cushions, listened what was told and watched what was demonstrated by explainer. Furthermore, some of the observed teachers were also coded as observer during free exploration. These teachers generally approached to an exhibit, looked but not tried a particular exhibit, or just observed what the others do (that was also considered as a behavior of teacher who adopted a role of controller).

4.2.1.6.2 Reader

Some of the observed teachers were coded as "Reader" because these teachers generally approached to an exhibit and just read its label, not tried to interact with the exhibit during free exploration.

4.2.1.6.3 Experimenter

The role, experimenter, was attributed to the teachers who try something to discover or find out more about it. The teachers who coded as "experimenter" conducted experiments especially during free exploration with two different approaches, trying exhibits through reading or without reading the labels attached beside the exhibits which includes information about the exhibit such as "To do and notice", "What's going on?", and "In everyday life". Furthermore, teachers' forms of trying exhibits were also different (e.g., first read and then try; first read, try, and then read again; first try and then read; first try, read, and then try again), even though the researcher could not determine whether they read all parts or one part of the labels such as "To do and notice", "What's going on?", and "In everyday life".

4.2.1.6.4 Group member

It can be defined as a teacher who gets involved in activities and becomes a member of group. Some of the observed teachers were coded as "Group Member" because these teachers tried to get involved in group activities as a group member. However, their forms of participation were different. For instance, some of them engaged in the activities what was requested by explainers such as *please clap your hands, take a deep breath, rub hands together, hold the spring to feel vibrations*. Furthermore, some of them asked questions to explainer that was also considered as a behavior of teacher who adopted a role of information seeker (e.g., what did you mean by SF_6? [007], are there any differences between lightning occurred between two clouds, or between a cloud and the surface of Earth? [006]), or answered questions raised by explainer (e.g., during Newton's cradle demonstration, explainer asked that when I pull one ball (two and three

balls respectively) towards me, how many balls will rise on the other side? Teacher [001] replied to all situations correctly.). In addition, some of teachers [e.g., 002] have discussed questions raised by explainers and/or demonstrations with students or their colleagues. The following example represents direct quotation from a natural science teacher.

> Teacher 1 *(T1):* If the sound is comprised of vibrations occurred in resource, what is the order of vibrations until the hearing happens after clapping? Hand, air molecules, eardrum?
>
> Teacher 2 *(T2):* I think the first vibration occurs in our hands, and then these vibrations are transferred to air molecules.
>
> *T1:* But our hands are also comprised of atoms and molecules. Then, we should say that the first vibration occurs in atoms and molecules comprising our hands. Then, these vibrations are transferred to air molecules, right?
>
> *T2:* Yes, I agree with you. It seems to be more reasonable.
>
> *T1:* We are teaching all the time that sound waves need a medium to spread. Sound does not travel in a vacuum. Why?
>
> *T2:* We have to look at the generation of sound. First, we need a vibration in a resource to create a sound, right?
>
> *T1:* Yes, totally.
>
> *T2:* Vibration also needs a medium such as solid, liquid, or gaseous. But does sound waves spread in plasma? I am curious about it. Let's explore it today too. Anyway…
>
> *T1:* You say medium is required to create a sound, so, the propagation of sound needs a medium.
>
> *T2:* Yes. Sound is resulted from vibrations in a source. Then, we need these vibrations to be transferred into a medium, which can be solid, liquid, gaseous, most probably plasma because it refers to ionized gas. If there is not a medium, how are these vibrations transferred? In fact, where are these vibrations transferred to? Does it make sense?

> *T1:* Actually, it does. A question came to my mind now. What if sound waves could travel in a vacuum? What if we could hear the explosions occurred in the Sun or in other stars?

4.2.1.7 Indifferent

Some of the observed teachers were coded as "Indifferent" because these teachers have showed some indifference towards (1) *what students/parents/colleagues asked to them,* (2) *what was demonstrated by explainer,* (3) *field trip in general,* (4) *what explainer asked for,* (5) *what was told by explainer during summarizing,* (6) *participating in activities requested by explainers.*

4.2.1.7.1 Indifference towards what students/parents asked

Some teachers have showed indifference to what students/parents asked to them. The examples were as follows:

> One student approached to the teacher and asked how he can interact with that exhibit. The teacher replied "do it as told on its label" [Free exploration, 004].

> Some students asked "How does this experiment work?" Teacher replied: "There is an explanation on the label, read it." [Free exploration, 008]

> One student asked "What are we gonna do now?" and teacher replied "How do I know? Soon explainer would tell us". Also, one of parents asked to teacher that "why are mass and weight not the same?". Teacher ignored her. [Explainer demonstration, 010].

4.2.1.7.2 Indifference towards demonstrations conducted by explainer

Some teachers have showed indifference towards what was demonstrated by explainer. These teachers generally

- checked their e-mails and messages via their mobile phones [e.g., 004, 011, 012], even one of them played a game [e.g., 011],
- chatted with other teacher/s about different issues (e.g., about the examinations held in the next week [e.g., 003, 004]), about how their students have limited knowledge [e.g., 011]),

- took photos of students [e.g., 004],
- moved right-to left and checked out exhibits [e.g., 005], and
- organized their bags [e.g., 010].

4.2.1.7.3 Indifference towards field trip in general

Some teachers have showed indifference to field trip in general. These teachers generally talked on their phones [e.g., 006], left science center building for smoking [012] or cared with other personal matters [014], and chatted with other teacher [015] or parents [022].

4.2.1.7.4 Indifference towards what explainer asked for

Some teachers have showed indifference towards what explainer asked for. For instance, one teacher was chatting with other teacher about the exhibits in the center while students were trying to accommodate themselves, even though explainer asked for by stating that "Dear teachers, please sit wherever you want too." The observed teacher [003] sat when she heard the third request. In another case, even though explainer asked switching off all electronic devices for students as well as teachers, some teachers [e.g., 013, 021] were ignorant to this request. Instead, they continued to take photos of buildings and their students via their mobile phones.

4.2.1.7.5 Indifference towards explanations provided by explainer

Some teachers [e.g., 003, 012] have showed indifference towards what was told by explainer, especially while explainer was summarizing the important concepts of the day they covered. They generally checked their mobile phones, looked at photos taken before, chatted with students near them.

4.2.1.7.6 Indifference towards participating in activities requested by explainers

Some teachers [e.g., 008] have showed indifference towards participating in activities requested by explainers such as clapping hands, taking a deep breath, holding a spring to feel vibrations.

4.2.1.8 Summary

The results of the observations conducted on twenty-five teachers clearly showed that teachers adopted many roles during a field trip to an informal learning environment (see Appendix N). These roles were identified to be superintendent, information provider, information seeker, facilitator, recorder, participator, and indifferent. Among others one teacher role, recorder, seem to belong exclusively to informal learning environments. Some teacher roles could be categorized into several sub-roles. For instance, teachers who adopted mainly superintendent role took some sub-roles of technical directions giver, attention stimulator, controller, requester, technical assistant, and motivator. Similarly, teachers who adopted mainly participator role took some sub-roles of observer, reader, experimenter, or group member. Nonetheless, whatever teacher role is, the results revealed that teacher did not took a single role throughout the whole visitation to the METU SC. At least three different roles seemed to be adopted by each teacher, even though one role may superior to another. Their roles also seemed to depend upon the parts of the visit. For instance, while superintendent role generally was adopted at welcoming and accommodation or free exploration, information provider role was generally adopted at free exploration. Further analysis on the variation of roles on different part of the visit was conducted on Case II.

4.2.2 Teacher roles in different parts of the visit

To determine the kind of roles teacher mostly adopt for themselves during different parts of the visit (i.e., welcoming and accommodation [W&A], explainer demonstration [ED], and free exploration [FE]) direct observations were conducted on Case-II including forty-nine teachers who agreed to participate.

During observations, the checklist (see Appendix J) developed after the observations on Case-I was used. All specific teacher behaviors including their interactions with students, explainers, and exhibits were recorded in the related teacher role on the checklist during the different parts of the visit. If additional new categories were immerged they were also included into the checklist. Two observers passively observed eight teachers at the same time to increase the reliability of observations. The resulting intra-class coefficient (ICC) was calculated to be 0.998, demonstrating that observers had a high degree of agreement. During the analysis, frequencies were calculated for each major teacher role across the different parts of the visit. Table 18 shows the frequencies of each major role adopted by teachers according to the parts of the visit.

Table 18

The frequencies of each major teacher role according to the parts of the visit

Teacher roles	W&A	ED	FE
Superintendent	99	102	169
Information provider	2	17	115
Information seeker	0	0	32
Facilitator	0	2	13
Recorder	26	30	312
Participator	0	212	217
Indifferent	4	68	12

Note. W&A: Welcoming and accommodation; ED: Explainer demonstration; FE: Free exploration

It can be clearly seen from the Table 18 that most repetitive teacher role at the welcoming and accommodation part of the visit was “Superintendent”. “Participator” role was mostly adopted by teachers during explainer demonstrations. In terms of free exploration time, it can be seen that teachers mostly adopted the “Recorder” role. For further details, the sub-roles of each major role were also calculated. The following table represents the frequencies of the sub-roles of superintendent adopted by teachers in welcoming and accommodation part of the visit.

Table 19

The frequencies of the sub-roles of the major role "Superintendent" adopted by teachers in welcoming and accommodation part of the visit

Teacher sub-roles	W&A
Technical directions giver	88
Attention stimulator	11
Controller	0
Requester	0
Technical Assistant	0
Motivator	
by encouragement	0
by praise	0

By considering the sub-roles of teachers who adopted "Superintendent" role in welcoming and accommodation part of the visit, it can be seen that they mostly adopted a sub-role of "Technical Directions Giver". The next most repetitive sub-role was "Attention Stimulator". The rest of them did not appear at this part of the visit. In a similar fashion, Table 20 shows the frequencies of the sub-roles of "Participator" adopted by teachers in explainer demonstration part of the visit.

Table 20

The frequencies of the sub-roles of the major role "Participator" adopted by teachers in explainer demonstration part of the visit

Teacher sub-roles	ED
Observer	48
Reader	0
Experimenter	
Trying exhibits by reading labels	0
Trying exhibits by without reading labels	0
Group Member	
Engage in physical activities	89
Ask questions to explainer	16
Answer questions raised by explainer	22
Discuss questions raised by explainer or demonstrations with teacher/students next to him/her	37

By considering the sub-roles of teachers who adopted “Participator” role in explainer demonstration part, it can be seen that they mostly adopted a sub-role of “Group member”. Most repetitive teacher behaviors were seemed to be engaging in physical activities during explainer demonstrations.
Correspondingly, when the frequencies of teacher behaviors categorized as “Recorder” during free exploration were examined, taking photos of students (n=269) outnumbered taking photos of experiments and their labels (n=43).

4.2.3 Teacher reflections on a field trip to the METU SC

To determine teacher reflections on a field trip to the METU SC, semi-structured interviews were conducted with twelve teachers who agreed to participate in the study. Audio-records were transcribed verbatim. After completing the analyses, they were translated into English. To check the translation made by the researcher, “back translation” strategy suggested by Merriam (2009) was used. An expert from the Faculty of Education of METU was asked to translate all of the texts (translated by the researcher into English) back into the Turkish.
The interview data were analyzed by using the constant comparison method (Boeije, 2002). At first, the researcher rigorously reviewed each teacher transcript line-by-line to determine what teacher exactly said and the data segmented into meaningful pieces. Then, each segment/passage was labeled with the most appropriate code(s). Then systematic examination of similarities between teachers’ responses were carried out to identify categories within and across in teacher responses (Boeije, 2002). The researcher initially determined codes, which reflects teacher views about particular question. Subsequently the researcher identified the relationship between these codes by context and content. Then, the researcher labelled these codes with the emerging categories (e.g., cognitive gains, design of exhibits). Finally, the emerging categories were grouped according to the appropriate themes such as reflection about explainers, free exploration, and exhibits. Figure 9 represents themes and the related categories of teacher reflections emerged from the interviews.

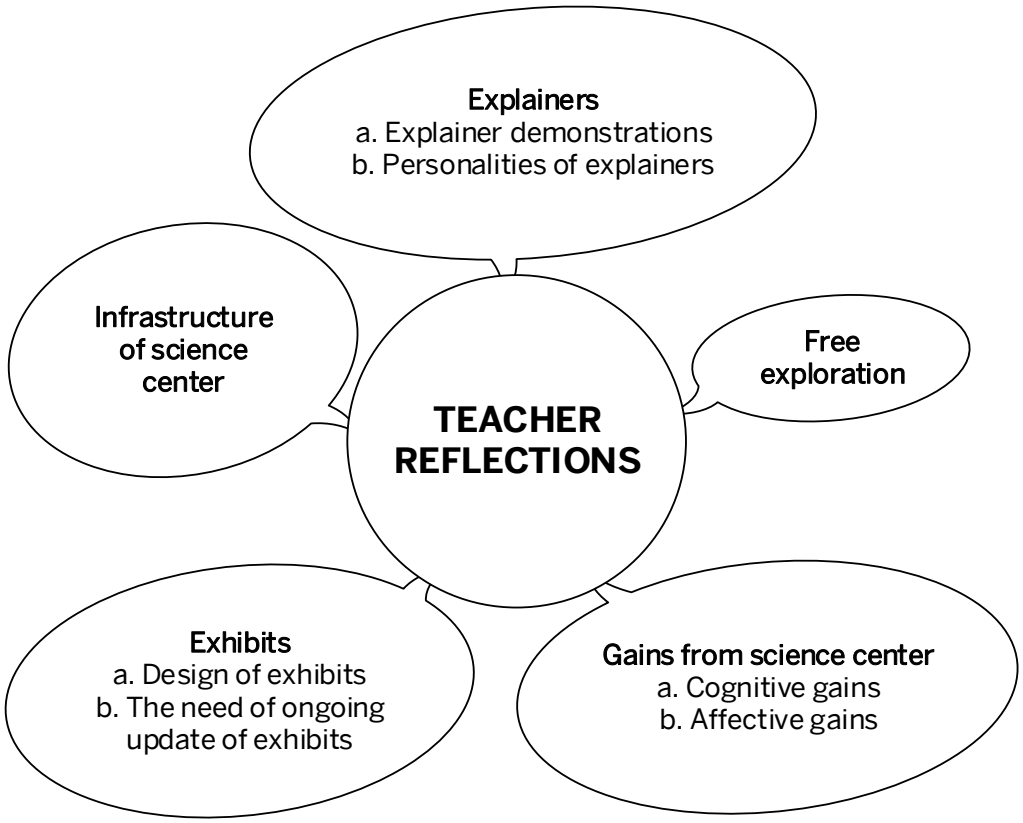


Figure 9. Teacher reflections on different themes

4.2.3.1 Reflections on gains from science center

The analysis of teacher responses showed that teachers made reflections on the gains of students or themselves by focusing on two different dimensions of learning, which were categorized as cognitive and affective gains. The term *cognitive gains* refer to the reflections of teachers related to students' or their own gains about either learning science or development of a scientific point of view due to a field trip to the science center. On the other hand, *affective gains* refer to the teachers' reflections related to students' interest in physics as well as increased social interaction between teachers and students due to a field trip to the science center. The following sections exemplify the possible gains reported by the teachers in terms of cognitive and affective.

4.2.3.1.1 Cognitive gains

The first cognitive gain from a science center visit reported by the teachers was emerged as science learning. While four teachers reported that learning occurred in science center for their students, only one teacher reported that learning occurred in science center for both herself and their students. For instance, one psychological and guidance teacher [009] highlighted that both she and their students have learned by doing as well as having fun:

> Perhaps the most important gain from field trip was that we learned by having fun. Our students even us as teachers, even though we are outside from science domain, learned a lot from science center. As I said, students have also learned. They were engaged in activities as well as interact with exhibits on their own. They have learned by doing.

A physics teacher [006] who has participated with her students in explainer demonstration regarding electricity and magnetism topics reported that students understood electricity and magnetism topics: "After the field trip, we embarked on electricity. We also finished magnetism yesterday. Everything was well-understood."

Another physics teacher [001] reported that there was a gain from a science center visit in terms of knowledge by highlighting the socio-cultural view on learning:

> There was a gain in terms of knowledge. Well, students are coming together. They are performing together. One of them is pulling another one and saying 'come and look there is a thing we try'. They are helping each other. They are learning by seeing as well as doing. I mean they are interacting with one another all the time. In fact, the learning begins when we get on the bus on the way to the science center.

Two psychological and guidance teachers emphasized the gains from science center in terms of cognitive awareness and a scientific point of view:

> Students' awareness was increased. Thanks to a visit to your science center, the inquiry process is beginning for students, which is very crucial to us. [009]

> Students gained a scientific point of view. Asking right questions, making a good observation, inquiry, refutation and the like, students saw all of these during their visitation. In my opinion, students gain more at science center than schools. [007]

4.2.3.1.2 Affective gains

Beside cognitive gains from science center, two teachers made reflections on students' affective gains. For instance, a physics teacher [015] reported that the interest of a naughty student with a low physics grade in physics was increased by the visit:

> The most important thing was that students saw there [science center] that science can also be fun. Considering student feedbacks, I understand that they really enjoyed the visit. They talked what they saw in science center for days. Students really learn when they enjoy. They were not bored. In contrast, they enjoyed even though this group was hard to be handled. In fact, they were hard to be handled. But I cannot believe that my naughty student, …, even his interest in physics was increased.

Another physics teacher [006] reported that there was a change in the relationship between her and her students beside the increase on students' interest in physics:

> Physics is naturally perceived as not likeable. Seeing a university, getting knowledge about this university, and visiting a science center have changed many things. Students' relationships with me and their perspectives on physics are now different. For instance, there was a mediocre student. She got top score in physics exam after our visit. When I think how that was possible, I realized that we had have lunch together at campus after the visit. We had have a little chat. A while ago, we were apart from each other. After visit, we started to close to each other. The visit has contributed to our relationship between me and my student. Also, after the visit, she started to bring physics questions to me. Her interest in physics seemed to be increased by the visit.

4.2.3.2 Reflections on exhibits

According to the analysis of teacher responses, teachers made reflections on the exhibits by focusing on the design of the exhibit or the maintenance services needed to improve the quality of the exhibits. While a few teachers were emphasized that the design of exhibits are very well, four teacher highlighted that science center should be updated by providing repair and maintenance services for exhibits or adding new exhibits.

4.2.3.2.1 Design of exhibits

Reflections on design of exhibits were provided by two psychological and guidance teachers who reported that the exhibits of science center are quite intriguing. For instance, the teachers stated the following comments:

> We find that the exhibits are quite intriguing. Their labels are also good. As I said, even though we are outside from science domain, we can try by following the instructions on exhibit labels. Also, student do not have an anxiety regarding what if I break down or damage the exhibits. They were all well-designed. [009]

> The exhibits are quite well and intriguing. Even I try to interact with exhibits whenever I came. [007]

4.2.3.2.2 The need of an on-going update of exhibits

Three teachers emphasized that the exhibits should be updated by providing repair and maintenance. The following excerpts exemplify how teachers make reflections on this issue:

> The exhibits need maintenance and repair. I mean some of them have an electricity leak. It was required that some modifications should be made. [006]

> The science center should be updated. There were some broken exhibits. We would really like if you repaired them. Then some exhibits were out-of-service, unavailable. I strongly recommend that either you remove those exhibits from science center or replace them with new ones. [012]

> Some of the exhibits seemed to be too old-fashioned and it may be better if they are updated. [020]

Furthermore, two teachers highlighted that science center should be updated by adding new exhibits by stating that

> Scince center may include exhibits regarding earthquake and water waves. I did not see the exhibits concerning these topics. Renewal must be done in your science center. It may be better if you put some new exhibits. Because we cannot bring the same student who was brought to science center before again and again. Whereas I really want to bring them more than once. [006]

> I wish there was something more. Every year we really want to see different things. The science center needs to get new exhibits. [012]

4.2.3.3 Reflections on explainers

The analysis of teacher responses showed that teachers made reflections on explainers by commenting on explainer demonstrations or personal characteristics of explainers. While two teachers reflected on explainer demonstrations, four teachers reflected on the personalities of explainers.

4.2.3.3.1 Explainer demonstrations

Two teachers reported that explainer demonstrations are quite fascinating. For instance, a psychological and guidance teacher [005] emphasized the most gripping event during the visit was the explainer demonstration.

> Those demonstrations are very beautiful. For instance, you put a system in a ping-pong ball. When you touch both metals, it is lighted. Conductor etc. Even though I am a guidance teacher, it really got my attention. This explainer demonstration was a presentation that I could not find even though I have been looking for. It was fascinating that includes both academic and fun components. Students amazingly participated and listened. Until today, they may have not been exposed to or listened to such a good demonstration. That is why the most gripping event during entire visit was explainer demonstration.

Correspondingly, a physics teacher [015] reported her satisfaction with explainer demonstration.

> This year I was more satisfied with our visit. What was I satisfied with? Explainer demonstration. The thing that I have been trying to do, also to make students do was ready there. This was extremely good.

