EXPLORING THE ENACTMENT OF THE 2007 SECONDARY SCHOOL PHYSICS CURRICULUM AT AN ANATOLIAN HIGH SCHOOL IN ISTANBUL

by

Elif Özülkü

B.S., Secondary School Science and Mathematics Education, Teaching Physics,

Boğaziçi University, 2010

Submitted to the Institute for Graduate Studies in

Science and Engineering in partial fulfillment of

the requirements for the degree of

Master of Science

Graduate Program in Secondary School Science and Mathematics Education

Boğaziçi University

2013

EXPLORING THE ENACTMENT OF THE 2007 SECONDARY SCHOOL PHYSICS CURRICULUM AT AN ANATOLIAN HIGH SCHOOL IN ISTANBUL

APPROVED BY:

Fatih Çağlayan Mercan, Ph.D. (Thesis Supervisor)	.....
Assist. Prof. Fatma Aslan-Tutak	.....
Assist. Prof. Devrim Güven	.....

DATE OF APPROVAL: 22.07.2013

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to Fatih Çağlayan Mercan for his patience, and the guidance and assistance he has provided as my thesis supervisor. He has dedicated a lot of his time for my studies.

I would like to thank my dear mother and sister for their support and understanding. Their patience, generosity and understanding throughout my undergraduate and graduate studies were invaluable. I cannot find the words to express my deeply-felt gratitude to my beloved fiancé Yavuz Öz; without his endless love, support, and English vocabulary, I could not have finished this thesis in such a limited time.

I am grateful to my old friend Yazgım Koral, my cousin Nilay Aktürk, and my colleague Ayşegül Kasaba for their professional and personal supşport.

This study was in part supported by the Boğaziçi University Scientific Research Fund (BAP) with the project code 6031. I would like to thank the Boğaziçi University Scientific Research Fund for their support.

ABSTRACT

EXPLORING THE ENACTMENT OF THE 2007 SECONDARY SCHOOL PHYSICS CURRICULUM AT AN ANATOLIAN HIGH SCHOOL IN ISTANBUL

The purpose of this study was to describe the enactment of the 2007 Secondary School Physics Program introduced in the 2008-2009 school year by three physics teachers in an Anatolian high school in İstanbul, and explain the possible interactions between the enacted curriculum and the agents of the enacted curriculum. The case study approach was adopted in this study. Data were collected through classroom observations and interviews with the observed teachers and students. All data were coded and themes were constructed according to these codes. In light of these data collected from various sources, it was concluded that; the only manner in which the teachers conformed to the intended curriculum was that they followed the order of topics, they gave few examples related to daily life, they almost never employed the teaching methods stated in the intended curriculum but instead spent most of their time in the classroom solving questions that may be asked in the national examinations, they solved questions not from the official textbook published by MEB (Ministry of National Education) but from other textbooks published by dershanes which they also used when preparing the examinations they administered at the school. It was also concluded that the components that shaped the enacted curriculum were; the intended curriculum, university entrance examinations, other textbooks, the teachers and their colleagues, the students and their parents. The teachers were heavily influenced by the university entrance examinations, which also put a lot of pressure on the students; this is among the most significant findings of this study. Suggestions for policy makers and future research were given.

ÖZET

2007 ORTAÖĞRETİM FİZİK DERSİ ÖĞRETİM PROGRAMI'NIN İSTANBUL'DAKİ BİR ANADOLU LİSESİ'NDE UYGULANIŞININ İNCELENMESİ

Bu çalışmanın amacı 2008-2009 öğretim yılında uygulanmaya başlanan 2007 Ortaöğretim Fizik Dersi Programı'nın İstanbul'da bir Anadolu lisesinde görev yapmakta olan üç fizik öğretmeni tarafından nasıl hayata geçirildiğini ortaya koymak ve sınıfta uygulanan programın eğitimin diğer bileşenleri ile olası etkileşimlerini açıklamaktır. Bunun için durum çalışması yaklaşımı kullanılmıştır. Veriler, sınıf içi gözlemler ve dersleri gözlemlenen öğretmenlerle ve öğrencilerle bireysel görüşmeler yapılarak toplanmıştır. Toplanan bütün veriler kodlanmış, ve bu kodlardan faydalanarak temalar oluşturulmuştur. Farklı kaynaklardan toplanan bu verilerin analizi ışığında, öğretmenlerin istenen müfredatın sadece konu sıralamasını takip ettikleri, günlük hayattan az sayıda örnekler verdikleri, istenen müfredatta belirtilen öğretim yöntemlerini neredeyse hiç kullanmadıkları, bunun yerine derslerinin büyük bir kısmını konularla ilgili üniversite sınavında çıkabilecek soruları çözmeye ayırdıkları, bu soruları MEB'in yayınlamış olduğu kitabın yerine kullandıkları test kitaplarından çözdükleri, ayrıca bu kitaplardan sınav hazırladıkları belirlenmiştir. Bu çalışmada uygulanan müfredatı şekillendiren unsurlar ise istenen müfredat, üniversite sınavları, test kitapları, öğretmenler ve meslektaşları, öğrenciler ve velileri olduğu belirlenmiştir. Öğrencinin üzerinde büyük bir baskı oluşturan üniversite sınavının öğretmenlerin müfredatı uygulama aşamasında onları çok etkilediği çalışmanın en büyük bulguları arasındadır. Çalışmanın sonuçlarına dayanarak çeşitli öneriler sunulmuştur.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS iii
ABSTRACT iv
ÖZET v
LIST OF FIGURES x
LIST OF TABLES xii
1. INTRODUCTION 1
1.1. Purpose of the Study and Research Questions 4
1.2. Significance of the Study 5
2. LITERATURE REVIEW 7
2.1. Definition and Domains of Curriculum 7
2.1.1. Definition of Curriculum 7
2.1.2. Domains of Curriculum 8
2.2. Education Reforms in Turkey 11
2.2.1. The Fundamental Aims and Principles of Education in the Republic Period 11
2.2.2. Reforms in Secondary School Science Education in Turkey . . . 13
2.3. Previous Studies on Curriculum Reform in Turkey 18
2.3.1. Findings Regarding the Enacted Curriculum 18
2.3.2. Findings Regarding the Intended Curriculum 22
2.3.3. Findings Regarding the National Examinations and Enacted Curriculum 24
2.3.4. Findings Regarding the Textbooks and Enacted Curriculum . . 25
2.3.5. Findings Regarding the Teachers and Enacted Curriculum . . . 27
2.3.6. Findings Regarding the Students and Enacted Curriculum . . . 29
3. METHODOLOGY 31
3.1. Design of the Study 31
3.1.1. Case Study Approach 32
3.1.2. The Research Site 33
3.2. The Participants 34

3.2.1. The Participant Teachers 34
3.2.1.1. Mr. Doe 35
3.2.1.2. Mr. Smith 35
3.2.1.3. Ms. Brown 35
3.2.2. The Participant Students 35
3.3. Data Collection 35
3.3.1. Classroom Observations 36
3.3.2. Interviews with the Teachers 37
3.3.3. Focus-Group Interviews with Students 38
3.3.4. Data Collection Process 39
3.4. Data Analysis 41
3.5. The Role of the Researcher 42
3.6. Validity, Reliability, and Ethical Considerations 42
4. FINDINGS 46
4.1. The Enacted Curriculum 46
4.1.1. Classroom Activity Modes 46
4.1.1.1. Short Presentations 48
4.1.1.2. Question Solving 72
4.1.1.3. Demonstrations 88
4.1.1.4. Off-Task Activities 109
4.1.2. Assessment 110
4.1.2.1. Formative Assessment 111
4.1.2.2. Summative Assessment 112
4.2. Interactions with the Enacted Curriculum 116
4.2.1. Intended Curriculum 116
4.2.1.1. The Intended Curriculum 116
4.2.1.2. The Intended and Enacted Curriculum 120
4.2.2. National Examinations 120
4.2.2.1. The National Examinations in Turkey 121
4.2.2.2. The Interaction of the National Examinations and the Intended Curriculum 123

4.2.2.3. The Interaction of the National Examinations and the Enacted Curriculum . . . 125
4.2.3. The Textbooks . . . 126
4.2.3.1. The Interaction of Textbooks and the Intended Curriculum . . . 126
4.2.3.2. The Interaction of the Textbooks and the National Examinations . . . 129
4.2.3.3. The Interaction of the Textbooks and the Enacted Curriculum . . . 130
4.2.4. The Teachers . . . 136
4.2.4.1. The Teachers and the Intended Curriculum . . . 136
4.2.4.2. The Teachers and the Enacted Curriculum . . . 150
4.2.4.3. The Teachers and the National Examinations . . . 166
4.2.4.4. The Teachers and the Textbooks . . . 171
4.2.4.5. The Teachers and the Students . . . 176
4.2.4.6. The Teachers and their Colleagues . . . 178
4.2.5. The Students . . . 181
4.2.5.1. Students and the Intended Curriculum . . . 181
4.2.5.2. Students and the Enacted Curriculum . . . 189
4.2.5.3. Students and the National Examinations . . . 192
4.2.5.4. Students and the Textbooks . . . 199
4.2.5.5. Students and the Teachers . . . 201
4.3. Summary of the Findings . . . 211
5. CONCLUSION, DISCUSSION AND SUGGESTIONS . . . 212
5.1. Conclusion and Discussion . . . 212
5.2. Suggestions . . . 228
5.2.1. Suggestions for Policy Makers . . . 228
5.2.2. Suggestions for Future Research . . . 230
5.3. Limitations of the Study . . . 230
APPENDIX A: INTERVIEW QUESTIONS WITH THE TEACHERS . . . 232
APPENDIX B: INTERVIEW QUESTIONS WITH THE STUDENTS . . . 233

REFERENCES 234

LIST OF FIGURES

Figure 2.1. Domains of Curriculum (Adapted from Schmidt *et al.* 1996). . . . 8

Figure 4.1. Summary of "the Enacted Curriculum". 47

Figure 4.2. Classroom activity modes. 48

Figure 4.3. Short presentations. 48

Figure 4.4. Possible teacher reactions to students' questions. 61

Figure 4.5. Question Solving. 72

Figure 4.6. Question 1. 77

Figure 4.7. Question 2. 77

Figure 4.8. Question 3. 78

Figure 4.9. The circuit that the student drew before he solved the question. . 85

Figure 4.10. Demonstrations. 89

Figure 4.11. The layout of the laboratory. 91

Figure 4.12. Off-task activities. 109

Figure 4.13. The summary of interactions with the enacted curriculum. 117

Figure 4.14. Summary of “Interactions with the Enacted Curriculum”. 118

LIST OF TABLES

Table 3.1. Observed Topics. 40

Table 3.2. Criteria for validity and reliability. 45

1. INTRODUCTION

Turkey is going through a significant science curriculum reform since 2005 which began with primary school level and continued with secondary school level. 2007 Secondary school physics curriculum was one of the renewed curricula with this curriculum reform. The focus of the 2007 physics curriculum was parallel with Organization for Economic Co-operation and Development (OECD) (2003) as "capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity" (p. 133). Turkey's low rank in 2003 PISA scores which assess students' scientific literacy show that future citizens of Turkey are far from being scientifically literate (OECD, 2004). Hence the low ranking of Turkey in Programme for International Student Assessment (PISA) in 2003 was presented as a reason for the need of a curriculum change (Gür, 2011). The exponential increase of the amount of data as a result of the new technological developments and the change of the needs of the society due to the frequency of data production is presented another need of science curriculum change by the curriculum designers (MEB, 2011a, MEB 2011b). The new physics curriculum means a paradigm shift for Turkish physics education since scientific literacy is a new term especially for teachers and students. While discussing scientific literacy, DeBoer (2000) summarizes the desired outcome of educating people as scientifically literate: "a public that finds science interesting and important, who can apply science to their own lives, and who can take part in the conversations regarding science that take place in society" (p.598). It is a sophisticated goal that one can hardly object. The initiative of the curriculum reform movement is a big step for Turkish education and it would be disappointing if the reform does not be successful.

The first phase of the curriculum reform movement started in 2005 with the adoption of a new curriculum designed for the one through six grades. The second phase of the reform movement started with the renewal of biology, chemistry, and physics curricula for the ninth grades in 2008. Every succeeding year since 2008, the new curriculum for an upper grade in secondary school was put into action. The cohort

of students who had graduated in 2012 was the first one that was taught with the new science curricula. Even though the curriculum reform covers all branches of secondary science education, biology, chemistry, and physics, the focus of this study is on the physics curriculum which had been put into action in September 2008. Throughout this study, this curriculum is referred to as 2007 physics curriculum since it was announced in 2007.

A needs analysis was conducted by The Office of Educational Research and Development (EARGED) before the development process of the curriculum was started in order to prepare a curriculum that is in alignment with the needs of the Turkish society (EARGED, 1997). The development phase of the new secondary school physics curriculum for all four grades (9-12) started after the needs analysis, in March, 2006 and finished in June, 2007 (Güneş, 2009). The new physics curriculum was put into action for all schools in Turkey in 2008-2009 fall semester without any pilot study. Two comprehensive seminars were prepared in order to introduce the new curriculum to physics teachers chosen from all over Turkey (Güneş, 2009). In addition, small scale seminars about the new curriculum, the new teaching approaches, and laboratory applications were offered to physics teachers in different regions of Turkey, however, the number of these seminars decreased every year since 2008. Feedback was sought from teachers about the structure and the content of the new physics curriculum; consequently, some small arrangements were done based on the feedback. (MEB, 2011a). An assessment was conducted by MEB (2010) for ninth and 10th grade students reaching the conclusion that across the country, students learn just one thirds of what was desired in science curricula. Researchers conducted studies in order to investigate the attitudes towards curriculum and its implementation by teachers (Balta and Eryılmaz, 2011; Baybars and Kocakülah, 2009; Demir and Demir, 2012; Ergin *et al.*, 2011; Kapucu, 2010; Karal, 2010; Kurnaz and Yiğit, 2010, Mercan, 2012) reaching varying conclusions. Some of those studies indicate that teachers cannot implement the new curriculum adequately based on interviews with teachers (Demir and Demir, 2012; Kapucu, 2010; Mercan, 2012). One of the reasons for the inadequacy of implementation could be the insufficient in-service training for the teachers (see for example, Baybars and Kocakülah, 2009; Demir and Demir, 2012; Ergin *et al.*, 2011).

Despite the efforts for spreading the new curriculum all over the country, it seems that what have been done so far is not sufficient. This might be because of the lack of a detailed strategic plan for curriculum reform. For example, in the strategic plan released by Ministry of National Education (MEB) for the years 2010-2014, secondary school curriculum reform was mentioned but what will be done in order to spread the curriculum is not explained in detail (MEB, 2009). Moreover, the number of in-service trainings for physics teachers about the new physics curriculum decreased since 2008. For instance, according to the governments' in-service training plans, there was only one in-service training that was planned for physics teachers about the new curriculum in 2012, which was cancelled as well (MEB, 2012). One reason for the drop in the number of in-service training about the new curriculum might be the assumption that teachers have internalized the new curriculum even though the research studies do not indicate so.

Countries other than Turkey also are dealing with implementation of curriculum reforms and United States (US) is one of them. According to Fullan (2007), educational reform consists of three stages. The first stage is "adoption" where policy makers decide to implement and plan a reform. The implementation of the reform should be planned along side the content of the reform at this stage. The following stage is "implementation" which corresponds to the first two or three years of reform where individuals are introduced to the reform. The experiences of the individuals about the reform in the implementation stage are important in order to proceed to the next stage, which is called "continuation". Continuation refers to acceptance of the reform and its internalization by the individuals, which means reform is accomplished successfully. According to the weak implementation plan of the curriculum reform in Turkey and the findings of the studies about the implementation of the new curriculum it might be possible that after four years, the reform has not reached the continuation stage.

A lesson learned from the reform experience in the United States (US) for the past 50 years is that reform efforts in which a community is forced to change do not succeed (Fullan, 2007; Sarason, 1996). Curriculum change is more than changing of the content. It means changing of teaching approaches of teachers, hence changing of the

roles of teachers and students and most importantly curriculum change means changing beliefs of people about education (Fullan, 2007). Overall, reform means a significant change in the school and classroom culture. Hence a resistance in the school and the classroom culture towards the reform can be expected (Evans, 2001; Sarason, 1996). Therefore, understanding the enactment of the 2007 Physics Curriculum in schools can give important information about how much the curriculum is adopted and at which points significant resistance occurs. Even though the 2007 physics curriculum was replaced with another one in 2013, exploring the enactment of 2007 physics curriculum and its relations with the other agents of the enacted curriculum may help policymakers to develop more effective implementation plans for 2013 physics curriculum. The problem is, to what extent the 2007 physics curriculum was being enacted and which agents may influence the curriculum to be enacted as intended in Turkish classrooms is not known comprehensively. Hence, this study is designed to fill this gap in knowledge about enactment of the 2007 physics curriculum in classroom.

1.1. Purpose of the Study and Research Questions

Although the former physics curriculum was replaced with a more detailed one, it cannot be assumed that teachers started to implement the 2007 physics curriculum completely. Curriculum change is more than change of the content to be learned by the students. It means changes in the teaching approaches of teachers hence changes in the roles of the teachers and the students in the classroom and most importantly change in beliefs of people about education. (Fullan, 2007). Therefore, understanding the enacted curriculum and its relation with agents of the enacted curriculum will give invaluable information about to what extent the curriculum is adopted by the teachers and the students. Determining what should be done is crucial for latter curriculum reforms such as the 2013 physics curriculum reform. Directly observing what is going on in physics classrooms in order to understand the enacted curriculum can give the policy makers an idea what could be done to improve the 2013 physics curriculum implementation process.

Hence, the purpose of this study was to understand how the intended curriculum

is being enacted in schools and why it is being enacted the way it is now by determining the interrelations between the enacted curriculum and its agents. Specifically the following research questions were explored:

(i) How the 2007 9th, 10th, and 11th grade physics curricula are being enacted in an Anatolian High School in İstanbul?
(ii) How the agents of the enacted curriculum play part in the shaping process of the enacted curriculum at the research site?

1.2. Significance of the Study

As stated before the physics curriculum reform initiation is a promising improvement for science education in Turkey since it emphasizes the importance of creating more constructivist learning environments for the students. Without a well-prepared implementation plan, the failure of the curriculum reform is likely to occur (Fullan, 2007). According to what had been done so far to help teachers and students internalize the new curriculum, the 2007 secondary school physics curriculum reform appears to have a poor implementation plan. It would not be surprising to observe inconsistencies between what is happening in the classroom and what is desired to happen. This study may shed light on the obstacles that prevented the 2007 physics curriculum to be enacted as intended by describing the enactment of that curriculum in the classroom and explaining its relation with the agents of the enacted curriculum. By doing so, what should be done to improve the implementation of 2013 physics curriculum reform can be determined.

There are few studies conducted in Turkey on the new physics curriculum reform. The focus of those studies was commonly teachers' views on the intended curriculum. Very few studies focused on the enacted curriculum in the classroom (Kapucu 2012; Taşçı, 2011; Tortop, 2012). So, there is little information about what the teacher and the students do and experience in the classroom. Kurnaz and Çepni (2012) note that there is little research conducted on the enactment of the physics curriculum in the classroom to emphasize the need for research on this issue. This study is expected to

provide a detailed description of the enacted curriculum and its relation between the agents of the enacted curriculum.

2. LITERATURE REVIEW

In this chapter, the definitions, the theoretical framework, and previous studies about curriculum reform and enacted curriculum are presented. To do so, the chapter is divided into three main sections which are namely, the definition and domains of curriculum, educational reforms in Turkey, and previous studies on curriculum reform in Turkey respectively. In the curriculum section, definitions and domains of curriculum, and curriculum reform will be discussed. The section which follows curriculum is devoted to previous reform efforts in Turkey starting from the declaration of the Turkish Republic to discuss what have been done so far in order to improve science education in Turkey. The last section is left for a review of literature about studies about current secondary school physics curriculum.

2.1. Definition and Domains of Curriculum

2.1.1. Definition of Curriculum

On defining the term curriculum, Ornstein and Hunkins (2004) stated that "The way we define curriculum by and large reflects our approach to it." (p.10). The approaches to education and learning are changing in time. As a consequence, the definition of curriculum evolves and varies with time (Wiles and Bondi, 2007). Among all, there are two main interpretations of curriculum. One of them is defining curriculum as a plan, the other is seeing it as experiences. Ornstein and Hunkins (2004) mention the definition of curriculum of Marsh and Willis which is "experiences in the classroom, [which are] planned and enacted" (p.10) in order to highlight the difference between what is planned by the policy makers and what is enacted by the implementers. Ornstein and Hunkins (2004) add learned curriculum to this definition. This interpretation of curriculum reflects one of the main assumptions of this study: planned and enacted curriculum is not always in alignment. The terms "intended curriculum", "enacted curriculum" and "attained curriculum" are called as domains of curriculum, which are described and discussed in the next section.

2.1.2. Domains of Curriculum

Schmidt *et al.* (1996) stated three levels of influence of factors that affect quality of education. These influences may be in "system" level, in "classroom" level, or in "student" level (p. 16). These levels of influence lead researchers to define terms for the curriculum which are called "domains of curriculum" (Schmidt *et al.* 1996; Ornstein and Hunkins, 2004). These domains are called specifically as intended, enacted, and attained.

Although the labels and the number of these domains of curriculum differs in literature, there are generally three domains: intended (planned), enacted (sometimes called implemented), and attained (learned) curriculum (e.g. Clarke, Clarke, and Sullivan, 1996; Corrigan, Dillon, and Gunstone, 2007; Osborne 2002; Porter and Smithson (2001); Robitaille, 1993; Schmidt, Cogan, Barrier, *et al.* , 1996).

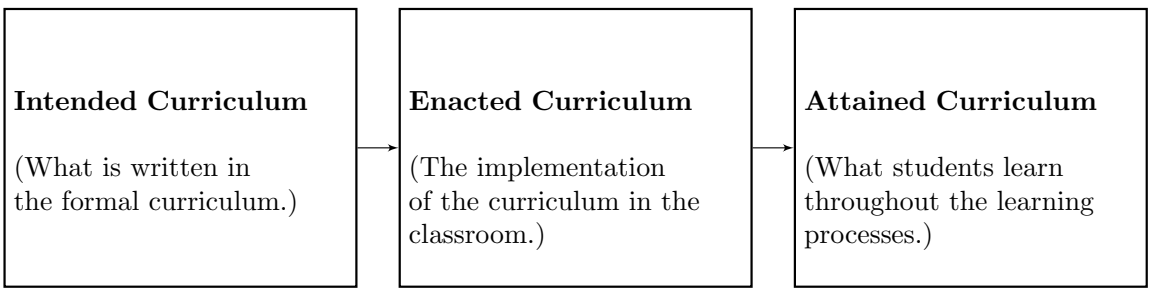


Figure 2.1. Domains of Curriculum (Adapted from Schmidt *et al.* 1996).

A summary of the domains of curriculum and their relations with each other are summarized in Figure 2.1. Intended curriculum is defined as "the educational systems' goals and means" (Schmidt *et al.* , 1996, p. 16), which is what the policy makers want students to attain through a collection of activities. According to Porter and Smithson (2001), analysis of the intended curriculum is very important since it has an essential role while the teacher uses it to figure out how the curriculum will be taught to students.

There are various definitions of enacted curriculum in the literature. While some of the researchers are concentrating on the content, some of them are focusing on interactions between teachers and students. For instance, Blank (2009) use the term enacted curriculum as "the subject content and instructional practices taught in classrooms and experienced by students" (p. 86-87) and Porter and Smithson (2001) defined it as "actual curricular content that students engage in the classroom" (p. 2). However, while defining the enacted curriculum, Remillard (1999) put more emphasis on the experiences of both teachers and students than simply doing what is written in the intended curriculum. Enacted curriculum can be also used as implemented curriculum in the literature (Jonnaert *et al.*, 2007). For example, Osborne *et al.* (2002) define it as "the set of activities, learning experiences and pedagogic strategies which teachers use to enact the intended curriculum" (p.18). Although most of the time implemented and enacted curriculum is used interchangeably, Ornstein and Hunkins (2004) briefly mention that these two terms may be used to highlight a difference. They say "Some researchers prefer to use enacted instead of implemented in order to refer to a non-technical approach" to imply that enacted curriculum can be used to mention the unpredictable nature of implementation of the curriculum in the classroom (p. 299). In this study, the enacted curriculum approach of Remillard (2005) where the teacher is considered as curriculum decision maker who do not just do what she is expected to do but rather as a curriculum developer who makes decisions on curriculum. According to this approach, one of the important characteristics of enacted curriculum is that it can be predicted by neither curriculum planners nor classroom teachers (Remillard, 1999). Interactions between the teacher and her students determine what will be done in the classroom. So enacted curriculum involves interactions with the agents of the enacted curriculum.

Attained curriculum refers to "outcomes of learning – the concepts, processes and attitudes towards school subjects that students have acquired as a consequence of their experience of any given course" (Osborne *et al.*, 2002, p.18). It is also defined as "portion of the curriculum actually attained by students. [It includes] achievement measures as well as students' attitudes, perspectives, and values" (Kuiper, Boersma, and Akker, 2005, p. 42). The indicators of attained curriculum are assessments done

in classroom or nationwide where the latter is much more dominant to make judgments and decisions on curriculum policy.

Curriculum actually does not only consist of the written documents that are delivered to teachers. Ornstein and Hunkins (2004) noted that policy makers may ignore the implementation process thinking that once the curriculum is planned and materials are arranged, the curriculum is finished. The importance of the micro-managing may not be considered adequately in a curriculum change process (Ornstein and Hunkins, 2004). But curriculum change is an extensive process which should be planned, implemented, and analyzed carefully. This may be because of the impatience of politicians who want immediate solutions to problems (OECD, 1998). As Kraig and Sharp (2004) emphasize, inevitably, there exist differences between intended, enacted, and attained curriculum. There is a gap between what policy makers want students to learn, what teacher really does in the classroom, and what students actually learn at the end. The more the realities of each group (policy makers, teachers, and students) are different, the larger the gap between intended and attained curriculum (Fullan, 2007). Enacted curriculum has the mediating role between these two. Since what is done in the classroom strongly effects what is learned by the student, this domain of curriculum requires serious consideration.

The curriculum reform movement for Turkish science education has its roots from outside the country. Spreading from the US and the United Kingdom, to all over the world, an approach in science education has begun to be adopted. International assessments such as PISA and Trends in International Mathematics and Science Study (TIMSS) have mobilized this process. This approach generally includes the goal "science for all citizens" with the teaching approach "inquiry"; hence it urges a shift of focus from the teacher to the student in the classroom (Atkin and Black, 2003). This is a very radical change for every individual in an education system beginning from curriculum developers to the students and their parents. However, shared meaning should be constructed among all individuals who are linked to curriculum change for reform to be successfully adapted. (Fullan, 2007). Hence, developing a curriculum and publishing it does not guarantee implementation. Teachers have the key role. If the

teachers do not reach a shared meaning about why the curriculum has changed, what has changed, how they should implement it and so on, the curriculum is not likely to be implemented as intended (Fullan, 2007).

2.2. Education Reforms in Turkey

In this section the educational reforms in Turkey, especially the science education reforms are discussed from the declaration of the republic in 1923 to today, 2013. Soon after the declaration of the Republic, radical regulations had been administered in Turkey especially in the fields of politics, economy, law, culture, and education. One of the most significant regulations about education after the declaration of republic is "The Law of Unification of Education" which was put into effect on March 3rd 1924. With this law the regulations listed below were administered:

(i) All education and science institutions are dependent on the Ministry of Education.
(ii) All schools and madrasah that were under the administration of religious affairs, pious foundations, or private foundations are now dependent on the Ministry of Education.
(iii) The money allocated from the budget of religious affairs and pious foundations for schools and madrasah is transferred to the budget of ministry of education.
(iv) The Ministry of Education will open a seminary in Darülfünun to train high religion experts and open separate schools for imam and preacher trainings. (Akyüz, 2008, p.330)

After these regulations all educational institutions in Turkey have been administered by the Ministry of Education.

2.2.1. The Fundamental Aims and Principles of Education in the Republic Period

With the administration of Fundamental Law of National Education in 1973, the aims and principles of national education were determined as a whole and were

explained in detail. Until that time circulars of the Ministers of Education met that need. The aims of National Education are listed as follows:

To raise all individuals of Turkish Nation as

(i) Citizens that adopt, protect and develop Turkish Nation's national, moral, human, spiritual, and cultural values ; love and always try to raise her family, home and nation; know her responsibilities to Turkey Republic, a democratic, secular and social constitutional state that depends on human rights and the basic principles that are stated at the beginning of the Constitution.