4.2.3.3.2 Personalities of explainers

Beside explainer demonstrations, five teachers reflected on the personalities of explainers. For example, a psychological and guidance teacher [007] reported her dissatisfaction with the personality of explainer by stating that

> I wish the explainer was more colorful, positive, and has a good-humor. I wish he could use his body language more with gestures and mimics. If he could act like that, the visit could be more attractive and intriguing.

Other four teachers reported their satisfactions with the personalities of explainers. For instance, one psychological and guidance teacher [009] reported her satisfaction by stating that

> The guidance service was extremely satisfying. As I said, the explainer assisted students in interacting with exhibits during free exploration by suggesting how to perform related activities. This was quite striking. Even she offered awarded questions for students to increase their motivation. For instance, she said I have a question. If you can find an answer, you will be granted an award. This resulted in a willing participation by students. We did not need to manage and control our students. The explainer kept them busy very well. Briefly, the explainer was really experienced about working with students even though the group was crowded.

Similarly, a natural sciences teacher [013] reported her satisfaction with explainer by emphasizing that the success of the visit is directly related to explainer.

> I was deeply satisfied with the explainer. The explainer was really great. His presentation, the way of teaching, communication with students were fascinating. The success of the visit is directly related to

> the explainer. The way of presenting, communication with students, those are secret details. I was very satisfied.

Another natural sciences teacher [020] also emphasized her satisfaction with explainer.

> At first, I have to say that explainer was very positive. She really wanted to help me and my students. We did not by any means hear bad words from her. We were not exposed to any bad glance as well. I do not know how I can say. In fact, the explainer was quite well-experienced. We could consult with her without any hesitation when we had a question.

4.2.3.4 Reflections on free exploration

Most of the teacher reported that giving a free exploration time for making students perform their own activities on the exhibits is required. Even though three teachers reported that the free exploration is a good implementation, two teachers reported that a change is needed in its implementation. For instance, a physics teacher [006] pronounced that the allocated for free exploration was not sufficient for her students.

> The implementation of free exploration time is a good implementation. But more time can be allocated for our students. Our students have been saying for a couple of years that we wish we had more time to try the exhibits. Maybe you can offer for a long period of time for free exploration by asking how much time school groups want to stay in science center.

From a different point of view, a natural sciences teacher [013] pronounced that letting students free was seen as a play time by some of the students who have no interest in exhibits. For that only reason, she recommended its implementation needed to be changed.

> The implementation of free exploration is good. But are students controlled during this time? Because students who have interest in learning are already interested in interacting with exhibits as it should be. But students who have no interest see the free exploration time as play. For instance, one of my students tried to perform pulley system.

> However, he did not perform as instructed in its label. Even he did not read its label. Why? Because letting students free was seen as play by some of students. This kind of students try the exhibits on their own but they do not know what to do. Let me give you another example. For instance, we have recently covered light topic. When I have tried to teach primary and additive colors, I said that 'did you remember we saw this in our field trip to the science center?'. Some students responded that I did not see it. That is why some students think it is a play when they are let free. All in all, maybe you can change its implementation. You can put students into small groups. You can increase the number of explainers so each group has an explainer. Explainer can demonstrate all exhibits one by one by saying 'Now we interact with that exhibit. Now we explore that exhibit.' Thus, all exhibits could be explored by students consciously one by one thanks to explainers. Maybe this implementation can be better than the current one. But the free exploration is necessary. Fortunately there is such an implementation.

Even though two teachers reported that the implementation of free exploration needs to be changed, three teacher pronounced their positive opinions about the way it is implemented.

> I think that both the given time and implementation of free exploration were good. [012]

> The allocated time for free exploration was sufficient. After the implementation, nobody said I did not see or interact with exhibits. [015]

> Students could interact with exhibits on their own during free exploration. The explainers could also help us during free exploration. In my opinion, offering such an implementation was very good. [020]

4.2.3.5 Reflections on infrastructure of science center

Only one psychological and guidance teacher [009] reflected on the infrastructure of the science center. She/he reported that they need a cafeteria to drink tea at the science center: "We need a cafeteria there. We want to drink tea. We really need it."

4.2.3.6 Summary

By evaluating teachers' reflections on their field trips to the METU SC, five major themes were emerged: (1) gains from science center: cognitive (e.g., science learning, awareness, scientific point of view) and affective gains (e.g., interest in physics and teacher-student relations) from science center, (2) infrastructure of science center, (3) explainers including both explainer demonstrations and personalities of explainers, (4) exhibits including the design of exhibits and the need of an on-going update of exhibits, and (5) free exploration. Even though positive reflections on most of the different themes were superior to negative ones, the reflections on exhibits were an exception. Five teachers emphasized that the METU SC should be updated by either getting new exhibits or getting some renovations and maintenance services. In terms of reflections on explainers, one teacher's reflection was quite striking. She argued that the success of visit is directly related to explainer. Another interesting result was a natural science teacher's reflections on free exploration. Even though she highlighted the importance of the implementation of free exploration, she wants to change its implementation because some of the students who have no interest see it as play. Instead of letting students free to make on their own experiments, she suggested that a few explainers should demonstrate all exhibits one by one.

CHAPTER 5

DISCUSSION, IMPLICATION, AND RECOMMENDATION

5.1 Discussion

No one denies that field trip is a pivotal component of science education, and teachers are the key decision-makers for conducting field trips to informal learning environments. Therefore, understanding teacher perspectives on, roles in and reflections on field trips is one of the critical first step for the inquiries about informal learning environments.

5.1.1 Teacher perspectives on field trips

Teachers in the study reported high levels of implementation of field trips to informal learning environments. Most of the teachers claimed that they conduct field trips to informal learning environments (ILEs) twice a year and more, and almost all of the teachers mainly conduct field trips to science centers. In addition, as also reported in other studies (Anderson & Zhang, 2003a; Anderson et al., 2006; Michie, 1998), a great majority of teachers reported that they consider field trip visitations as highly valuable educational experiences for their students. Therefore, it is important that schools and parents recognize the potential contributions of these informal settings and support teachers' use of these settings to increase children's possible gains on cognitive, affective, and psychomotor domains. When the current distribution of responsibilities while planning a field trip to an ILE was considered, it was appeared that almost everything was in the responsibility of teachers except for getting the necessary permissions from Ministry of National Education's (MONE) and making arrangements for transportation. These two issues were mostly reported to have made by school

administration, and most of the teachers did not complain about the distribution of responsibilities. This may be resulted from the general idea that teachers hold, this is already our job. However, the rest of the teachers would like to see some changes in their responsibilities for planning of field trip. These teachers felt that beside getting MONE's permission and making an arrangement of transportation, school administration should also collect transportation cost and get other required permissions such as parental and internal school. Interestingly, unlike other international studies (e.g., Anderson et al., 2006; Anderson & Zhang, 2003a; Michie, 1998, Storksdieck, 2001), almost none of the teachers would like to get help from informal settings when planning field trips, even in terms of preparation of pre-visit and follow-up activities. This may be resulted from the fact that most of the teachers are not aware of what they should do beforehand, during, or after the visit or simply they may not prefer to do even they know what to do.

In terms of teachers' considerations while planning field trips, the most cited issue and the top priority were the level of student utilization of the field trip setting. Besides, even though "getting required permissions" and "the availability of the setting at the time teacher desires to visit" were among the most cited issues considered when planning a field trip, they did not appear among the top five priorities. Instead, teachers highlighted "the subject matter knowledge of explainer and his/her communication with students" and "the degree to which the field trip visitation fit their school-based curriculum". Similar to Yu's (2005), but unlike the other studies (Anderson & Zhang, 2003a; Hannon & Randolph, 1999), the current study revealed that curriculum appropriateness of the field trip setting was not the first priority for most of the teachers while planning field trips to ILEs. According to Anderson and Zhang (2003a) the curriculum appropriateness of the setting has usually been proposed as the first priority when planning field trips because of the requirement of justification of field trips in terms of curriculum fit which assure its legitimacy and approval of administrative authority to conduct field trips.

"The amount of enjoyment that students will have at the setting" was reported by teachers in the second rank among the top five priorities when planning field trips.

In fact, as reported in other studies, many teachers consider affective goals to be equally or more important than cognitive ones (Anderson et al., 2006; Storksdieck et al., 2006).

In the current study, teachers also think that students should be informed before the visit about the field trip setting, the field trip program, the purpose of the visit, the rules to be obeyed at the setting, and the expectations about the gains from the field trip. Their suggestions seemed to center on technical rather than educational aspects of the field trip, and the expectations about the gains (cognitive, affective, social or psychomotor gains) were not specified. Also, they did not suggest that they should conduct specific pre-visit activities even though the importance of providing pre-visit activities has been highlighted by researchers (Gennaro, 1981; Kisiel, 2003a; Melton et al., 1936; Orion & Hofstein, 1994; ASCD, 2010). In fact, many studies clearly demonstrated that teachers had very little preparation for their visits and they were often organizational (i.e. Griffin, 1994; Griffin & Symington, 1997; Cox-Petersen & Pfaffinger, 1998; Faria & Chagas, 2013; Yu, 2005). Put differently, teachers seem to have a prevalent tendency that they are not responsible for conducting pre-visit activities. Their efforts seem to be limited to informing students about the field trip in general. Cox-Petersen and Pfaffinger (1998) claimed that this results from that teachers do not want to distort students' visit. Instead, they want their students to have experiences when they see it rather than providing prior knowledge via pre-visit activities. Other reasons can be time constraints and lack of information about the field trip setting. Kisiel (2005) claimed that tight curriculum, time constraints, and district/state mandate testing program prevent teachers from implementing both pre- and follow-up visit activities. For the current study, lack of information about the METU SC is most likely to be a reason. This is because even though METU SC published a field trip guide for teachers in the first week of September and February months, teachers' responses clearly disclosed that almost half of the teachers were not aware of such a guide published for themselves. Even if they were aware of such a guide, one-quarter of them could not access to it, whereas the field trip guide includes many information regarding the visit that includes science center program, its layout,

activities that can be done beforehand, during and after the visit, their connections with the curriculum, information about the science center and the exhibits, the entire field trip program, explainers, and suggested teacher roles.

Additionally, even though most of the teachers claimed that they should supervise and facilitate the learning experiences of their students during an actual field trip, the most repetitive suggestion to maximize the learning experiences of students was "getting an explainer for their students throughout an entire field trip." This result consisted with the findings of Faria and Chagas (2013) and Yu (2005). According to Faria and Chagas (2013), teachers hold a belief that explainers have more profound knowledge about the concepts involved in the exhibitions; thus they can promote deeper learning, keep students more focused on and interested than teachers can during visits. According to Yu (2005), this may be related to teacher subject areas because teachers whose subject areas are not associated with science still prefer explainers to do their jobs for them and they may not have sufficient confidence to help their students to participate in activities actively. In fact, this may be the case for the current study because when considered the subject matters of these thirty-three teachers who suggested getting an explainer during a field trip to maximize students' learning experiences, it was appeared that only two teachers' subject areas were physics and sevens' were natural sciences. Another reason may be related directly to teacher perspectives. Teachers may believe that students solely learn when they participate in guided tour (Yu, 2005). In addition, teachers may consider field trips as a day out activity (Griffin, 1994) or as a fun event and not as an educational experience that they should be well-prepared (Tal et al., 2005) or they may believe that they have little responsibility to engage students in learning activities at the science center (Griffin & Symington, 1997; Yu, 2005). Whatever the reason might be, the dependency on explainers appeared repeatedly. In this respect, as stated by Hein (1990), "if the museum was to have a liberating effect on the teaching of science to children, it first had to change the attitudes of the teachers." (p.132).

In terms of teacher's perspectives on follow-up activities, getting feedbacks (e.g., pros and cons of the visit, what the most interesting exhibit was) from students

about the visit was more cited than providing curriculum connection or making students share their experiences. In fact, the available literature clearly demonstrated that teachers prefer to conduct follow-up activities after the visit (e.g., Cox-Petersen & Pfaffinger, 1998; Mosabala, 2009; Tal & Morag, 2007), and their follow-up activities center on the motivational aspects of field trips (Anderson et al., 2006). Even teachers claim that they would conduct some follow-up activities which often includes collecting and reviewing student-completed worksheets (e.g., Griffin, 1994; Griffin & Symington, 1997; Mosabala, 2009). This again may be resulted from time constraints (Kisiel, 2005). However, there may be other reasons. For instance, when teacher subject areas are considered, it was clearly seen that while one third of teachers were from natural sciences, a few teachers were from physics. More than half of them were from different subject areas like Geography, English Language, Classroom, Religion and Ethics and the like. In this respect, how do we expect from teachers to implement pre- and follow-up activities if their subject areas were not related to natural sciences. How is school-based curriculum connection possible after field trips? In addition, when the level of classes were considered, it was clearly seen that teacher preferred to bring mixed groups consisting of students with different grade levels to the METU SC. In detail, just one-fifth of the teachers have brought their single classes to the METU SC for the visitation. The rest of them preferred to bring mixed groups. This situation may also explain why teachers are not able to conduct pre- and post-visit activities.

Additionally, the key issues that currently prevent teachers from making more field trips to the METU SC emerged as time constraints, transportation, and science center's busy schedule. In fact, time constraints due to mainly tight curriculum, was generally reported as block for both making more field trips and conducting pre- and follow-up activities (Anderson & Zhang, 2003a; Kisiel, 2005). Similarly, transportation cost and venue entry cost were generally reported as blocks for making more field trips (e.g. Anderson & Zhang, 2003b; Kisiel, 2005). However, in this study, entry cost was not considered as a block since METU SC like several other science centers (e.g. Bursa Science and Technology

Center) admit visitors free of charge. Still transportation cost may be a block since school field trips in Turkey like in Taiwan (Yu, 2005) are paid by the parents, and even though most of them usually view field trips as a part of school activities, teachers claimed that parents frequently have complained about the transportation cost.

5.1.2 Teacher roles

No one denies that a teacher's role should include more than simply standing in front of a class and giving a lecture. Teachers have to adopt multiple roles to ensure that all students are exposed to a good quality education (Harden & Crosby, 2000). In fact, teachers can adopt many roles during a field trip to an informal learning environment such in the case of formal settings. In the current study, these roles were identified as superintendent, information provider, information seeker, facilitator, participator, indifferent, and recorder. One of teacher role, *recorder*, seemed to belong exclusively to informal learning environments. The explicit identification of these seven roles offers a useful framework for teachers, museum educators, informal learning environments, and school administrators to reflect on advantages and disadvantages of specific roles and make decisions concerning field trips since different roles require different specific skills and abilities. Furthermore, some teacher roles included some sub-roles. For instance, teachers who adopted mainly superintendent role took some sub-roles such as *technical directions giver, attention stimulator, controller, requester, technical assistant, and motivator*. In a similar fashion, teachers who adopted mainly participator role took some sub-roles such as *observer, reader, experimenter, and group member*. Nonetheless, the roles adopted by teachers clearly showed that most of the teachers in this study also had no clear idea of how to use science center as informal learning resource as the teachers in other the studies (e.g., Griffin & Symington, 1997). A great majority of teachers did not take a role of facilitating the learning experiences of their students as the teachers in other the studies (e.g., Tal et al., 2005; Tal & Steiner, 2006). This may be resulted from that the presence of explainers may lead the most of the teachers not to take a facilitator role (Tal et al., 2005). Faria and Chagas (2013) claimed that

guided visit provides very little choice for interactions among students, teachers, and even informal environment resources. On the other hand, in a study conducted by Kisiel (2006b), one of the teachers said that "having experts to explain what's in the exhibits would be nice" (p.440). Similarly, teachers' perspectives may account for their adoption of a passive role. Even though explainers have been tried to make teachers involve in the process during their field trips, most of them did not prefer to participate in the process because they may still think that they should not interfere with explainers as well as activities at informal settings (Tran, 2006). Teachers may also think that field trip settings belong to explainers, classrooms belong to them (Tran, 2006). From another perspective, teachers may consider the visit as a fun experience rather than an educational experience that they should be well-prepared (Tal et al., 2005). The notions of "losing children, risking the reputation of their school, not knowing where to go, being asked questions they cannot answer, and not having any back-up as they do at school" (Griffin and Symington, 1997, p.775) as well as the subject areas of teachers may also explain why most of the teachers adopted passive roles in general. Additionaly, there are many studies showing that if teachers have a good memory regarding their field trips, primarily as teachers or students, they will more likely to conduct a successful field trips (e.g., Michie, 1998). However, the number of science centers in Turkey is very limited when compared to its population, and they are generally located in metropolitan cities like Ankara, Bursa, İstanbul, and Konya. In addition, the first science center in Turkey was opened in 1993. For that reason alone, teachers in this study may not have a good memory regarding field trips to science center because they most probably did not go to any science center during their childhood or adolescence. Another reason may result from no existence of in-service training towards informal learning environments for teachers given by either informal learning environments or universities. Just a few universities (e.g., Hacettepe University) have started to offer courses regarding informal learning environments to their undergraduate students recently. Tal et al. (2005) claimed that the major reason of the passive role adopted by teachers was teacher professional development programs since they focus mainly on inform teachers about their offers and resources, not on the pedagogical aspect of their

visit (e.g., how to conduct successful field trip). Lastly, like teachers in Taiwan (Yu, 2005), teachers in Turkey have full responsibility of students during their field trips to anywhere. This perceived responsibility may lead to being developed a notion by most of the teachers that bringing students back alive and healthy is teachers' first priority. Teachers may also solely focus on technical aspects rather than educational aspects of their visit due to this perception.

Whatever teacher role is, the results revealed that teacher did not took a single role throughout the visitation to the METU SC. At least three different roles seemed to be adopted by each teacher, even though one role may superior to another on different parts of the visit. For instance, the most repetitive teacher roles were (1) *superintendent* at the welcoming and accommodation part with a sub-role of *technical directions giver*, (2) *participator* at the explainer demonstrations part with a sub-role of *group member,* and (3) *recorder* at free exploration part of the visits. Put differently, teachers mostly gave technical directions during welcoming and accommodation part of the visit. At explainer demonstration part, they adopted the role of group member. They mostly engaged in physical activities requested by explainers such as rubbing hands together or taking a deep breath. At free exploration part, they adopted a recorder role. They mostly took photos of students as well as exhibits and their labels. Kisiel (2006b) claimed that the aim of taking photos of students as well as exhibits seem to document field trip experience at first, other purposes can be such as promoting student interest and family conversation about the trip, or preventing students from the distraction with using their own cameras. Nonetheless, there may be many other possible reasons. Teachers may have taken photos of students and exhibits for school website, social networks, their own archive, reading on a later time to deepen their own knowledge, using in their lectures to remind students what they saw or to provide curriculum-connection, using in upcoming science festivals, or providing evidence for school administrations that they really visited the center. Furthermore, one teacher's response to the question, "What should teachers do during an actual visit to informal learning environments to maximize students' gains from the visit" revealed that the reasons of taking photos of

students can be used to evaluate the success of the field trip (*Both at the beginning and at the end, I take photos of students' faces. If they are happy at the end of the visit as compared to the beginning of the visit, I decide that the visit is successful*).

Even though it is illogical to expect a teacher to exhibit behaviors concerning all major seven roles during a field trip to an informal setting, some roles like facilitator and information provider are more desirable. The researchers would like to see teachers' active involvement in field trips, and they wish that teachers accompany their students by taking a facilitator role and by providing opportunities for students to experience a greater diversity of exhibits and hands-on activities rather than a superintendent or recorder role. However, teachers mostly took photos of students and exhibits rather than facilitating student learning experiences at free exploration part of the visit. This may decrease the quality of field trips, as indicated by Hood (1992), poor classroom field trips can lead students to be non-users of informal settings in the future, and teachers may be unaware of these long-term consequences (Michie, 1998). Therefore, informing teachers about possible roles that they can adopt while visiting is very crucial since the roles adopted by teachers have direct impacts not only on the success of visit in terms of student learning experiences (Cox-Petersen & Pfaffinger, 1998) but also on creating potential visitors of informal settings in the future.

5.1.3 Teacher reflections

Teachers' reflections on their field trips to the METU SC were categorized into five major themes, which were (1) cognitive (e.g., science learning, awareness, scientific point of view) and affective gains (e.g., interest in physics and teacher-student relations) from science center, (2) infrastructure of science center, (3) explainers, (4) exhibits, and (5) free exploration. Even though positive reflections on most of the different themes were superior to negative ones, the reflections on exhibits were the other way around. Five teachers especially emphasized that the METU SC should be updated by either getting new exhibits or some renovations and maintenance and repair.

By considering reflections on explainers, two teachers' reflections were quite striking. One teacher claimed that the success of visit is directly related to explainer (e.g., explainer's presentation, the way of teaching, and communication with students have an impact on the success of visit in terms of student learning). In fact, another teacher reported her satisfaction with explainer in a manner supporting this claim.

> The guidance service was extremely satisfying. As I said, the explainer assisted students in performing exhibits during free exploration by suggesting how to perform related activities. This was quite striking. Even she offered awarded questions for students to increase their motivation. For instance, she said I have a question. If you can find an answer, you will be granted an award. This resulted in a willing participation by students. **We did not need to manage and control our students. The explainer kept them busy very well.** Briefly, the explainer was really experienced about working with students even though the group was crowded.

However, two bold sentences have raised two important questions: (1) Do the presence of explainers lead most of the teachers not to take a facilitator role? (Tal et al., 2005), or (2) Do teachers think that they have no or little responsibility to engage students in learning activities at the science center? (Griffin & Symington, 1997; Yu, 2005). Another interesting result was a natural sciences teacher's reflections on free exploration. Even though she highlighted the importance of the implementation of free exploration, she wants a change in its implementation because she claimed that some of the students who have no interest see it as play. Instead of letting students free to make their own experiments, she suggested that a few explainers should perform all exhibits one by one. Teachers may really believe that students can learn when they participate in a fully-guided tour. Whereas one physics teacher highlighted the importance of social interaction in learning by stating that "…students are coming together. They are performing together. One of them is pulling another one and saying 'come and look there is a thing we try'. They are helping each other. They are learning by seeing as well as doing. I mean they are interacting with one another all the time." In fact, humans are social creatures and sociocultural view on learning, generally referring to

Vygotsky (1986), highlighted the importance of social interactions through which students gain new and more complex knowledge via facilitated experiences provided by their more capable peers or teachers. As Falk and Dierking (2000) claimed that if we do not know the answer we want to know about, we ask for help or read about it.

5.2 Implications and Recommendations

5.2.1 Implications and recommendations for teachers, teacher educators, the educators of science centers

Teachers who have not visited or have no intention of visiting a science center can benefit from the science center and similar informal settings since teachers reported that there are many gains from the visit to an informal learning environment (e.g., learning science, development of scientific view, cognitive awareness, interest in physics, social interaction). In fact, to maximize student learning experiences on the level of cognitive, affective, social, and psychomotor domains, teachers are expected to do some activities integrated with curricular objectives before and after the visit to an informal learning environment. If teachers are familiar with the informal setting, conduct some activities before and after the visit, and take a facilitator role during the visit, students can more likely to gain a good quality of experiences at this informal setting. However, teachers still seem to impose their habits and experiences regarding formal school settings onto informal settings. Although teachers adopted many roles during a field trip to the METU SC, their roles generally remained passive. Cox-Petersen and Pfaffinger (1998) clearly demonstrated that students whose teachers gave them guidance experienced a greater variety of activities than students whose teachers did not. Furthermore, some of the teachers showed indifference towards demonstrations, activities and/or field trip in general, whereas several studies clearly showed that if teacher had clear goal for their visitation and positive attitudes to field trip, students had as well (Griffin, 1994; Griffin & Symington, 1997). Therefore, improving teachers' attitudes towards field trips are required. Similarly, some teachers adopted the roles of experimenter (exploring exhibits on

their own), reader (reading labels of exhibits on their own) which may show that teachers' novelty regarding the setting are also high. However, teachers are recommended to visit the field trip settings before the actual trips or the websites of settings or talked to someone who has visited the setting before so that they can facilitate the learning experiences of students at the settings. In a similar fashion, some teachers used derogatory approach while they were giving directions to their students (e.g., don't say stupid things!, give logical and reasonable answers!) or showed indifference towards what students/parents asked (total ignorance). All of these must be paid greater attention by the educators of science centers and teacher educators because several researchers showed that such roles adopted by teachers can arouse anger and anxiety on students and promote low academic engagement, achievement, perceived competence, and self-esteem (e.g., Assor et al., 2005; Boggiano & Katz, 1991; Deci et al., 1981; Hein, 2012).

From another perspective, Tal and Steiner (2006) claimed that the success of the field trip to an informal learning environment is directly affected by the presence of science teacher. They argued that if a science teacher exists, explainer will be well-prepared and students will be more focused. In this respect, the implementation of field trips, especially conducted by science teachers can be encouraged or the reason of why science teachers do not prefer to conduct field trips can be explored. In fact, facilitating learning experiences of students in informal settings is a hallmark of effective teachers who master the subjects provided by the settings and know how to teach those subjects to students. Nonetheless, the subject areas of most of the teachers conducting field trips may not be directly science-related or visiting classes may not be single classes as such in this study, which in turn influence the implementation of pre- and post-visit activities. Put differently, the success of the visit depends on the competency of the teacher on the related subject area. Therefore, some steps should be taken by educators to improve the quality of field trips conducted by non-science teachers.

Beside the roles adopted by teachers during field trips to the METU SC, teacher perspectives on field trips also needs to be given special attention since almost none of the teachers requested help from informal settings when planning field

trips, even in terms of pre- and post-visit activities. Curriculum appropriateness of the field trip setting was also not the primary consideration for most of the teachers in the planning of field trips to informal learning environments. Teachers seemed to be unaware of the educational potential of informal learning environments. This must be paid attention by educators of science centers and teacher educators. Educators are required to develop programs where teachers are able to learn unique pedagogical strategies to be used in these environments. Both pre-service and in-service teachers need to be trained to be aware of the importance of their roles in informal learning environments in terms of facilitating their students' learning experiences and to develop positive attitudes towards field trips. In fact, several researchers have been proposing specific ideas on how to develop effective professional development (PD) programs for teachers to improve the quality of their practices in informal learning environments. According to their suggestions, PD programs should

- present field trips as parts of total school experience rather than an isolated one-day event (Cox-Petersen & Pfaffinger, 1998);
- include informing teachers about informal settings' resources and offers (Melber & Cox-Petersen, 2005; Neathery, 1998) and about how to conduct successful field trips to these environments (Smith, McLaughlin, & Tunnicliffe, 1998);
- include visitations to informal environments at early stages of teacher education program (Ferry, 1993);
- not be evaluated based solely on teachers' self-reports to determine its effectiveness but also include objective achievement tests (Holiday, Lederman, & Lederman, 2013).

5.2.2 Implications and recommendations for science centers

Informal learning environments like the METU SC should find a way to establish a collaboration between them and teachers when planning field trips. Educators and explainers of science centers should know what teachers expect from them. Teachers should also know what science centers expect from them. Put differently, teachers should be informed about what they are expected to do beforehand, during, and after the field trip to maximize students' learning experiences from the field trip. Therefore, the science center should find an effective way to inform teachers before the actual field trip about its program, offers, resources, and expectations from them. In fact, teachers reported the importance of the access to the field trip guide for frequent visitations, and also a great majority of teachers who accessed to the field trip guide considered it beneficial. Therefore, the METU SC should find effective ways of helping teachers to access the field trip guide that includes the program of science center, its offers, and resources for teachers, and also expectations from them. Some possible solutions can be (1) collecting teachers' e-mail addresses. Thus, in the next term teachers can be informed about the program of science center as well as what they are expected to do beforehand, during, and after the field trip to maximize students' learning experiences from the field trip; (2) signing a protocol with MONE. Thus, MONE can send field trip guide of the METU SC to all schools. Even though METU SC provide materials regarding field trip for teachers, these materials may not be appropriate to teacher needs. Anderson et al. (2006) claimed that these materials should be fit teachers' needs. Similar informal settings can cooperate with one another to produce materials regarding field trips, and these materials can be developed in conjunction with teachers, educators, and explainers, based on a diversity of their objectives.

Some teachers asked explainer to get information about the science center program during the field trip, which may imply that they did not have a clear goal for their visitation and they did not conduct any pre-visit activities, whereas students whose teachers made efforts to plan structured activities before, during,

and after (or combinations of these) the field trip develop more positive attitudes than their counterparts whose teachers did not plan any such activities (Finson & Enochs, 1987). Therefore, the METU SC should inform teachers about the program of the science center, its offers and resources for teachers, and also expectations from them.

Some teachers asked explainers to get information about demonstrations, the supply of materials, and scientific explaination. This can be a sign of which teachers can benefit from informal settings at what level. In this respect, informal settings like science centers keep teachers informed about their offers and resources. Teachers are reminded that they can benefit from informal settings in many ways.

In addition to the obstacles for frequent visitations reported in international studies such as time constraints and transportation, teachers in this study also reported the METU science center's busy schedule as an obstacle for their repetitive visitations. Therefore, the science center may reconsider its operation and increase their sessions in a day. In addition, since teachers reported the allocated time for free exploration part of the visit was not sufficient, the science center may provide more allocated time (more than one hour) to school groups for the free exploration part of the visit. However, the average visit duration of school groups in this study was 72 minutes. Therefore, the science center may separate school groups according to their grade levels such as elementary, middle, and high school, and provide more free time for exploration to high school students who generally prefer to explore exhibits on their own.

Even though most of the teachers in this study did not complain about the distribution of responsibilities regarding field trips, it is worth to note that the accessible population of the study includes only the visitors of the METU SC. For the others who have not visited or have no intention of visiting a science center, current responsibilities may be a barrier for their visitations. Therefore, MONE and school administrations can decrease the workload of teachers concerning field trips so that they can focus on educational aspects of field trips rather than

technical aspects of the field trips. Informal learning environments can also provide effective resources that minimize the teachers' load back in the classroom (Anderson et al., 2006).

Since teachers highlighted the importance of the presence of explainers in many ways (e.g., the consideration of explainer demonstrations as the most gripping events, of the subject matter knowledge of explainers and their communications with students as top priority, and the relevance of the success of the visit to explainer), informal settings should provide on-going professional development programs focusing on science communication for their explainers. Explainers should also provide on-going encouragement for teachers to make them participate in activities actively.

Some teachers especially emphasized that the METU SC should be updated by either getting new exhibits or some renovations and maintenance and repair. Steps should be taken by the science center to improve their resources for their potential visitors.

Since teachers reported their unfamiliarity with informal settings (e.g., Feza Gürsey and MTA Energy Park), science centers should improve their brands and images. They may provide outdoor advertising and cooperate with the MONE and local municipalities to inform about their resources and attract more visitors.

5.3 Recommendations for Further Research

Since each informal learning environments is unique in terms of the implementation of field trips (e.g., fully-guided, half-guided, or unguided), teacher roles may be very different from one to another setting. Therefore, studies exploring different informal settings having different field trip implementations to determine whether teacher roles are completely different or have a lot in common are needed. For instance, which roles do teachers adopt for themselves during unguided visits? The investigation about the possible reasons of the adoption of each role can help educators to design effective professional development programs.

Since teachers have a great variety in their personal variables, teacher roles may be very different in terms of these variables. Therefore, the investigation of the variation of teacher roles according to teachers' subject areas, school type (private vs. public), school level (elementary vs. high), teaching experience, the number of their visitations to the setting (first time vs. 20th), the number of trainings towards informal learning environments participated (experienced vs. novice teachers) can elaborate the results of the current study.

Conducting an experimental study to improve teacher roles during the visit is also needed. For this purpose researchers can develop PD programs and test the effectiveness of these programs on teachers' adopted roles during the visit.

Altough there are strong assumptions about the relationship between teacher roles and students' gains, the available literature does not provide a clear picture about the details of the relations. Therefore, exploring possible relations can contribute to the literature. It is also possible that students' roles may change according to teachers' adopted roles. It would also contribute to the literature to explore how students' roles change according to teachers' roles or vice versa.

REFERENCES

Anderson, D. (2003). Visitors' long-term memories of world expositions. *Curator, 46*(4), 401-420.

Anderson, D. (1999). *The development of science concepts emergent from science museum and post-visit activity experiences: Students' construction of knowledge*. (Doctoral dissertation). Retrieved from http://eprints.qut.edu.au/36601/1/David_Anderson_Thesis.pdf

Anderson, D., Kisiel, J., & Storksdieck, M. (2006). School field trip visits: Understanding the teacher's world through the lens of three international studies. *Curator: The Museum Journal, 49*, 365-386. doi:10.1111/j.2151-6952.2006.tb00229.x

Anderson, D., & Lucas, K. B. (1997). The effectiveness of orienting students to the physical features of a science museum prior to visitation. *Research in Science Education, 27*, 485-495. doi: 10.1007/BF02461476

Anderson, D., Lucas, K. B., Ginns, I. S., & Dierking, L. D. (2000). Development of knowledge about electricity and magnetism during a visit to a science museum and related post-visit activities. *Science Education, 84*, 658-679. doi: 10.1002/1098-237X(200009)84:5<658::AID-SCE6>3.0.CO;2-A

Anderson, D., & Zhang, Z. (2003a). Teacher perceptions of field-trip planning and implementation. *Visitor Studies Today, 6*(3), 6-11. Retrieved from http://vsa.matrix.msu.edu/

Anderson, D. & Zhang, Z. (2003b). *An Investigation of the Factors Influencing K-7 Teacher's Decisions to Make Field-Trip Visits to Science World BC*. Unpublished research report. Department of Curriculum Studies, University of British Columbia, Vancouver, Canada.

Association of Science-Technology Centres [ASTC]. (n.d.). *About science centers*. Retrieved September 19, 2014, from http://www.astc.org/sciencecenters/index.htm

Assor, A., Kaplan, H., Kanat-Maymon, Y., & Roth, G. (2005). Directly controlling teacher behaviors as predictors of poor motivation and engagement in girls and boys: The roles of anger and anxiety. *Learning and Instruction, 15*, 397-413. doi: 10.1016/j.learninstruct.2005.07.008

Auerbach, C. F., & Silverstein, L. B. (2003). *Qualitative data: An introduction to coding and analysis*. NY: NYU Press.

Bailey, E. (1999). *School group visits to museums*. Retrieved September 19, 2014, from The Association of Science-Technology Centres, Resource Center website: http://www.astc.org/resource/education/bailey.htm

Balling, J. D., & Falk, J. H. (1980). A perspective on field trips: Environmental effects on learning. *Curator: The Museum Journal*, *23*, 229-240. doi: 10.1111/j.2151-6952.1980.tb01672.x

Bamberger, Y., & Tal, T. (2008b). An experience for the lifelong journey: The long-term effect of a class visit to a science center. *Visitor Studies, 11,* 198-212. doi:10.1080/10645570802355760

Bamberger, Y., & Tal, T. (2007). Learning in a personal context: Levels of choice in a free choice learning environment in science and natural history museums. *Science Education, 91,* 75-95. doi: 10.1002/sce.20174

Bamberger, Y., & Tal, T. (2006). Learning in a personal context: Levels of choice in a free choice learning environment in science and natural history museums. *Science Education, 91,* 75-95. doi: 10.102/sce.20174

Barmby, P., Kind, P.M., & Jones, K. (2008). Examining changing attitudes in secondary school science. *International Journal of Science Education, 30,* 1075-1093. doi:10.1080/09500690701344966

Beardsley, *D. G. (*1975*)*. Helping teachers to use museums. *Curator: The Museum Journal*, *18*, 192-199. doi:10.1111/j.2151-6952.1975.tb01253.x

Behrendt, M., & Franklin, T. (2014). A review of research on school field trips and their value in education. *International Journal of Environmental & Science Education, 9,* 235-245. doi:10.12973/ijese.2014.213a

Beiers, M. R., & McRobbie, C. (1992). Learning in interactive science centres. *Research in Science Education*, *22*, 38-44. doi:10.1007/BF02356877

Birney, B. A. (1988). Criteria for successful museum and zoo visits: Children offer guidance. *Curator: The Museum Journal*, *31*, 292-316. doi:10.1111/j.2151-6952.1988.tb00701.x

Bitgood, S. (1989). School field trips: An overview. *Visitor Behavior*, *4*(2), 3-6. Retrieved from http://vsa.matrix.msu.edu/vb.php

Boeije, H. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality and Quantity, 36,* 391-409.

Boggiano, A. K., & Katz, P. (1991). Maladaptive achievement patterns in students: The role of teachers' controlling strategies. *Journal of Social Issues, 47*(4), 35–51.

Braund, M. (2004). Learning science at museums and hands-on centres. In M. Braund & M. Reiss (Eds.), *Learning science outside the classroom (pp.113-128)*. London: RoutledgeFalmer.

Braund, M., & Reiss, M. (2006a). Validity and worth in the science curriculum: learning school science outside the laboratory. *The Curriculum Journal*, *17*, 213-228. doi:10.1080/09585170600909662

Braund, M., & Reiss, M. (2006b). Towards a more authentic science curriculum: The contribution of out-of-school learning. *International Journal of Science Education*, *28*, 1373-1388. doi:10.1080/09500690500498419

Braund, M., & Reiss, M. (2004). The nature of learning science outside the classroom. In M. Braund, & M. Reiss (Eds.), *Learning science outside the classroom* (pp. 1-12). London: RoutledgeFalmer.

Brisson et al. (2010). *Informal science education policy: Issues and opportunities*. *A CAISE inquiry group report*. Retrieved September 19, 2014, from Center for Advancement of Informal Science Education website: http://informalscience.org/images/research/InformalScienceEducationPolicy.pdf

Bozdoğan, A. E., & Yalçın, N. (2009). Determining the influence of a science exhibition center training program on elementary pupils' interest and achievement in science. *Eurasia Journal of Mathematics, Science & Technology Education* , *5*(1), 27-34.

Bozdoğan, A. E., & Yalçın, N. (2006). Bilim merkezlerinin ilköğretim öğrencilerinin fene karşı ilgi düzeylerinin değişmesine ve akademik başarılarına etkisi: Enerji parkı. *Ege Eğitim Dergisi* , *7*(2), 95-114.

Carlisle, R. (1985). What do children do at a science center? *Curator: The Museum Journal*, *28*, 27-33. doi:10.1111/j.2151-6952.1985.tb01687.x

Canadian Association of Science Centres [CASC]. (2008). *Step up Canada! A science & technology engagement program for all Canadians*. Retrieved September 19, 2014 from Canadian Association of Science Centres website: http://www.canadiansciencecentres.ca/filestorage/CASC_Proposal_Elres_red.pdf

Cox-Petersen, A. M., Marsh, D. D., Kisiel, J., & Melber, L. M. (2003). Investigation of guided school tours, student learning, and science reform recommendations at a museum of natural history. *Journal of Research in Science Teaching, 40*, 200-218. doi:10.1002/tea.10072

Cox-Petersen M. & Melber, L. M. (2001). Using technology to prepare and extend field trips. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 75*, 18-20. doi:10.1080/00098650109599227

Cox-Petersen, A. M., & Pfaffinger, J. A. (1998). Teacher preparation and teacher-student interactions at a discovery center of natural history. *Journal of Elementary Science Education, 10,* 20-35. doi:10.1007/BF03173782

da Costa, A. G. (2005). Should explainers explain? *Journal of Science Communication, 4*(4), 1-4. Retrieved from http://jcom.sissa.it/

Deci, E. L., Schwartz, A. J., Sheinman, L., & Ryan, R. M. (1981). An instrument to assess adult's orientation toward control versus autonomy with children: Reflections on intrinsic motivation and perceived competence. *Journal of Educational Psychology, 73*(5), 642-650.

Delaney, A. A. (1967). An experimental investigation of the effectiveness of the teacher's introduction in implementing a science field trip. *Science Education, 51*, 474-481. doi:10.1002/sce.3730510515

deMarrais, K. (2004). Qualitative interview studies: Learning through experience. In K. deMarrais, & S. D. Lapan (Eds.), Foundations for Research: Methods of Inquiry in Education and the Social Sciences (pp. 51-68). Mahwah, NJ: Lawrence Erlbaum.

Dewey, J. (1938). *Experience and education*. New York: Kappa Delta Pi.

DeWitt, J., & Storksdieck, M. (2008). A short review of school field trips: Key findings from the past and implications for the future. *Visitor Studies, 11*, 181-197. doi:10.1080/10645570802355562

European Network of Science Centres and Museums [ECSITE]. (2008). *The impact of science and discovery centres. A review of worldwide studies.* Retrieved September 19, 2014, from http://sciencecentres.org.uk/reports/downloads/impact-of-science-discovery-centres-review-of-worldwide-studies.pdf

Ellenbogen, K. M. (2002). Museums in family life: An ethnographic case study. In G. Leinhardt, K. Crowley, & K. Knutson (Eds.), *Learning conversations in museums* (pp. 81-101). Mahwah, NJ: Lawrence Erlbaum Associates.

Ertaş, H., Şen, A. İ., & Parmasızoğlu, A. (2011). The effects of out-of-school scientific activities on 9th grade students' relating the unit of energy to daily life. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 5*(2), 178-198.

Eshach, H. (2007). Bridging in-school and out-of-school learning: Formal, non-formal, and informal learning. *Journal of Science Education and Technology, 16*, 171-190. doi: 10.1007/s10956-006-9027-1

Falk, J. H. (Ed.). (2001). *Free-choice science education: How we learn science outside of school*. New York: Teachers College Press.

Falk, J. H. (1983a). A cross-cultural investigation of the novel field trip phenomenon: National Museum of Natural History, New Delhi, India. *Curator: The Museum Journal, 26*, 315-323. doi:10.1111/j.2151-6952.1983.tb00618.x

Falk, J. H. (1983b). Field trips: A look at environmental effects on learning. *Journal of Biological Education, 17*, 137-142. doi: 10.1080/00219266.1983.9654522

Falk, J. H., & Adelman, L. M. (2003). Investigating the impact of prior knowledge and interest on aquarium visitor learning. *Journal of Research in Science Teaching, 40*, 163-176. doi:10.1002/tea.10070

Falk, J. H., & Balling, J. D. (1982). The field trip milieu: Learning and behavior as a function of contextual events. *Journal of Educational Research, 76*(1), 22-28. Retrieved from http://www.jstor.org/

Falk, J. H., & Dierking , L. D. (2010). The 95 percent solution. *American Scientist, 98*, 486-493. doi:10.1511/2010.87.486

Falk, J. H., & Dierking, L. D. (2000). *Learning from museums.* Walnut Creek, CA: AltaMira Press.