(ii) Persons who have a physically, mentally, morally, spiritually, and emotionally balanced and healthy personality and character; who have a power of free and scientific thinking; who respect human rights and value personality and enterprise; who feel responsible to the society; and who are constructive, creative, and productive.

(iii) To prepare students for life by developing their abilities and capabilities with the necessary knowledge, skills, and the habit of working in collaboration and to provide them to have a profession that can make both the individual and the society happy.

According to the same law, the fundamental principles of the national education are listed as follows:

(i) Generality and Equality
(ii) The needs of the individual and society
(iii) Orientation
(iv) Right to education
(v) Equality of opportunity
(vi) Continuity
(vii) Atatürk's principles and reforms and Atatürk's nationality
(viii) Democracy education
(ix) Secularity

(x) Being scientific
(xi) Being planned
(xii) Co-education
(xiii) School-parent cooperation
(xiv) Education everywhere

These aims and principles have not changed since 1973. As one can see both in the aims of national education and in fundamental principles of the national education, scientific thinking is present, although not as a primary item.

2.2.2. Reforms in Secondary School Science Education in Turkey

In Turkey, Modern science education resulted in many changes inspired by foreign policies like the Europe and the US. Especially at the early stages of the declaration of the republic, French science curriculum was adapted to Turkey's science education curriculum (Yilmaz and Morgil, 1992). The first such movement in Turkey was the founding of Science High Schools (Fen Liseleri) to develop modern science education with the collaboration of MEB, TUBITAK and international associations in 1964. At that time Turkey was following a very dense science program especially in high schools and it led students to memorize what they were responsible for instead of developing scientific reasoning and literacy skills. The aim of establishing Science High Schools was to construct and develop, and then spread a new science curriculum based on scientific thinking and literacy. The relation of science topics with daily life had been strengthened and a science curriculum was designed for students to develop their scientific skills. But while implementing this project, the failure to meet the need of qualified teachers, unsatisfactory level of implementing the written curriculum by using students' and teachers' guide books, and the inadequate financial support for the project lead to a break of cooperation between MEB and TUBITAK. Even though the results in pilot studies were successful, the spreading of the curriculum could not have been carried out. So the program that was being implemented in 1950's continued to be enacted until 1990's (Yilmaz and Morgil, 1992).

As a part of the aim of modernization of science curricula, in 1971, 100 general high schools and 89 teacher training high schools were introduced with the new science curriculum named as 'modern science program'. The number of the schools that adopted the new science curriculum increased up to 843. So there were two types of schools in Turkey until 1985: Modern Science Schools and Classical Science Schools. (MEB, 2011a)

In 1985 the two different types of physics, chemistry, and biology curricula were united into one type. These curricula and textbooks were based mostly on the "modern science program" with less emphasis on experimentation. The aims of these new curricula emphasized scientific thinking, and the need for less teacher-centered instruction where students can discuss scientific issues during lessons. There were no published objectives. Only one page long aims and explanations for the three curricula were presented with the sequence of topics that have to be covered were given. It was assumed that teachers would figure out the curriculum from the textbooks. The aims and explanations for the curricula had some common points:

(i) Science should be introduced to students as a falsifiable set of knowledge which is continuously developed.
(ii) Lives and characteristics of scientists should be introduced to students during lessons by pointing out that hardworking and patience is two important aspects of scientists.
(iii) Students should not memorize the knowledge, instead they should be able to think critically.
(iv) Atatürk's principles and his great emphasis on the development of science should be reminded to students in appropriate moments (MEB, 1985).

Besides, there were specific issues highlighted while enacting these new curricula that were put into action in 1985 (MEB 1985). For example, the physics program recommended that students should work individually. New technology topics such as lasers and transistors should be introduced to students in the physics lessons. Students

were expected to make observations, engage in investigations, and conduct experiments in order to learn physics. Teaching students how to learn was another important point highlighted in aims of the 1985 physics program. Also preparing students for further education is another aim for this new curriculum. In chemistry, like in physics, individual study was emphasized. Laboratories were highlighted in the aims. Developing chemistry laboratory skills were pointed as important for chemistry education. It was stated that the habit of thinking, trying, reading, retrying, reading, thinking, and making their own conclusions should be instilled to students. Chemistry for further education and teaching how to learn are also emphasized in the explanations. For the Biology curriculum, laboratory applications were not emphasized anywhere in the aims or explanations. By highlighting environmental education it was expected from the students to develop a consciousness of environmental issues(MEB, 1985).

Just seven years after the beginning of the implementation of the 1985 curriculum, in 1992 the whole education system had transformed to credit based system. So from that time on students had to take common courses as compulsory and they could select other courses to fulfill their credit limits. The aim of this reform was to give students the chance to specialize in different subjects based their interest. This could have been seen as forming a strong basis for their higher education. In this system, in 9th grade, physics, chemistry, and biology lessons consolidated under the name of these science lesson. In the 9th grade students had to take this science courses as compulsory and select others according to their interest. Only for this course, we can observe more detailed explanations for the content and list of experiments that should be done in lessons. The elective science courses that students could select were; Physics 1-2-3, Chemistry 1-2-3, Biology 1-2-3, Advance Physics 1-2, Advance Chemistry 1-2, Advance Biology 1-2, Environment and Human, Astronomy and Space Sciences, History of Science. The aims and principles of the curricula were very similar with the previous ones.

Even for these changes which seem reasonable on paper, some serious problems emerged during implementation (Ünal *et al.*, 2004). For example, teachers and teaching materials were very limited for offering so many elective courses. Consequently, stu-

dents started to register the courses offered in different high schools, which in turn led to security problems in schools. During their free time students did not stay in school, which again caused security problems. In addition, the expected student success in university entrance examination was not reached (Ünal *et al.*, 2004).

Because the credit based system was criticized for not being suitable for high school students, the system was again converted to the old system in 1996. The topics of the science course that was offered as compulsory in the 9th grade were distributed into physics, chemistry, and biology courses. The topics that were covered in the elective courses Physics 1-2-3, Chemistry 1-2-3, and Biology 1-2-3 were distributed among 10th and 11th grade physics, chemistry, and biology courses. In 1997 the 5-year compulsory education was raised to eight years. Secondary school was not compulsory then, but was extended from 3 to 4 years in September 2005.

In 1997, apart from the studies of curriculum developments up to that time, EARGED prepared physics, chemistry, and biology curricula where scientific literacy and student-centered learning environments were highlighted (Ünal *et al.*, 2004). In those proposed curricula, the aims, goals and objectives were described in detail with sample activities for every course. These programs were piloted in 50 curriculum laboratory schools. Unfortunately, only the biology program was found successful as a result of pilot testing, so the physics and chemistry programs remained the same whereas the biology were changed in all schools until 2008.

In the report of MEB that was prepared for the European Commission (EU) in 2005, the need for the development of new curricula for all grade levels from primary to secondary school was stated. The rationale was to catch up to the needs of today's world. With this regard the curricula were based on the following:

(i) Take all the transformations and developments in the world as directive guidelines;
(ii) Adopt EU standards and educational perspective of EU;
(iii) Consider the identification of the current educational problems of our country,

the evaluation and the outcomes of the achievements and failures (MEB, 2005, p.65-66).

The aims of these new curricula were to develop students':

(i) Intellectual learning skills such as reading, writing, speaking, listening, calculating, arithmetic, communication, observation, estimation and evaluation and using new information technologies;
(ii) Capacity for thinking and reasoning through materials such as books, music, visual and performing art;
(iii) Psycho-motor capacity and perception capacity (MEB, 2005, p. 65).

Technological developments, the content, educational research studies and standards of European Union were considered while restructuring the curriculum. Needs analysis was conducted by special commissions in order to investigate the needs of different groups of society like universities, non-governmental organizations and so on (MEB, 2005). In addition, Third International Mathematics and Science Study- Repeat (TIMSS-R) and Progress in International Reading Literacy Study (PIRLS) reports were used in the design process. Aims, goals, skills, and objectives were prepared carefully, by referring to different branches (MEB, 2005). In 2013, curricula of all grades are being implemented in all government and private schools in Turkey. Different from the curricula which were prepared before the 2007 physics curriculum, the 2007 and 2013 physics curricula were prepared in detail, distinct from the textbook, where aims, goals and objectives are present. Although teacher guide books are present for the primary school, no such book was presented to high school teachers so far. Because the high school education expanded to four years, the class hours per weeks were reduced drastically. For the 9th and 10th grades the number of hours left for physics, chemistry, and biology set up to two for each, and for the 11th and 12th grades it is three. Despite of all of its deficiencies, this curriculum reform was a major improvement for science education in Turkey. The important point now is to make sure if the teachers are aware of the aims, goals, and objectives and if they can implement the new curriculum in the classroom successfully.

2.3. Previous Studies on Curriculum Reform in Turkey

In this section, the studies conducted previously on the physics curriculum in Turkey will be discussed. The number of those research studies increased and their approaches and methodologies varied over time. The main aim of the research studies were similar: investigating teachers' views on the new curriculum (e.g. Akdeniz and Paniç, 2012; Ayvacı, 2010; Baybars and Kocakülah, 2009; Mercan, 2012; Yolbaşı, 2010). There were also few studies that focused on the enactment of the curriculum (e.g. Kapucu, 2012; Taşçı, 2011) and also students' views on the new physics curriculum (Marulcu and Doğan, 2010). The methodologies of the previous studies conducted differ as well. While most of the conducted studies were survey design studies (e.g. Arslan *et al.*, 2012; Ayvacı, 2010; Baybars and Kocakülah, 2009; Ergin, 2010; Karal, 2010; Yolbaşı, 2010), some of them were conducted as case studies involving semi-structured interviews with teachers (Akdeniz and Paniç, 2012; Demir and Demir, 2012; Künbet, 2010; Tortop, 2012) or semi-structured interviews with teachers accompanied with classroom observations (Kapucu, 2012; Taşçı, 2011). However, none of the studies found in the literature involve interviews with both teachers and students and classroom observation at the same time.

Throughout this section, the findings of the aforementioned studies will be presented under six different categories which are about the findings; the intended physics curriculum, the enacted physics curriculum, the influence on the national examinations on the enacted physics curriculum, the textbooks and their use in the classroom, the teachers' situations regarding the 2007 physics curriculum reform, and the students' views and their situation regarding the new physics curriculum. The emergence of those categories is explained in data analysis section. While most of those findings present similar results, there are some points where the findings of the studies conflict.

2.3.1. Findings Regarding the Enacted Curriculum

In this section, the findings of the studies which are related to the enacted curriculum are presented. First, the findings on how the topics were presented in the

classroom are discussed and then to what extent the classroom activities were done in the classroom and how the teachers assess students' understanding according to the findings of the studies are explained throughout this section.

According to Ergin (2010), the teachers were not having trouble with the enactment of the curriculum which means that the enacted and intended curricula are in alignment. In the study of Tortop (2012) 49% of the teachers claimed that they started to enact the new curriculum as soon as it was put into action where 40% of them started to enact the curriculum since they had to. This might show that 89% of the teachers are enacting the physics curriculum in accordance with the intended curriculum. According to the same study, 44% of the teachers stated that they adapted to the new curriculum while 32% of the teacher stated that they were still in the adaptation phase and 23% stated that they did not adapt to the new curriculum. The findings of these studies show that teachers reported that they were generally enacting the 2007 physics curriculum.

To look at the enacted curriculum in detail, findings of the studies which define how the teachers were presenting the topics in the classroom were examined. Akdeniz and Paniç (2012) reported teachers had to skim through the topics; they cannot go into detail since they do not have enough time to cover all of the topics in detail. In the same study, the teachers also complained that because of the spiral structure of the curriculum, the students forgot what they have learned in the previous grade so the teachers have to remind students what they had learned the year before which caused them losing time.

According to Sadi and Yıldız (2012), even though the teachers frequently state that they are using different methods while presenting the topics in physics courses, there are some teachers who prefer traditional teaching approaches. In the study of Engin and Bülbül (2010), it was reported that 38% of the teachers prefer question solving, while 27% of the teachers prefer experimenting, 19% of the teachers prefer question and answer techniques, and 15 % of the teachers prefer using the computer while presenting a topic. Another method that was used by the teachers was giving

examples from everyday life (Ayvacı, 2010; Kapucu, 2012; Taşçı, 2011). According to the analysis of Ayvacı (2010), the teachers usually give examples from daily lives of students when they were teaching the topics "Force and Motion", "Energy", "Electricity", and "Density". According to the classroom observations of Kapucu (2012), the first-year teachers prefer giving daily life examples more than experienced teachers. Moreover, according to Kapucu (2012), the experienced teachers thought that they were enacting the intended curriculum as desired since they were giving examples from daily lives in the classroom. In addition, Taşçı (2011) stated that what she observed in the classroom was the fact that the teachers indeed were giving examples from daily life yet, they were not enough for encouraging students to feel the need of learning.

Some of the studies also discuss to what extent the classroom activities are conducted in the physics courses. These activities may be classified as showing demonstrations or animations using the computer, performing demonstrations, performing hands-on activities for the students. For instance, in the study of Akdeniz and Paniç (2012), the teachers stated that they prefer using computer animations or demonstrations especially for the difficult topics. Akdeniz and Paniç (2012) reported that the experiments consisted of demonstrations performed by the teachers. Kapucu (2012) stated that contrary to the experienced teachers, first years teachers were trying to conduct hands-on activities in their classroom. In addition, Taşçı (2011) stated that among the four teachers whose lessons were observed by her, only one of the teachers in one of her lessons used computer animations. Taşçı (2011) also stated that one of the teachers had tried to conduct classroom activities at the first years of the curriculum change, yet the teacher gave up thinking that the activities were time consuming and useless. Instead, the teachers preferred lecturing, question and answer technique, and solving exemplary questions throughout their lessons. In light of the results of the survey conducted by Sadi and Yıldız (2012) 60% of the teachers preferred to conduct the experiments as demonstrations, they did not let students conduct the experiments on their own. According to the survey results of Söğüt *et al.* (2012), 42% of the teachers preferred using computer technology in their classroom.

Many studies stated that the teachers purported that they cannot use laboratories

or conduct classroom activities because of lack of equipment (Akdeniz and Paniç, 2012; Arslan *et al.*, 2012 ; Baybars and Kocakülah, 2009; Ergin, 2010; Karal, 2010; Kapucu, 2012; Tortop, 2012; Taşçı, 2011). In addition to lack of equipment, the teachers also stated that lack of time is also another obstacle for conducting classroom activities (Arslan *et al.*, 2012; Ergin, 2010; Kapucu, 2012; Karal, 2010; Marulcu and Doğan, 2010; Taşçı, 2011; Tortop, 2012). However, according to the findings of Marulcu and Doğan (2010), the lack of time was because of the inadequacy of using the time efficiently by the teachers. In addition to lack of time and equipment, Kapucu (2012) stated that national examinations, students' low economic status, and lack of information communication technologies in the school were obstacles for the intended curriculum to be enacted as planned. Taşçı (2011) also purported that the teachers do not prefer to include classroom activities because of the fear that they cannot cover all of the topics in the curriculum, the fear of losing control over the students, and teachers' lack of knowledge of the new teaching approaches of the curriculum. Taşçı (2011) also mentioned that the teachers believe that the students cannot manage to conduct the experiments themselves.

Some of the studies also described the assessment techniques used by the teachers (Engin and Bülbül, 2009 ; Taşçı, 2011). According to the survey results of Engin and Bülbül (2009), while assessing the performance of the students, 52% of the teachers preferred question and answering, 21% of the teachers preferred having students conduct experiments, and 17% of the teachers preferred having students present a topic which they choose. For summative assessment, the teachers preferred preparing questions of multiple-choice format (21%), asking questions similar to what the students have in their notebooks (35%), and preparing questions that are neither from their textbooks nor notebooks (29%). Taşçı (2011) stated that the teachers assessed students' understanding through question and answer technique in the classroom, adding that any efforts of evaluating students' skills and attitudes were not observed throughout the classroom observations.

In light of the research findings presented, the alignment between the intended curriculum and enacted curriculum is very limited. The teachers are trying to cover

all of the topics in the curriculum but while doing so they are not always taking care of the teaching approach of the intended curriculum. The nearest thing the teachers can do in the classroom is giving examples from daily life. The most frequently stated reason by the teachers for not conducting classroom activities are lack of time and lack of laboratory equipment.

2.3.2. Findings Regarding the Intended Curriculum

In this section the findings of the research studies regarding the intended curriculum are discussed. At first, the views of teachers and students about the aims, goals, and objectives of the intended curriculum are discussed. After that, what teachers and students think about the teaching approach of the intended curriculum according to the research studies are presented, ending with the discussion of the findings about teachers and students' reflections about the content of the intended curriculum.

To begin with, according to the some of the research findings, the teachers are content with the aims, goals, and objectives of the intended curriculum. For instance, according to the survey results of Arslan *et al.* (2012), the teachers' attitudes towards the intended curriculum are generally positive. Arslan *et al.* (2012) reported that the objectives of the intended curriculum can easily be understood by the teachers, the boundaries of the objectives are stated clearly, and they are appropriate for students' levels. Balta and Eryılmaz (2011) also stated that the teachers show positive attitudes towards the 9th and 10th grade physics curriculum, adding that the teachers' attitudes towards 10th grade physics curriculum are more positive than ninth grade curriculum. According to the survey results of Baybars and Kocakülah (2009), half of the teachers participated in the study agreed that the intended curriculum was well articulated and 41% of the teachers thought that the teaching approach of the curriculum was clearly stated. This means that half of the teachers did not agree that the curriculum is well articulated and more than half of the teachers do not think that the teaching approach of the curriculum is well defined. According to the same study, 73% of the teachers agreed that the objectives of the curriculum are clearly defined. On the other hand, the teachers thought that assessment and evaluation part of the curriculum is not explained

properly. Yolbaşı (2010) reported that the teachers think that the intended curriculum is not providing enough guidance for the teachers although they find the curriculum useful. The findings of Karal (2010) also support the aforementioned studies: the teachers find the curriculum applicable.

On the other hand, there are some studies which reach the conclusion that the teachers and the students are not content with the new physics curriculum. For example, Marulcu and Doğan (2010) stated that both the teachers and the students participated in the study are not content with the new curriculum. The 76% of the students think that the intended curriculum needs a revision. Similar conclusion is drawn in the study of Tortop (2012). Kapucu (2012) stated that even if the teachers are generally satisfied with the intended curriculum, they complain that it does not explain how to attain the objectives of the curriculum in detail. In addition to these research findings, Söğüt *et al.* (2010) reported that 58% of the teachers think the curriculum was partially reaching its goals. According to the same study, 35% of the teachers thought that the intended 2007 physics curriculum was no different compared to the previous one and 27% of the teachers stated that the 2007 physics curriculum was worse than the previous one.

Teachers' views about the teaching approach of the intended curriculum are also investigated in the research studies on physics curriculum. Teachers agreed that the intended curriculum is student-centered (Akdeniz and Paniç, 2012; Yolbaşı, 2010) and related to everyday life (Akdeniz and Paniç, 2012; Tanuğur *et al.* , 2012). On the other hand Engin and Bülbül (2009) stated that the curriculum was not adequately related to daily lives of the students. Akdeniz and Paniç (2012) stated that even though the teachers are aware that the intended curriculum is student-centered and related to everyday lives of the students the teachers do not adapt those approaches in their teaching. The teachers also believed that the classroom activities in the curriculum motivate the students and increase the participation of the students to the course (Yolbaşı, 2010).

Teachers' reflections on the content that was included in the intended 2007 physics

curriculum and its presentation were also investigated in some of the studies. The teachers generally agreed that the content of the 2007 physics curriculum was very dense and they had very little time to cover all of the topics included in the intended curriculum (Akdeniz and Paniç, 2012; Arslan *et al.* , 2012; Sadi and Yıldız, 2010). On the other hand, Baybars and Kocakülah (2009) stated that teachers find the class hours per week enough for ninth grade curriculum. The teachers also appeared think that the sequence of some of the topics is wrong (Kapucu, 2012; Tortop, 2012). There are also some topics that the teachers and students find inappropriate. According to the survey findings of Marulcu and Doğan (2010), only 38% of the students agree that the topic "Modern Physics" should be included in the intended curriculum. In addition to what students think, Künbet (2010) stated that the dershane teachers reported that the objectives about "Modern Physics" were not appropriate for students' levels. According to the findings of Karal (2010), the topic "Nature of Physics" included in ninth grade curriculum was useless and the topics "waves" should not have been covered in 9th grade since the boundaries of the objectives about that topic caused teachers having difficulties while presenting it.

According to the research findings about the intended curriculum, the teachers generally show positive attitude towards the physics curriculum. They think that the curriculum is well articulated and the objectives are generally applicable. Yet, even though the teachers are aware that the curriculum is student-centered and related to everyday lives of the students they do not prefer adopting these approaches in their classroom. It seemed that the topic "Modern Physics" is problematic since it was stated in two different research studies.

2.3.3. Findings Regarding the National Examinations and Enacted Curriculum

The national examinations are presented as an obstacle for the intended curriculum to be implemented in a few studies on the physics curriculum. Akdeniz and Paniç (2012) report that the focus of the students is national examinations and what they want from their teachers is to help them prepare for those examinations. Marulcu

and Doğan (2010) also stated that the main aim the students is preparation for the national examinations. On the other hand, in most of the studies concluded that the national examinations are not in accordance with the intended curriculum (Akdeniz and Paniç, 2012; Ayvacı, 2010; Karal, 2010; Marulcu and Doğan, 2010; Söğüt *et al.*, 2010; Tortop, 2012) and it is one of the reasons why the intended curriculum cannot be enacted as desired (Kapucu, 2012; Marulcu and Doğan, 2010; Mercan, 2012) Taşçı stated that the reason why the teachers only follow the sequence of the topics but not adapt the teaching approach of the intended curriculum is the national examinations. According to the study of Engin and Bülbül (2009), only 15% of the teachers think that the intended curriculum is designed to help students acquire the knowledge and skills that they may need throughout their higher education. According to Mercan (2012), the main aim of the secondary school physics education is preparing students for the national examinations and the curriculum the teachers enact is mainly based on preparation for those examinations.

2.3.4. Findings Regarding the Textbooks and Enacted Curriculum

In this section the teachers' and students' views about the official textbook and its use in the classroom are discussed. Throughout this thesis the textbook that MEB distributed to state schools are called the "official textbook". The general attitude of the teachers and the students towards the official textbook is negative because of different reasons according to the various research findings which are discussed in the following paragraphs.

In some of the studies it was stated that the official textbook is not in accordance with the intended curriculum (Arslan *et al.*, 2012; Kurnaz and Çepni, 2012). Marulcu and Doğan (2012) reported that 53% of the students thought the opposite probably assuming that the students had read the intended curriculum. In addition, the teachers stated that the questions in the official textbook did match with the objectives of the 2007 intended physics curriculum (Akdeniz and Paniç, 2012).

There are also some comments about the classroom activities included in the

textbook. According to Akdeniz and Paniç (2012), some of the activities in the textbook are too simple. On the contrary, Arslan *et al.* (2012) stated that according to the teachers the activities were above the students' level. Engin and Bülbül (2009) found that only 4% of the teachers stated that there were too many activities on the official textbook while on the other hand Taşçı (2011) stated that the teachers stated that there were too many activities on the textbook and the stories in the textbooks are useless.

The teachers also found the quantity and quality of the questions in the official textbook insufficient (Akdeniz and Paniç, 2012; Taşçı, 2011). According to the findings of Marulcu and Doğan (2010), the students did not find the quantity of the questions sufficient. They also stated that the textbook was not prepared to meet the needs of the students since it failed to prepare the students for national examinations. Taşçı (2011) also highlighted that the textbook was not prepared according to the national examinations since it does not contain many questions and because of that the teachers do not prefer to use them in the classroom. According to the textbook evaluation of Dülgeroğlu (2010), the assessment and evaluation aspect of the textbook got 53 points out of 100 from the teachers. On the other hand, Engin and Bülbül (2009) stated that 62% of the teachers agreed that the number of exemplary questions of the official textbook is satisfactory.

Since the official curriculum is generally not found satisfactory by the teachers and the students, other textbooks which are published by private institutions called "dershane" which prepares students for the national examinations are used in classroom (Akdeniz and Paniç, 2012; Marulcu and Doğan, 2010; Taşçı, 2011). Unlike the official textbooks, other textbooks contain many questions which resemble the questions asked in the national examinations. Marulcu and Doğan stated that students prefer using those textbooks since those textbooks are useful while studying the topic and while solving questions. In the same study, it was reported that the students complain that there are no alternative official textbook stating that they did not have the chance to choose their textbook. The problem with the other textbooks is that they are not always in accordance with the intended curriculum or the official textbook (Akdeniz

and Paniç, 2012; Karal, 2010).

All in all, the official textbook provided by MEB is not found sufficient enough for the teachers mostly because that the official textbook did not involve many questions that help students to get prepared for the national examinations. The teachers and the students prefer to use other textbooks prepared by the dershanes.

2.3.5. Findings Regarding the Teachers and Enacted Curriculum

In this section the findings of the studies related to the teachers and the enacted curriculum are presented. First, the teachers' level of confidence with the aspects of the new physics curriculum and the needs for in-service trainings and the in-service trainings the teachers had so far are discussed.

To begin with, the studies conducted so far abut the current physics curriculum generally show that one of the reasons why the curriculum cannot be enacted as it is intended is that the teachers have lack of content, pedagogical content, and pedagogical knowledge. Akdeniz and Paniç (2012) found that the teachers cannot implement the new curriculum since they do not know how to conduct physics experiments, the new assessment techniques mentioned in the intended curriculum, the content they had to teach students, context-based education, and constructivist learning approach. Ayvacı (2010) revealed that the teachers confuse context based learning with student-centered approach and the teachers did not see themselves competent while enacting the new curriculum. Balta and Eryilmaz (2011) stated that the teachers did not define themselves as well-versed with the topics "plasma state of matter", "earthquake waves", "special relativity", and "adhesion-cohesion-capillarity-surface tension" that are recently included topics in the new physics curriculum. Baybars and Kocakülah (2009) found that the teachers were not confident with the assessment process of the new curriculum, which was not clearly stated on the intended 207 physics curriculum. Karal (2010), on the other hand, claimed that the teachers were competent enough to enact the new curriculum as intended. Sadi and Yıldız (2012) assert that the teachers spend time while preparing for the lesson and preparing assessment which means

they need to preliminary preparing before the lesson. Taşçı (2011), pointed that the teachers had read the intended curriculum in detail yet, they were not aware of the objectives of the intended curriculum. The conflict between teachers' statements and their lack of awareness might be an explanation to the conflicting results when the teachers' attitudes towards the objectives of the curriculum are compared in different studies.

Another point that is discussed is the quantity and quality of in-service training. Akdeniz and Paniç (2012) stated that the teachers who worked in elementary school before were more knowledgeable about the philosophy and teaching approaches of the new physics curriculum. This may show that the in-service trainings conducted for elementary school science curriculum was more informative than the in-service trainings for 2007 secondary school physics curriculum. According to the findings of Sadi and Yıldız (2012), 25% of the teachers had not attended any in-service training about the physics curriculum since the curriculum was started to be implemented. Tortop (2012) claimed that only 44% of the teachers stated that they got used to the curriculum, where as more than half of the teachers are still trying to or could not adapt to the new physics curriculum. Tortop (2012) stated that this might be due of the fact that the in-service training for the teachers about the aspects of the new physics curriculum was not enough. Kurnaz and Çepni (2012) also highlighted that the in-service trainings conducted so far were insufficient and suggest that guiding books for the teachers should be prepared in order to help teachers. Moreover, Taşçı (2011) stated that the in-service training was found insufficient by the teachers because the trainers were also incompetent about the new aspects of the curriculum. Another finding which may point out the insufficient in-service training provided to teachers was that when the attitudes of the teachers towards the 2007 physics curriculum was compared, there were no statistically significant difference between the teachers who received in-service training and the teachers who did not receive any in-service training (Baybars and Kocakülah, 2009; Yolbaşı, 2010). This may show the level of success of in-service trainings.

According to Akdeniz and Paniç (2012) and Mercan (2012) the teachers could

not internalize the new physics curriculum since they were not informed enough and because of the fact that breaking the habits of the people is a very hard thing to manage. With such a limited support, expecting teachers to immediately change would not be a realistic.

Only one study mentioned the interactions between the physics teachers. According to the findings of Ergin (2010), the teachers keep in touch with the other physics teachers and share what they know about the new curriculum with each other.