Falk, J. H., & Dierking, L. D. (1997). School field trips: Assessing their long-term impact. *Curator: The Museum Journal, 40*, 211-218. doi:10.1111/j.2151-6952.1997.tb01304.x

Falk, J. H. & Dierking, L. D. (1992). *The Museum experience*. Washington, DC: Whalesback Books.

Falk, J. H., Martin, W. W., & Balling, J. D. (1978). The novel field-trip phenomenon: Adjustment to novel settings interferes with task learning. *Journal of Research in Science Teaching, 15*, 127-134. doi: 10.1002/tea.3660150207

Falk, J. H., Moussouri, T., & Coulson, R. (1998). *The effect of visitors' agendas on museum learning*. *Curator: The Museum Journal, 41*, 107-120. doi:10.1111/j.2151-6952.1998.tb00822.x

Falk, J.H., & Needham, M.D. (2011). Measuring the impact of a science center on its community. *Journal of Research in Science Teaching, 48*, 1-12. doi:10.1002/tea.20394

Falk, J. H., Storksdieck, M., and Dierking, L. D. (2007). Investigating public science interest and understanding: Evidence for the importance of free-choice learning. *Public Understanding of Science, 16,* 455-469. doi: 10.1177/0963662506064240

Faria, C., & Chagas, I. (2013). Investigating school-guided visits to an Aquarium: What roles for science teachers?. *International Journal of Science Education, Part B: Communication and Public Engagement, 3,* 159-174. doi:10.1080/09500693.2012.674652

Finson, K. D., & Enochs, L. G. (1987). Students' attitudes toward science-technology-society resulting from a visit to a science-technology museum. *Journal of Research in Science Teaching, 42,* 593-609. doi: 10.1002/tea.3660240702

Flexer, B. K. & Borun, M. (1984). The impact of class visit to a participatory science museum exhibit and a classroom science lesson. *Journal of Research in Science Teaching, 21,* 863-873. doi:10.1002/tea.3660210902

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2011). *How to design and evaluate research in education (8th ed.)*. New York: McGraw-Hill.

Garcia, B. (2012). What do we best: Making the case for the museum learning in its own right. *Journal of Museum Education,* 37*(2),* 47-56. Retrieved from http://museumeducation.info/jme

Garnett, R. (2001). *The impact of science centers/museums on their surrounding communities: Summary report*. Retrieved September 18, 2008, from The Association of Science-Technology Center: Resource Center website: www.astc.org/resource/case/Impact_Study02.pdf

Gennaro, E. D. (1981). The effectiveness of using previsit instructional materials on learning for a museum field trip experience. *Journal of Research in Science Teaching, 18,* 275-279. doi: 10.1002/tea.3660180312

Gilbert, J., & Priest, M. (1997). Models and discourse: A primary school science class visit to a museum. *Science Education, 81,* 749-762. doi: 10.1002/(SICI)1098-237X(199711)81:6<749::AID-SCE10>3.0.CO;2-I

Gottfried, J. (1980). Do children learn on field trips? *Curator: The Museum Journal, 23,* 165-174. doi:10.1111/j.2151-6952.1980.tb00561.x

Griffin, J. (2004). Research on students and museums: Looking more closely at the students in school groups. *Science Education, 88,* S59-S70. doi: 10.1002/sce.20018

Griffin, J. M. (1998). *School-museum integrated learning experiences in science: A learning journey.* (Doctoral dissertation). Retrieved from http://epress.lib.uts.edu.au/research/handle/2100/254

Griffin, J. (1994). Learning to learn in informal science settings. *Research in Science Education, 24*, 121-128. doi:10.1007/BF02356336

Griffin, J., & Symington, D. (1997). Moving from task-oriented to learning-oriented strategies on school excursions to museums. *Science Education, 81*, 763-779. doi:10.1002/(SICI)1098-237X(199711)81:6<763::AID-SCE11>3.0.CO;2-O

Hallgren, K. A. (2012). Computing inter-rater reliability for observational data: An overview and tutorial. Tutor Quant Methods Psychology, 8(1), 23-34.

Hannon, K., & Randolph, A. (1999). Collaborations between museum educators and classroom teachers: Partnerships, curricula, and student understanding. Retrieved from ERIC database. (ED448133).

Harden, R. M., & Crosby, J. R. (2000). The good teacher is more than a lecturer – the twelve roles of the teacher. *Medical Teacher, 22*(4), 334-347.

Hein, G. E. (1998). *Learning in the museum.* (E. Hooper-Greenhill, & F. Kaplan, Eds.) Oxon: Routledge.

Hein, S. H. (1990). The Exploratorium: The museum as laboratory. Washington, D.C.: Smithsonian Institution Press.

Hein, V. (2012). The effect of teacher behaviour on students motivation and learning outcomes: A review. *Acta Kinesiologiae Universitatis Tartuensis, 18*, 9-19.

Hofstein, A., & Rosenfeld, S. (1996). Bridging the gap between formal and informal science learning. *Studies in Science Education, 28*, 87-112. doi: 10.1080/03057269608560085

Holliday, G. M., Lederman, N. G., & Lederman, J. S. (2013). Comfort and content: Considerations for informal science professional development, *International Science Education, Part B: Communication and Public Engagement*. doi: 10.1080/21548455.2013.855834

Hood, M. G. (1992). Significant issues in museum audience research. *ILVS Review, 2*(2), 281-286.

Hooper-Greenhill, E., Dodd, J., Gibson, L., Phillips, M., Jones, C., & Sullivian, E. (2005). *What did you learn at the museum today? Second study*. Retrieved September 20, 2014, from University of Leicester, Research Centre for Museums and Galleries website: https://lra.le.ac.uk/bitstream/2381/29/3/Whatdidyoulearn2.pdf

Institute for Learning Innovation. (2007). *Evaluation of Learning in Informal Learning Environments*. Retrieved from September 19, 2014, from Board on Science Education: Division of Behavioral and Social Sciences and Education website: http://sites.nationalacademies.org/DBASSE/BOSE/DBASSE_080133

Jarvis, T., & Pell, A. (2005). Factor influencing elementary school children's attitudes toward science before, during, and after a visit to the UK National Space Centre. *Journal of Research in Science Teaching, 42*, 53-58. doi:10.1002/tea.20045

Jarvis, T., & Pell, A. (2002). Effect of the challenger experience on elementary children's attitudes to science. *Journal of Research in Science Teaching, 39*, 979-1000. doi:10.1002/tea.10055

Kaspar, M. J. (1998). *Factors affecting elementary principals' and teachers' decisions to support outdoor field trips*. (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (UMI No: 9838013)

Kılıç, H. E., & Şen, A. İ. (2014). The effect of physics education based on out-of-school learning activities and critical thinking on students' attitudes. *Education and Science, 39*, 13-30. doi: 10.15390/EB.2014.3635

Kisiel, J. (2007). Examining teacher choices for science museum worksheets. *Journal of Science Teacher Education, 18*, 29-43. doi:10.1007/s10972-006-9023-6

Kisiel, J. (2006b). An examination of fieldtrip strategies and their implementation within a natural history museum. *Science Education, 90*, 434-452. doi: 10.1002/sce.20117

Kisiel, J. (2006d). Helpful hints for a successful trip. *Science Activities: Classroom Projects and Curriculum Ideas, 43*, 36-36. doi:10.3200/SATS.43.2.35-36

Kisiel, J. (2005). Understanding elementary teacher motivations for science fieldtrips. *Science Education, 89*, 936-955. doi:10.1002/sce.20085

Kisiel, J. (2003a). Teachers, museums and worksheets: A closer look at a learning experience. *Journal of Science Teacher Education, 14*, 3-21. doi:10.1023/a:1022991222494

Kisiel, J. F. (2003b). *Revealing teacher agendas: An examination of teacher motivations and strategies for conducting museum fieldtrips*. (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (UMI No: 3133296)

Koran, J. J., & Baker, S. D. (1979). Evaluating the effectiveness of field experience. In M. B. Rowe (ed.), *What research says to the science teacher*,

No. 2. (pp. 50-67). National Science Teachers' Association, Washington DC. Retrieved from ERIC database. (ED166057).

Krepel, W. J., & DuVall, C. R. (1981). *Field trips: A guide for planning and conducting educational experiences*. National Education Association, Washington, DC. Retrieved from ERIC database. (ED205526).

Krishnamurthi , A., & Rennie, L. (2011). *Informal science learning and education: Definition and goals.* Retrieved November 11, 2013, from Board on Science Education: Division of Behavioral and Social Sciences and Education website: http://sites.nationalacademies.org/DBASSE/BOSE/DBASSE_080110

Krombaβ, A., & Harms, U. (2008). Acquiring knowledge about biodiversity in a museum - Are worksheets effective?. *Journal of Biological Education, 42*, 157-163. doi:10.1080/00219266.2008.9656134

Kubota, C. A. & Olstad, R. G. (1991). Effects of novelty-reducing preparation on exploratory behavior and cognitive learning in a science museum setting. *Journal of Research in Science Teaching, 28*, 225 - 234. doi: 10.1002/tea.3660280304

Lelliott, A. D. (2007). *Learning about Astronomy: a case study exploring how grade 7 and 8 students experience sites of informal learning in South Africa.* (Doctoral dissertation). Retrieved from http://wiredspace.wits.ac.za/handle/10539/45

Lessow, B. D. (1990). *Factors related to elementary teachers' effective utilization of field trips to informal science resources*. (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (UMI No: 9119445)

Linn, M. C. (1983). Evaluation in the museum setting: Focus on expectations. *Educational Evaluation and Policy Analysis*, *5*(1), 119-127. Retrieved from http://www.jstor.org/

Lucas, K. B. (2000). One teacher's agenda for a class visit to an interactive science center. *Science Education, 84*, 524-544. doi:10.1002/1098-237X(200007)84:4<524::AID-SCE6>3.0.CO;2-X

Lyons, T. (2006). Different countries, same science classes: Students' experiences of school science in their own words. *International Journal of Science Education, 28*, 591-613. doi:10.1080/09500690500339621

Martin, W. W., Falk, J. H., & Balling, J. D. (1981). Environmental effects on learning: The outdoor field trip. *Science Education, 65*, 301-309. doi: 10.1002/sce.3730650309

McCallie et al. (2009). *Many experts, many audiences: Public engagement with science and informal science education. A CAISE inquiry group report.*

Retrieved September 20, 2014, from Center for Advancement of Informal Science Education website: http://www.informalscience.org/documents/public_engagement_with_science.pdf

McManus, P. (1985). Worksheet-induced behaviour in the British Museum (Natural History). *Journal of Biological Education, 19*, 237-242. doi: 10.1080/00219266.1985.9654736

Melber, L. M., & Cox-Peterson, A. M. (2005). Teacher professional development and informal learning environments: Investigating partnerships and possibilities. *Journal of Science Teacher Education*, *16*, 103–120.

Melton, A. W., Feldman, N. G., & Mason, C. W. (1936). *Experimental studies of the education of children in a museum of science*. American Association of Museums, Washington, DC. Retrieved from ERIC database. (ED044929)

Meredith, J. E., Fortner, R. W., & Mullins, G. W. (1997). Model of affective learning for nonformal science education facilities. *Journal of Research in Science Teaching, 34*, 805-818. doi:10.1002/(SICI)1098-2736(199710)34:8<805::AID-TEA4>3.0.CO;2-Z

Merriam, S. (2009). Qualitative research: A guide to design and implementation. San Francisco, CA: Jossey-Bass.

Michie, M. (1998). Factors influencing secondary science teachers to organise and conduct field trips. *Australian Science Teacher's Journal, 44*(4), 43-50. Retrieved from ERIC database. (EJ580552)

Michie, M. (1995). Evaluating teacher perceptions of programs at a field study centre. *Science Teachers Association of the Northern Territory Journal, 14,* 82-92. Retrieved September 20, 2014, from http://members.ozemail.com.au/~mmichie/evaluation.html

Miglietta, A. M., Belmonte, G., & Boero, F. (2008). A summative evaluation of science learning: A case study of the Marine Biology Museum "Pietro Parenzan"(South East Italy). *Visitor Studies, 11*, 213-219. doi: 10.1080/10645570802355984

Mortensen, M. F., & Smart, K. (2007). Free-choice worksheets increase students' exposure to curriculum during museum visits. *Journal of Research in Science Teaching, 44*, 1389-1414. doi:10.1002/tea.20206

Mosabala, M. S. (2009). *Looking closely at teachers who prepare for museum visits* (Master's thesis). Retrieved from http://mobile.wiredspace.wits.ac.za/handle/10539/7240

Mullins, J. A. (1998). *How Field Trips in Natural Areas Associated with Museums, Arboreta, and Aquaria Impact the Educational Experiences of*

Teachers and Students. (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (UMI No: 9840837)

Murray, I., & Reiss, M. (2005). The student review of the science curriculum. *School Science Review, 87*(318), 83-93. Retrieved from http://www.ase.org.uk/journals/school-science-review/

National Research Council [NRC]. (2009). *Learning science in informal environments: People, places, and pursuits*. Retrieved September 20, 2014, from The National Academy Press website: http://www.nap.edu/

National Research Council [NRC]. (2000). *Inquiry and the National Science Education Standards: A guide for teaching and learning*. Retrieved September 20, 2014, from The National Academy Press website: http://www.nap.edu/

National Research Council [NRC]. (1996). *National Science Education Standards*. Retrieved September 20, 2014, from The National Academy Press website: http://www.nap.edu/

Neathery, M. F. (1998). Informal learning in experiential settings. *Journal of Elementary Science Education, 10*(2), 36-49.

ODTÜ. (2006, June 7). *Orta Doğu Teknik Üniversitesi Toplum ve Bilim Uygulama ve Araştırma Merkezi Yönetmeliği*. Retrieved September 20, 2014, from Toplum ve Bilim Merkezi website: http://tbm.metu.edu.tr/yonetmelik.aspx

Orion, N. (1993). A model for the development and implementation of field trips as an integral part of the science curriculum. *School Science and Mathematics, 93,* 325-331. doi:10.1111/j.1949-8594.1993.tb12254.x

Orion, N., & Hofstein, A. (1994). Factors that influence learning during a scientific field trip in a natural environment. *Journal of Research in Science Teaching, 31,* 1097-1119. doi:10.1002/tea.3660311005

Patton, M. Q. (2002). Qualitative research and evaluation methods (3rd ed.). Thousand Oaks, CA: Sage.

Phillips, M., Finkelstein, D., & Wever-Frerichs, S. (2007). School site to museum floor: How informal science institutions work with schools. *International Journal of Science Education, 29,* 1489-1507. doi: 10.1080/09500690701494084

Pompea, S., & Hawkins, I. (2002). Increasing science literacy in optics and photonics through science centres, museums, and web-based exhibits. In T.-K. Lim & A.H. Guenther (Eds.), Proceedings of SPIE: Vol. 4588. *Seventh International Conference on Education and Training in Optics and Photonics* (pp. 554-560). Singapore: SPIE Digital Library. doi:10.1117/12.468750

Price, S. & Hein, G. E. (1991). More than a field trip: Science programmes for elementary school groups at museums. *International Journal of Science Education, 13*, 505-519. doi:10.1080/0950069910130502

Quin, M. (1990). What is hands-on science, and where can I find? *Physics Education, 25,* 258-262. doi:10.1088/0031-9120/25/5/306

Ramey-Gassert, L.,Walberg, H. J. III, &Walberg, H. J. (1994). Reexamining connections: Museums as science learning environments. *Science Education, 78*, 345-363. doi:10.1002/sce.3730780403

Rebar, B. M. (2009). *Evidence, explanations, and recommendations for teachers' field trip strategies.* (Doctoral dissertation). Retrieved September 20, 2014, from Oregon State University (OSU) Libraries website: http://ir.library.oregonstate.edu/xmlui/handle/1957/13022

Rebar, B. M., & Enochs, L. G. (2010). Integrating environmental education field trip pedagogy into science teacher preparation. In A. M. Bodzin, B. S. Klein, & S. Weaver (Eds.), *The Inclusion of Environmental Education in Science Teacher Education* (pp. 111-125). Springer Science+Business Media. doi:10.1007/978-90-481-9222-9

Rennie, L. J. (1994). Measuring affective outcomes from a visit to a science education centre. *Research in Science Education, 24,* 261-269. doi: 10.1007/BF02356352

Rennie, L. J., & McClafferty, T. P. (1996). Science centres and science learning. *Studies in Science Education, 27,* 53-98. doi:10.1080/03057269608560078

Rennie, L.J., & McClafferty, T. P. (1995). Using visits to interactive science and technology centres, museums, aquaria, and zoos to promote learning in science. *Journal of Science Teacher Education, 6*, 175-185. doi:10.1007/BF02614639

Rickinson et al. (2004, March). *A review of research on outdoor learning.* London, UK: National Foundation for Educational Research and King's College. Retrieved September 20, 2014, from Field Studies Council: Bringing Environmental Understanding to All website: http://www.field-studies-council.org/media/268859/2004_a_review_of_research_on_outdoor_learning.pdf

Rix, C., & McSorley, J. (1999). An investigation into the role that school-based interactive science centers may play in the education of primary-aged children. *International Journal of Science Education*, *21*, 577-593. doi:10.1080/095006999290453

Roschelle, J. (1995). *Learning in interactive environments: Prior knowledge and new experience*. Retrieved September 18, 2014, from Institute for inquiry website:

http://www.exploratorium.edu/ifi/resources/museumeducation/priorknowledge.html

Russell, I. (1990). Visiting a science centre: What's on offer? *Physics Education, 25*, 258-262. doi:10.1088/0031-9120/25/5/309

Sakofs, M. S. (1984). Optimizing the educational impact of a museum tour. *Curator: The Museum Journal, 27*, 135-140. doi:10.1111/j.2151-6952.1984.tb00966.x

Salmi, H. (2003). Science centres as learning laboratories: Experiences of Heureka, the Finnish science centre. *International Journal of Technology Management, 25*, 460-476. doi:10.1504/03.3113

Schatz, D. (2004, October). *The field trip challenge: Finding common ground*. Retrieved September 19, 2014, from Association of Science-Technology Centers: Publications website: http://astc.org/pubs/dimensions/2004/sept-oct/index.htm

Scribner-MacLean, M., & Kennedy, L. (2007). *More than just a day away from school: Planning a great science field trip*. Retrieved September 20, 2014, from National Science Teachers Association, Books & Resources website: http://www.nsta.org/publications/news/story.aspx?id=53714

Shortland, M. (1987). No business like show business. *Nature, 328*, 213-214. doi:10.1038/328213a0

Storksdieck, M. (2006). *Field trips in environmental education*. Berlin, Germany: Berliner Wissenschafts-Verlag.

Storksdieck, M. (2001). Differences in teachers' and students' museum field-trip experiences. *Visitor Studies Today, 4*(1), 8-12. Retrieved from http://vsa.matrix.msu.edu/

Storksdieck, M., Werner. M. & Kaul. V. (2006). *Results from the Quality Field Trip Study: Assessing the LEAD program in Cleveland, Ohio*. Annapolis, MD: Updated Technical Report. Institute for Learning Innovation. Retrieved September 20, 2014, from University Circle website: http://www.universitycircle.org/files/resources/2006leadfinalfieldtripsummary.pdf

Stradeski, L. A. (2011, May). Why children need school field trips [Web log post]. Retrieved from http://experts.eureka.org.uk/2011/05/03/why-children-need-school-field-trips/

Stronck, D. (1983). The comparative effects of different museum tours on children's attitudes and learning. *Journal of Research in Science Teaching, 20*, 283-290. doi:10.1002/tea.3660200403

Swift, M. (2010). Learning outside the classroom. *Education Update, 52*(10). Retrieved September 20, 2014, from ASCD website: http://www.ascd.org/publications/newsletters/education-update/oct10/vol52/num10/Learning-Outside-the-Classroom.aspx

Şentürk, E., & Özdemir, Ö. F. (2014). The effect of science centres on students' attitudes towards science, *International Journal of Science Education, Part B: Communication and Public Engagement, 4*, 1-24. doi: 10.1080/21548455.2012.726754

Tal, R., Bamberger, Y., & Morag, O. (2005). Guided school visits to natural history museums in Israel: Teachers' roles. *Science Education, 89*, 920-935. doi:10.1002/sce.20070

Tal, T., & Morag, O. (2007). School visits to natural history museums: Teaching or enriching?. *Journal of Research in Science Teaching, 44*, 747-769. doi:10.1002/tea.20184

Tal, T., & Steiner, L. (2006). Patterns of teacher-museum staff relationships: School visits to the educational centre of a science museum, *Canadian Journal of Science, Mathematics and Technology Education, 6*, 25-46. doi: 10.1080/14926150609556686

The Association for Supervision and Curriculum Development [ASCD]. (2010). How to / Making your field trips more meaningful. *Education Update, 52*(10). Retrieved September 20, 2014, from ASCD website: http://www.ascd.org/publications/newsletters/education-update/oct10/vol52/num10/Making-Your-Field-Trips-More-Meaningful.aspx

Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation, 27,* 237-246. doi: 10.1177/1098214005283748

Thomas, G. (2011). How to do your case study: A guide for students and researchers. Thousand Oaks, CA: Sage

Tran, U. T. (2006). Teaching science in museums: The pedagogy and goals of museum educators. *Science Education, 91,* 278-297. doi: 10.1002/sce.20193

Tuckey, C. J. (1992a). Schoolchildren's reactions to an interactive science center. *Curator: The Museum Journal, 35*, 28-38. doi:10.1111/j.2151-6952.1992.tb00732.x

Twiss, G. R. (1917). *A textbook in the principles of science teaching*. New York: MacMillan.