To sum up, the teachers are not feeling themselves competent with the new aspects of the curriculum; they need in-service trainings about the new included content, the new teaching approaches, and the assessment and laboratory techniques. Moreover, it was generally concluded that the in-service trainings which were conducted so far were insufficient.

2.3.6. Findings Regarding the Students and Enacted Curriculum

The previous studies on the physics curriculum generally did not focus on students. What is known about students is limited to what teachers share about them. There is only one study which investigated students' views about the intended curriculum (Marulcu and Doğan, 2010). In this section, the situation of the students will briefly presented in light of the research studies conducted so far. According to what the teachers said about their students, the students' prerequisite knowledge is very poor (Akdeniz and Paniç, 2012). This means that the students forgot or did not actually learn what they have to know in the previous grade. According to the same study, the students' ability to do mathematical calculations is very poor and they also find physics as boring and unimportant. There are also studies which state that students' lack of motivation is a problem for the enactment of the curriculum (Engin and Bülbül, 2009; Marulcu and Doğan, 2010; Taşçı, 2011). Moreover, Tortop (2012) stated that the readiness of the students to learn Physics was very low according to the teachers. On the other hand the students were keen on relating the topics in physics to their everyday lives (Taşçı, 2011) Taşçı (2011) stated that when the teachers began

to present examples from daily lives of the students they started to ask questions, give examples hence participate to the lesson. In his thesis Ergin (2010) stated that there were no problems about the students with regards to the enactment of the intended curriculum.

Students' focus of national examinations is presented as an obstacle for the enactment of the physics curriculum as intended. For instance, Akdeniz and Paniç (2012) reported that the students want their teachers to prepare them for national examinations during classes. When the teachers attempt to ask questions according to the new curriculum, the students show discontent. Marulcu and Doğan (2010) also highlight students' anxiety and stated that since the main aim of the students is getting prepared for national examinations, they pay more attention on their work in dershanes.

Despite the significance of the enactment of the curriculum, most of the studies, no matter if they are on elementary or secondary science curriculum, they focus on what the teachers think about the intended curriculum. The previous literature provides a very rough sketch of the current state of the enacted curriculum. To get a precise idea about what is happening inside the classroom, observations of the actions of teachers and students in their natural setting can give detailed information. By doing so, more solutions could be proposed.

3. METHODOLOGY

3.1. Design of the Study

It is likely to face with some resistance during a curriculum change process (Evans, 2001). Also as Fullan (2007) implies, there should exist some common meaning about the curriculum in order for it to be implemented as intended, which he calls shared meaning. Considering the lack of professional development in terms of quantity and quality, it can be inferred that it is quite difficult for the shared meaning to be constructed. The purpose of this study was to understand how the intended curriculum is being enacted in schools and why it is being enacted the way it is now, to describe the interrelations between the enacted curriculum and other components of education in order to understand the possible influences on the shaping process of the enacted curriculum, and this may inform future reforms. One way to analyze this complex situation is observing what happens in the classroom and trying to understand the enacted curriculum and its interactions with the agents of the enacted curriculum.

The methodology employed in this research was the case study methodology. The focus of analysis was how the curriculum was being enacted at the selected research site and how the agents of the enacted curriculum may influence the implementation of the 2007 physics curriculum. Understanding how the curriculum is being enacted in classroom requires a complex analysis. Trying to sketch a general picture about the enacted curriculum and also trying to figure out the interactions between enacted curriculum and its agents, which may affect teachers' decision making is an even more complex process than only analyzing the enacted curriculum. Hence, in order to get a deeper understanding on the enacted curriculum, qualitative research methodologies were preferred for this study. Qualitative researchers, as Merriam (2009) explained, "are interested in understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences". Focusing on meaning and understanding, the qualitative researcher gathers data at the participants' site (home, office, classroom, and so on) (Creswell, 2003). That is why

qualitative research is often called naturalistic (Bogdan and Biklen, 2003).

Since the qualitative researchers try to understand, interpret or investigate phenomena, the data are collected for description purposes (Bogdan and Biklen, 2003). The data mostly consist of words, sounds, pictures and so on gathered from the documents, field notes, and participant interviews are used to understand, construct, and describe the phenomenon under discussion (Merriam, 2009). So the primary data collection and analysis instrument is the researcher herself (Merriam 2009). Being in such a position enables the researcher to response immediately and adapt to situations, to process and analyze information immediately, and reflect what she analyzed to members in order to check the validity of the analysis (Merriam, 2009). However, this opportunity comes with its shortcomings. One of the primary shortcomings is the ethical issues that the researcher should consider seriously (Creswell, 2003). These ethical issues will be addressed and discussed in the proposed study.

The purpose of this study was to understand how the intended curriculum is being enacted in an Anatolian high school in İstanbul and why it is being enacted the way it is. Since the research was focused on only one research site and the researcher tried to analyze the phenomenon deeply, the case study approach was chosen as the appropriate research methodology for this study. In the following section the characteristics of the case study approach is discussed in detail.

3.1.1. Case Study Approach

Merriam (2009) defines case study as "in-depth description and analysis of a bounded system" (p.40). Bounded system refers to the unit of analysis, for example a school, a teacher and so on. What makes case study distinct from others is the focus on unit of analysis (Merriam, 2009). Focusing on a phenomenon in a research site can help the researcher gain an in-depth understanding of the phenomena under discussion. Since the purpose of this study is to investigate the enacted curriculum which also means the level of implementation of a program and its interactions with the agents of that program, case study research approach is preferred. Gay *et al.*

(2009) state that case study approach is appropriate not only to investigate the level of implementation of a new program but also how this program affects the individuals such as teachers, principals, students and so on.

Merriam (2009) describes three special features of case study: being particularistic, descriptive and heuristic (p.43). Case studies are particularistic since it focuses on a particular phenomenon as mentioned before. Being descriptive is another characteristic of case studies which means they give a thick description of a phenomenon as a product. Thick description is described by Merriam (2009) as "the complete, literal description of the incident or entity being investigated (p. 43). In other words, in a case study the researcher try to describe the underlying, deep meaning instead just describing what is being observed.

Being heuristic is the last feature of case study that is discussed. This means enlightening the reader who retrieves her own thoughts, values, and experiences while reading. The reader might learn from the study, or change her thoughts, attitudes or at least confirm the findings of the study.

In this study, the school that was chosen as the research site is the bounded system of this study. In other words, the case of this study was the school being discussed throughout this study. In this school, there were three physics teachers and their enactment of the 2007 physics curriculum was considered as one case.

3.1.2. The Research Site

One Anatolian high school in İstanbul was chosen as the research site. This school was selected for many reasons. First, the school was a qualified high school, but among qualified high schools it was an average one. Schools admit students based on which percentile they rank in, and this particular school, with respect to its percentile requirement falls between the third and the seventh; the exact percentile is not given so as to hide the name of school. The conditions of Anatolian High Schools (the number of students is low, they are better equipped, and the level of student achievement is

higher compared to general high schools) are better than general high schools, it can be assumed that the alignment level of the 2007 physics curriculum in general high schools is lower than in Anatolian High Schools. A preliminary insight for general high schools could be derived from the conclusions on the situation in Anatolian High Schools. A school having more than one physics teacher was preferred since observing different teachers might give a deeper understanding of the enacted curriculum. In addition, observing the classrooms of more than one teacher enabled the researcher to make comparisons for deeper understanding. Hence, a research site was chosen such that there were three different teachers whose backgrounds are quite different from each other. For instance, one of the teachers is a doctoral student in the field of education and she is offering college level physics courses while another teacher taught science and English in elementary schools for several years. The ages of the teachers also vary as well as their gender (one of the teachers was female and the other two were male) which may be another factor affecting the teachers' enactment of the curriculum. Moreover, the three teachers' willingness to participate in the study is another factor that influenced the researcher in the process of selection of the research site.

3.2. The Participants

The participants of this study were the three physics teachers who were working at the research site. In addition to teachers some of the students in the study also participated in focus-group interviews. The rest of this section is devoted to providing information about the teachers and the students participated in this study.

3.2.1. The Participant Teachers

As mentioned before, the three physics teachers working at the research site who accepted to participate in this study were participants of this study. Information about the individual teachers is presented below. The information provided about the teachers is limited for confidentiality reasons. In addition, pseudonyms are used to protect the teachers' identities.

3.2.1.1. Mr. Doe. Mr. Doe had worked as a physics teacher for four years. He had also worked as an English teacher in an elementary school for eight years. He had finished a teaching physics program offered by a school of education.

3.2.1.2. Mr. Smith. Mr. Smith had been working as a physics teacher for 14 years. He also had worked as a primary school teacher for two years. Since he had worked as a teacher for a total of 16 years, he was the most experienced teacher in this study. He had finished a teaching physics program offered by a school of education.

3.2.1.3. Ms. Brown. Ms. Brown was the only female teacher in this study. She had been teaching physics for six years. She had also worked as a primary school teacher for six years, so she had 12 years of experience. She had graduated from a teaching physics program offered by a school of education. She also had a master's degree and was working towards a PhD in the field of education.

3.2.2. The Participant Students

The students who participated in the focus group interviews were from 9th, 10th, and 11th grades. The students were chosen from the classes that were observed continuously during this study. The students were chosen among the volunteers and the researcher paid careful attention to select students of varied academic success (physics grades).

3.3. Data Collection

The main data sources for a case study generally can be listed as observations, interviews, and documents. Gathering data from different sources (triangulation) is counted as one of the strategies for validation (Creswell, 2003). For this study, there were three main sources of data: non-participant observations, semi-structured interviews with the teachers, and focus group interviews with the students whose classrooms were observed. Additional data sources such as students' examinations or portfolios,

casual conversations with teachers or students were used as needed throughout the study. In the followings sections specific information on each type of data collection technique used in this study is discussed with their advantages and disadvantages.

3.3.1. Classroom Observations

Merriam (2009) notes, "observation is the best technique to use when an activity, event, or situation can be observed in firsthand, when a fresh perspective is desired, or when participants are not able or willing to discuss the topic under discussion" (p. 119). Considering the focus of this study, teachers, intentionally or unintentionally, may not want to talk about their "real" classroom activities since they might be aware that it is not in alignment with the intended curriculum. Hence, observations were the primary source of data for this study. There are generally four types of observations which are classified according to the role of researcher in the culture: complete participant, observer as participant, participant as observer, and non-participant observer (Creswell, 2003; Merriam, 2009). Throughout this study, the researcher was a non-participant observer, which means she just made observations inside and outside of the classroom, not taking an active role in any of the classroom activities. The most distinctive feature of observations was that it enables the researcher to gain first-hand experience unlike interviews and documents. In addition, while making observations, the researcher may catch unusual events in the research setting. On the other hand, some information that cannot be shared could be gained or the participants could be highly disturbed because of being observed (Creswell, 2009). Also the participants may change their behaviors when they are being observed, which can be a threat for the validity of the study. This change in the behavior of the participant is known to be observer effect (Bogdan and Biklen, 2003). But the effect can be minimized by spending a long amount of time in the setting. In this study, the level of the effect was not threatening because the teachers and students were accustomed to being observed by intern student-teachers.

Videotaping the classroom while making observations could be the most effective way in order not to lose any data but this can also bring problems with it. Teachers or students could feel themselves uncomfortable while they are thinking that an out-

sider can watch them too. Also these data, the dissemination of which could prove very detrimental to the study, should be well protected. So the observation data was recorded by taking detailed field notes. Since the researcher cannot record everything, she focused on especially teachers' decision making while implementing the curriculum, students or teachers reactions to issues considering the curriculum, and if there exist any common language among the classroom culture special for the curriculum. An observational protocol which includes demographic information (the date, time, classroom, code of the teacher and classroom etc.), descriptive codes (like description of the participants, a dialogue between participants, the classroom environment, events or activities that is special to this day) as well as reflective notes (researcher thoughts on these observations), were filled in for each observation session. At the end of almost each day of observation, referring to these observational protocols, the researcher wrote logs about what happened that day and more detailed thoughts and analysis on these events.

3.3.2. Interviews with the Teachers

Interviews with the three teachers whose classes were observed were conducted in order to better understand the enacted curriculum and its interactions with other components of education. According to Merriam (2009), interviewing is helpful for the researcher when what she is looking for cannot be observed. These could be behaviors as well as feelings and the participants' interpretations. One of the advantages of the interviews is that it gives the researcher information about the past. Gaining historical information is much harder during observations. Another advantage of interviews is that it gives the researcher the opportunity to control over the questioning (Creswell, 2003) so that she can concentrate on the focus of the topic.

The kinds of interviews vary according to their structure. The interview can be open ended, only guided by some general questions. Another type is semi-structures interviews where a number of questions are guiding the researcher but the order of questions and their exact wording can differ interview to interview. This type of interview structures enables the researcher respond to the situations and to add follow-up ques-

tions if necessary (Merriam, 2009). One of the disadvantages of the semi-structured interviews is that it cannot give information about how the participant structures the problem or topic under discussion (Bogdan and Biklen, 2003). The last type of interview is called highly structured by Merriam (2009). Before conducting this type of interview the exact questions and their order are determined. This type of interview technique may lack the perspective and understandings of the respondents (Merriam, 2009). It can be used while gathering demographic information such as age, marital status, education level, etc.

Semi-structured interview technique was chosen in order to gain information about the teachers, and to draw a picture of how she sees curriculum, and her enactment in the classroom. Considering the possibility that the teachers may prefer to talk about other issues rather than her decision making while enacting the curriculum (since there were so many problems that teachers suffer from) to keep the focus the interviews were conducted as semi-structured instead of open-ended.

Consents of the teachers were taken from the teachers for interviews and voice recording of those interviews. The length of the interviews varied by the average length of an interview was 30 minutes. All of the interviews were audio-taped and transcribed to be analyzed. These audio recordings were protected by a password, for confidentiality.

3.3.3. Focus-Group Interviews with Students

Focus group interviews consist of a group of participants whose number can vary from 4 to 12 and a moderator gathered in order to discuss an issue and come up with a general conclusion about it (Bogdan and Biklen, 2003, Breen, 2006, Krueger, 1994, Merriam, 2009). "[Focus groups] are particularly useful when the topic to explore is general, and the purpose is either to stimulate talk from multiple perspectives from the group of participants so that the researcher can learn what the range of views are, or to promote talk on a topic that informants might not be able to talk so thoughtfully about in individual interviews" (Bogdan and Biklen, 2003, p.101). In this study this

data collection technique will be used with the students for both of the reasons that Bogdan and Biklen (2003) propounded. The focus-group interviews in this study were conducted in order to answer the following questions: (i) how much were the students aware of the aspects of the new curriculum?, (ii) what do they think about these aspects?, (iii) what and how they want their physics lessons to be like? The most important feature of the focus group interview is that it helps participants to share their beliefs, ideas more comfortable than they do while participating in a one-to-one interview. On the other hand, the participants may feel ashamed of sharing their experiences, or feelings (Bogdan and Biklen, 2003). Since the topic under discussion is not in a form that lead the students to be ashamed of their thoughts, this has little possibility. Conducting more than one focus group is suggested by Krueger (1994) since sometimes the groups can be cold (which means the members of the group can remain silent during the interview). For this study the number of the focus groups was determined according to the level of data saturation as Krueger (1994) recommended. The role of the researcher was that of a mediator during focus group interviews, which means she informed the participants about the research and what they were expected to do; she prepared and posed the discussion questions as well as the probing questions if the group needed. Before each interview, the researcher requested the consent of each participant. The focus-group interview questions are given in Appendix B. The interviews were audio-taped and transcribed before data analysis. Also an interview protocols were filled which included the date, time and location of the interview and demographic information of the participants as well as the reflections of the researchers about the specific interview as Creswell (2003) recommends.

3.3.4. Data Collection Process

The data collection was conducted between April 20, 2012 and June 8, 2012. The time period was chosen, because it is at this time of the year that the new topics introduced by the 2007 physics curriculum, such as modern physics, astrophysics and some new topics in the waves unit, are taught. Class sessions in which these new topics were taught, as well as those in which the old ones, such as force and motion, electricity

and so on, were taught would also be observed. It was thought that this would help the researcher gain insight into the enactment of new curriculum with regards to both the new and old topics, and that it would also be informative on how the teachers handle the new topics which they have been out of touch with for quite some time. A complete list of the observed topics is given in Table 3.1.

Table 3.1. The topics, the enactment of which were observed, in each grade level. They were observed in the order they are given in the table (from left to right).

Grade Level	Observed Topics		
9th	Force and Motion	Electricity	Waves
10th	Electricity	Modern Physics	Waves
11th	Modern Physics	Waves and Light	From Stars to Quasars

The teachers at the research site were informed of the study and their permission and consent was secured beforehand. Official consent was also requested from the provincial Directorate of National Education. The researcher prepared a schedule in accordance with those of the teachers, picking the days and hours at which classes of different teachers would be observed. The researcher started observing from day one, conducting observations four days a week for the whole duration of the study. The class sessions of specific class sections taught by different teachers were continuously observed without interruption. The participant students of the focus-group interviews were selected from these particular class sections, since the researcher were more familiar with them. One class section from the 9th grade, two from the 10th grade and three from the 11th grade were observed. Only one 9th grade class could be observed, but since all 9th grade students were taught by Ms. Brown, this was deemed acceptable, as observing other class sections would only help the researcher further observe Ms. Brown and no other teacher. Since the other teachers taught 10th, 11th and 12th grades, the researcher had to observe at least two different class sections from both the 10th and 11th grades, so as to be able to observe how both teachers taught at the same grade level. In addition to the particular class sections that were observed without

interruption, some other class sections were also observed for a limited number of class hours.

The researcher initially only conducted classroom observation. The focus-group and teacher interviews were conducted near the end of the study on purpose. The rationale behind this was that by that time the researcher would have gotten to know the teachers and students better, which helped her shape the questions posed in the interviews accordingly, and it would ensure that the actions of the researcher would affect the behavior of the students and teachers as little as possible. The focus-group interviews were done in the last two weeks, while the interviews with the teachers were conducted in the last two days.

A total of 195 class hours were observed by the researcher. Individual interviews with the teachers were conducted, with each lasting about 30 to 45 minutes. Six different focus-group interviews were conducted, each lasting about 40 to 50 minutes.

3.4. Data Analysis

Merriam (2009) states that in qualitative research, data analysis starts with the first collection of data. "The researcher usually does not know ahead of time every person who might be interviewed, all the questions that might be asked, or where to look next unless data are analyzed as they are being collected" (p. 169). Hence, ongoing analysis was done during the data collection stage of the study. The data collected as field notes and interviews were filed systematically and transcribed into digital media by the researcher as soon as possible after the collection of each piece of data. Since the researcher did not have the chance to use video recording, the preliminary analysis was done immediately after the data collection when the memories of the researcher were still fresh. While analyzing, both the field notes and the verbatim transcriptions of the interviews were coded. In order to make the management of the analysis of data easier, Atlas.ti 6.2, the qualitative data analysis software was used. The researcher first went over her field notes, since that was the primary source of data. She went over every line, created her own codes; i.e. none of those codes came

from the literature. Some of those codes were created in-vivo, and some were labeled by the researcher. This procedure is usually referred to as open-coding in the literature (e.g. Merriam, 2009). The same strategies were used when analyzing the teacher and focus-group interviews. After all data were open-coded, the researcher went over the codes, picking those that were frequent, and merging the less frequent ones into the picked ones, when appropriate. Then, these new codes were categorized, and themes were constructed according to these categories. Eventually there were 10 main themes after code reduction and rearrangement. Five of those themes were used for describing the enacted curriculum (short presentations, question solving, demonstrations, off-task activities, and assessment) and the remaining five themes were used for describing the interactions between the enacted curriculum and its agents. These themes were: the intended curriculum, national examinations, textbooks, teachers, and students. The researcher then looked at the possible relations between these themes about agents of the enacted curriculum, and built a concept map to illustrate them.

3.5. The Role of the Researcher

During the study, the researcher was a non-participant observer in the classroom. Since the aim of the study involved understanding the teachers' and students' behaviors and their relation with the enacted curriculum, the researcher tried not to disturb the natural setting of the classroom as much as possible. Teachers were asked to inform students about the research and role of the researcher in the classroom. The interviews with teachers were semi-structured so the researcher could ask additional questions in order to gain a deep understanding. While posing questions, the researcher avoided of being judgmental or leading. During focus-group interviews, the researcher was in the role of moderator and she posed the interview questions and follow-up questions in order to stay focused on the subject under discussion.

3.6. Validity, Reliability, and Ethical Considerations

Considering the validity and reliability of a study increases the quality of the study. Although they should be discussed both in qualitative and quantitative re-

search studies, their methods and terminology differ according to the type of the research approach. The terms that Lincoln and Guba (1985) use is accepted by most of the researchers in the field of qualitative research. For instance, they prefer to use trustworthiness for validity, credibility for internal validity, and transferability for external validity and confirmability for objectivity. Trustworthiness simply means to what degree the findings of a study makes sense. (Merriam, 2009). Merriam (2009) states that to assure trustworthiness, the researcher should think about the design of the study in detail by considering the standards of the scientific community. For example, gathering data from different sources and supporting the findings using those data from multiple sources can help the reader to be content about the believability of the findings. In this study, triangulation was used by gathering data through observations, interviews with the teachers and students. Also documents such as the exams conducted and the handouts prepared by the teachers were used when necessary. Data retrieved from all these different sources was analyzed carefully and used in order to support the conclusions drawn from those analyses. Another strategy to strengthen the credibility of the study is staying at the research site for a long time and conduct persistent observation. The researcher in this study was present at the research site four eight weeks and observed some of the classes persistently by not missing any session throughout the study. Moreover, peer-debriefing was conducted by continuously sharing ideas and findings with the researcher' thesis advisor throughout the study for credibility. Even though the observations cannot be recorded as videos, while taking field notes, the researcher tried to record exactly what the teachers' and students' said to collect "slice-of-life" data items as much as possible as Guba (1981) recommends.

Transferability is a used term for external validity in qualitative research by Lincoln and Guba (1985). To ensure transferability, the data was collected as in detail as possible and detailed descriptions of the context (thick description) was tried to be presented in the study.

Because the replication of qualitative studies is problematic, Lincoln and Guba (1985) define the term dependability instead of reliability for qualitative research design: a measure of the reproducibility of the findings of an inquiry across multiple

applications thereof with the same or similar subjects and context. In order to assure consistency, a log as an audit trail will be recorded throughout the research process in order to present every phase of the research. This concept is also mentioned as "consistency" by Lincoln and Guba (1985). To ensure dependability, a researcher's log was kept during the study to document what had been done at the research site.

Confirmability refers to the objectivity of the data collected (Gay *et al.*, 2009). To strengthen the confirmability, triangulation and reflective journal keeping is suggested by Guba (1981). By gathering data from three different sources (field notes, interviews with the teachers and focus group interview with the students), the researcher not only increased the credibility but also confirmability ensuring that the same finding emerged from three different sources of data which means the possibility of presentation of biased data was reduced. Including reflective notes about the data while keeping the researcher's log helped the researcher to refer back to her comments and ensure that her interpretations was not biased by her previous reflections. A summary of the measures taken by the researcher to ensure validity and reliability are summarized in Table 3.2.

For ethical issues, required permissions from provincial directorate of national education were taken. The teachers and principals were informed about the research in detail and their permissions were taken individually. Teachers were informed about the confidentiality that their names or schools were not mentioned in any part of the study. In addition, the focus group interviews were conducted with the students who were willing to participate. The students were also informed about the research study and confidentiality issues. The data of all kinds were protected by passwords to prevent other people to reach the data. No information that may lead to the recognition of any participant or research site was shared to ensure confidentiality.

To exercise confidentiality, the names of the teachers, students and textbooks were not given. Students were assigned numbers or letters in the context of each excerpt; a label given to a student did not carry over to another excerpt, the numbering or lettering was restarted for each excerpt. The teachers, as mentioned before, were

referred to using their pseudonyms. The texbooks were simply called textbook "A", "B", and "C".

Table 3.2. Criteria for validity and reliability.

Criteria	Strategies employed by the researcher
Credibility	Prolonged participation at the research site Persistent observation was conducted Peer-debriefing wit the thesis advisor Triangulation
Transferability	Detailed descriptive data was collected Detailed description of the context was presented in the findings (thick description)
Dependability	Overlap methods Keeping researcher's log
Confirmability	Triangulation Keeping researcher's log (including reflections)

4. FINDINGS

The purpose of this study was to explore physics teachers' enactment of the curriculum through a case study and investigate interactions of the agents and the curriculum. The findings chapter is divided into two main sections in order to present the answers to the research questions. The first section is called "the enacted curriculum" where the enacted curriculum was described in detail to answer the first research question: "How the intended curriculum is being enacted in the classroom?". The second section is called "interactions with the enacted curriculum" where the interactions between the enacted curriculum and agents that might shape the enacted curriculum are investigated.

4.1. The Enacted Curriculum

The enacted curriculum observed at the research site will be described under two main sections. The first section is called "classroom activity modes" where what was happening at the classroom is described. The second section is called "assessment" where the assessment techniques used at the research site is described. A summary of the findings regarding the enacted curriculum at the research site is presented in Figure 4.1.

4.1.1. Classroom Activity Modes

The classroom activity modes presented in this section is comprehensive; they describe what may happen at any given time in the classroom. When someone enters the classroom at a random time, the person is likely to find that teacher and students are engaged in one of the activity modes. The activity modes describe, in their entirety, how in class time is used.

Figure 4.2 shows the classroom activity modes identified in this study, which are: short presentations, question solving, demonstrations and off-task activities. These

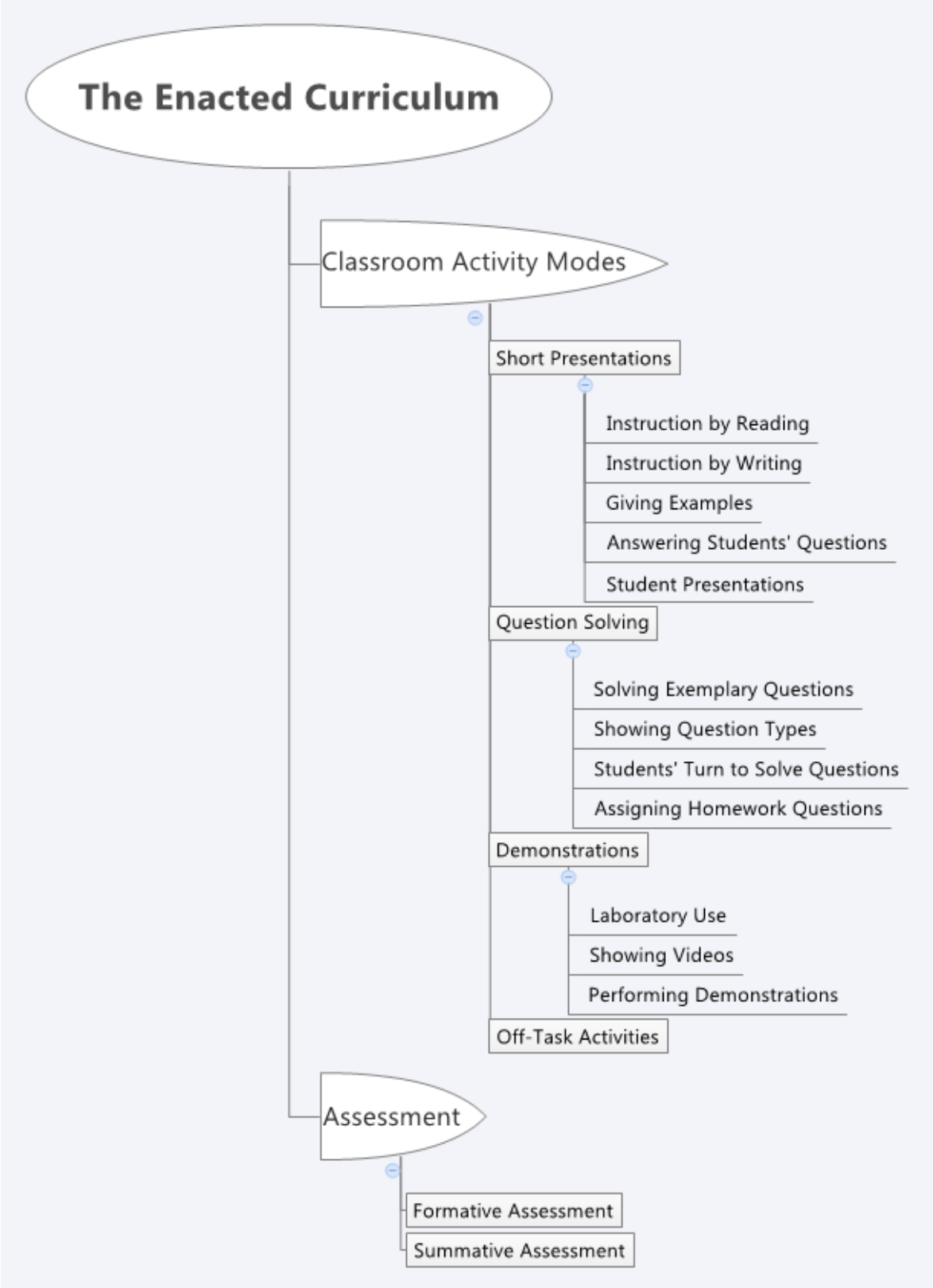


Figure 4.1. Summary of the section "The Enacted Curriculum".

modes branch into sub-modes, which are described and discussed in detail in the following sections.

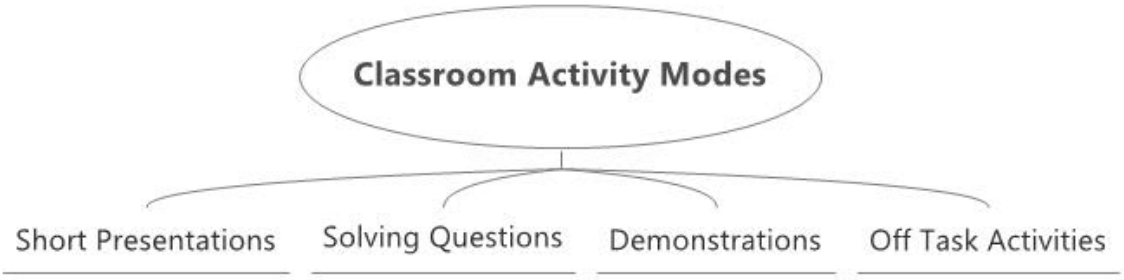


Figure 4.2. Classroom activity modes.

4.1.1.1. Short Presentations. The first classroom activity mode is short presentations. At the beginning of a unit or a subtopic teachers primarily introduced the topic to the students. As shown in Figure 4.3, the teachers preferred different methods while doing short presentations. In this section each method used by the teachers described and discussed separately.

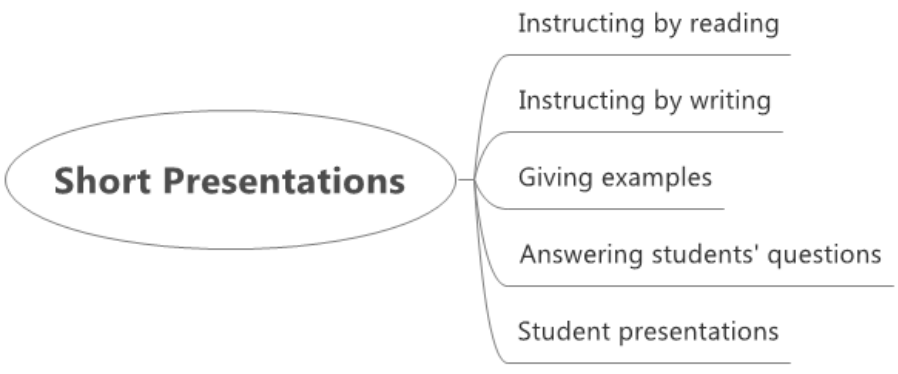


Figure 4.3. Short presentations.

Instructing by Reading. Instructing by reading was used during short presentations of the topic. While instructing by reading, the teacher wanted a student to

read aloud portions of text from the textbook and others to follow what she read. The teacher often stopped the student at points which she thought was important and repeated what was written in the textbook usually by warning students that that point was important.

Instructing by reading usually happened when the topic was one of the new topics that were included after the curriculum reform. For example, in one of the lectures at 10th grades, when the topic was "the existence of ether" in modern physics unit, Mr. Doe referred to the textbook when he felt difficulty explaining what ether was and the setup of the Michelson - Morley's experiment.

> Before he came to the explanation of ether, Mr. Doe mentioned inertial – non-inertial reference frames and stated that the speed of light was constant in all inertial reference frames, yet students did not understand how the speed of light remained constant. Mr. Doe told students to accept this. Then he began to explain the idea of ether and Michelson – Morley Experiment.
>
> Mr. Doe: In Michelson- Morley experiment the scientists try to prove the existence of ether. If the existence of ether is proved then scientists could explain the phenomena easily. So they conducted an experiment. In that experiment, Michelson and Morley set an experiment which is . . . how can I explain it to you? Let me explain it to you by reading it from the book.
>
> He asked one of the students to read it aloud. (from field notes, of 02.05.2012)

In this excerpt, the teacher introduced the Michelson - Morley experiment. Then he attempted to describe the importance of this experiment for modern physics, but he seemed to struggle. Finally, he simply resorted to reading the text in the textbook. After they had read the text, they discussed neither the details of the experiment nor its importance. It appeared that the teacher was not confident in his own understanding of the topic, and therefore might have chosen to skip discussing what the experiment meant. Consequently, this topic seemed to be covered superficially; it was not pursued for deeper student understanding.

Instructing by Writing. Instruction by writing was another classroom activity mode the teachers used while teaching a topic. The belief behind instruction by writing appears to be that taking notes is a good way to record what has been done in the classroom so far and it helps students to stay on the topic as well.

Teachers at the research site sometimes preferred having students write down notes. Teachers' habits of having students write down might differ from one teacher to another and from topic to topic. For instance Mr. Doe did not have the students write down anything since what they had talked was already included in the students' textbooks. He started to use this strategy recently. Mr. Doe used to have students keep notes the year before. He explained why he changed this strategy in the interview:

> As you observed I did not force them to copy the board. It is up to them to do so or not, they did not want to do it. I had them write down everything in the first semester, I even checked their notebooks. I did that to emphasize the importance of keeping a notebook and writing everything down, because some students have the capacity to understand by writing down. Last month they collectively told me that they did not want to keep a notebook, so I did not push it and told them it was fine (from interview with Mr. Doe in 08.06.2012).

From what Mr. Doe commented on note taking, that it was the students who did not want to take notes, not the teacher because he was aware that some students understand better when they write down what they had done in the classroom. He also might have thought that the more questions they solve in the classroom the better the students understand the topic and taking notes obstructed it since it was time consuming. So, he did not require the students to have a notebook or to bring it to the classroom. On the other hand, very rarely, he wanted students to take notes. For instance, in one of the 11th grade classes, he wanted students to write down what he says verbatim:

> Mr. Doe came into the classroom (not into the laboratory) and wished good morning to students. One of the students cleaned the board. Other students were talking amongst themselves. The teacher brought his laptop with him and turned it on. He opened the pdf of a scanned textbook other than the students had and projected it on the screen.

Mr. Doe: Stop talking. Open your notebooks.

Students: Notebooks? (they were surprised)

Mr. Doe: Then open your textbooks.

Mr. Doe: I have prepared a summary of the topic by looking at three or four different resources. Let us look at it. "In wave mechanics, orbitals are where an electron can be located with a high probability." More or less you know it from Chemistry. Write what I say now. (Most of the students began to write down) "It is thought that one or more orbitals form sub-shells, one or more sub-shells form shells, and that shells are on orbits."

Students did not understand what he said. Some of them were not writing.

Mr. Doe: The ones who do not write, do not chat

Student: Sir, are you going to explain later what we have written?

Mr. Doe: Ok. I will. "In the modern theory of the atom, the numbers and symbols that are used to clearly define the state of an electron in the atom are called quantum numbers. They can be divided into four groups:

(i) Principal quantum number
(ii) Orbital quantum number
(iii) Magnetic quantum number
(iv) Spin quantum number

The first three determine the properties of an electron like energy, angular momentum. The fourth one expresses the special spin movement."

He continued to have students write down for a while and then began to solve a couple of examples. (from field notes of 30.04.2012)

In this excerpt, the teacher did something that he did not usually do. He wanted students to open their notebooks but students did not have any notebooks for the

physics course since they did not usually take notes. That is why the students were surprised when they heard the sentence "open your notebooks". Then Mr. Doe had students write down what he said verbatim and stopped at points where he needed to make short explanations like "you know it from Chemistry". These explanations are very shallow thus they may not have done much to help students understand the topic. That might be why the student asked the teacher if he would explain what they had written on their notebook. After that lesson Mr. Doe told the researcher that it was the first time he taught that topic, that was why he needed to read the topic from four different resources and solve the questions related to that topic. It seems that he was not very confident with the context of the topic "quantum numbers" so he needed to study it first. He decided to have students write down a summary of the topic probably due to his lack of confidence. Although he told the students that he prepared this summary by using three or four different resources, the sentences he wanted students to write down were the exact sentences from a textbook that the teacher frequently referred to. It seems that he did not synthesize the information from the three textbooks, instead, he picked one of the textbooks and the students wrote what was exactly written on this textbook. Moreover, he did not make use of any images or figures from the textbook that he projected on the board while explaining the meaning of quantum numbers.

Another strategy that teachers use in instruction by writing is having students jot down notes on their notebooks or textbooks. In this strategy, the teacher wanted students to take short notes what is written on their textbooks or what the teacher said. Teachers wanted students to jot down notes especially the points which the teachers thought were important. Those important points might be the definitions, rules, formulas or important questions' solutions which were usually from the students' textbook.

> It was the lesson for 11th grades. Mr. Smith talked about quantum numbers at the beginning of the lesson by projecting the pdf of the textbook. After he finished talking about quantum numbers, the next topic in the book was Pauli Exclusion Principle. In order to explain what Pauli's exclusion principle means, it was written on the textbook that "To explain the distri-

> bution of electrons in multi-electron atoms, Pauli proposed the principle that "there are no two electrons with identical quantum numbers in an atom". Mr. Smith underlined the sentences written in bold and wanted students to write it down. As the recess bell rang he wanted them to read the rest of Pauli Exclusion Principle and examine the examples. (from field notes, 03.05.2012)

In this example, the teacher used the textbook in order to follow the curriculum. He also used it to teach the topic by reading it. He did not explain what it meant; he just read it and wanted students to write down what was written on the textbook. Hence, the following lesson, (four days later) when the teacher asked "Who remembers Pauli's exclusion principle?" nobody raised their hands. This might mean that writing alone did not help students remember, even if it was the basic definitions.

Sometimes the teacher did not want students to write down but she just wanted them to highlight the important points in the textbook. This saves time and guide students where to focus while they were studying for the exam.

Another strategy used while instructing by writing was asking students copy what was written on the board. This method was frequently used by Ms. Brown who did not prefer using any computers or projectors. She wrote the definitions of terms, formulas, explanations, or questions on the board and let students copy what she had written on the board. She was using the board very effectively to prevent wasting time. From time to time she went fast and attempted to erase the board before the students finished copying. At those times the students asked the teacher to wait for a while and she let them copy what she had written.

Some students believed that they understood better when they write down what they learn whereas some of them thought that it was a waste of time since what they were writing had already been written on their textbooks. This controversy between the students showed up in focus group interviews:

> E: If you were a teacher, how would you teach physics?

(A few seconds of silence)

E: Have you ever thought, ugh this is boring, I wish it were more like this...

Student 1: It would probably be more experiment-oriented. I would conduct more experiments.

Student 2: I would just write on the board like the usual.

Student 1: Because when it is visual... I would choose to teach using experiments because since experiments are visual they are better able to maintain students' attention.

Student 3: I would probably use analogies, you know like with electromagnetic waves. Or mechanics, perhaps. I don't know which type of wave sound waves are at the present, like those that require a medium or those that do not, I would say something like, I would tell them for instance to consider sound, is sound mechanical?

Student 2: Right.

Student 3: I would get them to remember by doing that, like when they think of sound, it requires a medium for propagation, and thus they would understand the properties of mechanical waves. I would do such things.

Student 2: I would simply teach by writing on the board, this is the way I learn. I do not like to use visual materials that much.

Student 4: I would write the summary on the board, and go on that when teaching.

Student 5: Actually it is good to write...

Student 2: I would give pointers; which topics produce more questions, how to solve them...

Student 5: Our elementary school teacher would give us two weeks to copy a 30-40 page material to paper, since it is easier to remember when you write it. It helped better commit that subject to memory since we also covered the same material in class, but it was boring since you listen to the same things that you wrote down, it was not fun.

> Researcher: Was copying it to your notebook enough to help you understand it fully that you got bored in class?
>
> Student 5: You do understand it.
>
> Student 2: If visual materials, slides or experiments are to be used we have to study daily for us to remember. Yet I forget since I do not study daily. (From focus-group interviews with 9A)

In this focus group interview with ninth grade students, half of the students believed that they understand physics concepts by visualizing it while on the other hand; half of the students believed that writing was essential for understanding. Moreover, Student 2 preferred writing the summary of the topic to conducting experiments. One reason might be that the experiments he conducted so far were not guided by the teacher sufficiently so he might not understand the phenomenon under discussion. One other reason might be that, luckily, the student really understood the topic by just writing down what had been taught. Moreover, Student 5 said that their elementary school teacher was used to have them write down the summary of the topic beforehand which helped the student understanding the topic so well that he got bored during the lesson since he had already covered it by writing down the summary. Student 2, who preferred writing a summary of the topic to conducting experiments in the classroom, admitted that he did not study on a daily basis and he thought that he had to do so for the experiments conducted to be meaningful for him. So students might not understand physics in the classroom, instead they could understand it after studying what they had done in the classroom a while later. Probably, these are the times when they had a physics examination.

While the ninth grade students in the focus group interviews stated that they preferred writing to other instructional methods, the 11th grade students stated that writing was a waste of time:

> The Researcher: How would you like to see it taught in class? If your teacher asked you how you want the subject to be taught, how would reply?

Student 1: Let us not use the projector to read from the book, that is no good.

Student 2: There is no time, if he wrote on the board we would fall behind, what is one to do?

Student 3: We also do not want to write down everything that is on the board, we get bored.

Student 4: I think it is better not to copy everything on the board. We all have copies of the book, and the teacher uses the projection when solving questions during which we can take notes on our own copy.

Student 3: At least we do not lose time. (from focus- group interview with 11-E)

In this interview, Student 1 first referred to their physics teacher's use of the projector. In order to solve as many problems as he can, Mr. Smith used to project the students' textbook on the board and talk about the topic by following the textbook. He was also using this method while solving questions from the students' textbooks or other textbooks. While Student 1 was not very pleased with this method since it was very boring and she could not concentrate on the lesson with that method, Student 2 claimed that they did not have any other option since the time was very limited. Student 3 also stated that they got bored when they take notes during the lesson. While student 4 agreed with Student 2 since he thought that instead of writing what is already written in the textbook, solving as many questions as they can help them better understand the topic. Solving as many questions as they can was very important for those students since they thought they were sure they understand the topic if they solve questions by themselves.

Giving Examples. Another instruction mode for short presentations that the teachers frequently resorted to was giving examples. Examples were used as a way to explain a phenomenon that students are not familiar, as well as a tool that might help students to recognize and understand the everyday use of the phenomenon. The teachers used this method in their lectures with different frequencies. The examples that the teachers refer usually originated from the students' textbooks or from teachers'

own experiences. Though most of the time, the examples were from the textbook. When the teacher gave an example relevant to the topic, students began to ask what if questions. In one of the lectures of Mr. Doe the following episode took place:

> The lesson was for 11th grades and the topic was "sound waves". Mr. Doe was trying to explain what supersonic meant and what a shock wave and a sonic boom were.
>
> Mr. Doe: Back in my day, concords and F-16's and their derivatives were famous. They can exceed the speed of sound. Doppler Effect occurs when the speed of an object does not exceed the speed of sound. Sonic boom occurs when the object exceeds the speed of sound. The important point is to know when a sonic boom occurs.
>
> (. . .)
>
> Student A: Does it happen when the object is at the same speed with sound:
>
> (Mr. Doe did not answer that question either he did not hear it or he ignored it)
>
> Student B: Is it the same thing as sound barrier?
>
> Mr. Doe: No. Sound barrier is different. (He continues to explain the supersonic airplanes) For instance they do not fly at low altitudes near towns. If they do it may cause damage to houses. They may break the windows.
>
> Student C: Doesn't the pilot hear that sound?
>
> Mr. Doe: No.
>
> Student D: Does it break the quarter glass too?
>
> Mr. Doe: Son, please ask meaningful questions!
>
> Student D: Ok. I won't ask again.
>
> On the textbook, the teacher showed the two figures that show the sound waves produced on

two situations: when the object is at the same speed with sound and when the object exceeds the speed of sound.

Mr. Doe: There are two types of sonic boom. (Showing the two figures)

Student E: Does they fly at low speeds on August 30?

Mr. Doe: Shock waves are used in medicine. For instance, while breaking the kidney stones, they use shock waves. Fishers also use sound waves in order to find the places of shoals. The ultrasound machines are also work by sending sound waves to the body.

Student F: How the sound waves transform into three dimensional images?

The recess bell rang and teacher left the classroom. (From field notes, 11.05.2012)

In this excerpt, the teacher gave the example of supersonic aircrafts and emphasized that these aircraft can exceed the speed of sound. Then he explained that Doppler Effect only occurs when an object moves with a speed less than the speed of sound. But he did not explicitly say that Doppler Effect does not occur at speeds that exceed the speed of sound. Instead, he implied this by introducing sonic boom as the phenomenon that occurs when an object exceeds the speed of sound. Then he pointed out what the students are expected to know about sonic boom, that is, under which conditions it occurs. Student A asked a very interesting question: "Does sonic boom happens if the object's speed is equal to the speed of sound?" This question appears to be a genuine attempt for understanding. The student had just learned what happens when an object's speed is less than and greater than the speed of sound, but not the case when it equals the speed of sound. However, the teacher did not respond. He either did not hear the question or he simply ignored it. Since I heard the question while I was sitting at the back of the class, it is unlikely that he did not hear it. The question was left unanswered.

After that, another student asked a question, which seems like a genuine attempt to understand as well. The teacher talked about what sonic boom is, but he said

nothing about the sound barrier. Student B wondered whether these two concepts have the same meaning. The teacher responded by simply stating that sonic boom and sound barrier are different concepts, but he did not explain how and why they are different. So Student B's attempt for understanding is reduced to a binary answer. Why the student should accept the answer as correct is not clear. The teacher provided no reason. (A missed opportunity for a teachable moment) Then the teacher returns to talking about supersonic airplanes, and explained why these airplanes do not fly low near towns.

While the teacher was continuing, another genuine question came from Student C. "Does the pilot hear the sound" who is flying the supersonic airplane which produces the sonic boom? Again, the teachers' answer was a simple "no", with no reasons, no explanations. Then, the intention in asking questions changed slightly and the student asked "Does it break the quarter glass too?" The student might have gotten bored and wanted to cheer up the class by asking if the shock wave break the quarter glass of the cars. He might have heard before that the quarter glasses are the ones which were frequently preferred to be broken by car thieves. Probably the teacher was getting stressed with the previous questions and finally got angry with the last one so warned the student to ask meaningful questions, and the student said he would not do it again. Mr. Doe continued to talk about sonic booms and by looking at the two figures in the book he said that there were two kinds of sonic boom. Unfortunately, that was a misunderstanding since there was no such information written in the textbook. It can be concluded that the teacher was unfamiliar with the topic; moreover he did not read what was written in textbook. If he had read it carefully before, he would realize that there is only one type of sonic boom which corresponds to one of the figures drawn in the book. The other figure was representing the condition when speed of the moving object is at the same speed with sound where the other one was when the speed of the object exceeds the speed of sound. This might explain why he left student A's question unanswered. After the unfortunate answer of Mr. Doe, one of the students asked a question about supersonic aircraft: "do they fly low speeds in August 30?" August 30 is a national holiday named "victory day" in Turkey. Since that day is for memorial of the victory of Turkish army in 1922 in Dumlupınar, Turkish aircraft pull

off stands in cities. The student was curious if the aircrafts exceed the speed of sound that day even if they were near city centers. Again the teacher did not respond to the question probably because he did not want to spend too much time on the example of supersonic aircrafts. Then, Mr. Doe started to talk about the use of shock waves in medicine. This example was written on the students' textbooks. He also mentioned ultrasound and the use of sound waves in fishing even if it was not about shock waves. These examples were also given in the textbook but on previous pages when the topic was the devices that utilize sound waves. The teacher probably could not have found one example enough so he may have wanted to provide more examples.

As can be seen from the quotes from the field notes, the students were very interested with the topic when the teacher gave examples of concords and F-16's. This might also show that the students were interested in the topic and began to understand it, so they asked further questions in order to understand it better. Sometimes they might ask silly questions (they probably aware that their questions were silly, they just want to mock the teacher) but most of the time they asked good questions (such as the student who asked what happened when the object travel at the same speed with sound). Moreover, not all of the students' questions were answered by the teacher. The reason behind this might be the possibility that the teacher might not know the answer or the teacher might think that the explanation needed further understanding which the students could not achieve. Alternatively, the teacher might have told students that he did not know the answer and, he could have wanted them to research and share their findings with the class or he might want them to make a guess by asking them what the answer might be according to them.

Answering Students' Questions. Another instruction mode in short presentations that the teachers used was answering students' questions. Students' questions may be used as a good evaluation tool since these questions may shed light on how they construct the knowledge. They might also show that students are trying to understand the phenomenon instead of just accepting what the teacher said. Answering those questions sometimes might be difficult since further information might have to

be given or teacher might not know the answer of the question. Though the important point is how the teacher uses those questions to help students understand the concept better. At the research site students were used to ask questions at points where they did not understand or when they were curious. The things that triggered students to ask questions may be the moments when they began to understand the phenomenon. A similar example was given in the previous section. Those questions are sometimes apt, sometimes naïve, and sometimes asked purposefully to mock the teacher. The possible teacher reactions to students' questions are shown in Figure 4.4.

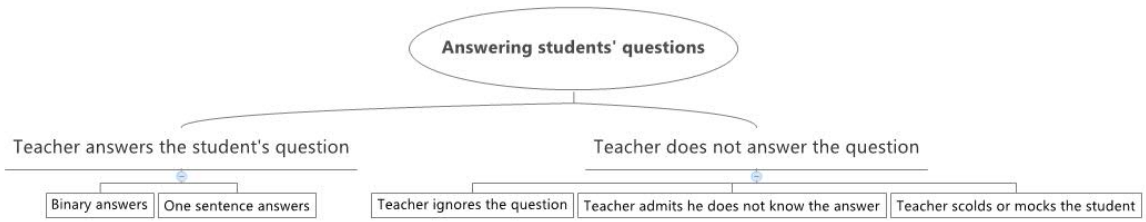


Figure 4.4. Possible teacher reactions to students' questions.

There were two different things that the teacher might do when a student asked a question: either the teacher answered the question or she did not. A summary of teachers' possible reactions to students' questions is presented in Figure 4.4.

When a teacher answered a student's question, usually she preferred short answers. Sometimes the answer could be binary, a simple yes or no, without any explanation. If the student was lucky enough, the answer could be one sentence long yet, again without any satisfactory explanation. The following excerpt is an example of this situation, which is the longest answer that a teacher gave during the classroom observations:

> The lesson was for 11th grades and the topic was modern physics, the spectrum of the Hydrogen atom. While solving questions, one of the students asked:
>
> Student: What does discreet mean?

> Mr. Doe: It means that the energy cannot take every value. For instance angular momentum is discreet, energy is discreet but linear momentum is not discreet, it can take any value. (from field notes of 27.04.2012)

In this excerpt, the student asked Mr. Doe the meaning of a term while they are talking about modern physics, energy levels. Since the teacher did not tolerate any time loss, he did not put very much emphasis on definitions of terms; he might think that definitions are easy to learn so that they can allocate more time for question solving. When the student posed the question "what does discrete means?" the teacher first said that when something is discreet it means that thing cannot take any value. In that situation, energy and angular momentum was discrete but linear momentum was not. Mr. Doe's explanation was not wrong though he failed to emphasize that what he said was true for quantum particles. He did not say that the situation was not the same in classical mechanics. Student might think that energy and angular momentum are discrete hence they cannot take any values in all situations. He could also have explained the meaning of discreet in physics with more illustrative examples.

The teachers preferred not to answer a question most of the time when they thought they did not know the answer. Another possibility is when a student directed a question to the teacher, they might give wrong or dubious answers. Even though the teachers avoid answering questions and elaborating their answers, they might sometimes give wrong answers too. The following excerpt is presented in order to give an example of teachers' wrong answers to students:

> The lesson was for 11th grades and the topic was resonance and forced vibrations under the title of sound. Mr. Doe was trying to explain what resonance is. As he usually did he gave examples from real life. He first gave the example of a swing and then talked about bridges. He mentioned a recent marathon race called "Eurasia Marathon" He said that when the marathon contesters were passing the Boğaziçi Bridge resonance occurred and the bridge started to oscillate.
>
> Student 1: Many cars cross the bridge but they do not cause such oscillations? Why is that?
>
> There was a moment of silence

Mr. Doe: Because all of the cars do not apply breaks at the same time.

Then Mr. Doe moved on by giving examples of resonance (from field notes of 18.05.2012).

In this example, the Mr. Doe employed the method of example giving as he usually did while talking about the topic "resonance". Hence, the students started to pose questions regarding the examples ad they usually did. When the teacher gave the example of Eurasia Marathon, the students were engaged with the topic and one of them asked why the bridge does not oscillate as it did the marathon when many cars are crossing the bridge. There was a silence, probably because the students wanted to hear the answer to this meaningful question and teacher hesitated to answer it. The teacher then said that the cars do not break at the same time, probably thinking that the friction force caused by the breaks of the car does cause forced oscillations. In reality, cars cause a bridge to drop when they enter, and rise back when they exit it; the only way a group of cars could cause a bridge to oscillate significantly would be if the entry of each car was precisely timed so as to reinforce the oscillation caused by the previous one (Denny, 2010). The teacher did not have to know the answer, he could just have said that he made a guess and given reasons why he thought so. He could also have said that he did not know why it was so but he could have try to learn the right answer or ask the student to try to find the answer to his own question.

Another possibility that might arise when a student posed a question was that the teacher did not answer that student's question. There might be different reasons for a teacher not to answer a student's question. She might have not heard or understand the student's question, she might not know the answer to that question and might not want students to know that, she might think that the answer to that question was beyond the students' knowledge of physics. The teachers at the research site did it so by simply ignoring the question, by saying that he did not know the answer, or by scolding or mocking the student who asked the question. Below there is an excerpt presented in order to illustrate the classroom when the students started to ask questions regarding the topic under discussion:

It was a physics lesson for 11th grades and the topic was hearing range of different species under the title of sound. Mr. Doe explained students what infrasonic and ultrasonic sound meant. Then he told students that different animal species had different hearing ranges. He gave the examples of dogs and dolphins for animals that can hear ultrasonic sounds. He also gave the example of elephants for animals that can communicate in infrasonic sound range. Mr. Doe gave the example of dog whistle which produces ultrasonic sound and which was heard by dogs but not by humans.

Student 1: Can dolphins not hear our voice?

Mr. Doe: Yes, they can hear us.

Student 2: Can they produce sounds of the same frequency as those they hear?

Mr. Doe: Probably they cannot.

Then the teacher started to talk about the relationship between the loudness and frequency of sound. Then he turned to the examples of animals with different hearing range. He said that the bats can hear ultrasonic sounds and they can find their prey by producing ultrasonic sounds since their eyes do not see well. After that he continued to talk about the loudness of sound:

Mr. Doe: 20db sound is 10 times louder than 10db, not two times.

Student 3: Why is that so?

Mr. Doe: Because it is that way.

Student 3: What use do bats have for their eyes if they hear so well?

The teacher did not answer the question. The class started giggling.

Student 4: Teacher was shocked.