Watson, S., Dodd, J., & Jones, C. (2007). *Engage, learn, achieve*. Retrieved March 24, 2012, from University of Leicester, Research Centre for Museums and Galleries website:

http://www2.le.ac.uk/departments/museumstudies/rcmg/projects/engage-learn-achieve/ELA%20summary.pdf

Vygotsky, L. (1986). *Thought and language*. Cambridge, MA: The MIT Press.

Weitze, M.-D. (2003, June). Science centers: Examples from the U.S. and from Germany. Paper presented at the conference 'From the itinerant lecturers of the 18th century to popularizing physics for the 21st century', June 1–6, in Pognana sul Lario, Italy. Retrieved from http://www.histodid.uni-oldenburg.de/projekte/pognana/publication/Pognana.pdf

Wellington, J. (1990). Formal and informal learning in science: The role of interactive science centers. *Physics Education, 25*, 247-250. doi:10.1088/0031-9120/25/5/307

Yaakobi, D. (1981). Some differences in modes of use of an environmental education programme by school teachers and community leaders. *European Journal of Science Education, 3*, 69-76. doi:10.1080/0140528810030107

Youker, C. R. (2002). *Teachers' perspectives of why and how they use the resources of informal science education sites*. (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (UMI No: 3108542)

Yu, J.-C. (2005). Museum field trips in Taiwan: Teachers' perceptions of large group visits to a science museum. *Visitor Studies Today, 8*(3), 11-16. Retrieved from http://vsa.matrix.msu.edu/

APPENDIX A

THE REFERENCES USED IN TABLE 2

[1] Anderson, D. (1999). *The development of science concepts emergent from science museum and post-visit activity experiences: Students' construction of knowledge*. (Doctoral dissertation). Retrieved from http://eprints.qut.edu.au/36601/1/David_Anderson_Thesis.pdf

[2] Anderson, D., Kisiel, J., & Storksdieck, M. (2006). School field trip visits: Understanding the teacher's world through the lens of three international studies. *Curator: The Museum Journal*, *49*, 365-386. doi:10.1111/j.2151-6952.2006.tb00229.x

[3] Anderson, D., & Lucas, K. B. (1997). The effectiveness of orienting students to the physical features of a science museum prior to visitation. *Research in Science Education*, *27*, 485-495. doi: 10.1007/BF02461476

[4] Anderson, D., Lucas, K. B., Ginns, I. S., & Dierking, L. D. (2000). Development of knowledge about electricity and magnetism during a visit to a science museum and related post-visit activities. *Science Education*, *84*, 658-679. doi: 10.1002/1098-237X(200009)84:5<658::AID-SCE6>3.0.CO;2-A

[5] Balling, J. D., & Falk, J. H. (1980). A perspective on field trips: Environmental effects on learning. *Curator: The Museum Journal*, *23*, 229-240. doi: 10.1111/j.2151-6952.1980.tb01672.x

[6] Bamberger, Y., & Tal, T. (2007). Learning in a personal context: Levels of choice in a free choice learning environment in science and natural history museums. *Science Education*, *91*, 75-95. doi: 10.1002/sce.20174

[7] Barnard, W. A., Loomis, R. J., & Cross, H. A. (1980). Assessment of visual recall and recognition learning in a museum environment. *Bulletin of the Psychonomic Society*, *16*, 311-313. doi:10.3758/BF03329552

[8] Beiers, M. R., & McRobbie, C. (1992). Learning in interactive science centres. *Research in Science Education*, *22*, 38-44. doi:10.1007/BF02356877

[9] Bitgood, S. (1989). School field trips: An overview. *Visitor Behavior*, *4*(2), 3-6. Retrieved from http://vsa.matrix.msu.edu/vb.php

[10] Braund, M. (2004). Learning science at museums and hands-on centres. In M. Braund & M. Reiss (Eds.), *Learning science outside the classroom* (pp.113-128). London: RoutledgeFalmer.

[11] Carlisle, R. (1985). What do children do at a science center? *Curator: The Museum Journal, 28*, 27-33. doi:10.1111/j.2151-6952.1985.tb01687.x

[12] Cox-Petersen M. & Melber, L. M. (2001). Using technology to prepare and extend field trips. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 75*, 18-20. doi:10.1080/00098650109599227

[13] Cox-Petersen, A. M., & Pfaffinger, J. A. (1998). Teacher preparation and teacher-student interactions at a discovery center of natural history. *Journal of Elementary Science Education, 10*, 20-35. doi:10.1007/BF03173782

[14] Delaney, A. A. (1967). An experimental investigation of the effectiveness of the teacher's introduction in implementing a science field trip. *Science Education, 51*, 474-481. doi:10.1002/sce.3730510515

[15] Ellenbogen, K. M. (2002). Museums in family life: An ethnographic case study. In G. Leinhardt, K. Crowley, & K. Knutson (Eds.), *Learning conversations in museums* (pp. 81-101). Mahwah, NJ: Lawrence Erlbaum Associates.

[16] Falk, J. H. (1983b). Field trips: A look at environmental effects on learning. *Journal of Biological Education, 17*, 137-142. doi: 10.1080/00219266.1983.9654522

[17] Falk, J. H. (Ed.). (2001). *Free-choice science education: How we learn science outside of school*. New York: Teachers College Press.

[18] Falk, J. H., & Adelman, L. M. (2003). Investigating the impact of prior knowledge and interest on aquarium visitor learning. *Journal of Research in Science Teaching, 40*, 163-176. doi:10.1002/tea.10070

[19] Falk, J. H., & Balling, J. D. (1982). The field trip milieu: Learning and behavior as a function of contextual events. *Journal of Educational Research, 76*(1), 22-28. Retrieved from http://www.jstor.org/

[20] Falk, J. H. & Dierking, L. D. (1992). *The Museum experience*. Washington, DC: Whalesback Books.

[21] Falk, J. H., & Dierking, L. D. (2000). *Learning from museums*. Walnut Creek, CA: AltaMira Press.

[22] Falk, J. H., Martin, W. W., & Balling, J. D. (1978). The novel field-trip phenomenon: Adjustment to novel settings interferes with task learning. *Journal of Research in Science Teaching, 15*, 127-134. doi: 10.1002/tea.3660150207

[23] Finson, K. D., & Enochs, L. G. (1987). Students' attitudes toward science-technology-society resulting from a visit to a science-technology museum. *Journal of Research in Science Teaching, 42,* 593-609. doi: 10.1002/tea.3660240702

[24] Gennaro, E. D. (1981). The effectiveness of using previsit instructional materials on learning for a museum field trip experience. *Journal of Research in Science Teaching, 18,* 275-279. doi: 10.1002/tea.3660180312

[25] Gilbert, J., & Priest, M. (1997). Models and discourse: A primary school science class visit to a museum. *Science Education, 81,* 749-762. doi: 10.1002/(SICI)1098-237X(199711)81:6<749::AID-SCE10>3.0.CO;2-I

[26] Gottfried, J. (1980). Do children learn on field trips? *Curator: The Museum Journal, 23,* 165-174. doi:10.1111/j.2151-6952.1980.tb00561.x

[27] Guisasola, J., Morentin, M., & Zuza, K. (2005). School visits to science museums and learning sciences: a complex relationship. *Physics Education, 40,* 544-549. doi:10.1088/0031-9120/40/6/006

[28] Hofstein, A., & Rosenfeld, S. (1996). Bridging the gap between formal and informal science learning. *Studies in Science Education, 28,* 87-112. doi: 10.1080/03057269608560085

[29] Kisiel, J. (2003a). Teachers, museums and worksheets: A closer look at a learning experience. *Journal of Science Teacher Education, 14,* 3-21. doi:10.1023/a:1022991222494

[30] Kisiel, J. (2005). Understanding elementary teacher motivations for science fieldtrips. *Science Education, 89,* 936-955. doi:10.1002/sce.20085

[31] Kisiel, J. (2006a). Making field trips work. *Science Teacher, 73*(1), 46-48. Retrieved from ERIC database. (EJ758628)

[32] Kisiel, J. (2006c). More than lions and tigers and bears: Creating meaningful field trip lessons. *Science Activities: Classroom Projects and Curriculum Ideas, 43,* 7-10. doi:10.3200/SATS.43.2.7-10

[33] Kisiel, J. (2006d). Helpful hints for a successful trip. *Science Activities: Classroom Projects and Curriculum Ideas, 43,* 36-36. doi:10.3200/SATS.43.2.35-36

[34] Kisiel, J. (2007). Examining teacher choices for science museum worksheets. *Journal of Science Teacher Education, 18,* 29-43. doi:10.1007/s10972-006-9023-6

[35] Kubota, C. A. & Olstad, R. G. (1991). Effects of novelty-reducing preparation on exploratory behavior and cognitive learning in a science museum setting.

Journal of Research in Science Teaching, *28*, 225 - 234. doi: 10.1002/tea.3660280304

[36] Martin, W. W., Falk, J. H., & Balling, J. D. (1981). Environmental effects on learning: The outdoor field trip. *Science Education, 65*, 301-309. doi: 10.1002/sce.3730650309

[37] Martin, S. S., & Seevers, R. L. (2003). A field trip planning guide for early childhood classes. *Preventing School Failure: Alternative Education for Children and Youth, 47*, 177-180. doi: 10.1080/10459880309603364

[38] McLoughlin, A. S. (2004). Engineering active and effective field trips. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *77*, 160-163. doi:10.3200/TCHS.77.4.160-163

[39] Melton, A. W., Feldman, N. G., & Mason, C. W. (1936). *Experimental studies of the education of children in a museum of science*. American Association of Museums, Washington, DC. Retrieved from ERIC database. (ED044929)

[40] Mullins, J. A. (1998). *How Field Trips in Natural Areas Associated with Museums, Arboreta, and Aquaria Impact the Educational Experiences of Teachers and Students*. (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (UMI No: 9840837)

[41] Orion, N., & Hofstein, A. (1994). Factors that influence learning during a scientific field trip in a natural environment. *Journal of Research in Science Teaching*, *31*, 1097-1119. doi:10.1002/tea.3660311005

[42] Price, S. & Hein, G. E. (1991). More than a field trip: Science programmes for elementary school groups at museums. *International Journal of Science Education, 13*, 505-519. doi:10.1080/0950069910130502

[43] Rennie, L.J., & McClafferty, T. P. (1995). Using visits to interactive science and technology centres, museums, aquaria, and zoos to promote learning in science. *Journal of Science Teacher Education*, *6*, 175-185. doi:10.1007/BF02614639

[44] Storksdieck, M. (2006). *Field trips in environmental education*. Berlin, Germany: Berliner Wissenschafts-Verlag.

[45] Stronck, D. (1983). The comparative effects of different museum tours on children's attitudes and learning. *Journal of Research in Science Teaching, 20*, 283-290. doi:10.1002/tea.3660200403

[46] The Association for Supervision and Curriculum Development. (2010). How to / Making your field trips more meaningful. *Education Update*, *52*(10), 4-5. Retrieved from http://www.ascd.org/publications/newsletters/education-update/oct10/vol52/num10/Making-Your-Field-Trips-More-Meaningful.aspx

[47] Watson, K., Aubusson, P., Steel, F., & Griffin, J. (2002). A cultural of learning in an informal setting. *Journal of Australian Research in Early Childhood Education, 9*(1), 125-137. Retrieved September 20, 2014, from http://epress.lib.uts.edu.au/research/bitstream/handle/10453/5930/2004002867.pdf?sequence=3

APPENDIX B

QUESTIONNAIRE

ÖĞRETMENLERİN GÖZÜNDEN SINIF GEZİLERİ: BAKIŞ AÇILARI, ROLLERİ VE DEĞERLENDİRME BİÇİMLERİ

Orta Doğu Teknik Üniversitesi Toplum ve Bilim Uygulama ve Araştırma Merkezi'ne bağlı faaliyet gösteren Uygulamalı Bilim Merkezi, üniversite yerleşkesi içerisinde bulunan, 7'den 70'e tüm bireyler için temel bilimsel prensipleri eğlenceli ve eğitsel bir şekilde sunan, etkileşimli bir bilim merkezidir. Merkez Araştırma Görevlisi Eray Şentürk doktora çalışması kapsamında tez danışmanı Yrd. Doç. Dr. Ömer Faruk Özdemir ile siz değerli öğretmenlerimizin bir okul dışı öğrenme yerine gezi düzenlerken ki bakış açınızı, rolünüzü ve algınızı tespit etmek için bir çalışma yürütmektedir. Bu çalışmaya vereceğiniz katkılardan dolayı teşekkür ederiz.

Teşvik
Anketi tamamlayarak esenturk@metu.edu.tr adresine gönderdiğiniz takdirde Merkez faaliyetlerinden haberdar edilecek ve katılabileceğiniz etkinliklere ücretsiz katılımınız sağlanacaktır. Programlarımız hakkında sizleri bilgilendirebilmemiz için lütfen iletişim bilgilerinizi yazınız.

Ad-Soyad : _____
E-posta : _____
Cep Tel : _____

Sorularınız
Çalışma ile ilgili herhangi bir sorunuz olduğunda, Arş. Gör. Eray ŞENTÜRK ile iletişime geçebilirsiniz. Adres: ODTÜ Toplum ve Bilim Uygulama ve Araştırma Merkezi 06800 Çankaya/Ankara/TÜRKİYE; E-posta: esenturk@metu.edu.tr; İş Tel: 0312 2106053; İş Faks: 0312 2107939; Cep Tel: (532)5843422

Anketi Doldururken

Değerli öğretmenimiz, anketi doldururken aşağıda sıraladığımız noktaya dikkat etmenizi önemle rica ediyoruz.

> "Kutucuk" işaretlerken, Örn. Cinsiyetiniz: ☐ Erkek ☐ Kadın;
> kutucuğun üzerine çift tıkladığınızda açılan pencerede "**Varsayılan Değer Kısmında**" "**Onaylandı**" seçeneğini işaretlemeniz ve "**Tamam**" tuşuna basmanız yeterli olacaktır [Örn. Cinsiyetiniz: ☒ Erkek ☐ Kadın].

Sınıf Gezisi (Genel)

1) Takip eden <u>okul dışı öğrenme yerlerinden</u> hangisine/hangilerine bir sınıf gezisi düzenlediniz?

☐ Bilim Merkezi
☐ Hayvanat Bahçesi
☐ Akvaryum
☐ Gözlem Evi
☐ Kültürel/Tarihi Müze
☐ Sanat Müzesi
☐ Çocuk Müzesi
☐ Bilim Parkı
☐ Açık Hava Müzesi
☐ Diğer (<u>Lütfen yazınız</u>)_____
☐ Bugüne kadar öğrencilerimi herhangi bir okul dışı öğrenme yerine götürmedim.

2) <u>Okul dışı öğrenme yerleri dışında</u> öğrencilerinizi herhangi bir sınıf gezisine götürdünüz mü?

☐ Hayır
☐ Evet →

Cevabınız "**Evet**" ise, öğrencilerinizi nereye/nerelere götürdünüz?

3) Öğretmenlik yaptığınız süre boyunca, <u>okul dışı öğrenme yerlerine</u> yaklaşık kaç sınıf gezisi düzenlediniz?

☐ Hiç
☐ 1-2
☐ 3-5
☐ 6-10
☐ 11-20
☐ 20'den fazla

4) Okul dışı öğrenme yerlerine <u>ne sıklıkla</u> sınıf gezisi düzenliyorsunuz?

- ☐ Hiç
- ☐ Her 2-3 yılda bir kez
- ☐ Yılda bir kez
- ☐ Yılda iki kez
- ☐ Yılda ikiden fazla

5) Aşağıda sınıf gezisi düzenlerken göz önünde bulundurabileceğiniz bazı maddeleri listeledik. Fakat sınıf gezisi düzenlerken dikkate aldığınız başka konular da olabilir. Eğer öncelik verdiğiniz başka konular varsa, bunları "Diğer..." satırına yazınız. <u>Ardından</u> sizin için önem arz eden maddeleri (X) işaretleyiniz.

No	Maddeler	(X)
1	ailelerin katılımı ya da ziyaret edilecek yer seçiminde ailelerin tercihinin dikkate alınması,	
2	gerekli izinlerin alınması,	
3	ulaşım ücretleri,	
4	ziyaret edilecek yerin giriş ücreti,	
5	ziyaret edilecek yerin uzaklığı,	
6	ziyaret edilecek yerin istediğiniz zamanda gezi düzenlemek için müsait oluşu,	
7	sınıf gezisi düzenlerken karşılaştığınız zorluklar, iş yükü, harcayacağınız çaba miktarı,	
8	soruşturmadan korunma konuları,	
9	ziyaret edilecek yerin öğrenciler için ne kadar yararlı olacağı bilgisi,	
10	gezi yerinden öğrencilerinizin alacağı keyif düzeyi,	
11	gezi sonrası, elde edilen deneyimlerin sınıf içi etkinliklerde kullanılabileceği bilgisi,	
12	gezi yerinde eşlik eden rehberin öğrencilerle iletişimi, alan bilgisi,	
13	ziyaret edilecek yerdeki etkinliklerin okul öğretim programına uygunluğu,	
14	ziyaret edilecek yeri sizin görme isteğiniz,	
15	okul öğretim programı ya da eğitim-öğretim yılı dikkate alındığında uygun zaman yaratılması,	
16	ziyaret edilecek olan yere sizin aşinalığınız (daha önce görmüş olmanız),	
17	ziyaret edilecek yerin size ne kadar fayda sağlayacağı bilgisi,	
18	**Diğer...**	
19	**Diğer...**	
20	**Diğer...**	
21	**Diğer...**	

6) Yukarıda işaretlediğiniz maddelerden sizin için önem arz eden ilk 5 maddeyi "1=İlk dikkate aldığınızı; 5= En son dikkate aldığınızı" temsil edecek şekilde <u>madde numaralarını yazarak</u> sıralayınız.

Derecelendirme	1	2	3	4	5
Madde Numarası					

7) Genel olarak, okul dışı öğrenme yerlerine yaptığınız sınıf gezilerini öğrencilerinize sağladığı eğitimsel deneyim açısından değerlendirecek olsanız, nasıl değerlendirirsiniz? Bir sayının <u>altını çiziniz</u>.

Eğitimsel değeri çok az <-----**1-2-3-4-5**----> Eğitimsel değeri çok yüksek

8) Öğrencilerinizin yapılacak bilimsel geziden maksimum derecede deneyim kazanması için <u>gezi öncesinde, gezi sırasında ve gezi sonrasında</u> yapılması gerekenlerle ilgili düşünceleriniz nelerdir?

9) Okul dışı öğrenme yerlerine şimdiye kadar yaptığınız sınıf gezilerinde aşağıda sıralanan konulardan hangilerini siz ya da okulunuzdaki diğer öğretmen(ler), hangilerini okul yönetimi, hangilerini gezi düzenlenecek yer gerçekleştirmektedir? İlgili kısımları (X) işaretleyiniz.

Hazırlık/Planlama	Ben	Diğer Öğretmen(ler)	Okul Yönetimi	Gezi Düzenlenecek Yer
Gezi düzenlenecek yerin belirlenmesi				
Gezi düzenlenecek yerin eğitimsel katkısının ve okul öğretim programına uygunluğunun belirlenmesi				
Okul içi izinlerin alınması				
Ebeveyn izinlerinin alınması				
MEB'den izinlerin alınması				
Ulaşım için servislerin ayarlanması				
Servis ücretlerinin toplanması				
Gezinin organize edilmesi				
Gezi öncesi etkinliklerin belirlenmesi				
Gezi sonrası etkinliklerin belirlenmesi				

10) Yukarıdaki sorumluluk dağılımından memnun musunuz?

☐ Evet

☐ Hayır

Eğer cevabınız "**Hayır**" ise, sorumluluk dağılımlarının nasıl olmasını isterdiniz? Aynı tabloyu düşüncelerinize göre tekrar (X) işaretleyiniz.