After that the teacher began solving questions. (from field notes of 11.05.2012)

This except is presenting teachers' different reactions to the students' questions. Mr. Doe was trying to explain what ultrasonic and infrasonic meant and that the hearing ranges of different animal species were different at the beginning. Then, he began giving examples as he usually did. He gave the example of dogs and dolphins as animals that can hear ultrasonic sounds where he gave the example of elephants as animals that can hear and also communicate in infrasonic frequencies. The first two examples were from the students' textbook where the elephant example was from another textbook that the teacher used as a resource frequently. It seemed that he had read that topic from different textbooks. After the teachers' examples one of the students asked a genuine question: "Can dolphins not hear our sound?" The answer of the teacher was binary: "yes, they can". Another question about dolphins came: "Can dolphins produce sounds of the same frequency as those they hear?" The teacher guessed the answer: "Probably they cannot" without explaining students how he guessed the answer. He could have asked the student if he could produce every sound he could hear and let him make his own guess. Then, the teacher jumped to the relationship between the loudness and frequency of sound. This section was not included in the students' textbooks but it was covered in the textbook from which the teacher gave the elephant example. For a moment, Mr. Doe returned to the hearing range of different species and gave the information that the hearing range of bats and how they caught their prey. Then he continued to talk about the loudness of sound. Probably he forgot to mention bats before he moved on to loudness and felt a need to talk about that. When he came back to loudness, he said that the 20db sound is not twice loud as 10db sound; it is 100 times as loud as 10db. That information was again given in the textbook that the students did not possess, without any further explanation about why it was so. Naturally, one of the students asked why it was so. The teacher's response was very disappointing: "because it is that way". The reason why 20db is 100 times bigger than 10db is that the loudness of the sound increases logarithmically. The teacher might have given that information but he did not do that. He might or might not have known why it was so, but he did not want to go into detail because the textbook did not. Besides, in the curriculum the loudness is not even mentioned. There are not any objectives about that. Either the teacher trusted the textbook too much with

respect to its fidelity to the curriculum or he did not know the answer. He might not have thought that the students could not understand it since they had already known logarithm in their mathematics course. After that unfortunate moment came a naïve question: "What use do bats have for their eyes if they hear so well?" The teacher probably thought that the student was mocking, he did not say anything. The class started to giggle after they heard the student's question and saw the teacher's reaction. In response, one of the students said that the teacher had been shocked. The teacher again did not react and continued the lesson by solving example questions.

Even though it happened very rarely, the teachers told the student that she did not actually know the answer. The topics that the teachers confessed that they did not were usually the recently included topics. Such an incidence took place while Mr. Doe was explaining Heisenberg's Uncertainty Principle, one of the recently included topics in the intended curriculum, as quoted below:

> It was the lesson for 11th grades and the topic was the Heisenberg's Uncertainty Principle. Mr. Doe was having students write down what he was saying. He wanted students write down the formula:
>
> $$\Delta x \Delta p \geq \frac{h}{4\pi} = \frac{\hbar}{2}$$
>
> Student: What happens when they are equal?
>
> Mr. Doe: I don't know exactly.
>
> The teacher moved on to the topic "excitation of atoms". (from field notes, 30.04.2012)

In this situation Mr. Doe did not deny that he did not know the difference between the two situations when the product of uncertainty in position and uncertainty in momentum is equal to $\frac{h}{4\pi}$ or is bigger than $\frac{h}{4\pi}$. Admitting that he did not know the answer was a noble move for a teacher but it would be much better and constructive if he had said "let's search from the books and internet the answer to your question." He could have done it himself even if the student did not. However, there were incidences

when he did so and students appreciated that. But it occurred mostly when the student showed a question to the teacher from the textbook and the teacher could not solve it. A dialogue emerged during one of the focus group interviews about to this issue:

> The Student: I am under the impression that the teacher would not be able to explain certain topics without brushing up first, if he has not taught it in years. A new curriculum comes along, the topics to be covered are outlined, and he does not step outside that boundary. Yet he is human, he forgets after a while, no one can remember everything. Hence, I think we should be curious and look things up. For example, I got stuck when solving a problem, and Mr. Doe too was unsure, but I know Mr. Doe went ahead and look it up and I too look it up. That is how we managed to solve it.
>
> The Researcher: What was it about?
>
> The Student: It was about electrostatic induction, I had a different approach. The object was both grounded, and was affected by induction. We got stuck, I do not recall clearly, but the teacher and I were both unsure. That is why I feel it is wrong to assume teachers know everything, because they are indeed human and may forget. (from focus group interviews with 10-B).

One of the students said that their teacher did not have to know everything related to physics. She seemed to be trying to defend her teacher. She stated that teachers might have forgotten what they had learnt in university if they did not teach it for a long time. She was aware that there were new topics included with the new curriculum and their teacher probably forgot those topics since he had not taught them for years. While she found that normal, she appreciated her teacher's effort to find the answer to her question. On the other hand, what she asked the teacher was not a question that comes up to her mind; it was a question from one of her textbooks. Instead of simply saying "I don't know" to this student's question by not bothering to find the answer later, Mr. Doe tried to find the answer when the question was from a textbook. This might show the teacher's priorities: The questions that the students could not solve from their textbook were more important than the students' questions that came from their curiosity while they were trying to understand a phenomenon. This might be a result of the excess emphasis on the national examination.

The last possible response of the teacher to a student's question was scolding or mocking the students. From time to time teacher mock the students when they ask questions or they say they did not understand. For instance, one of the students expressed discontent with his teacher's attitude towards his questions:

> Student 1: I always say I did not understand and they make fun of me for that.
>
> (Students laugh)
>
> The Researcher: Do you ask when you truly do not understand?
>
> Student 1: Yes.
>
> The Researcher: I mean is it that you pay attention but still cannot understand?
>
> Student 1: The important thing is to learn, is it not? I fail to understand a tiny thing, and I ask, because whom will I ask later? (from focus group interviews with 10-C)

That student was one of the students who asked many questions during the observed physics classes. It was also observed that it was the same student whom the teacher mocked the most. This attitude of the teacher probably prevented other students asking questions. The same group also mentioned that their teacher mock them when they could not solve questions on the board. Worse than that from time to time, the teachers got angry with the students' questions and scolded the student who asked that question. Such incidence was presented in the previous section.

Student Presentations. Another instruction mode that the teachers deployed was student presentations. The teacher assigned specific topics from physics to students who selected physics for term project and want them to prepare a PowerPoint presentation. Mostly, it was the teacher who selected the topic for the student, not the students themselves. The teachers chose the topics that would be presented as a term project among the topics which were included with the new curriculum. Some

examples from the topics that were presented are; special relativity, lasers, experiments being conducted at CERN, stars and quasars. There might be two reasons why the teachers preferred such topics: either the teachers did not feel themselves confident in those topics or they did not think that they are important and students would not encounter questions about those topics in the national examinations. It seemed as though the topics the students were assigned to present were not taken seriously by the teachers. The teachers did not think these were important topics. In relation to the less important topics with respect to the teachers, when asked Mr. Doe if there exist any topics that he skipped, he answered as follows:

> Ermm... Usually... I mean... We cover almost all of it, although of course we consider past exams when cut a topic short or cover it superficially. For instance, in photoelectric effect, there are two types of questions. There are usually two graphs. And then there is the energy of light. We skip the other parts. I mean, we go a little faster (from interview with Mr. Doe in 08.06.2012).

The teacher said that they covered almost all of the topics in the intended curriculum but with different emphases. The topics that he chose to skip or skim through were the ones that he thought were not relevant for the university entrance examinations. This decision was based on his analysis of the previous years' questions in the exams. Within a topic, different parts also were emphasized with various weights. For instance, when he was talking about photoelectric effect, he stated that there are three styles of questions; two of them are about graphs and one is about the energy of light. He admits that he focuses on teaching the concepts related to these three question styles, and not paying much attention to the rest of the concepts. The parts that the teacher thinks are less important are assigned as term homework and student presentations.

The recently included topics such as special relativity, lasers, and stars and quasars had not been asked in national examinations before. Hence the teachers appear to think that they will not be asked in this year's exams as well. This can explain why these are the topics that the teachers prefer to assign as student presentations.

The students gave their presentations on days the relevant subjects would have been covered. They came to the lesson prepared and with a PowerPoint presentation. Before the lesson, the students who would present their topics came to the teacher and reminded that they were going to present their term homework. The teachers usually preferred leaving the last ten minutes for the students' presentations. In the beginning of the lesson they solve problems regarding the previous topics. An 11th grade student's homework presentation is quoted below from the field notes in order to illustrate the structure of the presentations:

> It was the second physics lesson for 11-B that day. At the beginning of the lesson two of the students reminded the teacher that they were going to present their term homework topics. The teacher first checked the students' regular homework and solved the questions which could not have been solved in the homework. The solution of the homework questions continued until the middle of the second physics lesson. When all the unsolved questions were solved, the teacher announced that their friends would present the topic Laser then. Then the students began their presentation. They first read the class where the name "LASER" came from. Then they told the class who invented the laser and its working principle. While doing so, they preferred reading from the slide instead of explaining it.
>
> Mr. Doe: so what is a laser?
>
> Student 1: We haven't explained what a laser is; we just told who invented it and its working principle.
>
> The class started giggling.
>
> Student 1: I don't know how reliable those information that I found from the Internet.
>
> Then the students explained that lasers are used in order to measure distances accurately and gave the example of measuring the exact distance between the Earth and the Moon. They said that in order to measure the distance between the Earth and the Moon, the scientist had located a mirror on the Moon and send laser beams and measure the distance. The teacher said that he had never heard it before. The students continued to read from the slides the types of lasers: solid lasers, liquid lasers and gas lasers. One of the students asked which one was the most powerful. They could not answer him. After, the students talked about the use of lasers

> and finished their presentations by mentioning holograms. While giving examples, students mentioned that the scientists had cut the head of a fly and the fly continued to fly. One of the students said "Teacher, the medicine discipline improved very much".
>
> When the students ended their presentations there was one minute for the recess bell. The teacher did not ask the students who present their homework further questions but he gave homework to the class to solve the "exam questions" on Modern Physics from their textbook. (from field notes of 07.05.2013).

In the presentation example, the teacher set aside the last 10 minutes of the second lesson for the students' presentations. Most of the time each student prepared their term homework individually but that time the teacher accepted the two students' preparation of one presentation. The students started what the name laser comes from and continued by the working principle of it. They did not explain what a laser is so the teacher interrupted and asked what a laser is. Neither of the students could answer that question, instead they told that they did not talk about what a laser is but who invented it and its working principle. The answer was found funny by the other students. The answer to that basic question (that the laser is a light source which emits parallel light waves of the same frequency and the same phase) was written on their textbook in bold but they were not careful enough to include it in their presentation. They also prefer reading from the slides to explaining what they had understood. This shows that they did not study the content well. Even though Mr. Doe asked a good question to the students, and they could not answer it, he did not make any other comments or explanations. Then the students told their teacher and their friends that the information they had found was from the Internet to imply that they did not really trust the information that they gave in their presentations. Usually the students and the teachers did not trust any information they found on the Internet. They rely more on the information they reach from textbooks or books. The reason of their mistrust might be that they could not distinguish reliable information from questionable on the Internet. After that the students gave examples of the uses of lasers in science and daily life. The examples that the students had presented were interesting while some of them were not very credible. Cutting the head of a fly with laser beam was an example for such information. Another point that should be noticed was that the

students had prepared their presentation adhering to their textbook. They just added a few examples for the use of lasers to enrich their presentation.

The teacher did not prefer making any explanations about lasers in neither that nor the consecutive lessons. These topics were simply presented by the students and not taught by the teacher. Hence, students' presentations were not very informative for the students and teachers were aware of that. Since the teachers thought that no questions would be asked in the national examination they did not feel the need of explaining the topic in detail.

4.1.1.2. Question Solving. So far, the first major classroom activity mode, short presentations, has been described. In this section, the second major classroom activity mode, which is solving questions, is presented. After the introduction of the topic, as a next step teachers started to solve questions. The possible activities that the teacher and the students may engage in question solving is shown in Figure 4.5.

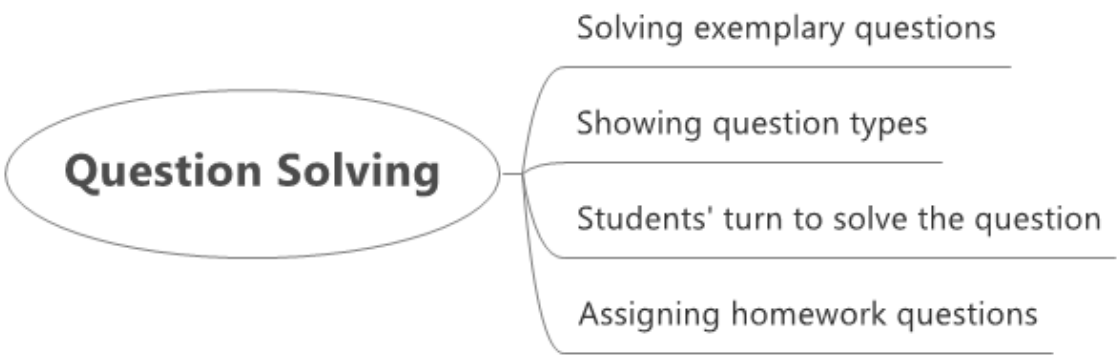


Figure 4.5. Question Solving.

Both the teachers and the students believed that solving questions are essential part of physics learning since it enables the students and the teachers to see whether the topic is learnt or not. One of the students emphasizes the importance of question solving by saying that ""we do not solve questions to practice, we learn the topic

through question solving." (from focus group with 10- C). Moreover, in one of the focus group interviews with the students, when they were asked the question: "how do you make sure that you learnt a topic in physics?" one of the students said "if I can solve the questions of that topic after two weeks, I can say that I understood the topic" (from focus group interview with 11-B). This might show that the students believe they understand a topic by solving questions and if they solve questions, they understood the topic.

There were different modes of question solving in the classroom. These are named as solving exemplary questions, showing question types, student's turn to solve questions and assigning homework questions. These four modes are described and discussed in the following subsections.

Solving Exemplary Questions. Since the teachers and the students believed that question solving is an important part of instruction, the teachers devoted most of their time for that activity. After the teachers talked about a part of the topic and presented the formula necessary for solving the questions (if there were any), she solved some straightforward questions that showed how to use the formula. These types of questions are exemplary questions. Teachers sometimes called this process as "grasping the logic of the topic":

> A lecture in 10th grades, the topic is Modern Physics, general relativity:
>
> The class had learnt Michelson – Morley experiment and the teacher made a brief summary of what they had learnt in the previous lecture.
>
> Mr. Smith: What did Einstein say? The time dilates and the length changes. Please just understand it at once so that we can move on, if you are distracted all that you learn will be messed up. There are one or two things that you have to know, if you do, you can solve all the problems.
>
> Mr. Smith: Let me give you the formulation part. Notice that we have not started the topic

yet.

He wrote the formula on the board:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Mr. Smith: Do not think of it as physics; just think of it as mathematics.

He presents an example: if the velocity of the particle is 0,6c then the gamma will be:

$$\gamma = \frac{1}{\sqrt{1 - \frac{36c^2}{100c^2}}} = \frac{5}{4}$$

Mr. Smith: The rest of it is physics, you can do it.

He wanted students to write on their notebooks, not at the empty space on their textbooks.

Mr. Smith: This topic will be finished next week. Then we move on to waves and then we have an exam.

Then he solved another example:

$$\gamma = \frac{1}{\sqrt{1 - \frac{64c^2}{100c^2}}} = \frac{5}{3} > 1$$

Mr. Smith: What was given as velocity in your textbooks?

$$\frac{4\sqrt{3}}{7}c$$

Mr. Smith: The provided numbers are usually easy to take the square root of.

$$\gamma = \frac{1}{\sqrt{1 - \frac{48}{49}}} = 7$$

Mr. Smith: Did you grasp the logic of it? It is important for me. (from field notes 03.05.2012)

To begin with, the teacher first summarized in one sentence what Einstein's findings: "time dilates" and "length changes". He did not even say under what conditions time dilation and length contraction occur. The teacher wanted to move on and he was trying to gather students' attention to have students understand the topic by saying "Please just understand it at once so that we can move on, if you are distracted all that you learn will be messed up". The teacher was aware that the topic was hard for the students to understand so he was trying to make it simple by just giving one or two rules they had to know to solve the questions. Then he immediately jumped to the formula of gamma used for finding amount of time dilation and length contraction and wrote the formula on the board. While he was presenting the formula, he wanted students to think of it as mathematics, not physics. He probably did not want students to think of the physical meaning of the formula. After he gave the formula, in order to understand its use in the questions, the teacher moved on to solve an example which presented how to find the gamma. Then, he calculated the value of gamma and he told students that the rest of it was physics. He did not explain where and when gamma is used. During the students copying what the teacher wrote on the board, the teacher wanted students to jot down the calculation on their notebooks, not on their textbooks. At the beginning of the field notes it can be sensed that the teacher was in a hurry to finish the topic by saying "understand the topic at once". While the students were copying how the teacher found the gamma, he also informed students that the topic had to be finished by the following week and what they would do after finishing the topic modern physics. It seems that Mr. Smith was in a hurry and wanted to cover all the topics in the curriculum. He calculated another value for gamma when the

particle's speed was 0.8c, where c is the speed of light in vacuum. This time, he noted that the calculated value was greater than one and said that the result would always be greater than one. Then he solved another example but this time it was from students' textbooks. That value of speed was given as an example which asked the value of the kinetic energy of the particle of that speed. While he was finding the value of gamma, he gave a tip for the students by saying that "The provided numbers are usually easy to take the square root of." Probably he did not want students to be scared of the numbers in roots. After solving three examples of how to calculate gamma, he asked the students if they grasped the logic of it by noting that having students grasp the logic of it was important for him. What he meant by the logic of finding gamma is how to calculate it correctly. He did not mention how it was derived, why and when we needed to use it in our calculations, how do we use it while calculating time dilation, length contraction, or kinetic energy of the particle but he could talk about the importance of grasping the logic of it.

As seen from the quotation from the field notes, the exemplary questions were simple questions that were prepared for drill and practice purposes hence did not require higher level of thinking while solving them. As a next step, the teacher began to solve straightforward questions which required a little higher level of thinking. This type of question solving is discussed in the following section.

Showing question types. After the teacher finished talking about a part of the topic and solving exemplary questions, in order to help students understand the topic better and to help them be familiar with different kinds of questions, she solved different question types which were usually from students' textbooks. The question types were chosen according to the previously asked questions in the national examination. The teachers called these kinds of questions as the typical questions of that topic:

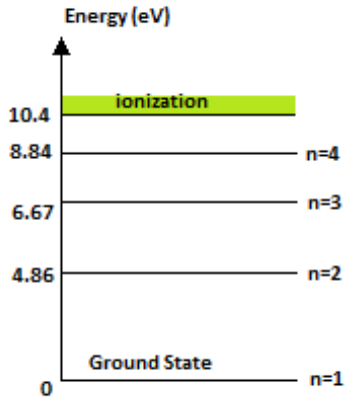
> It was the lesson for 11th grades and the topic was modern physics, the excitation of atoms. The previous lecture he mentioned the class about excitation of atoms, four different ways to excite an atom and solved an exemplary question. That lesson, the teacher first reviewed the

topic and list the four different ways to excite an atom.

Student: Sir, this topic is boring because it is qualitative.

The teacher did not respond.

Teacher: Let us solve some questions



The energy levels of mercury atoms are shown as in figure. According to this, which of the following can ionize the mercury atoms at the ground state:

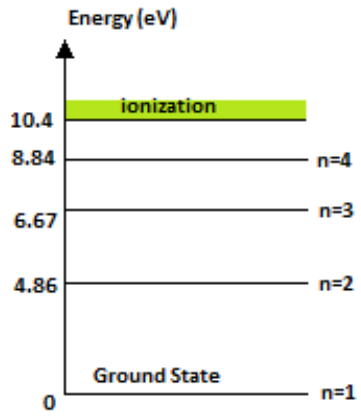
(i) electrons with energy of 11eV

(ii) photons with energy of 10,4 eV

(iii) photons with energy of 12 eV

Figure 4.6. Question 1.

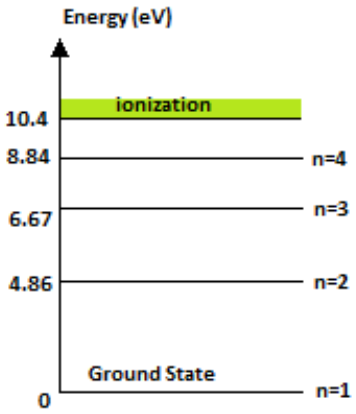
They solved the question and then move on to another one:



An excited hydrogen atom, some energy levels of which are given in the figure, radiates in all possible ways when returning to the ground state. If the greatest amount of radiated photon energy is 12.75 eV, which excited state was this atom in? n=?

Figure 4.7. Question 2.

After solving the question, the teacher said that "this topic's questions are like these. These are the typical questions of this topic." Then he began to solve another question from the same textbook:



A mercury atom, the energy levels of which are given in the figure, is excited by 9 eV electrons. Which of the following is not one of the possible energies of the photon radiated by this excited mercury atom?

Figure 4.8. Question 3.

After the teacher explained how to solve the problem, he asked the class who had understood it.

Student: Sir, can you explain it once more?

Teacher: OK. I will

Student: But please explain it quickly.

Then the teacher explained the solution of the question once more. (from field notes on 30.04.2012)

At the beginning of the lecture, the teacher reviewed the topic to help students remember what they had learnt. While he was doing it, one of the students probably got bored from the topic of excitation of atoms and wanted to share it with his teacher. A few minutes earlier another student had asked when they would start the topic waves. The student did so probably he was bored with the topic too. The student thought that the topic is boring since it is qualitative. What he meant was that there were

not any formulas that they can use while solving numeric questions. Yet, the teacher did not say anything probably since he agreed with the students. Instead, he began to show different question types that the students might encounter in the national examination and solved three different questions. Those questions were from one of the textbooks other than the students had which the teacher alternatively used while lecturing. After solving two questions, the teacher said that these are the typical questions that they might encounter. He was implying that the students did not have to know everything about excitation of atoms; they just had to know the information they needed to solve these questions. After the teacher solved the third question, he asked if they had understood it or not whereupon one of the students asked the teacher to explain the solution once more but as quick as possible. The student might have requested it because he knew that the class had grown tired of that topic and did not want his friends to be upset.

There were different classes of questions which will be referred to as "qualitative questions", "quantitative questions" and "interpretation questions" in this study. This classification was done by the teachers and the students, not the textbooks. The quantitative questions were the ones which involve numeric and calculations. There are two types of qualitative questions: questions that involve applying formulas and questions that involve integration of two topics and hence that need more complicated calculations. Qualitative questions do not involve calculations but students might have to know the topic well in order to find the right answer. Students might memorize the content in order to do the "qualitative questions". Students call the questions that they had difficulty in solving "interpretation" questions. The "interpretation" questions can either be qualitative or quantitative; the point is they involve higher level of thinking than the drill and practice questions. During focus group interviews, students explain what qualitative, quantitative and interpretation questions mean:

> The Researcher: You students keep saying "qualitative". You have two conceptions called "solving with logic" and "qualitative" that I cannot understand. What is qualitative, what is not?

Student 1: You have a formula; you memorize it and plug what is given into it to find the answer. For example in mechanics, it does not matter if you have the formula, you have to work out the system yourself. Like with those pulleys, you have to adjust them and look carefully. That, for us, is a quantitative subject.

Student 2: Like in, what was that thing we spin around, I forget the name of the subject (laughs)

Student 3: Circular motion.

Student 2: In circular motion we make the car make the turn, and then in the exam I saw this question; I had not seen anything like it to that day. The car is turning, hits a nail, and starts to turn around the nail.

Student 1: I saw it in a book, and instantly turned the page. Of course, I could not do that in the exam.

Student 2: We cannot even do the simple case, let alone the complication with the nail.

(. . .)

Student 2: You mentioned "qualitative" questions and those that require logic to solve. When one hears the word "qualitative", it implies memorization. For example, what causes an increase in the photoelectric current or in the intensity of light; these are things you have to memorize. When we memorize these. . . it is qualitative.

The Researcher: Is there not logic behind that?

Student 2: There is logic behind it but if you are not taught that logic, you have to memorize.(from focus group interview with 11-C)

At the beginning of the conversation, one of the students stated that the topic "modern physics" was qualitative. Then, the researcher asked the students what qualitative meant to understand why they believe that modern physics was a qualitative topic. One of the students tried to explain the interpretation questions. If the students

need to do more than applying the formulas or memorizing, these were interpretation questions. The topics that involve many questions of this type were also called "quantitative" topics. Then, another student gave an example of interpretation question of circular motion which was again classified by the students as quantitative topic. A couple of minutes later, a student returned to the discussion on the distinction between qualitative and quantitative questions and gave an example of a qualitative topic. Photoelectric effect which is a part of the unit "modern physics" was presented as an example for topic that usually involves qualitative questions. He said that qualitative questions can be solved if they memorize a few things that are related to that topic. For instance the question "what can be done in order to increase the photoelectric current?" was a qualitative question. It does not involve calculations and students do not have to make complex connections between what they had learnt. Even though those types of questions were prepared to help students develop reasoning skills, students find memorizing easier than reasoning even they had to memorize many things. Further discussion on the distinction between qualitative and quantitative topics will be done in Section 4.2.5.1.

As a result of the emphasis on question solving, the students felt that they understood the topic by solving questions. While we were talking about learning physics, they were always mentioning question solving. For instance during focus group interviews with 10th grades, the students admit that they did not learn the topic, they learnt the solutions to the typical questions.

> Student 1: Learning the topic is not important, learning how to solve questions is.
>
> The Researcher: What do you mean by that?
>
> Student 1: There are question types, there are different kinds of questions. The important thing is to learn how to solve them. I always study that way.
>
> The Researcher: So you do not learn the subject, you learn methods to solve questions?
>
> Student 1: That is how I study.

Student 2: I think so, too.

Student 3: So do I.

Student 4: We actually learn the subject while solving questions.

Student 1: Yes.

All students: Yes, exactly.

Student 2: Yes, we do not understand the subject when we study it, the logic sets in as we solve questions.

Student 1: You come to recognize the type of question.

Student 3: Yes we actually... Student 2 is right, we learn methods to solve questions. We do not learn about a subject, we learn methods.

Student 2: We do not solve questions to practice, we learn the topic through question solving.

Student 1: Yes, but part of the problem lies with us.

Student 3: Well, in class the teacher gives the formulae, and goes on directly to questions. He does not deal with the foundations of the subject. In class, we skip directly to questions. (focus group interview with 10C)

In these quotations form field notes, when asked about their study habits, Student 1 said that the important thing in learning physics was not learning the phenomenon but learning how to solve certain questions. Since the important point in learning physics is to solve those questions, the student tried to learn the solutions of those questions. Then, the researcher tried to confirm if they learn how to solve questions instead of learning the workings of physical phenomena. All of the students in the focus group agreed. Student 1 stated that there was something wrong with their method of learning. Then, another student explained one of the possible reasons for this problem.

She said that even their teacher used that method; he just gave the formulizations and jumped to question solving by not discussing much about the topic. It was also the teachers' method of teaching as well as students' method of studying.

While some of the students were complaining about the limited time allotted for discussing the topic, as in the previous excerpt, some of the students complain that they did not learn the solutions of the question types that they saw in other textbooks:

> Student 1: It varies from teacher to teacher. For instance in mathematics classes , we usually solve many different types of questions like my friend said. Even though we solve a few questions, they are of many different types, so when we encounter a question on other textbooks we can go, oh, we solved something like this before. In physics, though, we only solved questions on formula application, we did not solve interpretation questions, and therefore we fail at them.
>
> Student 2: We do not solve many interpretation questions.
>
> Student 1: That is not the case with mathematics, though. In mathematics, we solve many different kinds of questions, it includes interpretation or proofs. Unlike other teachers who do not discuss these proof questions, our mathematics teacher solves them, even if it appeared only once in any textbook, that is a good thing. I wish more teachers did that.
>
> Student 2: Indeed these questions are not that hard, the topics are not that hard. For instance, at the beginning of this year we had mechanical dynamics, I have not understood anything about it.
>
> Student 1: We covered it too fast.
>
> Student 3: Dynamics was hard.
>
> Student 2: I did not understand anything.
>
> Student 3: We checked other textbooks and saw that there were 20 different types instead of, say, three we saw in class.
>
> Student 4: Exactly.

Student 5: And they combine different things in dynamics, for example there is a simple Atwood machine, and projectile motion is considered in the same question.

Student 4: Pulleys.

Student 5: There is everything.

Student 6: It is a very broad subject and we set aside too little time for dynamics. We might be better at waves than with dynamics, we covered it too quickly.

Student 2: What was it about inclined planes, the teacher mentioned F=ma...

Student 6: Yes, for instance we know about F=ma, we do not know the rest. (from focus group interview with 10-B)

In this excerpt, one of the students gave an example from mathematics class. The students complained that even though they saw many questions the types of those questions were very similar. For instance they mostly saw how to apply formulae and saw very limited number of interpretation questions. They find the topic mechanics and its questions very hard and claimed that they passed the topic so fast that they did not understand anything. The students wanted their teachers to solve different types of questions, believing that only this way they can understand and solve the questions of that topic. What made students think like that was the other textbooks that the students use while studying the topic. When they did not see the question type that they saw on their textbook in the classroom, the students felt that they cannot solve the questions. One reason behind this might be students' proclivity to memorize everything instead of trying to internalize the underlying concepts. Since the students found dynamics much harder than the topic waves, they thought that their teacher should have left more time on dynamics rather than waves. The students also complained about the depth of their teachers' instruction: for instance, he gave only Newton's third law of motion while talking about the inclined plane and did not solve different questions of inclined planes.

Students' turn to solve question. Whilst the teachers were solving the problems, most of the students were just looking at the board without taking any notes or trying to solve the questions on their own. Even if they think that they understand, they cannot be sure before they try to solve questions on their own. So, the teachers sometimes let students to solve questions by calling one of them to the board to solve a question. If the teacher had solved a similar question before she expected the students to solve that question on the board. The teachers usually pick the volunteer students whilst they sometimes selected them from the class list. In that situation, the students might not want to solve the question, the teachers usually encouraged them by saying that she would help her or him or she would solve it if the student could not. If the question was a tricky one, the teacher said that she would give extra points to the student who solved it on the board correctly. A similar thing had happened in one of the lessons of Mr. Doe:

> The lesson was for 10-C and the topic was electric circuits. Mr. Doe was letting volunteer students solve questions from one of the textbooks other than the classroom textbook. They solve five straightforward questions about electric circuits so far. In each of the questions there was a diagram that shows a circuit. The sixth one was a little different from them: it did not have any diagrams:
>
> 4 identical batteries, each of internal resistance 1 ohm and e.m.f. 9V, are required to operate an FM radio. If the resistance of the radio receiver is 5 ohm, what is the magnitude of the current running through the circuit? a) 3 b) 4 c) 5 d) 6 e) 9
>
> Mr. Doe picked one student among the volunteers. The student came to the board and first drew the circuit inside the radio which is shown in Figure 4.9:

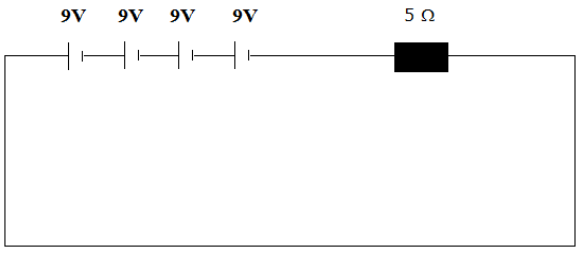


Figure 4.9. The circuit that the student drew before he solved the question.

And then he solved the question:

$$V = I \cdot R$$

$$36V = I \cdot 9\Omega$$

$$I = 4A$$

Hence the correct answer was B.

The class was surprised with the solution, some of them said "wow!". Then the teacher gave 80 points to the student as oral exam grade (from field notes on 20.04.2012)

The question that the student solved was a simple one although it was a little different from the previous ones: it does not have any circuit diagram and also it is a question related to the real life. The question is about a possible circuit in a simple radio where none of the previous questions had any relation with any electrical equipment. So the question was a little different for the students even if it was a simple one. One of the volunteer students came to the board and solved the question correctly. Before he made the calculations he drew the circuit diagram of the aforementioned radio correctly. After he explained his solution, the teacher gave 80 points to the student for his oral mark. Instead of giving 100 points the teacher preferred to give 80 points to the student. He might think that the question did not worth 100 points since it was simple even if its presentation was different. This might show that the teacher value the ability of solving hardest questions much more than the ability of making connections with the real life.

Even though the teachers let students solve questions on the board, students were not very satisfied with its frequency: they want to come to the board and solve questions hence be more active during the lessons:

Student 1: In last year's mathematics classes, since we students were forced to be passive, I grew sick of copying the board to my notebook, and it put me off. In this year's mathematics

classes, we are very active.

Student 2: We are very active.

Student 1: I am sure there is none among us who has not stepped up to the blackboard. We are very active, there is no other subject where I pay as much attention in class as I do in mathematics, I pay undivided attention in every lecture. This is however, because I know the teacher is going to make me active and involve me in the lecture. I do not blame my physics teacher, but we speed through the subject and there are two or three of us that understand it.

Student 2: The teacher only pays attention to them.

Student 1: It looks as though he is lecturing to them only, only they go up to the board and that makes me feel like I fail at physics. After a while, I become hesitant; what happens if I say I did not understand, if I say this, will the teacher call me to the board and make me solve a question? For this reason, I am afraid to ask (from focus group interview with 10-C).

Student 1 gave an example of their level of activeness during their mathematics courses.

Student 1 gave an example of their level of activeness during their mathematics courses. She stated that she did pay much attention to the mathematics lessons the year before since their teacher did not let them solve questions on the board. That year, she started to pay much more attention to mathematics classes since the teacher let them solve questions. Student 1 and Student 2 described themselves as "active" when they come to the board and solve a couple of questions. Unfortunately, this is what the students understand from being active. The students were so passive during the lesson that when they came to the board and solve a question they felt themselves active. That also may reflect the belief of the students that being able to solve questions means understanding the topic. When they come to the board and solve a question they show their teacher and other students that they understand the topic.

Assigning Homework Questions. At the research site practicing was a very important process in learning. The teachers allocate most of their time for question

solving. Yet, they were complaining that they had very limited time to cover all the topics in the intended curriculum. So they also assign homework questions to students so that the students could practice more. Those questions were from the students' textbook that they used in the classroom. The due date for the homework was usually a week after the homework was given. When it was the due date of the homework, the teachers wanted their students to open their textbooks and checked if they had done it or not. If a student did not do her or his homework, the teachers usually asked the student angrily why she had not done her homework and moved on. Mr. Doe was used to give student "chocolate penalty" when they did not do their homework. The chocolate penalty is a method used by only Mr. Doe for classroom management and also encouraging students to do their homework. If a student did not do her homework, she had to buy a chocolate bar for each homework she did not do (see Section 4.1.1.4. for more information about chocolate penalty).

After the teacher finished checking homework, he asked the class the questions they could not solve. If the teacher thought that the question was really hard, she solved it on the board. If the teacher thought that the question was easy then she asked one of the students to come and solve the question on the board. Then she usually asked the class if everybody understood the solution or not. If a student said "no" she explained the solution once more.

4.1.1.3. Demonstrations. The third major classroom activity mode observed in this study is demonstrations. The possible ways of using demonstrations is shown in Figure 4.10. Teachers may prefer showing videos, performing small demonstrations or let students conduct qualitative observations on their own. All of those strategies teachers use in the classroom will be discussed in the following subsections.

Laboratory Use. There was one physics laboratory at the research site. That laboratory had been in use since the previous year. It was Mr. Doe who tidied up and made the lab operational. With the help of intern teachers and some students, he tidied up the laboratory and managed the equipment which we present yet not in

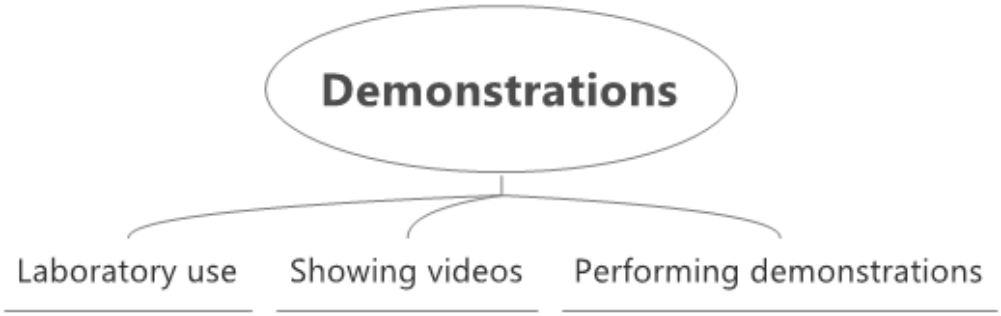


Figure 4.10. Demonstrations.

use for several years. Since the number of classes and total physics lessons were high, not all physics lesson took place in the laboratory. For instance Mr. Smith was the only teacher who uses the laboratory for all of his lessons. Mr. Doe taught in there when Mr. Smith did not have any physics lessons at the corresponding class hour. Ms. Brown did not use laboratory, she prefers to teach her physics courses in the students' own classroom.

The physics laboratory was one of the gloomiest places in the school. Next to the physics laboratory there was the chemistry laboratory. The laboratories were separated by a wall, two small windows and a sliding door. The chemistry lab have large windows hence was pretty bright where the physics laboratory only got sunlight from the small windows that was placed between the physics and chemistry lab. It was impossible teach a course without the lights turned on. The only advantage of such a gloomy laboratory could be that the projector machine can be seen easily. The physics laboratory is in front of the teachers' room so the teachers did not have to walk if their lessons were in the physics laboratory. As mentioned before, the next to the physics laboratory, there was chemistry laboratory. The only entrance to Chemistry laboratory was from the physics laboratory. So when one of the chemistry teachers wanted to go to the chemistry laboratory, she had to pass through physics laboratory. Although the chemistry laboratory was not used as frequently as the physics laboratory, there were moments of interruption when a teacher was passing through the physics laboratory. Interruptions also occurred when the two laboratories were in use and sound from the

next door laboratory caused distraction. For instance, in one of the physics lessons in the laboratory, the chemistry teacher was holding a make-up examination. Students must have been disturbed by the noise, so chemistry teacher asked Mr. Doe to close the window between the two laboratories. It would be pretty hard for the teachers to conduct their lessons if the two laboratories were actively used.

Figure 4.11 is given below to illustrate the layout of the laboratory. Students sit in groups of three. Since the number of seats was bigger than the total number of students in a class, the seats at the back were usually empty. Students usually sit at the same places every lesson. There was a desktop computer on the teacher's desk the keyboard of which was on the nearest student desk. In every class there was a student who was in charge of the management of the computer. For instance when the teacher wanted to open a scanned textbook, he asked that student to open the document and scroll down when needed. The equipment and chemicals of the chemistry laboratory were stored in cupboards located at the back of the laboratory. No cupboards were locked so sometimes students could take and examine the equipment in those cupboards. There were also some students who were in charge of the tidiness of the cupboards, they sometimes warned the students not to mess the cupboards. Those students might also tidy up the cupboards when needed.

Even though the use of laboratory as a classroom is a promising step, unfortunately most of the time the laboratory was used as a classroom. The only equipment that was used during the courses is the projector machine and the computer. Other equipment in the laboratory was not used since experimenting was not a popular teaching method in this school. Nevertheless, there were times when Mr. Doe used some simple equipment like springs and electrical devices (wires, power supplies, etc.) to conduct demonstrations. The tools in the laboratory were very old while some of them were broken. That could be one of the reasons why the teacher did not conduct experiments. The students also mentioned that the laboratory equipment they had was inadequate. In one of the focus group interviews, students complained about the lack of materials and also the age and poor conditions of the equipment:

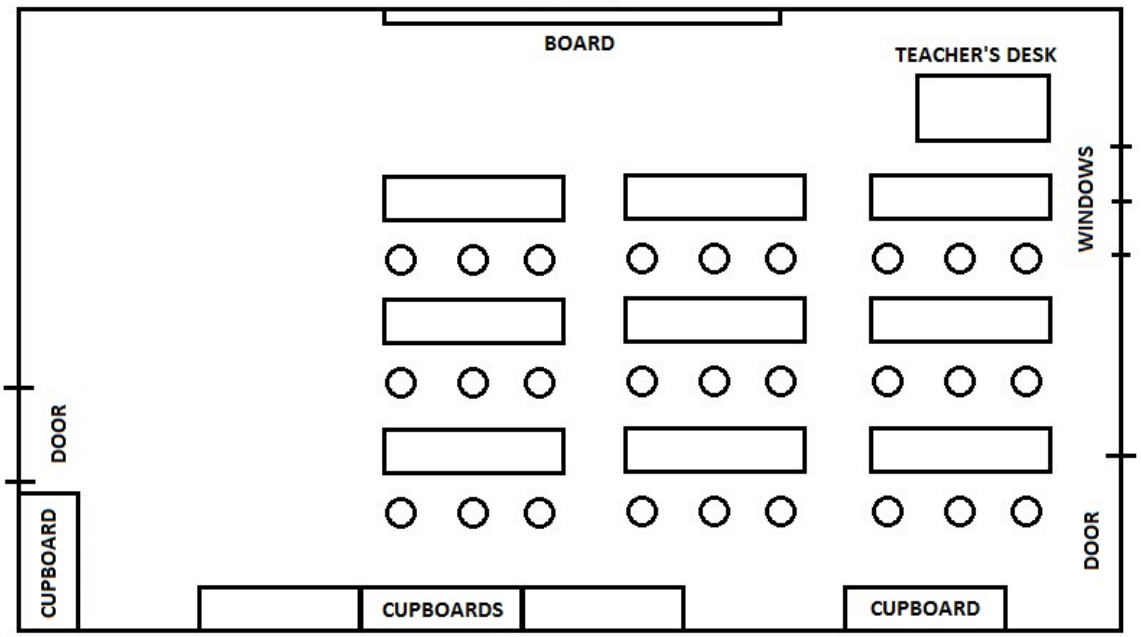


Figure 4.11. The layout of the laboratory.

Student 3: They had done that once, those who took term homework.

Student 4: About magnetism.

Student 5: Right, about magnetism.

The Researcher: What did you do?

Student 5: We had put a magnet like so, and an aluminum stick.

Student 3: We had plugged them into these (points to the power supply inputs on the tables)

Student 5: We plugged it into her, and when we supplied electricity the stick moved.

Student 4: The right hand Lenz rule.

Student 2: They made an stick with aluminum foil.

Student 4: We had done an application of the Lenz law.

The Researcher: Did you need that many resources to do it?

Student 2: I mean, it could be done at least once to understand the topic. Once we lacked a magnet, and some people found one, this big a magnet, but it was not enough. You still need resources. It is dependent on the resources of the school.

Student 1: It was very expensive.

(They laugh)

Student 1: It was 20 something.

Student 3: Something this small, it cost 50 Lira.

Student 4: Maybe we needed a bigger one, that 250-300 Lira ones.

Student 5: The school bought one, paid something like a 100 Lira, I mean that small.

Student: I mean resources are not that abundant.

The Researcher: Would your school not get it if you demanded one?

Student: They already id. (They laugh)

Student: I mean they would pay for it, but sometimes you need very different things for experiments.

Student: There were so few things.

Student: It is improper to ask the school to pay that much...

Student: If we asked the school for something, they would ask money from us.

Student: Exactly, the school already asks us for dues.

Student: Immediately, they ask for dues.

Student: Even if we pay dues, they use them to pay the salaries of the janitors or other things, our problems are of 3rd or 4th priority. The demands of students are low on their list, they say let them watch it on video.

Student: There are very few things in this school, there aren't many.

Student 2: And they do not seem to appreciate in this school. We had tidied that place with friends of mine. There are old timers there.

Student 3: They are not used, I mean, we do not use them.

Student 2: Even the teachers do not know.

Student 1: Even the teacher does not know.

Student 2: There were some things there, even the teacher did not know. We showed them to Mr. Doe, and he said god knows how old that thing is, and said that there were things even they did not know about.

Student 1: There was a reflector, you know how they put the paper on and it reflects it, and causes it to appear bigger, I do not know its name, looks like a projector.

Student 4: An overhead projector.

Student 1: We realized that after we turned it on. It is an overhead projector. There are two or three overhead projectors there, and we did not know about them.

Student 2: They are from 1940.

Student 4: Since the school is old, the materials are useless.

Student 2: Exactly. (From focus group interviews with 11-E)

In this long yet comprehensive excerpt the students were first talking about the lack of laboratory equipment. They share one of their experiences when they try to conduct an experiment. They tried to explain the design of the experiment. They did not remember the apparatus and design correctly yet they at least remember the name of the experiment. Referring to what the students said about the lack of opportunities, the researcher asked the students if finding the apparatus of that experiment was that hard. The students said that the magnets that they was needed for the experiment was very expensive. On contrary, magnets are sold by Ministry of National Education and they are affordable. The only thing that the teacher had to do was to talk with the principal and convince him to order at least some of the affordable and basic needs of the laboratory. According to what the students said, the principal had bought what they need for the experiment. So it was the teachers who did not bother to buy any apparatus for the laboratory. Moreover, students thought that requesting so much apparatus would not be appropriate. Probably they might think that what they wanted for their laboratory was a luxury. They were also worried that the school might want them to pay dues. In Turkey although the education in public schools are free, school administrations might want students to pay small amount of dues since they cannot get any financial help from the government. According to the students, with the money the principals got from the students, they would not buy the needed laboratory materials since it was not one of their priorities.

Lack of materials was a limitation for conducting experiments in the classroom. On the other hand, there were some materials which could have been used yet the teacher did not know the working principle of some of the equipment. While talking about the equipment in the laboratory, the teacher said that they have plenty of soft iron and asked me where soft iron was used in experiments. In addition, during focus group interviews presented above, students said that the tools at the laboratory were so old that even their teacher did not know what they were for. Indeed, the materials were old yet, for most of them their age was not an obstacle for using it. Those instruments were very simple hence; they were hard to be broken. The bigger obstacle for conducting experiments could be the teachers' unfamiliarity with the apparatus. The ministry of education had sent to high schools comprehensive laboratory sets.

Those sets include a small tablet pc that include some simple analysis programs, several detectors that measure different variables including speed, oxygen level, temperature, etc. With the set an instruction manual which also includes several experiments that can be conducted by that set was given. A teacher with a little knowledge of computers could understand how to use that set. The number of those sets (approximately 10) is enough for a class to work in groups and conduct the experiments. Unfortunately, those sets had been there for over a year and were sitting in their packaging, unopened. Mr. Doe had an attempt to learn how to use those sets by asking an intern student to understand and tell him how to use it instead of reading the manual and trying to use it on his own. Probably, he had not been satisfied with the intern teachers' tutorial so he did not prefer using it in the classroom. This situation may show that the teachers did not prefer to conduct experiments because of lack of materials. There could be other reason behind that.

Showing Videos. Visualization was a strategy rarely deployed by the teachers at the research site. In many cases the teachers did not even show the figures or photographs included in the students' textbooks to explain the physical phenomenon. Showing videos also was a strategy that the teachers rarely preferred while introducing a topic to the students for helping them to visualize the phenomenon easily. The videos teachers selected to present in the classroom were the ones that were prepared by a publisher of one of the textbooks used by the teachers other than the classroom textbook and usually composed of animations with lectures. During watching those videos, when felt necessary, the teacher stopped the video and made further explanations or just repeated what the lecturer in the video said to emphasize the important points. For instance, for the topic modern physics Mr. Smith told students that they did not have to know what the video was describing, the important part was the formulae.

When asked Mr. Smith how much he thought he was implementing the teaching approach of the intended physics curriculum he summarized what he had done in the classroom:

> Here is how I teach classes. I cover the topics in the old curriculum; I solve questions from the old curriculum that may be asked in the national examinations. In the remaining time, I teach according to the new curriculum. I do both, I do not want the student to suffer the consequences of the transition period. I try to use visual materials when I teach in accordance with the new curriculum There are pre-made compacts discs; I use them so as to enrich the visual aspect when I teach. I do however, feel inadequate in this regard, and think we should be trained and informed. (from interview with Mr. Smith on 08.06.2012)

The teacher stated that he integrated the different teaching approaches of the old and the current curriculum. What can be inferred from Mr. Smith's statements about what he had done in classroom is that he assumed that the questions of the following university entrance examination would be in accordance with the old curriculum, not the new one. Then, if he had time from questions solving, he tried to present visual materials by referring to the videos which are introduced above. At the end, Mr. Smith said that they needed to be informed about the new teaching approach of the new curriculum since the teachers did not receive any training neither before nor after the curriculum reform.

In addition to the lecturing videos, there were also documentaries that the teachers presented to the students at the end of the year, which were about a topic that they had covered during that year. These videos corresponded to the days when all the examinations were over and when student absence rate was high. So, not all of the students could have had the chance to see the videos. On the other hand, students liked watching videos which were less boring than the lectures and they found them educative as well so student absence was a cause for missed opportunity for teaching physics in a fun way. One of the 11th grade students mentioned the video that they watched at the end of the school year:

> Student 1: We covered modern physics last year, we learned about the speed of light. We talked about Einstein and in the last lecture no one attended this year, and Mr. Smith made us watch E=mc2 documentary. I had watched it before, it explains how Einstein came up with E=mc2. That changed our perspectives, it was a fun documentary which showed how important this formula we learned about is and explains how it may be utilized. I grew fonder of modern physics after watching it.

> Student 2: We also paused it from time to time and discussed, and that was very helpful. (from focus group interview with 11-C)

Student 1 stated that after watching a documentary about Einstein and his famous formula E=mc2 he admitted that his attitudes towards the topic modern physics had changed. Student 2, added to Student 1's comment that the teachers' explanations help them to understand the topic more comprehensively. Hence watching videos may not only help students learn physics in a fun way, it may also help students have positive attitudes towards physics.

Performing Demonstrations. Another major classroom activity mode was performing demonstrations. In none of the teachers' classrooms, experiments were playing a part in instruction. The closest to an experiment students ever get was teachers' performing demonstrations. Conducting experiments is regarded as crucial learning experience for learning natural sciences. The experimenting process is also a good way to help students understand the nature of science. The teachers did not prefer to have students conduct their own experiments but it happened rarely they attempt to conduct demonstrations for the students. Most of the demonstrations were very short and for most of the time unplanned and improvised. For instance, in one of the lessons on sound in 11th grades, Mr. Doe used one of the students' badminton racket that he brought to the laboratory to show the frequency of sound changes when he pull the rackets' stick and release it from different lengths. There were also demonstrations which were planned and were prepared beforehand. Those demonstrations were very few which was approximately one or two per each semester. One of those demonstrations were also observed by the researcher and presented as a quotation from the field notes as below:

> It was the lesson for 10-D. The teacher was Mr. Doe and the topic was waves. The teacher was introducing the unit waves to the students. He opened the textbook from his computer and want students to follow from their textbooks.
>
> Mr. Doe: There are different kinds of waves such as water waves, spring waves, earthquake

waves, light waves. A Mexican wave is also a different kind of wave.

The class was giggling.

Mr. Doe: Then how can we define a wave? A wave is a vibration that is produced in an elastic medium.

The teacher first talked about spring waves. He told students what an impulse meant and its propagation through a medium, what frequency, wavelength, period of a wave meant. He gave the formula that shows the relation between speed, wavelength, and frequency of a wave. He also gave the formula that shows the relation between the speed of the wave, the tension force on the spring, and mass density of the spring. Then Mr. Doe explained the reflection of an impulse from different types of end points. After all the things that he had to talk about the spring waves, the teacher take a spring in his hand and show it to the students. He called a student and wanted him to hold one of the ends of the spring. The teacher was holding the other end of the spring and wanted the student to walk away from him with the spring. The teacher said that the spring could not stand as a straight line as they saw on the textbook because of the weight of the spring. The teacher first sent a transverse wave and said that that one was transverse wave. He did that for a couple of times. Then he sent a longitudinal wave and kept sending to help students observe the propagation of the impulse. While sending impulses the spring was broken and the teacher and the student who was holding the spring tried to fix it for a while. After they fixed the spring the Mr. Doe showed the reflection of a spring waves from a fixed end point. Then he picked another spring with a smaller cross-section and sent transverse and longitudinal waves. He also increased the tension of the spring and sent impulses and had students observe that the speed of the impulse also increased. He reduced the tension of the spring and they observed that the speed of the impulse decreased. The teacher told students that an impulse on a spring can travel forever if there were not any energy loss due to the weight of the spring.

Mr. Doe: Now I will give the springs to you for you to play with them. Do not mix them. Whoever wants to try them can have a spring. (Showing the shelf where the springs stood)There are plenty of springs over there.

Most of the students stood up and took a spring in pairs and they started to send impulses as their teacher did. Then they stretched the spring and sent pulses and observed the increment of the speed of the wave but some of the students exaggerated the stretching and deformed the spring. Then the teacher got angry and scolded the students who did that. He told the class

> that if they stretch the spring too much it would deformed. After the students send a couple of waves as their teacher did, they started to play with it. They began to jump over the spring while two of them were holding and shaking the springs. After the students played with the springs for 10 minutes, the recess bell rang. The teacher wanted the students to remove the springs to their place and they did. (from field notes on 11.05.2012)

In this lesson the teacher was introducing the concept of waves to students. They had learnt in ninth grade the terms related to waves such as frequency, period, amplitude, transverse and longitudinal waves. The teacher first started to list the different kinds of waves, adding that a Mexican wave was also a wave to cheer the class up. Then, the teacher asked how a wave can be defined and by not waiting for an answer, he defined the term wave. He could have asked students to make their own definitions. After the definition, the teacher presented students all the things they had to know about the spring waves. He gave the definitions of the terms which the students had already known, gave the two formulae they had to know and show the reflections of the waves from different kinds of end points. Simply he summarized the whole unit for half an hour. While doing so he did not use the springs. For instance, he might have used the springs while giving the formula that show the relation between the velocity of the wave, the tension of the spring and the mass density of the spring. Rather, he preferred to show it at the end of the lecture. The teacher could not or did not blend the demonstrations with the lecturing. After he told all the things that the students had to know regarding spring waves, the teacher demonstrated longitudinal and transverse waves, the relation between the speed of the wave, the tension on the spring, and the mass density of the spring, and the reflection of the impulses from fixed and free end of the spring. After the demonstrations, Mr. Doe let students send waves and observe what he had shown on their own. At first, the students took the springs and send transverse and longitudinal waves by stretching the springs, as their teacher did but then they started to literally play with them by jumping over the springs. Some of the students stretched the springs so much that the springs were deformed. The teacher got angry and then warned the class that if they stretched the spring very much it might cause the springs to be deformed. If he had warned the students about it, the students might not have deformed the spring. The students were not used to do experiments or

any similar hands-on activities so they did not know what to do when they were left alone with any materials. The inappropriate behavior of the students might cause the teachers not to leave them with alone the laboratory equipment to work with it. They might not want the limited number of materials not to be deformed while the students were playing with them.

At the end of the lesson Mr. Doe told the researcher that before this demonstration, he took the springs and tried to send impulse. He was pretty successful for the first time. Since the teachers did not have much experience in the laboratory they have to allocate time for such demonstrations. They also had to try it on their own and assure that it will work in the classroom otherwise the reputation of the teacher might be lost. For instance, when asked Mr. Doe the parts that he cannot implement the new curriculum as intended, he said that conducting experiments cannot be done in the classroom as much as intended with the new curriculum. He explains the reason for that as:

> These activities for instance, they are the predominantly featured in the new curriculum. Especially in the first two units of the 9th grade, since they were more qualitative, subjects like the nature of physics, the definition of physics. In the first unit of 10th grade there was matter and its properties; there was capillary action. We set out to carry out the activities when teaching these subjects, and we started, but we are having trouble doing them to be honest. I tried to demonstrate the experiment where water rises or falls because of capillary action, but these could not be observed. When the experiments do not work, the students make fun of them, and ask "Is this the lecture? Is this how physics lessons are?" When I started working here last year, I learned that my co-worker before me had done experiments in the classroom, and he was criticized by the parents with arguments like "How can you teach physics sitting down? Can you not solve questions on the board?". These are problems. Teaching differently when others all follow the same method is another problem. Everyone is afraid to transition to this kind of teaching. (from interview with Mr. Doe on 08.06.2012)

Mr. Doe presented two main reasons for not conducting experiments in the classroom. One is when they tried to conduct experiments they saw that they did not work as written. So the teachers worried that students will mock them if the experiment does not work. Then the students might begin to despise physics by thinking that it

was composed of rules that cannot work in real life. Another reason why the teachers did not prefer to conduct experiments was the influence of teachers over other teachers. If all of the teachers in that school do not try to conduct experiments they do not want another teacher to do so since this might show them as unsuccessful teachers. Mr. Doe also mentioned the pressure from the parents when they did not leave enough time for question solving. According to Mr. Doe the social pressure on the teacher led them not to conduct experiments in their classrooms.

In none of the lectures of Mr. Smith could demonstrations be observed. When asked, students confirmed that they had not done any experiments throughout the year. Mr. Smith explained why they cannot conduct experiments in the classroom as:

> Here is what is expected (in the curriculum): Teaching with visuals by conducting experiments. This is not quite easy to do, it requires supplies and the right circumstances. Plus, we have to practice beforehand. Even if we practice, they should instruct us like doctors are briefed on, say, how to operate new technical equipment. Similar to that, there should be teachers who are tasked with introducing the new curriculum. If they want us to teach with experiments, people should be appointed to aid us in this matter. Mr. Smith admitted that they cannot conduct experiments in the laboratory. He presented two different reasons for that: one is the physical setting of the laboratory and the materials is not appropriate for experimenting where the second reason is the teachers had to study and prepare the experiments beforehand hence put extra effort for experimenting. According to Mr. Smith, teachers were incompetent and they should be trained about conducting experiments in the classroom. In another part of the interview Mr. Smith also stated that they just had participated only one seminar which was organized to introduce the new curriculum to the teachers. (from interview with Mr. Smith on 08.06.2012)

The response of the students to the question whether they had conducted experiments or not in the physics courses and their reactions to the experiments conducted so far in the classroom are presented:

> The Researcher: Are you doing any experiments right now?
>
> All students: No.