Hazırlık/Planlama	Ben	Diğer Öğretmen(ler)	Okul Yönetimi	Gezi Düzenlenecek Yer
Gezi düzenlenecek yerin belirlenmesi				
Gezi düzenlenecek yerin eğitimsel katkısının ve okul öğretim programına uygunluğunun belirlenmesi				
Okul içi izinlerin alınması				
Ebeveyn izinlerinin alınması				
MEB'den izinlerin alınması				
Ulaşım için servislerin ayarlanması				
Servis ücretlerinin toplanması				
Gezinin organize edilmesi				
Gezi öncesi etkinliklerin belirlenmesi				
Gezi sonrası etkinliklerin belirlenmesi				

ODTÜ Uygulamalı Bilim Merkezi Hakkındaki Görüşleriniz

11) Aşağıda sıralanan <u>okul dışı öğrenme yerlerini</u> ne kadar tanımaktasınız? Uygun olan seçeneği (X) işaretleyiniz.

	Çok	Biraz	Hiç
ODTÜ Uygulamalı Bilim Merkezi			
Feza Gürsey Bilim Merkezi			
MTA Enerji Parkı			

12) Sınıfınızı <u>ne sıklıkla</u> ODTÜ Uygulamalı Bilim Merkezi'ne getiriyorsunuz?

☐ Hiç	13.sorudan devam ediniz.
☐ Son 5 yılda bir kez	14.soruya geçiniz.
☐ Son 2 yılda bir kez	14.soruya geçiniz.
☐ Son 12 ayda bir kez	14.soruya geçiniz.
☐ Son 12 ayda birden fazla	14.soruya geçiniz.

13) <u>Eğer cevabınız "Hiç" ise</u>, bugüne kadar sınıfınızı neden hiç Uygulamalı Bilim Merkezi'ne getirmediniz? Soruyu cevapladıktan sonra <u>19. soruya</u> geçiniz.

14) ODTÜ Uygulamalı Bilim Merkezi'ne yaptığınız gezileri <u>daha sıklıkla yapmanızı engelleyen</u> en önemli etkenler nelerdir?

15) Sınıf gezisi düzenlediğiniz <u>diğer okul dışı öğrenme yerleri ile kıyasladığınızda</u> ODTÜ Uygulamalı Bilim Merkezi hakkında takip eden cümlelere ne kadar katılıyorsunuz? Uygun olan seçeneği (X) işaretleyiniz.

1 = çok daha kötü
2 = daha kötü
3 = hemen hemen aynı
4 = daha iyi
5 = çok daha iyi

Diğer okul dışı öğrenme yerlerine göre ODTÜ Uygulamalı Bilim Merkezi	**1**	**2**	**3**	**4**	**5**
öğrencilerimin keyif aldığı bir yer,					
bilimsel konular için iyi bir kaynak,					
okul öğretim programına uygun bir ortam,					
öğrencilerimi yıl sonu ödüllendirebileceğim bir varış noktası,					
bir çok açıdan fayda sağlayabildiğim bir kaynak,					
öğrencilerimin aktif bir şekilde etkinliklere katılabildiği bir ortam,					
ebeveynlerin gezi düzenlemeye uygun gördüğü bir yer.					

16) Sınıf gezisi düzenlediğiniz diğer okul dışı öğrenme yerleri ile kıyasladığınızda ODTÜ Uygulamalı Bilim Merkezi'nin öğretmenlerimizle iletişimini ve Uygulamalı Bilim Merkezi'nde neler yapıldığı konusunda öğretmenlerimizi bilgilendirmesini nasıl buluyorsunuz?

☐ çok daha kötü ☐ daha kötü ☐ hemen hemen aynı ☐ daha iyi ☐ çok daha iyi

17) *ODTÜ Uygulamalı Bilim Merkezi* öğretmenlerimiz için Toplum ve Bilim Merkezi *web sayfasında (www.tbm.metu.edu.tr)* Eylül ve Şubat aylarında bir "Gezi Rehberi" yayımlamaktadır. Gezi rehberi merkez tanıtımı, randevu alım işlem basamakları, gezi için tavsiyeler, ay ay hangi etkinliklerin gerçekleşeceği gibi farklı bilgileri içermektedir. Son 12 ayda bu belgeye ulaşabildiniz mi?

☐ Evet

☐ Hayır Cevabınız **'Hayır'** ise, 19.soruya geçiniz.

☐ Böyle bir belgenin varlığından haberim yok.

Cevabınız **'Böyle bir belgenin varlığından haberim yok'** ise, *haberdar olmanız için ne yapmamızı önersiniz?* Soruyu cevapladıktan sonra 19. soruya geçiniz.

18) Yayımlanan bu "Gezi Rehberi" gezi düzenlemenizde size ne kadar yardımcı olmaktadır? Bir sayının altını çiziniz.

Hiç yardımcı olmamaktadır. <----**1-2-3-4-5** --- > Çok yardımcı olmaktadır.

19) *ODTÜ Uygulamalı Bilim Merkezi* siz değerli öğretmenlerimizin ziyaret sıklığını artırmak için bazı öneriler sunmaktadır. Aşağıda sıralanan bu öneriler için uygun gördüğünüz seçeneği (X) işaretleyiniz.

Ziyaret sıklığımda bir değişiklik yaratmayacak	← 1-2-3-4-5 →	Ziyaret sayımı kesinlikle artıracak

Öneri	1	2	3	4	5
Öğretmenlerimizin e-posta adreslerini toplayarak her dönem başı Uygulamalı Bilim Merkezi Gezi Rehberi'nin gönderilmesi					
Uygulamalı Bilim Merkezi'ne gezi planlayan öğretmenlerimize gezi öncesi e-posta yoluyla bir tanıtım sunumu gönderilmesi					
Uygulamalı Bilim Merkezi'nde yapılacak olan etkinliklerin öğretim programındaki yerlerinin gösterilmesi ve öğretim programı ile ilişkisinin kurulması					
Gezi öncesi sınıf içi yapılabilecek etkinlik paketlerinin hazırlanması					
Gezi sonrası sınıf içi yapılabilecek etkinlik paketlerinin hazırlanması					

20) ODTÜ Uygulamalı Bilim Merkezi'ne yapacağınız <u>ziyaretlerinizin sıklığını artırmak</u> için ne yapmamızı önerirsiniz?

Kişisel Bilgiler

1. **Cinsiyetiniz:** ☐ Erkek ☐ Kadın
2. **Mezun olduğunuz fakülte**

   ☐ Fen-Edebiyat Fakültesi

   ☐ Eğitim Fakültesi

   ☐ Diğer (Lütfen Yazınız)_____

3. **Formasyon eğitimi aldınız mı?**

   ☐ Evet ☐ Hayır

4. **Sahip olduğunuz bir derece var mı?**
   (Örn: Yüksek Lisans, Doktora vb.)

   ☐ Hayır ☐ Evet

   Cevabınız **"EVET"** ise belirtiniz.

5. **Bugüne kadar kaç hizmet içi eğitim kursuna katıldınız?**

   ☐ Hiç ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ >16

6. **Görev yaptığınız okulun adı:**

   _____

7. **Görev yaptığınız okulun bağlı olduğu Köy/İlçe/İl**:

   _____

8. Okulunuzda laboratuvar imkânı var mı?

☐ Evet ☐ Hayır Cevabınız "**Hayır**" ise 9. Soruya geçiniz.

Cevabınızı "**Evet**" ise laboratuvarı kullanıyor musunuz?

☐ Evet ☐ Hayır

Cevabınız "**Hayır**" ise, laboratuvarı kullanmama nedenleriniz:

9. Branşınız: _____

Şu an öğretmenlik yaptığınız branş veya branşlarınız:

_____

10. Kaç yıldır öğretmenlik yapıyorsunuz?

☐ <5 ☐ 5-10 ☐ >10

11. Sürekli aynı branşta mı eğitim verdiniz?

☐ Evet ☐ Hayır

Cevabınız **"Hayır"** ise, şu an eğitim verdiğiniz branşı kaç yıldır sürdürüyorsunuz? ….

12. Şu an eğitim verdiğiniz sınıf düzeyi/düzeyleri:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8

☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 12+

13. Kaç yıldır bu sınıf düzeyine/düzeylerine eğitim veriyorsunuz? (Birden fazla sınıf düzeyine eğitim veriyorsanız, lütfen sınıf düzeylerini ve eğitim yıllarını yazın).

Sınıf Düzeyi	Yıl

APPENDIX C

THE COVER LETTER FOR MAIL SURVEY

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

Değerli Öğretmenim,

Ekte sunduğum ODTÜ Uygulamalı Etik Araştırma Merkezi tarafından onaylı anketi, değerlendirmeniz sonucunda uygun görürseniz doldurmanızı ve en geç 1 hafta içerisinde "**esenturk@metu.edu.tr**" adresine göndermenizi rica ediyorum. Eğer değerlendirmeniz sonucunda anketi doldurmak istemezseniz: "Çalışmaya katılmak istemiyorum" ibaresinin yazılı olduğu bir e-posta göndermenizi rica ediyorum. Çalışmaya katılım gönüllük esasına dayalı olup, çalışmaya katılmamanız ne şimdi ne de gelecekte ODTÜ Toplum ve Bilim Uygulama ve Araştırma Merkezi ile olan ilişkilerinize zarar verecektir. Çalışma hakkında detaylı bilgiye ekteki izin formundan ulaşabilirsiniz. Anketi doldurup göndermeniz durumunda, bu formu okuduğunuzu, çalışma hakkında bilgilendiğinizi ve çalışmaya gönüllü olarak katıldığınızı kabul edeceğim. Olumlu ya da olumsuz geri dönüşünüz için şimdiden teşekkür ederim.

Saygılarımla.

Arş. Gör. Eray ŞENTÜRK
ODTÜ Toplum ve Bilim Uygulama ve Araştırma Merkezi
Cam Silo 06800 Çankaya/Ankara/TÜRKİYE

Tel : +90 312 210 6053
Faks : +90 312 210 7939
Cep : +90 532 584 3422
E-posta : esenturk@metu.edu.tr

APPENDIX D

THE CONSENT FORM

ÖĞRETMENLERİN GÖZÜNDEN SINIF GEZİLERİ: BAKIŞ AÇILARI, ROLLERİ VE DEĞERLENDİRME BİÇİMLERİ

Çalışma

Siz değerli öğretmenimizi, bir okul dışı öğrenme yerine gezi düzenlerken ki bakış açınızı, rolünüzü ve algınızı belirleyebilmek için yaptığımız bu çalışmaya katılmaya davet ediyoruz.

Ben Eray ŞENTÜRK, Orta Doğu Teknik Üniversitesi (ODTÜ) Fizik Eğitimi bölümü doktora öğrencisiyim. Aynı zamanda, ODTÜ Toplum ve Bilim Uygulama ve Araştırma Merkezi'nde araştırma görevlisi olarak çalışmaktayım. Katılımınızı rica ettiğimiz çalışma, doktora çalışmam. Ben ve tez danışmanım Yrd. Doç. Dr. Ömer Faruk ÖZDEMİR, bu çalışma sayesinde, siz değerli öğretmenimizin bir okul dışı öğrenme yerine gezi düzenlerken neleri dikkate aldığınızı, bir bilim merkezi ziyareti sırasında neler yaptığınızı ve ziyaret sonrasında ziyareti nasıl değerlendirdiğinizi öğrenmeyi arzu ediyoruz. Bilim merkezleri, müzeler ve benzeri okul dışı öğrenme ortamlarının fen eğitimi için çok fazla imkânlara sahip olduğunu, fakat çoğu öğretmenimizin yeteri kadar bu okul dışı öğrenme yerlerinden faydalanmadığını bilmekteyiz. Bu yüzden, bu konunun çok önemli olduğunu düşünüyoruz. Siz değerli öğretmenlerimizin görüşleri sayesinde hem okul yöneticilerine, hem öğretmen yetiştiricilerine hem de diğer öğretmenlerimize bir yol çizmenin yanı sıra, siz değerli

öğretmenlerimizin ihtiyaçlarına daha iyi yanıt verebilmek için Türkiye'deki okul dışı öğrenme yerlerine bir yol çizmeyi arzu ediyoruz.

Katılımcı olarak seçilmeniz

Araştırmacılar 2012-2013 Eğitim-Öğretim yılında ODTÜ Uygulamalı Bilim Merkezi'nden randevu alan öğretmenlerimizin hepsini seçti. Siz, bu değerli öğretmenlerimizden birisiniz. Katılımın gönüllülük esasına dayandığını hatırlatmak isteriz.

Katılımcı olarak sorumluluklarınız

Eğer bu çalışmaya katılmayı kabul ederseniz, e-posta ekinde sunduğum anketi doldurmanızı rica ediyorum. Bu ankette, bir okul dışı öğrenme yerine sınıf gezisi düzenlerken neleri dikkate aldığınızı belirlemek için oluşturulan bazı sorulara yanıt vermenizi rica ediyorum. Farklı değişkenlere (okuma/yazım hızı, açık uçlu sorulara verilen cevap uzunluğu vb.) bağlı olmakla birlikte, yapılan pilot çalışma sonunda anketin dolum süresi en fazla 30 dakika olarak belirlenmiştir. Verdiğiniz bilgilere sadece ben ve tez danışmanım tarafından erişileceğini fakat bazı durumlarda dergi editörleri ve tez izleme komitesi üyeleri tarafından da incelenebileceğini bildirmek isterim. Bilgilerinizin ODTÜ Toplum ve Bilim Merkezi ana binasındaki ofisimde kilitli bir dolapta tutulacağını temin ederim.

Rizikolar ve Yararlar

Çalışmada öngördüğümüz herhangi bir risk faktörü bulunmamaktadır. Çalışmaya katılmak ile neden gezi düzenlediğinizi detaylı bir şekilde anlamanıza yardımcı olabiliriz.

Gizlilik

Yapılan anketin sonuçları öğretmen kodları, bazı durumlarda branşları ile rapor edilecektir. Örneğin, [010, Fen Bilimleri] gibi. Sizi tanımlayacak hiçbir bilgi herhangi bir yerde raporlanmayacaktır. Bu çalışmaya katılmakla bilgilerinizin sadece takma ad ile kullanılmasına izin vermektesiniz.

APPENDIX E

A SNAPSHOT OF OBSERVER POSITION DURING WELCOMING OF SCHOOL GROUPS

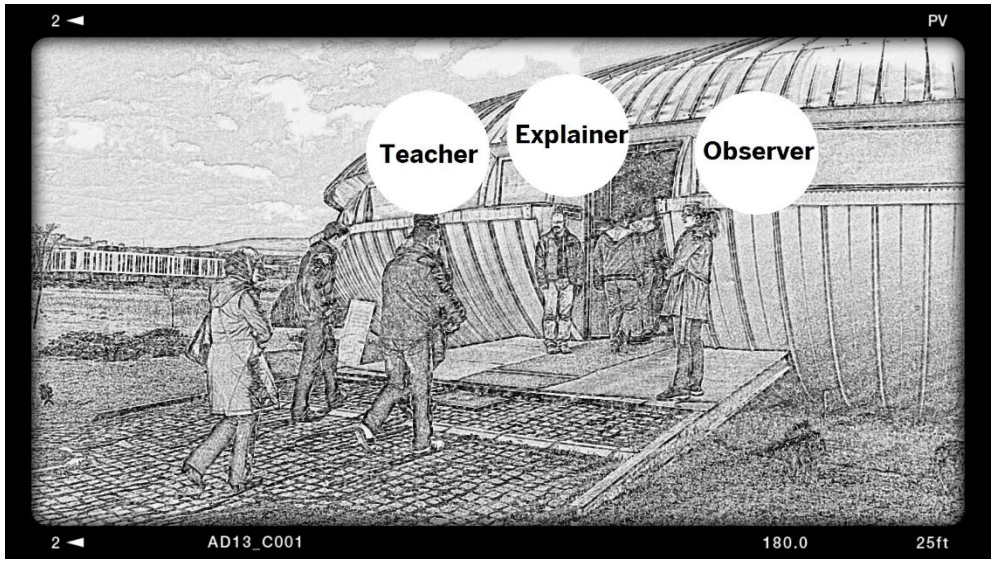


Figure 10. A snapshot of observer position during welcoming of school groups

APPENDIX F

FIELD TRIP GUIDELINE FOR EXPLAINERS

Anlatım Rehberi

ODTÜ Toplum ve Bilim Uygulama ve Araştırma Merkezi

Uygulamalı Bilim Merkezi

Güz Dönemi

2012

Değerli Hocalarım,

Uygulamalı Bilim Merkezi'ne gelen okul gruplarına sunulan hizmetin standartlaştırılması için oluşturduğum yönergeyi takip eden sayfalarda inceleyebilirsiniz. Her türlü görüş ve önerilerinize açık olan yönergedeki anlatımları 2012 Güz dönemi boyunca gelen okul gruplarına uygulayarak çalışmama destek olduğunuz için teşekkür ederim.

Saygılarımla.
Eray Şentürk

Sınıf Gezisi boyunca …

1. Öğrenci cevaplarına yanlış, doğru vb. yönlendirmeler yapmayalım. "Hımmm olabilir. Başka fikri olan var mı?" vb. kullanımları benimseyelim. Söylenenin doğru ya da yanlış olduğunu hissettirecek yorumlardan kaçınalım. Bu yaklaşımı, sınıf gezisinin başından sonuna kadar benimseyelim. Öğrenciler doğru biliyor olsa bile takdiri kendilerine bırakalım. Bu yaklaşımı benimsemedeki en büyük etken: doğru cevap veren bir çocuğu takdir ederken, başka doğru cevap veren bir çocuğu fark edemeyişimiz. Bunun sonucunda da öğrencinin küsme, surat asma ya da mutsuz bir şekilde ayrılabilir ya da "Ben de demiştim öğretmenim" vb. davranışlar sergileyebilir. Amacımız tüm çocukları güdülemek olduğu için takdiri kendilerine bırakmak da çalışan bir yöntem olduğu için bunu benimseyelim. Gözlemlerimiz öğrencilerin bu durumda "Demiştim, ben bildim. Yürü be. Oğlum bildim ya." gibi cümlelerle kendilerini takdir ettikleri yönünde.

2. Bilimsel açıklamalar, grubun seviyesine göre ayarlanabilir. Bu süreçte öğretmenlerimizi sürece dâhil etmek çok önemli! "Değerli öğretmenim, eklemek istediğiniz bir şey var mı?" vb. sorularla öğrencilerinin önbilgi düzeylerini, ilgilerini ya da nasıl iyi anlayabileceklerini en iyi bilenin kendilerinin olduğunu hissettirebilir, aktif katılımlarını sağlayabiliriz. "Sunumumu/Anlatımımı bölebilirsiniz. Ekleme ya da düzeltme yapabilirsiniz" gibi hatırlatmalar yaparak, öğretmenlerimizin konuşmasını, ilgili konuyu anlatmasını ya da öğrencileri için özetlemesini sağlayabiliriz. *Dikkat:* Eğer öğretmen herhangi bir ekleme yapma veya gösterimlerle ilgilenme gibi bir yaklaşıma sahip değilse, sizin sürekli hatırlatmalarınız öğretmenlerimizi rahatsız edebilir. Bu yüzden sadece başlangıçta hatırlatma yapmak farklı bakış açılarına sahip öğretmenlerimiz için iyi bir yaklaşım gibi gözüküyor.

3. Öğrenci gösterimleri sırasında önce tahmin etmelerini sağlayalım; sonra gözlemlemelerini sağlayalım; daha sonra açıklamalarını isteyelim. Hep bir soru ile başlamaya çalışalım. Öğrencilerden farklı cevaplar almak ve birbirlerinin cevaplarını değerlendirmelerini sağlamak çok önemli! "Arkadaşınıza katılıyor musunuz?; Farklı fikri olan var mı?" vb. cümlelerle çocukların büyük bir çoğunluğunun konuşmasını, fikir üretmesini sağlayalım.

4. Etkinliğiniz sırasında hiç konuşmayan bir öğrenci fark ederseniz, bu öğrencileri de etkinliğe dâhil etmeye çalışın. Bu öğrencilerden de fikir almaya çalışın. Her zaman doğru cevap vermenin önemli olmadığını, fikir üretmeninin önemine vurgu yapın. Gösterimleriniz sırasında gönüllü öğrenciye ihtiyaç duyarsanız, bu öğrencilerle gösterimi gerçekleştirin.

5. Serbest zaman esnasında bilim merkezi içerisinde gezinin. Bir yerde sabit durmayın. Öğrencileri sergi ünitelerini denemeleri için teşvik edebilirsiniz. Eğer öğrenciler sergi ünitelerinin çalıştırılmasına yönelik yardım isterse, yardım edin. Fakat bir sergi ünitesini direk anlatmanızı isterse, direk anlatmayın. Bunun yerine aşağıdaki senaryodaki gibi bir yaklaşım benimseyin.