Student 1: We had conducted one this year.

Student 2: We had one this year but that was done by the interns.

Student 3: He spent three or four weeks on that experiment, there was a quiz.

Student 1: We also did that thing on, on springs.

Student 2: We lost three class hours because of that experiment.

Student 3: We lost most of our physics class hours to those experiments and other things last semester.

The Researcher: What other experiments did you conduct?

Student 4: We tried an experiment with springs, I do not know if it can be called an experiment though. It was only a demonstration, for example thick springs, thin springs...

Student 2: It was that experiment where we had that demonstration, I did not understand anything about that experiment.

The Researcher: You sent a pulse, right? You are talking about the thing you did this year, I was present.

Student 2: No, I am talking about the one we had last semester. They had us conduct an actual experiment, (turns to his/her friends) did you understand anything from that experiment?

Student 1: But we lost three weeks because of that experiment.

Student 5: What was it?

Student 4: It was about the acceleration of something...

Student 1: Yes, it was force and motion, and linear motion.

Student 5: What were we doing?

Student 6: There was a thing repeatedly puncturing the paper.

Student 5: Oh, the one we did this year.

Student 2: We hung a weight on its end.

The Researcher: What was it for?

Student 1: That we did not know. We pretended to understand, but understood nothing.

Student 4: As gravity pulls on it, there is a thing that hits carbon paper. That is where we determined the acceleration from.

Student 6: The car whizzed pass in a second, I did not see anything

(Laughing)

The Researcher: So you did not find them to be useful? Ok, let us assume the interns who carried them out were not experienced enough, because it is their first time teaching a class, what did you do in elementary school? Did you not have similar activities in elementary school?

Student 1: We had four science class hours, and we always set one aside for experiments. Our teacher would always check our lab reports, and we learned and understood the fundamentals well. Our teacher was like that, it was really good.

The Researcher: Is it not possible for the same thing to happen here, in physics lessons?

Student 1: I think not.

(All students) Neither do I.

The Researcher: Why?

Student 4: They would not bother.

Student 5: They would not bother.

Student 2: The phrase "new generation" is thrown around constantly. I do not know what it means exactly, but I think it should be about keeping up with the present. There are so many students who are indifferent, there would be 15 students at most who would show interest in the experiment and try to learn. The rest will treat it like a free period and not pay attention.

The Researcher: Yes, but what if you were to be graded, what if you had to write lab reports?

Student 2: As I said, there would be 15 students at most who would do that. The rest would not.

Student 3: If it were mandatory, if the teacher checked our work, established authority in the classroom, I think it would work.

Student 2: When grades are introduced... There's students for you...

Student 3: Here is what we had in elementary school, we would not actually conduct the experiments but we were taught how the experiments worked, because we had the SBS exam. What happens in high school is that, instead of the SBS, you have YGS and LYS, and instead of doing the experiment, you can read it from the book and understand, we are after all not without wit. Instead of conducting the experiment, we could solve more questions, learn more question types, questions that would be asked in the YGS or LYS. This is what they did in elementary school (focus group interview with 10- C).

When asked if they had conducted any experiments, the students claimed that they had not, except the experiment that they conducted with the intern teachers. The prospective teachers tried to present a lesson with the new approach of the physics curriculum. They conducted a classical experiment of force and motion where a car was pulled with a weight and a recording sheet was taking data of position for 50 times in a second. The students had to find the acceleration of the car through the slope of the velocity-time graph. Even the experiment was a classical one, having students conduct such an experiment for the first time might be a hard experience both for the students

and the intern teachers. Also conducting such experiments might be time consuming. The experiment and its assessment took for three class hours and the students thought that it was a waste of time. They regard experiments as valuable learning experiences yet if the time dedicated to experimenting would be long, it would become a waste of time. Students also were aware that what Mr. Doe did with the springs was not an experiment but it was a lecture with demonstration. They can distinguish between experiments and demonstrations since they had conducted experiments and collected data in middle school. Contrary to high school, the students stated that their middle school teachers had time for experiments in their schedules. When asked why the same thing cannot happen in high school two of the students stated that the teachers did not bother to prepare experiments for the students. Another student also stated that the attitude of the students might let teachers not to bother to conduct experiments. The student claimed that less than half of the students might participate such a learning experience where the rest of them would just stay at the back of the class and did not show interest to the experiment. Hearing such a complaint from a student about her friends was quiet surprising for the researcher since she did not heard such a thing even from the teachers. In short, students want their teachers to conduct experiments but those experiments should be finished in the allocated time. Otherwise they regard experiments as waste of time. Another important obstacle stated by the students was the national examinations. The students said that when they were in middle school they had to study for the SBS examination and then they had to study for the YGS and LYS examination. Those examinations were also preventing teachers to conduct experiments. The student thought that she did not have to conduct the experiment rather she could read the experiment, understand the setup and learn the conclusions by not conducting the experiment itself. According to her, she could solve more practice questions instead of killing time by conducting the experiment.

In an interview with another focus group, the students presented other reasons for not conducting experiments in their physics courses such as lack of time and equipment. The group also stated that they had conducted experiment throughout middle school yet they were not doing in in high school:

The Researcher: So how many experiments have you done? Here or in elementary school. Up to now, how often have you dealt with experiments?

Student 2: Not that much. And it also has to do with the amount of resources the school has.

Student 3: Yes.

Student 2: I attended a private middle school, and since the school had more resources we had the chance to conduct more experiments.

Student 3: Our teacher wants to do the experiments but that are no materials.

Student 2: The necessary resources are not there.

The Researcher: Can't your teacher ask for them?

Student 3: Where can he get them from?

The Researcher: From the school.

Student 3: Our school does not care that much.

The Researcher: But the government pays for your books actually, the official textbooks?

Student 3: Those books have nothing in them.

Student 4: I examined the book once, it has too many experiments.

Student 3: The necessary materials are not there.

Student 4: We need materials to conduct those experiments. Further, two class hours does not suffice. Should we do the experiments, or try to grasp the topics?

Student 3: Exactly.

Student 4: There should be 6 class hours.

The Researcher: Can you not have both? Doesn't conducting those experiments help to grasp the subject? Is it just a game?

Student 4: Of course not, experiments make it easier to remember, but there should be six physics class hours for us to conduct all those experiments and grasp the subject, and the necessary materials should be there. For instance, we were going to do the tuning fork experiment the other day, but the school does not have tuning forks. Do we have tuning forks in the school?

Student 5: I looked for them, and there are none.

Student 4: No.

Student 3: There were not any.

The Researcher: What if you had done that experiment?

Student 4: If we had, I would remember two years from now, or next year, that we had done such a tuning fork experiment.

Student 3: It does not stick when you write it down ,but when you see things, they do, no matter what.

The Researcher: In elementary school, did you take any numerical readings, or measurements or plotting graphs, or were the experiments nothing more than demonstrations?

Student 3: We always did.

Student 4: In elementary school, we conducted this density experiment. We submerged the egg in water and it sank. Then, we added some salt and the egg floated, but we there were no numerical data.

Student 3: I cannot withhold credit from my middle school teacher in that matter, and we attended a state school but it was like a private school. Even our class size was like 16 people. We had laboratory notebooks, and we every week in the counseling period we would go to the

laboratory and conduct two or three experiments. We would take notes on what we did, how much of what we put in, how it worked,etc. It was great, but here it is nothing like that.

Student 5: It was the same with us.

The Researcher: What if you, instead of memorizing formulae, had experiments where you could observe, for instance, what quantity decreased when I increased this other quantity – Experiments that are feasible of course, it is impossible to do them all.

Student 3: For instance, I could solve these interpretation questions with the help of such experiments. (from focus group interview with 11-B)

Some of the students stated that they had not conducted many experiments neither in high school nor middle school. The students claimed that the opportunities that their school had were very limited so they thought that even if their teachers wanted experimenting they could not do it without lack of equipment. When asked if the school administrators would not do anything for the laboratory, they hopelessly said that the laboratory was not a priority for the school administration. The researcher tried to say that the materials needed to conduct the experiments in the official textbook were materials which were not expensive and which were not hard to be found. The students did not let the researcher finish her sentence and said that the official textbook was useless since it contained only experiments but nothing else. Yet the students claimed that the school could not have the materials necessary for conducting the experiments that were written in the official textbook. One of the students also stated that the teachers did not have enough time for experimenting since they had only four class hours in a week. The student stated that if they had six class hours per week they could conduct experiments in the classroom.

To summarize, what the students told about the obstacles for not conducting experiments in the classroom resemble the obstacles presented by the teachers on the same issue. This means that both students and teachers agreed they cannot conduct experiments since they do not have sufficient equipment and time, the students had to prepare for the national examinations, and not every student show equal enthusiasm

for conducting experiments.

4.1.1.4. Off-Task Activities. The final major classroom activity mode is off-task activities. Off-task activities may refer to several activities done by the students or events that take place in the classroom. Figure 4.12 shows possible off-task activities, as observed in this study.

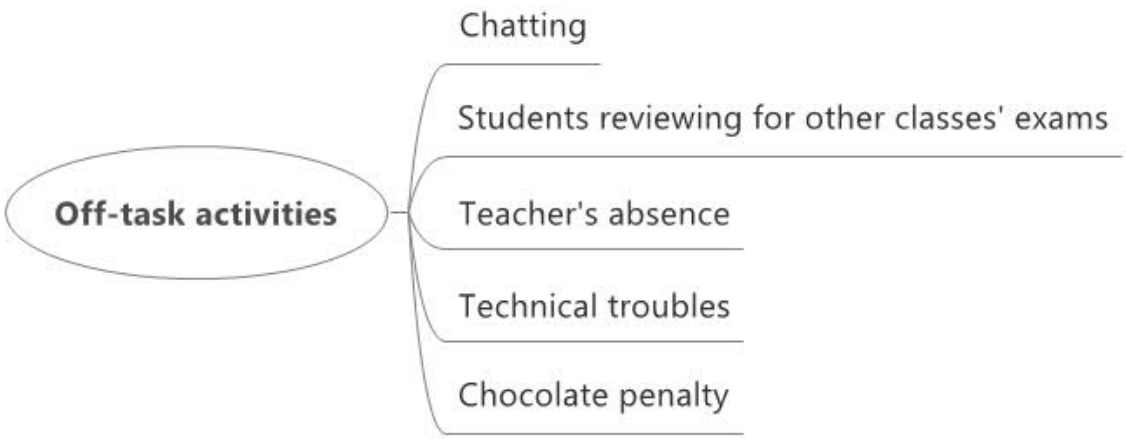


Figure 4.12. Off-task activities.

When the teacher was not lecturing, the students started to talk with each other. These moments corresponded the time when there were a couple of minutes for the recess bell and the teacher announced that it was enough for that session. Sometimes the teacher joined the students too.

Another off task activity that was observed was studying for other courses' examinations. Students pleaded with the teacher for time to study for other courses' examinations. The teachers had to give permission to students especially if the examination was right after that session since the students were not listening to him even if he insisted on lecturing. When the teacher finished the lesson, the students started to study the examination on their own or in groups. Yet, after a while half of the class started to chat and did not study any more.

From time to time the classes were cancelled because of the teachers' absence due to illness, other duties, or teachers' strike. At those times the students were free, they could read books, study any course they want, play basketball at the school yard, walk around the school, or just stay in the classroom and chat.

Technical troubles were also another obstacle for teachers to lecture. Since Mr. Doe and Mr. Smith were always using computers and projectors, they lost time when they encounter any technical problems throughout the class times. Moreover, since the teachers' computer skills were not very developed, the time they lost by grappling with the technical problems was considerable.

Another off-task activity in physics classes which was observed was the chocolate penalty. Chocolate penalty was a classroom management method used by Mr. Doe. If one of the students was not listening to the teacher or did not do her or his homework, she got a chocolate penalty. When the student was punished by the teacher, a student who was responsible for keeping records of the students who were sentenced to chocolate penalty wrote that student's name on the list. A student on the list had to buy as many chocolate bars as the number of times their name appeared on the list. When the number of chocolates reached the number of students, the teacher wanted the chocolates to be distributed to each student in the class. After everybody ate their chocolate, the teacher started his lesson.

4.1.2. Assessment

Up to this point, the findings related to classroom activity modes in the enacted curriculum were presented. In this section, the results related to assessment are described and discussed. There are generally two types of assessment in the literature which are called "formative assessment" and "summative assessment". Formative assessment is simply defined as what is done for diagnosing certain points a student has difficulty in understanding. Examples of formative assessment techniques are quizzes, projects, homework, etc. Teachers and students get feedback about their learning and teaching efforts with formative assessment. Summative assessment is what is done

for determining if a student has reached a certain level of competency of any topic. Examples of summative assessment techniques are tests administered at the end of units, grades given to students at the end of the semester, or large scale assessments like national examinations (National Research Council, 2001). The assessment activities that conducted at the research site are described and discussed according to this classification.

4.1.2.1. Formative Assessment. At the research site, there was no serious effort to use formative assessment techniques. The teachers usually were asking the class if they had understood or not to make sure that the topic was understood by the students. If more than half of the classroom raised their hand the teacher moved on, if there were not any students who raised their hands, then the teacher once again explain what he said and then moved on.

The teachers also stated that they understood if a student understood the topic by posing a question to that student during the lecture. If the student answered the teachers' question or solved the entire question on the board, the teacher knew that the student had understood the topic. When asked Mr. Smith how he could assure that the topic was understood by most of the students he explained as below:

> It can be understood with the questions we ask, the answers we get to those questions, asking questions to students randomly when working on an intermediate step of a calculation, it is easily understood. A student who is not paying attention or who has failed to understand will not be able to give a proper answer to a question about an ongoing calculation, so it becomes obviously that he is not getting it, he is just staring at the board. That can be realized. (from interview with Mr. Smith on 08.06.2012)

Those informal formative assessment techniques were done without any plan and were not applied to all of the students. Moreover, the levels of the questions that the teacher asked the students were knowledge, comprehension, or application. The questions that require higher level of cognitive skills were usually solved by the teachers. Hence, with these methods, it was very difficult for the teachers to make sure that the

topic that they were covering was actually understood by the students.

4.1.2.2. Summative Assessment. The summative assessment conducted at the research site was composed of written examinations during the school year. Oral marks were also given but students' performances were not playing much role while determining students' oral marks. In this section, the structure of the written examination and the teachers' and students' views on those examinations are presented.

The numbers of examinations conducted in a semester depends on the number of class hours per week. For instance, since the number of weekly class hours was two in ninth grade, two written examinations were administered in one semester. The number of weekly class hours was three in 10th and four in 11th grades hence the number of written examinations administered was three. At the research site, the students had their examinations in pre-determined weeks called exam weeks. Students from different grades were placed in different classes in order to reduce the risk of cheating.

The formats of the questions asked in a physics exam were open-ended except the last examination conducted in the semester. The last examination which was conducted at the end of the semester consisted of questions in multiple-choice format. The teachers informed the students about the format of the questions before so that the students could study according to this. The teachers also informed students about the topics that would be covered in the forthcoming examination. For instance, Mr. Doe announced the topics that would be covered in the examination for the last examination of the semester and the school year as below:

> It was the end of the lesson and the teacher said that he would stop there.
>
> Student: Sir, can you list the topics that would be covered in the examination?
>
> Mr. Doe: Ok. I will. One question from illumination, one question from sound, one question from shadows, three questions from electricity and magnetism, three questions from photo-electric effect and Compton scattering, four or five questions from the structure of the atom,

> especially about earlier models of atom, and the rest of the questions will be from the topics that we covered in the first semester, for instance from momentum, equilibrium. It would be better if you skimmed through sound, illumination and shadows, you have learned momentum, equilibrium, and energy, you can do them in the exam. Study modern physics and magnetism well, One question might be about Doppler Effect and the properties of sound waves. It will take 15 min. to study the properties of sound waves. From modern physics, a question may be about the particle nature of light, I will ask one question about one of the three topics: pressure, buoyant force, or heat and temperature, I won't say which topic I will choose. I am doing this because you will have national examination next year and you will be responsible for all the things you have learned in the last four years. (from field notes on 24.05.2012)

In this excerpt, the teacher lists what he would ask in the last examination. He previously told the students that the exam would cover all of the topics they had learned throughout the whole year. He also gave study tips for the students and while he was doing so he actually stated the level of importance of the topics according to him. Like Mr. Doe, Ms. Brown listed the topics that would be covered in the last examination for ninth grades. When asked Ms. Brown which topics would be included in the physics examination, she said that all of the topics they had learned throughout the school year would be covered but more questions would be about the topics that they had recently covered such as dynamics, force and motion, and electricity. She did not mention waves which was the topic that they were covering at that time. She also suggested students to solve all of the questions in their classroom textbook except the questions about the nature of physics. After that session, when asked the teacher why she had excluded the nature of physics while she was giving study tips to students, she said that they had already covered it extensively and that it was not that important.

Since the last examinations were in multiple-choice format, Mr. Doe did not prepare the questions himself, he chooses the questions from textbooks other than the official and classroom textbooks, copies them and literally cut and pasted the questions he liked and prepared the examination. Mr. Doe stated that while he was preparing the examination, he usually pick the questions that might be asked in the national examination. He did not want the students to stick to the classroom textbook so he never asked any questions from textbooks. After the teacher finished the copy-paste

operation, he checked if the number of questions was correct and copied them. After he copied and prepared the examinations and distributed the questions to the students, he solved the questions in order to prepare the answer key. While he was doing so he encountered a question which he did not even mentioned during the course. Even the did not know the answer. After the examination, the students were complaining that they had not ever learned what was asked in that question.

The students showed great importance to school examinations since the examinations would affect their Grade Point Average (GPA) and the GPA would be considered in the placement process of the students in programs of universities. Because of the importance of school examinations, students were continuously asking their teachers if the topics they were covering would be included in the school examination. When the students asked the teacher if the topic they were covering at that moment would be included in national examination or not, the teachers usually told the truth. For instance, if the topic or question was not covered in the intended curriculum, the teacher said that she would not ask about that topic or ask such a question since it was not covered in the intended curriculum. If the teacher said that the topic would not be included in the examination, the students did not care anything that the teacher talked about. So the teachers tried to cover all of the topics before the last examination date, knowing that the students would not try to learn the topic after the examination.

The students stated that they actually learn the topics they had covered in classroom when they were studying for the examination. For instance one of the students said:

> For example in the electricity unit, since we skipped ahead to examples without the subject matter being taught in class, the teacher started to solve the question saying things like "this attracts that, that repels this", but of course I did not get any of it in class. A few weeks after that, I had stopped listening in class, I learned of electrical charge and that they repel each other a week before the exam, as I was studying on my own and solving questions. (from focus group interview with 10-C)

The student stated that she did not understand the topic in the classroom since

she did not understand the fundamental concepts by solving questions. If she could not understand the fundamentals, she did not listen to what the teacher told afterwards. When the examination neared she started to study the topic and understood it on her own. It was obvious that she did not bother to learn the points she did not understand in the lesson if there were no examinations. This could be counted as the positive effect of school examinations on students.

Even though Mr. Doe stated that they were asking questions in accordance with the national examinations, the students asserted that the questions the teachers asked in the examinations were different than they solve in dershanes or in other textbooks. The students allege that open ended questions were very different than multiple-choice questions:

> Student 1: I am the best physics student at my dershane, everyone come to with to have their questions answered, here at school I received a 35 in my first exam, and a 45 in my second exam. This is absurd.
>
> The Researcher: Very interesting, the topics are the same, and it seems to me like you are taught in class in a manner very similar to that of a dershane. Why is there such a big difference?
>
> Student 2: Multiple choice and classical open ended questions are very different. With multiple choice questions, you may use the choices as hints or do elimination, but do you not have that kind of advantage with a classical open ended question.

The students stated that even though they were good at solving physics question in the dershane, they got very low marks from school examinations. The difference between national examinations and school examinations was that the school examinations (except the last one) were composed of open-ended questions. Since there were not any choices, the students did not have the chance to any make educated guesses. Hence, they fail in school examinations if the questions were open-ended. It might because the students were continuously solving multiple choice questions in classroom and they might not know how to show the calculations which they did not need to show in multiple choice questions. The students also learned to make educated guesses, elim-

inating the wrong answers and find the right answer even if they did not know the right answer. This may point that the students did not actually understand physics in school or in dershanes.

In summary, at the research site while formative assessments were not taken very seriously, summative assessments were very important for both the teachers and the students. Teachers did not pay much attention on using summative assessment to evaluate his or her teaching. Like the national examinations, the school examinations also play an important role in motivating the students to study physics.

4.2. Interactions with the Enacted Curriculum

So far the enacted physics curriculum was described and discussed. In this section the focus shifts towards the agents that might shape the enacted curriculum. Those agents can be classified into two groups: the first group is the structural agents such as the intended curriculum, national examinations, textbooks; whereas the second group consists of people such as teachers and their friends, students and their parents. This section explores these agents and their interactions that manifest as influences on the enacted curriculum. First the structural agents and their interrelations are described. Then the people agents and their interaction with the structural agents and the other people agents are described. These agents (namely teachers, students, national examinations, textbooks and the intended curriculum) and their interactions are summarized in Figure 4.13. A summary of the findings regarding the interactions with the enacted curriculum is presented in Figure 4.14.

4.2.1. Intended Curriculum

4.2.1.1. The Intended Curriculum. The intended Turkish high school physics curriculum began to be prepared in March 2006, and completed in June, 2007. Even though the curriculum was put into action gradually, the physics curriculum was prepared for all four grade levels in 15 months. Three years before the introduction of the new physics curriculum in 2005, elementary school science and technology curriculum had

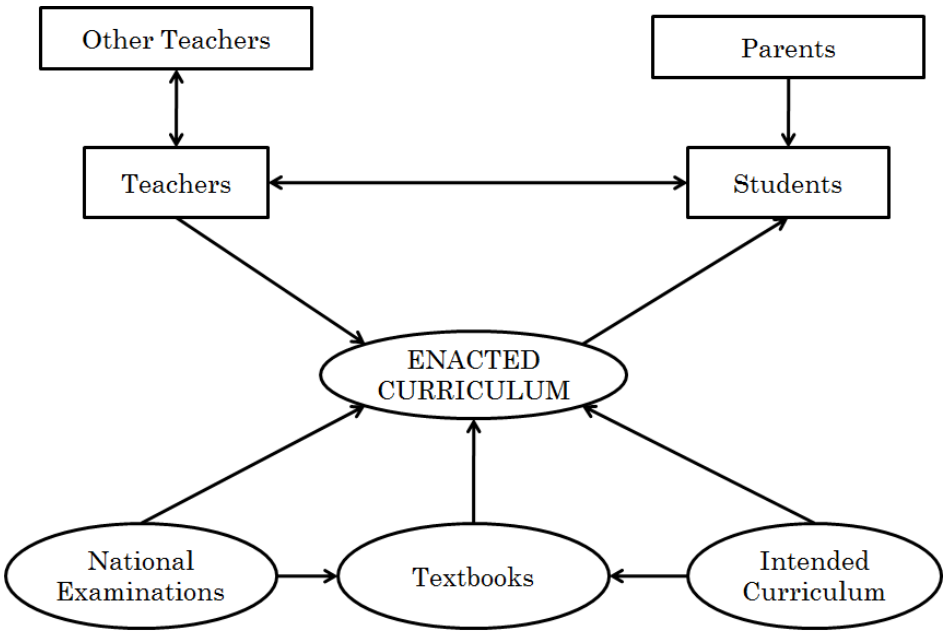


Figure 4.13. The summary of interactions with the enacted curriculum.

been changed. The rationale behind those changes in the curricula was the technological developments, low ranking of PISA scores, and the change in the need of human resources. Recently after the completion of the new physics curriculum the ninth grade physics curriculum was released and the books were rearranged in light of the new physics curriculum. In August, 2008 it was announced in the official announcement journal of MEB that the ninth grade physics curriculum would be changed since September, 2008.

The new physics curriculum was the first physics curriculum which had explicitly stated objectives. The previous curricula were composed of list of topics. There are two groups of objectives: the first one is knowledge objectives and the second one is skill objectives. The knowledge objectives include objectives on what physical phenomena a students should learn at the end of each unit. Those objectives include the teaching method that the teacher should use while helping students learn the phenomenon under discussion as well. Skill objectives are the objectives which refer to which skills that the students should develop at the end of each unit. For instance, the objective "the student will calculate the displacement of an object which does linear motion

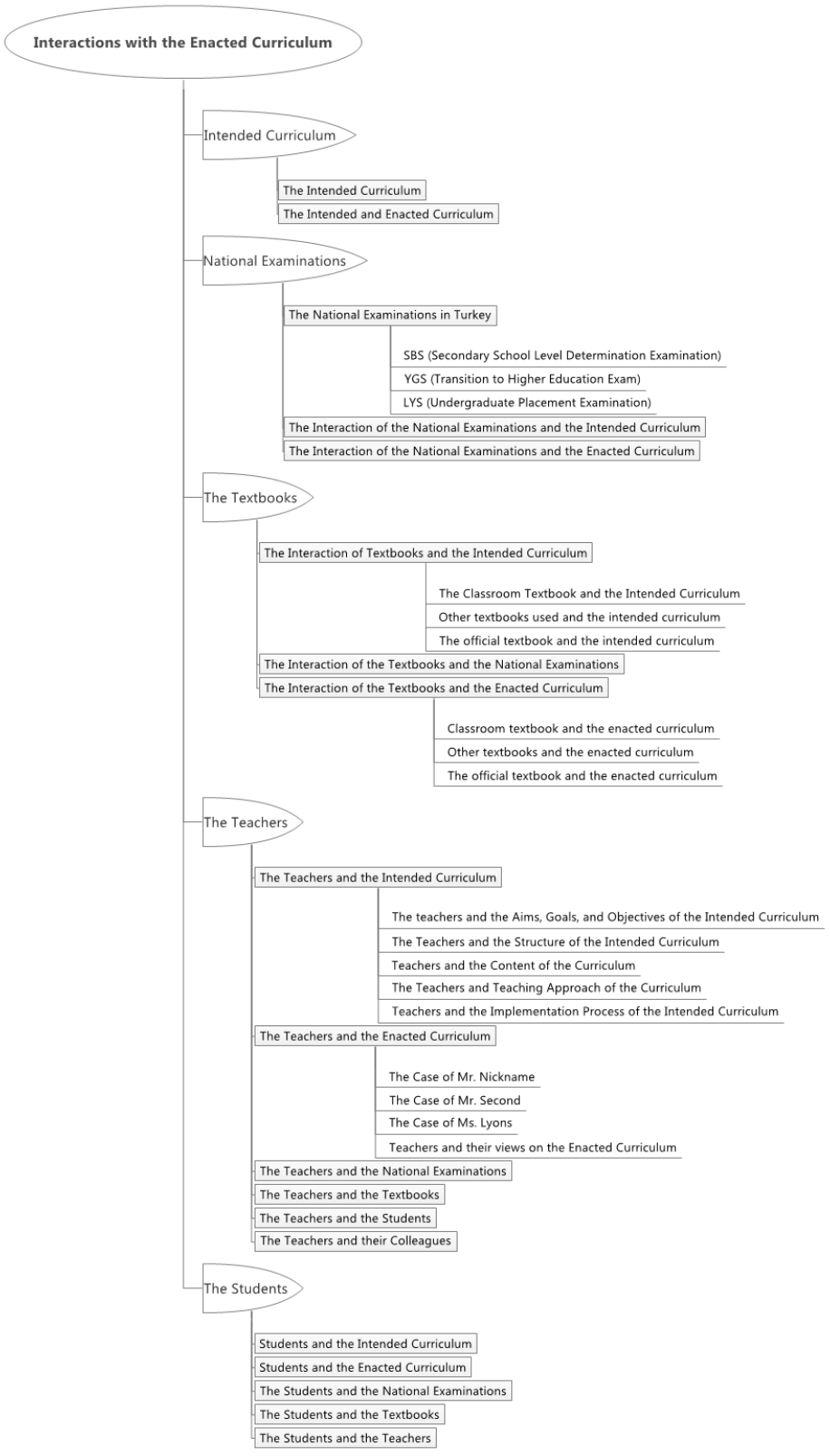


Figure 4.14. Summary of the section “Interactions with the Enacted Curriculum”.

with constant speed by using the velocity-time graph of the motion." is an example for knowledge objectives, "the student will investigate the relationship between the applications of physical knowledge and ethical considerations." is an example for skill objectives. Those objectives were prepared for each that will be covered for that grade level to remind the teachers what the students have to know and do at the end of each topic.