> "Bir grup öğrenci eğitmene yaklaşarak sergi ünitesini anlatmasını ister. Eğitmen anlatmak yerine birlikte denemeyi önerir. Öğrencilerden birinin, sergi ünitesine ait açıklama panosundaki "Deneyin" kısmındaki basamakları okumasını ister. Her bir basamağı öğrencilerle birlikte gerçekleştirir. Bu esnada deneyen hep öğrenciler olur. Gözlemlenen olayın neden kaynaklanabileceğini öğrencilerle tartışır. Tartışma esnasında farklı soru kalıpları kullanır: "Nasıl oluyor olabilir?, Şöyle olsaydı, ne olurdu?, Bu deneyiminizden yola çıkarak, siz ne söyleyebilirsiniz?" vb. En son öğrencilerin açıklama panosundaki "Neler Oluyor?" kısmını okumalarını sağlar. Eğer öğrencilerin hala sorusu var ise cevaplamaya çalışır. Yok ise, öğrencileri benzer şekilde başka sergi ünitelerini denemeleri için cesaretlendirir."

Öğretmenlerimiz genellikle herhangi bir yardım talebinde bulunmuyorlar. Fakat bulunan olursa, yine benzer bir yaklaşım benimsenebilir. Birlikte denenebilir. Fakat açıklama panosunu okutmak yerine nedenleri üzerine konuşulabilir.

Karşılama ve Yerleşim: [maks. 10 dakika]

Okul grubumuzu her zamanki gibi güler yüzle karşılayalım.

Hatırlatmalar: Merdivenleri kullanarak ve minderlere basmadan oturmalarını rica edelim. Öğretmenlerimize mavi minderlerin kendileri için hazırlandığını, fakat istedikleri yere oturabileceklerini bildirelim.

Kendimizi tanıtmayı unutmayalım.

Grup yerleştikten sonra:

Kısa bir ODTÜ Tanıtımı ve zamanın ne kadar kıymetli olduğuna vurgu yapalım. Bugün bilim merkezinde neler yapacağımız hakkında bilgilendirelim. Öğretmenlerimizin halini hatırını soralım. ***Örneğin:***

Arkadaşlar ve değerli öğretmenlerimiz hoş geldiniz! Ben … , araştırma görevlisi olarak çalışıyorum. Aynı zamanda … alanında doktora yapıyorum.

"Gruptan sorumlu öğretmenlerimiz kim(ler) acaba? Değerli Öğretmenim, öncelikle nasılsınız? Kendinizi bize tanıtır mısınız?, Buraya ilk gelişiniz mi?, Branşınız?, Kaçıncı sınıflar burada?"

Öğretmenlerimizi tanıdık. Şimdi sizlerle tanışalım arkadaşlar. Öncelikle nasılsınız? Çalışmalar nasıl gidiyor? En sevdiğiniz ders? Sakın boş ders demeyin lütfen ☺ İleride hangi meslekleri tercih etmeyi düşünüyorsunuz? Bugün hep birlikte bazı kavramları irdeleyeceğiz; kimi zaman hararetli tartışacak, kimi zaman biraz gerçekten ortamı sulandıracağız. Önce sizlere dört tane deney aleti göstereceğim, altında yatan prensipleri birlikte tartışacağız. Daha sonra sizleri serbest bırakacağım. Bilim merkezi içerisinde yer alan istediğiniz sergi ünitesini deneyebileceksiniz. Eğer yardıma ihtiyacınız olursa, bana seslenebilirsiniz. Seve seve yardımcı olmak isterim. Hadi başlayalım.

Eğitmen Gösterimi: [maks. 25 dakika]

1. **Sergi Ünitesi: Başka Gezegenlerde Ağırlığımız [maks. 7 dakika]**

Önce biraz tartışalım. Kütle mi, ağırlık mı? Aynı şeyler mi? Farklı şeyler mi? (Öğrencilerden farklı cevaplar alalım.)

Bilimsel Açıklama:

Günlük hayatımızda genellikle kütle ve ağırlığı birbirleri yerine kullanabiliyoruz, ama bir fizikçi ve gökbilimci (astronom) için kütle ve ağırlık birbirinden oldukça farklı kavramlardır. Kütle, cismin ne kadar madde içerdiğinin ölçüsüdür ve cisimler eylemsizlik denilen bir özelliğe sahiptir. Eğer duran bir cismi hareket ettirmek isterseniz, onun eylemsizliğini yenecek bir kuvvet uygulamanız gerekecektir. İşte cismin harekete karşı gösterdiği bu dirence biz eylemsizlik diyoruz. Eylemsizlik kısaca bize, bir cismin duruyorsa durmaya devam etme isteğini; hareket ediyorsa, hareket etmeye devam etme isteğini göstermektedir. Kütle de, bir cismin ne kadar çok bu eylemsizlik özelliğini gösterdiğinin ölçüsüdür. Ağırlık ise tamamıyla farklıdır. Evrendeki kütleye sahip her nesne, kütleye sahip başka bir nesneyi çekmektedir. Bu çekim, kütlelerin büyüklüklerine ve kütlelerin arasındaki uzaklığa bağlıdır. Kütleler büyüdükçe aralarındaki çekim artmakta, kütleler arasındaki uzaklık arttıkça ise aralarındaki çekim azalmaktadır. Günlük yaşamda kullandığımız nesneler için bu çekim, fark edilmeyecek kadar azdır, fakat Dünya gibi büyük bir nesne ve sizin gibi başka bir nesne arasındaki çekim kolaylıkla ölçülebilir. Nasıl? (Öğrencilerden farklı cevaplar alalım). Yapmanız gereken tek şey bir ölçek üzerinde durmak olacaktır. Ölçek, Dünya ve sizin aranızdaki çekim kuvvetini ölçmektedir. Dünya ve sizin aranızdaki bu çekim kuvveti, ağırlık olarak adlandırılmaktadır. Hadi deneyelim.

Etkinlik:

http://www.exploratorium.edu/ronh/weight/ sayfasındaki etkinliği yapalım. Daha sonra gönüllü olan birkaç öğrenci ile farklı gezegenlerdeki ağırlıklarımız sergi ünitesinde denemeler yapalım. Özellikle kızları teşvik edin. Tartı olunca biraz isteksiz davranabiliyorlar. Erkek öğrenciler de biraz dalga geçiyor gibi. Kız

öğrencilerin genel tepkisi: "Şapşal ya. Sen aynada hiç kendine baktın mı? Git kendinle bir tanış" vb. Çok eğlenilse de, dozajına dikkat etmemiz gerekiyor. İnsanın kendisi ile barışık olması gerektiğine vurgu yapılabilir, fakat sağlıklı olmak için de normal kiloya düşme çabası sergilenmesi gerektiği belirtilmeli. Bu yüzden bu tip espri ve sataşmaların yaşanmayacağı bir kız öğrenciyi tercih edebilirsiniz. Farklı gezegenlerde kız öğrencimizin kütlesinin değişmediğini fakat ağırlığının değiştiğini öğrencilerimizin fark etmelerini sağlayalım. Zamanınıza göre birden fazla öğrenciye denetebilir, serbest zamanda herkesin kendi kendine deneyebileceğini hatırlatabilirsiniz.

Öğrencilerden/Öğretmenlerden gelebilecek bazı sorular:

1. Şimdi Ay'da kilomuz 6'da 1 olmuyor mu? Yine ağırlık ve kütle ayrımını anlatın. Birimlerin önemine vurgu yapın. 60 kilogramın 10 kilogram olmayacağını hatırlatın.
2. Sergi ünitesinde niye Plüton yok? 2006'da Plüton'un gezegenlikten çıkarılarak, cüce gezegen olarak tanımlandığını söyleyebilirsiniz.
3. Jüpiter'in gaz devi olduğu yazıyor. Gazdan oluşan bir yerde nasıl böyle baskül üzerine çıkıp tartılabilirim ki? Eğer tartılabilseydik, ağırlığının bu olacağını söyleyebilirsiniz. Jüpiter'in gaz devi olduğu bilinmesine rağmen, tam olarak iç kısımlarında ne olduğu bilinmemektedir. Fakat kayaç bir yüzeyi olsaydı ve baskül üzerinde tartım işlemi gerçekleştirebilseydik, ağırlığının sergi ünitesinin ekranında gördüğü rakam kadar olacağını söyleyebilirsiniz.

Geçiş: Nitekim cisimlerin düşmesini sağlayan kuvvet, Dünya'nın yer çekimi kuvveti. Öğrencileri zıplatın, düştüklerini, göremedikleri bir kuvvet tarafından çekildiklerini fark ettirin. Ama benim merak ettiğim elimdeki esnek cismi belirli bir yükseklikten bıraksam zıplar mı? Zıplar, zıplamaz… Zıplamaz diyenlerin yanında olun. Eğer zıplar diyen öğrenciler var ise, nereye kadar zıplayacağını sorun? Yere fırlatmayacağınızı sadece tuttuğunuz yükseklikten serbest bırakacağınızı hatırlatın.

2. **Sergi Ünitesi: Çılgın Top [maks. 6 dakika]**

Çılgın top deneyini gerçekleştirelim. Çocuklarla neden böyle bir şey olduğunu tartışalım. Sergi ünitesi ile ilgili iki enerji türünden bahsedelim. Hareket enerjisi adında da anlaşılabileceği gibi bir varlığın (var olan her şey) hareketinden ileri gelen enerjidir. Bazı maddeler hareketli olmamalarına rağmen iş yapabilme yeteneğine sahiptirler. Bu maddeler iş yaparken potansiyel enerji kullanırlar. Varlıkların, konumlarından dolayı sahip oldukları enerjiye "potansiyel enerji" diyoruz. Bir cismi yukarıya kaldırdığımızda cisim üzerinde yer çekimine karşı iş yapmış oluyoruz ve cisimde bir enerji depoluyoruz. Bu enerjiye "çekim potansiyel enerjisi" denilmektedir. Cismin kütlesi ve yerden yüksekliği artıkça, çekim potansiyel enerjisi de artar. Cisimleri sadece yukarı kaldırdığımızda değil, esnek cisimleri sıkıştırma, germe ya da burma sonucunda da bir potansiyel enerji çeşidi depolayabiliriz. Örneğin, bir yay düşünelim. Yayı sıkıştırdığımızda yayda depolan potansiyel enerji türü, "esneklik potansiyel enerjisi"dir.

Bilimsel Açıklama:

Çılgın topu herhangi bir yükseklikten serbest bıraktığımızda, bıraktığımız yükseklikten daha yükseğe zıpladığını göreceksiniz. Bıraktığımız yükseklikten daha yükseğe zıplama nedeni, kendisini ters çevirerek depoladığımız esneklik potansiyel enerjisinden kaynaklanmaktadır.

Öğrencilerden/Öğretmenlerden gelebilecek bazı sorular:

1. Çılgın topu farklı yüksekliklerden bıraktığımızda zıplayacağı yükseklik değişir mi? Eğer aynı şekilde bırakabilirseniz değişmediğini göreceksiniz. Zıplanan yüksekliğin esneklik potansiyel enerjisinden kaynaklandığını tekrar hatırlatın.
2. Futbol ya da basketbol topu bıraktığımızda bıraktığımız yükseklikten daha yükseğe zıplamıyor. Neden? Ekstra enerji depolamıyoruz.
3. Futbol ya da basketbol topu bıraktığımızda bıraktığımız yüksekliğe bile zıplayamıyor? Neden? Sürtünme…

Öğrencilere “Hangi enerji biçimlerini biliyorsunuz?” sorusunu sorarak cevaplarını alalım. Çocuklardan farklı cevaplar gelecektir. Eğer gelmez ise, biz bulmalarına yardımcı olalım. Ellerini birbirine sürttürerek ısı, lambaların yanmasını sağlayan elektrik vb.

Öğrencilerin aklını karıştırmamak için enerji türü ve enerji biçimleri ayrımına girmeyelim. Enerji biçimlerine örnekler verelim: esneklik potansiyel enerji, çekim potansiyel enerjisi, ısı enerjisi, elektrik enerjisi, manyetik enerji, kimyasal, nükleer, rüzgâr, güneş enerjisi vs.

Geçiş: Enerji biçimleri birbirlerine dönüşebilirken, toplam enerji miktarı hep aynı kalmaktadır. Buna “enerjinin korunumu” denir. Enerjinin korunumuna göre, enerji bir biçimden başka bir biçime dönüşebilir ama hiç bir zaman yok olmaz; yoktan var edilemez. Gelin hep birlikte inceleyelim...

3. Sergi Ünitesi: Newton’un Beşiği [maks. 8 dakika]

Düzenekte bulunan bilyelerin bir enerjisi olup olmadığını sorun. Çocukların potansiyel enerji demesini bekliyoruz. "Pota” Yunanca “Duruyorum” anlamına gelmektedir. Bu yüzden duran tüm cisimlerin konumlarından dolayı bir durum, durgun (potansiyel) enerjiye sahip olduklarını söyleyin. Deney düzeneğinde bulunan 5 bilyeden sol ya da sağ baştaki birini kendinize doğru biraz çekerek bıraktığınızda bu durgun[1] (potansiyel) enerjinin hareket (kinetik[2]) enerjisine dönüşeceğini söyleyin ve karşı taraftan kaç bilye çıkacağını sorun. Çocuklar 1,2,3,4 ya da hepsi diyeceklerdir. Oylama yapabilirsiniz (1 diyenler el kaldırsın, 2 diyenler ... gibi). 1 bilye bırakın ve 1 bilye çıktığını çocuklarla birlikte gözlemleyin. 2 bilye bıraksak ne olur sorusunu sorun, oylama yapın. 1 diyen çocukların yanında olun. “Bence de 1 çıkar, ama daha hızlı ve daha yükseğe”. 2 bilyeyi bırakın ve çocuklarla birlikte 2 bilye çıktığını gözlemleyin. 3 tane bıraksak ne olur? Karşı taraftan kaç bilye yükselir? 3 diyen çocuk olursa, sorun: “3 bilye yükselttiğimde diğer tarafta 2 bilye kalıyor. Böyle bir şey nasıl olabilir ki?”; 2 bilye kalan yerden 3 bilye nasıl yükselebilir ki? Eğer öğrencilerden herhangi biri ortadaki top diğer tarafa gidebilir derse, “Böyle bir şey nasıl olabilir ki?” 2 bilye kalan yerden 3 bilye nasıl yükselebilir ki?” gibi sorularla çeldirmeye çalışın.

Önerdiği fikri savunanlara herhangi bir pekiştireç "Aferin, Bravo vb." demeden, hep birlikte görelim diyerek bilyeleri bırakın. Ama çoğu söylediğinden vazgeçiyor, blöfünüz işe yarıyor. Oylama yaparak, bilyeleri bırakın ve 3 bilye çıktığını çocuklarla birlikte gözlemleyin. Ortadaki bilyenin her iki tarafa katıldığını gördüklerinden emin olun. 4 bilye bıraksaydık ne olurdu? 4. Hepsi bırakılsaydı, deneyin adı olurdu. Beşik gibi tüm bilyeler sallanırdı.

[1] Bilyeyi kaldırarak esktra çekim potansiyel enerjisi kazandırmış oluyoruz.
[2] Kineo, Yunanca "hareket ediyorum" anlamına gelmektedir.

Öğrencilerden ve Öğretmenlerden gelebilecek sorular:

1. "Bilyeyi daha yüksekten ya da daha alçaktan bıraksaydık, ne olurdu?" Diğer tarafta çıkan bilye sayısında bir değişiklik olmadığını birlikte gözlemleyin.
2. "Enerji yoktan var edilmiyordu, var olan yok olmuyordu. Ama bu bilyeler en sonunda duruyor." Evet, enerji tüketilemez. Burada hareket enerjisinin bazı enerji biçimlerine dönüştüğünü görüyoruz. Bilyelerin hava ve birbirleriyle sürtünmelerinden dolayı bir kısım hareket enerjisi ısıya; bir kısmı birbirlerine çarptıkları anda çıkardıkları sese dönüştüğünü söyleyebiliriz. "Enerji dönüştürülebilir, fakat asla tüketilemez, yoktan da var edilemez."

Bilimsel Açıklama:

İlk bilye kaldırıldığında, bilyeye yükseklik potansiyel enerjisi kazandırılmış olunur ve bilye serbest bırakıldığında yerçekiminin etkisiyle bu yükseklik potansiyel enerjisi hareket (kinetik) enerjisine dönüşür ve bilye hız kazanır. Bıraktığınız bilye ikinci bilyeye çarpar, fakat ilginç bir şekilde sadece en sondaki bilye hareket ederek yukarı çıkar. Bu durumu "Momentumun" ve "Enerjinin Korunumu" kanunları ile açıklayabiliriz. Fakat çocuklar için sadece enerji korunumundan bahsetmenizi tavsiye ediyorum. Çünkü momentum kavramı pek çoğu özellikle ilköğretim öğrencileri için anlam ifade etmeyecektir.

Çocuklara ne anlatalım?

Sabit duran bir bilyenin durgun (potansiyel) enerjisi olduğunu, yükselttiğimizde çekim potansiyel enerjisi kazandığını ve bıraktığımızda bu enerjinin hareket (kinetik) enerjiye dönüştüğünü söyledik. Bu sırada, bırakılan bilye ile çıkan bilye sayılarının hep eşit olduğunu gözlemledik. Kısaca, ne kadar ekmek, o kadar köfte. Verdiğimiz enerjiyi alıyoruz diyebiliriz. Bu bize enerjinin korunduğunu göstermektedir. Enerjinin korunumu kanununa göre, enerji yoktan var edilemez ya da var olan enerji yok edilemez. Sadece bir enerji formu başka bir enerji formuna dönüşebilir.

Geçiş: Hadi ortamı biraz sulandıralım ☺

Paskal Prensibi [maks. 4 dakika]

Elimde bir tane cam şişe ve ucunda bir pompa var. Tıpkı şırınga gibi… Şırıngadan farklı olarak şişenin üzerinde birden fazla delik var. İçerisine su dolduruyorum. Benim merak ettiğim, içinde sıvı olan bu şişenin ucundaki pompayı ileri doğru ittirdiğimde hangi delikten su çıkacak? Çocuklardan cevaplar alalım. Gösterimi gerçekleştirelim. Çocukların gözlemlediklerini açıklamalarını isteyelim.

Bilimsel Açıklama:

Sıvılar akışkandır. Bu yüzden sıvılar, içine konuldukları kabın yalnızca tabanına değil temas ettikleri bütün yüzeylerine kuvvet uygular. Uygulanan basıncın etkisiyle sıvıların hacimlerinde gözle görülebilir bir sıkışma meydana gelmediğinden, sıvılar sıkıştırılamaz kabul edilir. Sıvıya bir noktadan uygulanan basınç, sıvı ile temasta olan bütün doğrultularda aynen iletilir. Blaise Pascal (Bleyz Paskal) prensibine göre: "Kapalı bir kaptaki sıvıya uygulanan basınç, bu sıvının her noktasına ve kabın iç yüzeyinin her yüzeyine aynen iletilir." Yukarıdan pistona bir kuvvet uyguladığımızda, suya etkiyen basınç eşit bir şekilde her yöne doğru iletilmektedir. Böylelikle, tüm deliklerden aynı basınçla su dışarı çıkmaktadır. Taşıma ve sıkıştırma sistemleri, tulumbalar, hidrolik fren sistemleri, vinçler Pascal prensibine göre çalışmaktadır. Paskal prensibi gözümüzdeki basınç,

doğumdaki ıkınma, omurilik sıvısında da karşımıza çıkmaktadır. Şimdi çocukları ıslatabilirsiniz ☺

Serbest zaman [maks. 60 dakika]

Serbest zamana geçerken öğrencileri bilgilendirelim. Örneğin, "Bilim merkezi içerisinde yer alan istediğiniz sergi ünitesini deneyebileceksiniz. Koşmamanızı, sergi ünitelerinin çevresinde bulunan açıklama panolarındaki "Deneyin" kısmını okuyarak sergileri denemenizi rica ediyorum. Eğer yardıma ihtiyacınız olursa, bana seslenebilirsiniz. Seve seve yardımcı olmak isterim" vb.

Gözlem Tarihi:
Seans Saati:
Eğitmen:

Gözlem Formu				
GK			Evet	Hayır
K ve Y		Okul grubuna karşılama ve yerleşim sırasında belirtilen hatırlatmalar yapıldı mı?		
		Eğitmen kendini tanıttı mı?		
		Grup yerleştikten sonra, belirtilen konuşmalar (ODTÜ Tanıtımı, bilim merkezi programı vb.) yapıldı mı?		
EG	Sergi 1	Gösterim süresine uyuldu mu? Uyulmadı ise nedenlerini not alınız.		
		İlgili bilimsel bilgi verildi mi?		
		Anlatım rehberinde belirtilen örnek/benzer sorular soruldu mu?		
		Diğer sergi ünitesine geçiş sağlandı mı?		
	Sergi 2	Gösterim süresine uyuldu mu? Uyulmadı ise nedenlerini not alınız.		
		İlgili bilimsel bilgi verildi mi?		
		Anlatım rehberinde belirtilen örnek/benzer sorular soruldu mu?		
		Diğer sergi ünitesine geçiş sağlandı mı?		
	Sergi 3	Gösterim süresine uyuldu mu? Uyulmadı ise nedenlerini not alınız.		
		İlgili bilimsel bilgi verildi mi?		
		Anlatım rehberinde belirtilen örnek/benzer sorular soruldu mu?		
		Diğer sergi ünitesine geçiş sağlandı mı?		
	Sergi 4	Gösterim süresine uyuldu mu? Uyulmadı ise nedenlerini not alınız.		
		İlgili bilimsel bilgi verildi mi?		
		Anlatım rehberinde belirtilen örnek/benzer sorular soruldu mu?		
		Serbest zamana geçiş hakkında bilgi verildi mi?		
SZ		Serbest zamanda belirtilenler yapıldı mı?		
		Öğretmenden ya da öğrenciden farklı bir istek geldi mi? Geldiyse lütfen not alınız.		
		Serbest zaman süresine uyuldu mu?		

Not. GK: Gezi Kısımları; K ve Y: Karşılama ve Yerleşim; EG: Eğitmen Gösterimleri; SZ: Serbest Zaman'ı temsil etmektedir. Farklı gerçekleşen her durum için detaylı notlar alınmalıdır.

İlgili Notlar:

APPENDIX G

THE DEMOGRAPHIC INFORMATION OF TEACHERS OF CASE I

Table 21

The demographic information of teachers of Case I

Teacher Codes	Observer	Date	Session	Explainer	Gender	Branch	Teaching Experience (years)	School Type	Grade	The number of participated students	The number of teacher(s)/ parent(s)	Visit Duration (min)
001	O1+ O2	19.12.2012	14.00	RY	Female	Physics	>10	Science High School (private)	9th and 10th (mixed)	23	1	72
002	O1	11.03.2013	14.00	SS	Female	Natural Sciences	5-10	Middle School (private)	7th and 8th (mixed)	40	3	75
003	O1	13.03.2013	14.00	SS	Female	Classroom	<5	Primary School (private)	1st through 4th (mixed)	37	3 / 1	73
004	O1	14.03.2013	14.00	SS	Female	Classroom	>10	Primary School (public)	1st through 4th (mixed)	39	3	71
005	O1+ O2	03.04.2013	11.00	RY	Male	Psychological Counselling and Guidance	>10	Anatolian High School (public)	9th	40	1	90
006	O1	04.04.2013	09.30	SS	Female	Physics	>10	Anatolian High School (public)	9th	38	1	78
007	O1	05.04.2013	09.30	RY	Female	Psychological Counselling and Guidance	>10	Anatolian Medical Vocational High School (public)	9th	30	1	75

Table 21 *(continued)*

Teacher Codes	Observer	Date	Session	Explainer	Gender	Branch	Teaching Experience (years)	School Type	Grade	The number of participated students	The number of teacher(s)/parent(s)	Visit Duration (min)
008*	01+02	05.04.2013	11.00	RY	Female	Natural Sciences	5-10	Middle School (public)	6th	40	1 / 1	60
009	01	10.04.2013	09.30	SS	Female	Psychological Counselling and Guidance	>10	Anatolian Vocational and Technical High School (public)	9th	30	1	77
010	01	11.04.2013	11.00	SS	Female	Classroom	>10	Primary School (public)	3rd	40	1 / 1	75
011	01	11.04.2013	14.00	RY	Female	Natural Sciences	>10	Middle School (private)	6th	40	1	80
012	01	15.04.2013	09.30	SS	Male	Physics	5-10	Anatolian High School	9th	40	1	60
013	01	07.05.2013	09.30	SS	Female	Natural Sciences	>10	Middle School (public)	5th	42	1	80
014	01	07.05.2013	14.00	RY	Female	Natural Sciences	>10	Middle School (private)	7th	40	2	87
015	01	08.05.2013	14.00	RY	Female	Physics	5-10	High School (private)	10th	40	2	100
016	01+02	13.05.2013	14.00	RY	Female	Natural Sciences	5-10	Middle School (public)	7th	40	1	59
017	01	16.05.2013	11.00	SS	Female	Classroom	>10	Primary School (private)	4th	40	1	71
018	01	20.05.2013	09.30	SS	Female	Natural Sciences	>10	Middle School (public)	6th, 7th, and 8th (mixed)	40	1	76
019	01	20.05.2013	11.00	SS	Female	Natural Sciences	>10	Primary School (public)	4th	40	1	73
020	01	22.05.2013	11.00	SS	Female	Natural Sciences	5-10	Primary School (public)	4th	30	1	60
021	01	22.05.2013	14.00	RY	Female	Natural Sciences	5-10	Middle School (public)	6th and 7th (mixed)	15	1	76
022	01	24.05.2013	09.30	RY	Female	Natural Sciences	>10	Middle School (private)	5th	40	1 / 2	70
023	01+02	28.05.2013	11.00	RY	Female	Chemistry	>10	High School (private)	9th	36	2	70
024	01	29.05.2013	11.00	RY	Female	Physics	>10	High School (private)	9th	37	1 / 1 bus driver	78
025	01	29.05.2013	14.00	RY	Female	Natural Sciences	>10	Middle School (public)	5th through 8th (mixed)	28	1	50

APPENDIX H

THE VIEW OF OBSERVER POSITIONS FROM THE EYES OF EXPLAINER DURING EXPLAINER DEMONSTRATION

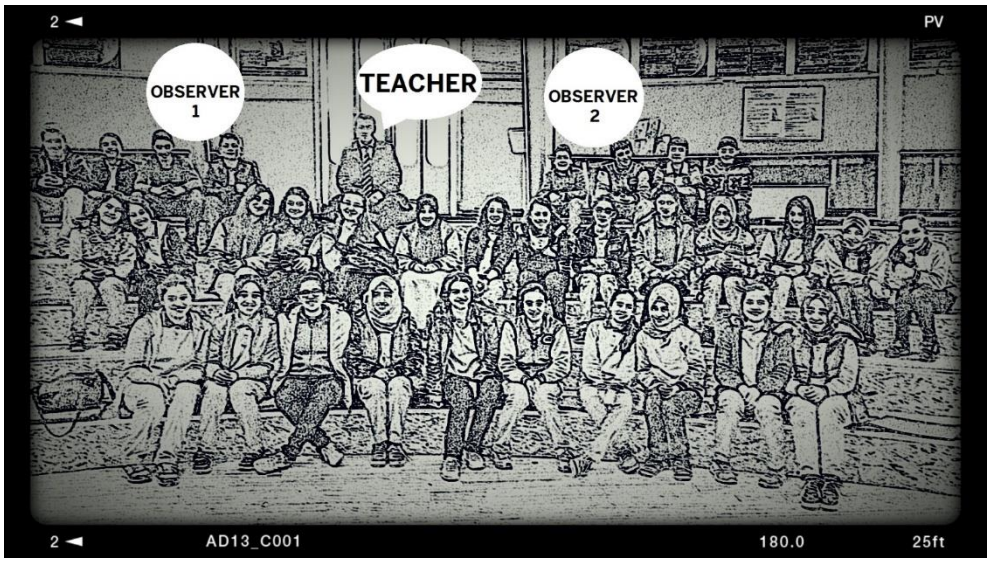


Figure 11. The view of observer positions from the eyes of explainer during explainer demonstration

APPENDIX I

A SNAPSHOT OF OBSERVER POSITION DURING FREE EXPLORATION

Figure 12. A snapshot of observer position during free exploration

APPENDIX J

OBSERVATION CHECKLIST

Table 22

Observation checklist

Date: / Session Time: / Private or Public / Male or Female / Branch: / Grade:
/ Teaching Experience: <5, 5-10, >1

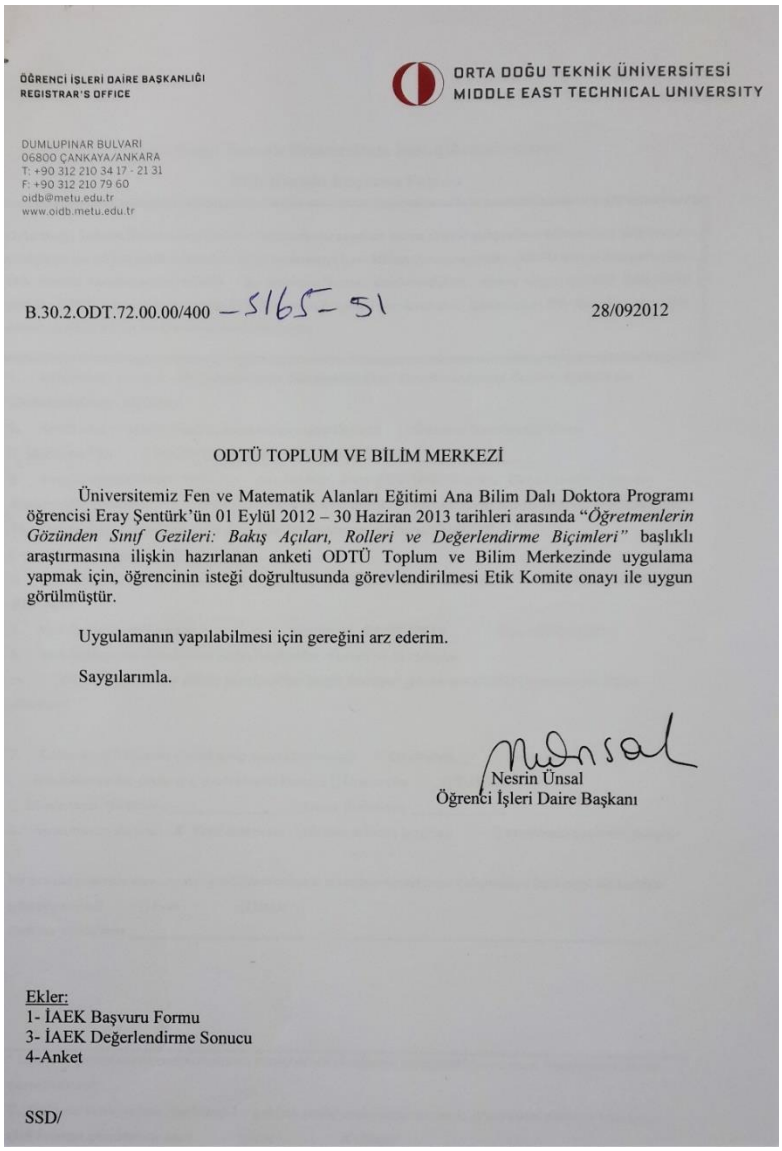
TEACHER ROLES			W&A	ED	FE
SUPERINTENDENT	**Technical Directions Giver** (Line up, Whom I'm speaking to etc.)				
	Attention Stimulator (We saw last week in Feza Gürsey etc.)				
	Contoller (keeping track of students' behaviours, **explaining** technical issues e.g., we're expected to see two other buildings, we're going out! etc.)				
	Requester (from explainer or students; taking pictures, repeating demonstrations etc.)				
	Technical Assistant (for explainer to select volunteer students, helping students in operation of the exhibits etc.)				
	Motivator	**By encouragement** (e.g., C'mon, you can do this!)			
		By praise (e.g., Well done to my son!)			
INFORMATION PROVIDER	These teachers generally inform students about what exhibits/demonstrations tell them by using different methods such as	by **explaining exhibits based on his/her prior knowledge**			
		by **explaining exhibits by label reading**			
		by **summarizing** what was told by explainer			
		by **rephrasing** what was told by explainer			
		by **connecting students' everyday life experiences** to the experiences provided by exhibits/demonstrations			
		by **connecting students' school experiences** to the experiences provided by exhibits/demonstrations			
	These teachers may also inform explainer about …	the current curriculum implementations			
		physics lectures at school			
		visit in general			
		Ministry of National Education regulations			
INFORMATION SEEKER	By **asking explainer** to get some information about	demonstrations/exhibits			
		visit in general			
		the supply of materials			
		the scientific explanations			

Table 22 *(continued)*

TEACHER ROLES			W&A	ED	FE
FACILITATOR	Helping students do something more easily or find answers to a problem, by discussing things and suggesting ways of doing				
RECORDER	Taking photos of students				
	Taking photos of experiments and/or their labels				
PARTICIPATOR	**Observer** (just sit, listen, and watch during explainer demonstrations or approach to an exhibit, look but not try just wander during free exploration)				
	Reader (read the labels of exhibits but not try)				
	Experimenter	by reading labels			
		by without reading labels			
	Group Member	Engage in physical activities requested by explainer (e.g., rubbing hands together, holding the spring to feel vibrations etc.)			
		Ask questions to explainer			
		Answer questions raised by explainer			
		Discuss questions raised by explainer or demonstrations with teacher/students			
INDIFFERENT These teachers showed some indifference towards	**w**hat students/parents/colleagues asked				
	what was demonstrated by explainer				
	field trip (entrusting students and leaving the building during field trip etc.)				
	what explainer asked for (e.g., "Dear teacher/s, please sit wherever you want too. Switch off your mobile phones, Is there anything you add to? etc.)				
	what was told by explainer				
	participating in the activities requested by explainer such as (rubbing hands together, holding the spring to feel vibrations etc.)				

APPENDIX K

ETHICAL APPROVAL TAKEN FROM METU HSEC



ÖĞRENCİ İŞLERİ DAİRE BAŞKANLIĞI
REGISTRAR'S OFFICE

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

DUMLUPINAR BULVARI
06800 ÇANKAYA/ANKARA
T: +90 312 210 34 17 - 21 31
F: +90 312 210 79 60
oidb@metu.edu.tr
www.oidb.metu.edu.tr

B.30.2.ODT.72.00.00/400 -5165-51 28/092012

ODTÜ TOPLUM VE BİLİM MERKEZİ

Üniversitemiz Fen ve Matematik Alanları Eğitimi Ana Bilim Dalı Doktora Programı öğrencisi Eray Şentürk'ün 01 Eylül 2012 – 30 Haziran 2013 tarihleri arasında "*Öğretmenlerin Gözünden Sınıf Gezileri: Bakış Açıları, Rolleri ve Değerlendirme Biçimleri"* başlıklı araştırmasına ilişkin hazırlanan anketi ODTÜ Toplum ve Bilim Merkezinde uygulama yapmak için, öğrencinin isteği doğrultusunda görevlendirilmesi Etik Komite onayı ile uygun görülmüştür.

Uygulamanın yapılabilmesi için gereğini arz ederim.

Saygılarımla.

Nesrin Ünsal
Öğrenci İşleri Daire Başkanı

Ekler:
1- İAEK Başvuru Formu
3- İAEK Değerlendirme Sonucu
4-Anket

SSD/

APPENDIX L

THE FIELD TRIP GUIDE FOR SCHOOL GROUPS

The field trip guide for school groups was provided in CD below.

APPENDIX M

AN EXAMPLE OF CODING THE PART OF A FIELD NOTE

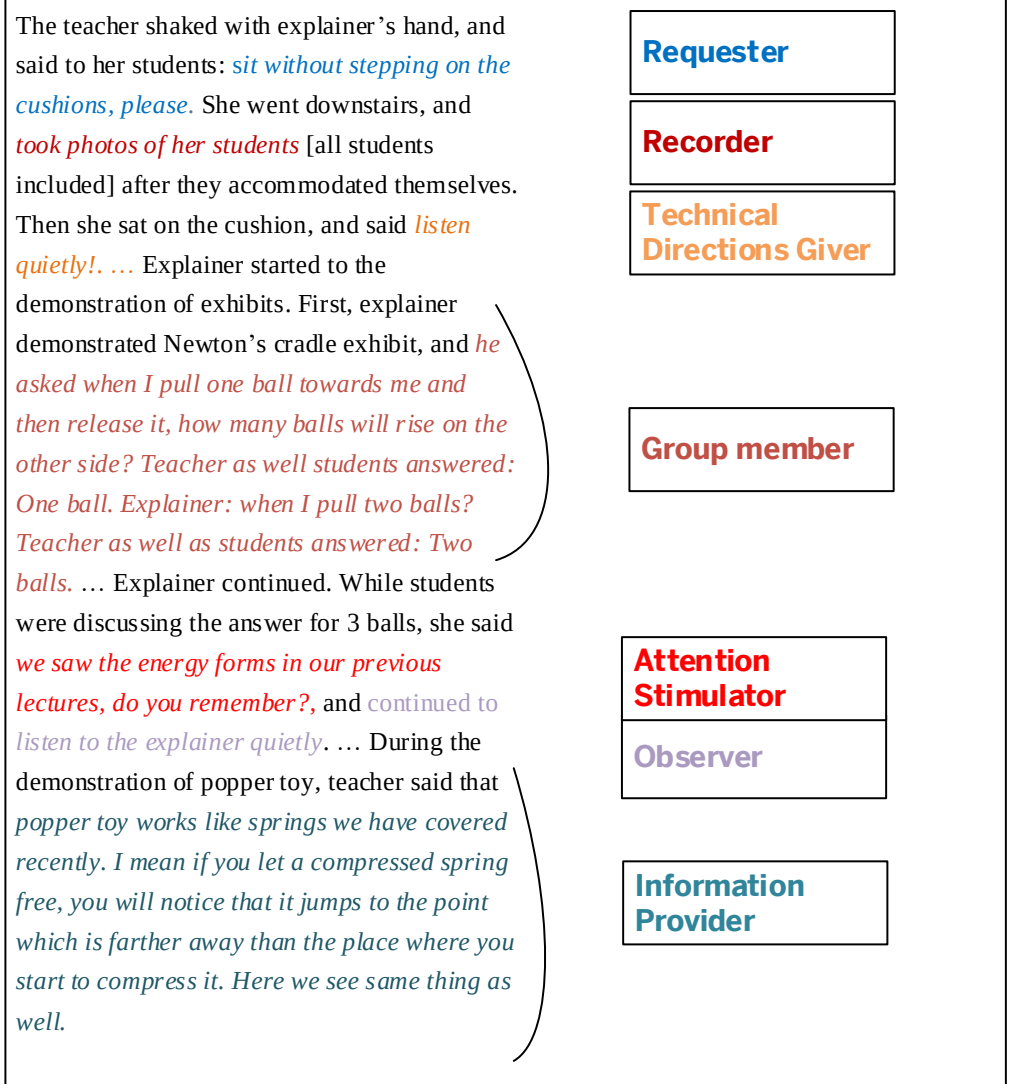


Figure 13. An example of coding the part of a field note

APPENDIX N

TEACHER ROLES

TEACHER ROLES

Information Seeker

By asking explainers to get some information about

- the demonstrations/exhibits,
- visit in general
- the supply of materials,
- the scientific explanations,
- working opportunities at science center,
- programs conducted by science center,
- science center personnel,
- donation,
- university.

Participator

Observer (just sat, listened, and watched during explainer demonstration OR approached to an exhibit, looked but not tried that exhibit, OR just wandered during free exploration

Reader (read the labels of exhibits but not tried),

Experimenter

- by reading labels,
- by without reading labels

Group Member

- by engaging in activities requested by explainers,
- by asking questions to explainers/students,
- by answering questions raised by explainers,
- by discussing questions raised by explainers or demonstrations with students/other teachers.

Indifferent

These teachers showed some indifference towards

- What students/parents asked,
- Demonstrations conducted by explainers,
- Field trip,
- What explainer asked for,
- Expectations provided by explainer,
- Participating in activities requested by explainers.

Superintendent

Technical Directions Giver

- Normal approach,
- Derogatory approach

Attention Stimulator

Controller

Requester

Technical Assistant

Motivator

- by encouragement
- by praise

Recorder

These teachers took photos of students, exhibits and their labels.

Facilitator

Teachers who helps a student or a group of students doing something more easily or finding answers to problems, by discussing things and suggesting ways of doing things.

Information Provider

These teachers have informed students about what exhibits/demonstrations tell them by using different methods such as

- explaining the exhibits based on his/her prior knowledge or former experiences,
- explaining exhibits by label reading,
- summarizing or paraphrasing what was told by explainers,
- connecting students' school experiences to the experiences provided by exhibits,
- connecting students' everyday life experiences to the experiences provided by exhibits,

These teachers have also informed explainers about

- the current curriculum implementation,
- science lectures at school,
- visit in general,
- Ministry of National Education 's regulations,
- science activities conducted at schools,
- logistic problems for conducting a visit,
- demonstrations/exhibits,
- pre-visit activity.

Figure 14. Teacher roles

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Şentürk, Eray
Nationality: Turkish (T.C.)
Marital Status: Single
Phone: +90 312 210 6053
Fax: +90 312 210 6044
E-mail: esenturk@metu.edu.tr

EDUCATION

Degree	Institution	Year of
MS, Middle East Technical University	Secondary Science and Mathematics Education, Physics Education	2009
MS, Hacettepe University	Secondary Science and Mathematics Education, Physics Education	2005
BS, Hacettepe University	Secondary Science and Mathematics Education, Physics Education	2005

Foreign Languages
English

PUBLICATIONS

A. Paper Published in Journals

Şentürk, E., & Özdemir, Ö. F. (2014). The effect of science centres on students' attitudes towards science, *International Journal of Science Education, Part B: Communication and Public Engagement, 4*, 1-24. doi: 10.1080/21548455.2012.726754

B. Papers Presented in International Conferences

Eryurt, K., & Şentürk, E. (2013, August). *Analysis of Historical Content in Modern Physics Chapters in High School Physics Textbooks*. Paper presented at the ICPE International Conference on Physics Education, Prague, Czech Republic.