The curriculum has a spiral structure which means a topic in a grade will be discussed in more detail in the following grades. For instance the unit waves appear in all grades from 9 through 12. In ninth grade students learn the term wave and the terms related to waves such as frequency, wavelength, amplitude, transverse wave, longitudinal waves. The students also learn in 9th grade the earthquake waves which are examples of waves which can affect us all. In 10th grade, with the things that they learn in ninth grade the students are supposed to learn spring waves and water waves. Then in 11th grade, students learn sound and light, and at last in 12th grade they learn they learn go in more detail in the topic light. The general topics that are covered in all four grades are mainly, the nature of physics, matter and its properties, force and motion, electricity and magnetism, and waves. There are also other topics which are introduced to students such as stars and quasars, and atom and quarks.

The intended curriculum specifies not only what the students should learn but also how they should learn. It gives a brief summary of the teaching approach of the new curriculum which may be defined as "student-oriented" and "inquiry-oriented". According to the intended curriculum students should learn physics starting from the everyday experiences and continuing with the physical laws and phenomena instead of starting from learning the physical rules and then findings examples of applications of those rules in real life (MEB, 2011a). With the objectives for each unit in each grade, the prerequisite objectives that the students should acquire, the boundaries of the topics, the connections with chemistry or biology, and the common misconceptions about that topic are included. A written announcement of the new intended physics curriculum was published and released by the announcements journal of MEB (MEB, 2007). In the following section the relationship between intended and enacted curriculum, the

role of the intended curriculum in the shaping process of the enacted curriculum is discussed.

4.2.1.2. The Intended and Enacted Curriculum. In Section 4.1, the physics curriculum being enacted at the research site was described as much as possible. In this section, how the intended curriculum might shape the enacted curriculum described before is discussed. The content and the structure of the intended curriculum were introduced in the previous section. As discussed in that section the intended curriculum has two different kinds of objectives: knowledge and skill objectives. As the knowledge objectives refer to what the students will know at the end of the course, the skills objectives refer to the skills and attitudes the students should develop at the end of the course. The knowledge objectives not only describe what the students should know they also describe how the teacher should help the students to learn it. The intended curriculum was being enacted with a fidelity to the knowledge objectives and with much less fidelity to the skill objectives and the teaching approaches of it. For instance, while the teachers were trying to cover almost every topic, sometimes to a greater extent than indicated in the intended curriculum, the way they taught was mostly teacher-centered even though the opposite was strongly suggested by the intended curriculum. This is the most significant difference between the intended and the enacted curriculum. There are many dynamics that may underlie the enactment of the intended curriculum in such a way, which are discussed in the following sections. To do that, the interactions between the intended curriculum and other agents that shape the enacted curriculum are explored. Those agents were the national examination, the teachers, and the textbooks.

4.2.2. National Examinations

Turkey has a high youth population. This youth population wants to receive higher education after secondary school, usually to improve their chances of getting a good job. Turkey, at the present, cannot meet the high demand for higher education. Administration of a central examination becomes inevitable due to the high number

of applicants to be placed in a limited number of programs. In the following sections, the main national examinations that students encounter during their 12-year education and their structure and their influence on enacted physics curriculum are discussed.

4.2.2.1. The National Examinations in Turkey. Currently there are three different examinations that a student might take during and after completing 12 years of compulsory schooling. The students are not required to enter any of the examinations, but in order to receive a qualified education most of the students prefer to do so. The number of applicants who want to enter university entrance examinations attests to the interest in taking these exams. Those central examinations are namely, SBS (Secondary School Level Determination Examination), YGS (Transition to Higher Education Examination), and LYS (Undergraduate Placement Examination) and they will be introduced in the following sections.

SBS (Secondary School Level Determination Examination). At the end of eight years of compulsory education, the students prefer to enter SBS in order to continue their compulsory education in a qualified secondary school. Although entering the test was not an obligation, the students prefer to do so in order to be placed in a reputable secondary institution. Before 2013, the test was administered in 6th, 7th, and 8th grades and an average of the scores of the students determined their final scores necessary to be placed in a secondary school. Since 2013, the students will be entering only one test at the end of 8th grade. Apart from the aim of placing students to secondary schools which are the most appropriate for the students, the test is being prepared for another reason: to assess the success of the elementary education.

The physics questions is SBS asked under the title of "science and technology" since physics, chemistry, and biology topics were introduced to middle school students in science and technology courses. On the most recent SBS exam administered in June 2013, there were 20 science questions. Among those 20 questions six of them were questions regarding physics. Whilst some of the questions assess lower level of thinking like knowledge, comprehension, and application, some of them assess higher level of

thinking like analysis, synthesis and evaluation. The questions of SBS were being developed by a commission composed of teachers and measurement and evaluation specialists under the supervision of Ministry of Education.

SBS plays a significant role in the determination of students' further education. Going to a qualified secondary school might help them get better scores in the university entrance examinations. Thus, SBS is of great importance for the elementary school students.

YGS (Transition to Higher Education Exam). YGS which is an acronym of transition to higher education exam in Turkish is the first phase of the university entrance examination. The aim of this exam is to measure students' cognitive skills and also eliminate students who do not meet a score barrier. For students who want to be placed in 2-year vocational programs it is enough to enter the YGS, they do not have to enter the second stage exam, LYS. The scores of the other student who want to be placed in four year programs calculated combining the scores of YGS and LYS. This two-phase exam system was put into action in 2011. Since that year the YGS exam is administered in March.

The questions asked in YGS exam usually covers the first one year of the secondary education that corresponds to the year all of the students were responsible for the same courses. After the first year, students choose majors hence are responsible for different courses for three years. The questions of the YGS are claimed to be prepared in order to measure students' cognitive skills rather than students' knowledge on certain topics. A student with high cognitive ability can get high grade without studying hard.

In 2012, the percentage of students who can pass the barrier to enter the second phase of the examination was 68% (ÖSYM, 2013). Only those students could enroll in a four-year undergraduate program. This shows that nearly half of the students eliminated at the first stage of the examination.

LYS (Undergraduate Placement Examination). LYS, Undergraduate Placement Examination, is composed of five different test administered at different dates and times every year in June. A student can take one or all of the five exams. Only one of those tests includes questions from the field of physics and it is named as LYS-2. In the rest of this section the characteristics of LYS-2 will only be discussed since only this test includes questions form physics.

In LYS-2 the physics section contains 30 questions which might come from a broad range of topics which the students learn for four years in the secondary school. The questions are prepared by a commission of teachers, measurement and evaluation specialists, and university professors under the supervision of ÖSYM (Student Selection and Placement Center). Contrary to YGS, LYS-2 has questions which assess students' knowledge on certain physics content. Thus students have to study LYS-2 more than they study YGS to get a good total score. The questions of LYS-2 involve more mathematical comprehension in order to be solved.

Although the formats of those questions differ, generally comprehensive knowledge on the topic is needed in order to solve the questions. In contrast to SBS exam LYS-2 exam does not involve only questions that assess students' reasoning skills in the context of an experiment. All of the questions are relying on the physical facts not scientific reasoning.

According to the statistics that ÖSYM (2012) administered, the average number of correct answers of the students to the physics test in LYS-2 was 9.79 with a standard deviation of 7.77 out of 30 questions. This is the lowest average number of correct answers when compared to chemistry and biology tests.

4.2.2.2. The Interaction of the National Examinations and the Intended Curriculum.
Whilst the main aim of the central examinations is to place the students the institutions that are the most appropriate for their academic background, they can also be used to estimate the average success of the education system. They also might indicate to

what extent a curriculum reform is being successful. For instance, the SBS test was prepared not only to place students to secondary schools; it is also being prepared to assess the curriculum. Since the institution that prepared SBS and prepared the elementary school curricula are the same, the alignment of the questions with the new curriculum is much easier. On the other hand YGS and LYS is being prepared not by MEB that also has prepared the secondary school curricula but by ÖSYM whose aim is just measuring student success in order to rank students according to their scores. Thus the institution does not necessarily seek alignment with the secondary school curricula. This was a missed opportunity to determine the success of the curriculum reform.

The questions asked in YGS or LYS exam are chosen from the topics that are included in the intended curriculum. Yet, the way the questions are posed does not match with the teaching approach of the new physics curriculum where the students were expected to relate the physical phenomena with their everyday lives. The questions are not prepared to assess student's skills or their perception of science and physics in general; instead they are prepared as to determine what students know about a specific topic. In addition, neither the YGS nor the LYS examination covers the recently included topics with the new curriculum until LYS-2 conducted in 2013. For instance, in the YGS examination in 2012 and 2013, only one question was about experimentation which assessed students' understanding of dependent and independent variables. In LYS-2 administered in 2012 there was not any question regarding nature of physics or experimenting. Moreover, only two questions were given by connecting physics with everyday lives of the students. In LYS-2 conducted in 2013, however, especially the topics that were recently included in the intended curriculum were covered (ÖSYM, 2013). On the other hand, even though the new topics such as stars and quasars, structure of the atom, the nature of physics, special relativity were covered in LYS-2, the questions merely assess only knowledge objectives. There were not any questions that involve an experiment and its interpretation. Under these circumstances, it cannot be wrong to say that the national university entrance examinations are not prepared in alignment with the new physics curriculum.

In the following section, the national examinations and their relation with the enacted curriculum is discussed.

4.2.2.3. The Interaction of the National Examinations and the Enacted Curriculum. As discussed earlier, SBS, YGS and LYS are probably the most important factors that shape students' future. If a student gets a good score from SBS, she can enroll to a qualified high school. If the same student continue her/his hardworking by studying, solving as many problems as she can she can enroll to a qualified university which opens doors of well-paid jobs and prestige. So, national examinations mean a lot for the students.

In those examinations, it was not enough to solve the questions right, the students have to solve the questions very quickly to solve them all. So understanding the topics that are covered in the school is not helping students to get a good score from YGS and LYS, they have to learn the possible question types that they may encounter in the national examinations. To do that, students have to solve as many questions as they can especially in the last two years of their secondary education. Teachers feel themselves responsible for preparing students for those exams both in elementary and in high school, they want their students to be successful in those exams and hence get a prestigious job at the end of their tertiary education. School administrators also want their students to be successful and enroll to qualified universities so that their school will gain prestige. So they reinforce the teachers' effort to prepare students for national examinations. The school administration also wants students to be motivated. To manage that, in every Friday at the end of the school day, one of the administrators mentioned the importance of national examinations and the students' performances.

Thus, the primary aim of the physics education at the research site was to prepare students for YGS and LYS. Under these circumstances, inevitably the enacted curriculum was very affected by the national examinations. Since the national examinations were not prepared in alignment with the intended curriculum, the enacted curriculum did not stay in alignment with the intended curriculum.

4.2.3. The Textbooks

Unfortunately, at the research site, textbooks were almost the only instructional material used by the teachers. There were three different sources that the teachers or students have: The textbook of the class, the textbook other than the classroom textbook, and the official textbook. All of these three different types of resources will be defined and their use in the physics classroom will be discussed under this section.

4.2.3.1. The Interaction of Textbooks and the Intended Curriculum.

The Classroom Textbook and the Intended Curriculum. In the context of this thesis, classroom textbook refers to the textbook used most of the time in the classroom which was suggested by the teacher to the students. It was the textbook of which the scanned version was projected onto the board most of the time. First the characteristic of that book will be discussed, then researcher's classroom observations will be presented ending up with the teachers' and students' views about the classroom textbook. This textbook is named as Textbook A when the teachers and students mentioned them in the excerpts presented.

This textbook was published by one of the many private educational institutions whose main scope is to prepare students for the national examination. Those institutions, which are called "dershane" in Turkey, publish various kinds of textbooks for students. Most of those books were prepared in order to help students prepare for the national examination. Others were prepared in order to be used as textbooks at schools. The textbook that the students had at the research site was one of the textbooks prepared for that purpose. There was a statement on the cover of the book which claimed that the book conforms to the new physics curriculum. At every grade level the textbooks of this publisher were used. At the beginning of the book the objectives of the official curriculum were written. The names of the units were the same as the curriculum. The units were divided into subsections. Under every title of the subsection, there involve information, formulas, graphics, pictures, images etc.

about the topic under discussion. At the end of each title, there were one or two exemplary questions regarding the topic. At the end of each subsection there were numerous questions of different kinds. At first there were practice questions which were not of the multiple choice question format. Then there were evaluation questions which were called "activities". Those questions were filling in the blanks, true-false, concept-mapping, matching, puzzles, crosswords, etc. Then there were multiple-choice type of questions which were called "comprehension test" and which had solutions. After comprehension tests with solutions, there were homework questions which again did not have multiple choice answers. Students had to write down the solution of those questions in the given space. At the end there were "comprehension tests" without solutions. Those questions were presented at the end of each subsection of the unit. In addition to these, there were unit test which were presented at the end of each unit the questions of which might came from every subsection of that unit. Also, at the end of each unit, there were exam preparation questions which were not in multiple choice format and resemble the questions that may come in the school physics exam. Those questions were not only useful for students but also useful for teachers while preparing exam questions.

Other textbooks used and the intended curriculum. Classroom textbook was the most frequently used textbook both by the teachers and the student. Besides the classroom textbook, other textbooks which were written in a similar format were used by teachers and the students. Likewise the classroom textbook, the other textbooks were prepared by the dershanes and have the same scopes that the classroom textbook had, therefore they have explanation of the topic, have exemplary questions at the end of the subsections, have different kinds of tests that were prepared in order to help students get prepared for the school examinations as well as national examinations. In that section the characteristics and use of textbooks other than the classroom textbooks will be discussed. In order to be short those textbooks will be called as "other textbooks" for the following pages and they are called as Textbook B or Textbook C etc. when the teachers and students mentioned them in the excerpts presented.

Other textbooks were prepared in a very similar format with the classroom textbooks. On the cover page of all of those books it was written that the book conformed to the new physics curriculum like the classroom textbook. Those textbooks have plenty of questions of different format. The writers of these books tried to include every possible type of questions that the students might encounter in the national examination.

Although all of those kinds of books claimed on their covers that they had been prepared in parallel with the new physics curriculum they may include different topics for the same units. For instance while the classroom textbook did not mention the loudness under the topic of sound, one of the other books that the teacher used the most include that topic.

More or less, the other textbooks that the teachers and the students used resembled each other; they have the same scope, the same format, almost the same types of questions and examples. The only point where those textbooks have the most distinct differences might be the level of hardness of the questions. In the following section how and how much the other books were used in the classroom is discussed in general.

The official textbook and the intended curriculum. The textbook that MEB provides for free for students and the teachers will be called "the official textbook" in this thesis. The official textbook was written by a commission that MEB assigned and prepared in accordance with the recent physics curriculum. The differences between the scopes of the official textbook and the other textbooks was the main reason for the difference of the formats between those books. The scope of the official textbook was scientific inquiry where the main scopes of the other textbooks were preparing students for the national examination. Inquiry was one of the teaching methods used which was a point where the other textbooks did not bother to try. Unlike the other textbooks, the official textbooks had a lot of classroom activities with little lecturing. In those textbooks the writers tried to integrate physics with students' daily lives. To do so, many activities were included in the official textbook which might help students

a conceptual understanding of the physical phenomenon. Since this textbook was prepared for all of the secondary state schools in Turkey, the experiments conducted were designed with materials that were easy to find so that schools with poor conditions can also conduct those experiments. Another significant difference between the official and other textbooks were their quality and quantity of questions. The official textbook has a limited number of questions which are not prepared in a similar format of university entrance examination. The textbooks other than the official one have a wide range of different questions the number of which satisfies both the teachers and the students. Unlike classroom textbook the official textbook had many experiments which could be conducted easily. Also, the questions that the official textbook had were much easier compared to the questions of other textbooks.

4.2.3.2. The Interaction of the Textbooks and the National Examinations. The textbooks discussed in the previous section are influenced by the national examinations at different levels. The official textbook for instance does not seem to be written by taking the national examinations into account since preparing students for the national examinations is not one of the goals of it. On contrary, the other textbooks including the classroom textbook chosen by the teachers of the research site have the primary aim of preparing students for the national examinations and helping students get better grades from school exams. This statement was written in almost all of the other textbooks' prefaces. Those textbooks was not purported to be used inside the classroom by the teachers. Even the official textbook is not useless for students to be prepared for the national examinations it was alleged not to be sufficient. The official textbook was designed to help students develop the scientific concepts in a context from students' everyday lives so it might help students give correct answers to the questions asked in the national examinations. On the other hand, because of the high number of questions and limited time allotted for solving those questions the students have to find the right answers to the questions as quick as possible which needs a lot of practice. Official textbook, unfortunately does not provide a wide range of questions which was presented as one of the most significant problems with the official textbook. While the other physics textbooks contained numbers of different questions, the offi-

cial textbooks contain only a small number of questions at the end of each unit. For instance while the 10th grade classroom textbook have 52 questions at the end of the "force and motion" unit, the official textbook had only 15 questions at the end of the same unit. The classroom textbook also had numerous questions at the end of each section of the unit.

4.2.3.3. The Interaction of the Textbooks and the Enacted Curriculum.

Classroom textbook and the enacted curriculum. The textbook used at the research site was not only used as an instructional tool for the students, it was also used as a guide for the teacher to follow the curriculum. In this section, how classroom textbook was used in and outside the classroom is discussed.

The textbook was chosen through the consensus among school physics teachers. At the beginning of the year the teachers announced which textbook they would use during physics classes. That year, the teachers had changed the classroom textbook since they did not content with the previous one. During the interview with Mr. Doe, he presented two main reasons why they had chosen that textbook instead of the previous one:

> The Researcher: Why had you picked that book earlier?
>
> Mr. Doe: The reason I chose it at that time was because "Textbook A" was needlessly difficult, it had questions that had to be solved entirely by calculator, but that was not our goal. ÖSYM's goal is not that, they do not even ask such questions, because they ask either ratios, proportions or comparison questions. They either ask for comparison, or a ratio. The calculation of numerical values is something that would be done at the end of a real laboratory experiment. We do not need that! This is not mathematics. It is not just that, but "Textbook B" keeps the old topics that are no longer included by the curriculum. They just shuffle the order of the topics and questions in the old editions and present the same thing. I mean they did not change anything, they just added the new stuff, but the topics no longer covered by the curriculum are still there (with an angry tone). Look at the 9th grade book, it is a disgrace! It has a lot of material on heat and temperature, it is all there. In the first year with the new curriculum,

when I was teaching heat and temperature, "Textbook B" even covered thermal expansion (laughs). Thermal expansion is covered way later in 11th grade. They printed all of heat and temperature. In 9th grade for instance, we are slowly realizing how much of the subject we have to cover, when we taught it the first year we did not know how much to cover. Even phase change is not included. There is only heat exchange, change of temperature. Q equals mc delta t. That is all. "Textbook B" covers even the properties of heat capacity, go figure. So we did it to get rid of "Textbook B". We thought the subject instruction should be strong, but we later realized that the questions are also important. The students find the questions in the book to be dissatisfactory. Because they find it dissatisfactory, they do not solve the homework that much. They do not study using the book that much either, but the subject instruction is really good, and they did a good job at sifting out the subjects not covered by the curriculum.

The Researcher: I was going to ask about that. How parallel is it to the new curriculum?

Mr. Doe: It is very parallel, it is very good. For example in the 10th grade, there should not be river problems where the boat is traveling at an angle, these types of questions are not in the curriculum, the boat should be perpendicular to the direction of the river, and "Textbook A" left angled questions out, as it should have. Most of the other books include angled versions. (from interview with Mr. Doe on 08.06.0212)

As Mr. Doe said, they preferred that textbook because they found the previous textbook's questions had included excessive calculations. Since one of their primary aim was to prepare students for the national examination and in that examination the questions were not similar to the previous one had the teacher tried to find a textbook whose questions were similar to what was asked in the national examination. Another reason why the teachers had chosen that textbook was its accordance with the new curriculum. Since the teachers predicted that the national examination's questions would be in alignment with the new intended curriculum, they wanted the textbook to be in alignment with the intended curriculum.

The teachers and the students also had a free official textbook published and distributed by MEB yet they did not find that textbook useful. So at the beginning of the school year, when the teachers announced that they would use a textbook that they had to pay for, students did not object. The students always brought their

textbooks with them when they were coming to the laboratory. Usually, the lesson starts after the teacher opened and projected the scanned version of the textbook onto the blackboard. Mr. Doe and Mr. Smith used that method in almost every physics classes where Ms. Brown did not prefer such a method. Yet, she also wanted students open their textbooks during the lessons. The teachers used that textbook to follow the sequence of topics and to know the boundaries of the topic. They also use it to present students examples from daily life. Since especially Mr. Doe uses the example giving strategy while explaining a phenomenon, he frequently uses the textbook in order to find examples. The textbooks were also used as a resource not only for students but also for teachers. For instance at places where they got stuck, the textbook was their primary resource. When asked Mr. Doe what he did when he got confused he listed the classroom textbook as one of his primary resources "I first consult Mr. Smith in recess, failing that, I consult the textbook" (from interview with Mr. Doe). The teachers also used it as a guide for the intended curriculum. He did not look at the curriculum since he believed that the textbook conformed to the new curriculum. There was one last use of the classroom textbook: all of the teachers used it while giving homework. Generally the homework was solving the questions at the end of the section in the book. The teachers checked homework usually a week after its assignment. Hence, the classroom textbook was at the center of the instruction. The teachers used it as a resource, an instructional tool, a question pool, the intended curriculum. Even if the textbook they used for that year was in alignment with the new curriculum and also its explanations were found decent by the teachers, they were thinking of changing it for the following year. Mr. Doe explained why they thought so:

> The Researcher: Are you not thinking of changing the book?
>
> Mr. Doe: I am thinking of changing the book next year. This year we used "Textbook B". The subject instruction is good, but I think the questions are inadequate. Hence, I might use a book for subject instruction, like Mr. Smith did this year; he used Textbook C all the time. As for a question workbook, I have Textbook D in mind. That is what I have in mind, but we might decide with Mr. Smith on what to do in a department meeting, but I am not thinking of keeping this book, because I find the subject instruction to be inadequate. (from interview with Mr. Doe on 08.06.2012)

Mr. Doe said that they changed the textbook because of the previous one's question types did not match with the national examination. Then they found the recently chosen textbook's questions to be not compatible with the national examination. He first said that he found the books' explanations satisfactory yet he stated that he would choose another textbook for the following year for explanations. He also said that he would use two different textbooks, one of them would be for lecturing and the other one would be for question solving. Considering that the students usually came from middle class families, some of the families might not afford that.

Other textbooks and the enacted curriculum. The usage of the other textbooks was similar to classroom textbook since they have similar format. In general, they may cover the same topics with a little different emphasis on the content and with different levels of difficulty of their questions.

When encountered discrepancies between the textbooks, Mr. Doe mentioned the details covered in the other textbooks even though it was not included in the intended curriculum and stated that they had to solve the questions about the topics that were not included in the intended curriculum or official textbook to prevent students think that they were not covering everything for national examinations.

> Mr. Doe: For example in the 10th grade, there should not be river problems where the boat is traveling at an angle, these types of questions are not in the curriculum, the boat should be perpendicular to the direction of the river, and "Textbook A" left angled questions out, as it should have. Most of the other books include angled versions.
>
> E: You do not cover them either?
>
> Mr. Doe: We did not cover them but the students have the other textbooks and point out that those questions are given in said textbooks, so we had to cover those types of questions. (from interview with Mr. Doe on 08.06.2012)

Mr. Doe presented an example of how the classroom textbook was in alignment

with the current curriculum. While doing it so, gave the example through the questions, not through topics. This might show how much importance he gave to question solving. The researcher asked what they preferred to do when they saw differences between the textbooks. The teacher gave a contradictory answer by stating at first that he had not mentioned the topics not included in the curriculum but then admit that he solved questions of those topics. It would be very odd to solve questions of the topics without discussing them. Mr. Doe did that for his students not to be surprised when they saw it in the other textbooks they had in their hands.

It would not be wrong to say that enacted curriculum was pretty much shaped by the textbooks other than the official one. In the next section, the official textbook's differences from the textbooks used by the teachers and the students and what the students and the teachers said about the official textbook are discussed.

The official textbook and the enacted curriculum. The official textbook was the only textbook which was written in accordance with the teaching philosophy of the intended curriculum. Other textbooks including the classroom textbook were written so as to meet only the knowledge objectives of the intended curriculum. Nevertheless there are some points where the writers failed to limit the content according to the boundaries drawn by the intended curriculum. As mentioned earlier, since the aim of the official textbook is trying to help students develop scientific inquiry skills in a student centered environment, the content of the textbook was prepared according to reach that goal. So, in the official textbook, the physical phenomena were given in a context from everyday lives. Contrary to other textbooks the aim of which was preparing students for the national examination which is not in alignment with the intended curriculum, the official textbook did not contain many question types that may help students get prepared for the national examinations. Because of this characteristic of the official textbook, teachers do not prefer to use it in their classrooms. During observations at the research site, none of the official textbooks were used by the teachers inside or outside of the classroom. Yet, there were times when the teachers tried to conduct the activities written on the official textbook. Those times corre-

sponded to the semester when the intended curriculum was first being implemented in the classroom. Then the teacher thought that conducting the activities took a lot of time and the activities were not worth doing. Ms. Brown is one of the two teachers who tried to conduct hands-on activities in the classroom. She said that some of the activities included in the official textbook did not worth doing and she explained why she thought that way in the following excerpt:

> Ms. Brown: Well, I do not remember much, but yes we had done the activities in the book in the first units. The pendulum was among those, and the students had prepared the set up and brought it to class. We had asked questions as to whether the period would change or not in class, we did that and apparently it stayed in their memory (. . .) these things require time, and not enough time is allotted to physics. We do not have the means to prepare experiments and do them with this much content. You spend 15-20 minutes for that experiments, and the only thing they learn from that is, say, that the period does not change with amplitude. This is what they learn, 20 minutes is too much time to teach just that. (Laughs) It would work if the number of class hours increased; there is a serious time shortage. (. . .) conducting experiments is no easy task, it is not something that you can show quickly and leave behind. You have to draw the students' attention, carry out the experiment, and then ask questions to improve their understanding, evaluations. . . You have to tidy up (laughs), these all take time. There have to be at least four hours outside of regular class hours so that you can do all that. You also have to choose the experiment carefully, and think is it worth it? There are experiments in the 9th grade textbooks for instance, and some are really not worth doing. The result is something that the students can understand even if you do not show them the experiment. There are such simple experiments. The experiments in the textbooks should be more instructive, they should be worth the time. (from interview with Ms. Brown on 08.06.2012)

After a couple of tries Ms. Brown stated that she decided not to follow the official textbook and switched to the other textbooks and began to spend most of her time to question solving in the classroom. According to the teachers' practices in the classroom, the influence of the official textbook over the enacted curriculum is very little compared to the other textbooks.

4.2.4. The Teachers

Teachers are one of the living agents that might shape the enacted curriculum. In this section, the three teachers and their interactions with the enacted curriculum and other agents are discussed in detail. The teachers were introduced in the participants section of this thesis whose pseudonyms are, Mr. Doe, Mr. Smith, and Ms. Brown. In the observed semester Ms. Brown was teaching only 9th grades, Mr. Doe and Mr. Smith were teaching 10th, 11th, and 12th grades. The most experienced teacher among the three teachers is Mr. Smith who was working as a physics teacher for 17 years, then comes Ms. Brown who worked as a physics teacher for seven years and the least experienced teacher was Mr. Doe who had been teaching physics for four years. Although the teaching styles of the three teachers hence the way enact the physics curriculum is pretty much the same, there were also some minor differences between the enacted physics curriculum in their classes. These differences most probably come from their views on the new curriculum and their teaching philosophy, and also their teaching experiences. In the following section, the teachers' views on the intended curriculum, the national examinations, the textbooks, and the students are discussed. At the end of Section 4.2.4., the relationship between the teachers and the way they enact the curriculum are summarized and the possible reasons why they enacted it as the way they enacted are discussed.

4.2.4.1. The Teachers and the Intended Curriculum. The way the teachers approach the intended curriculum may show the level of the alignment between the intended and enacted curriculum. So investigating what the teachers think about the curriculum that is expected from them to enact, may shed light on the problems on the intended curriculum and hence the enacted curriculum. As mentioned in the literature review section of this thesis, there were many studies conducted which investigates teachers' views on the intended physics curriculum the results of which may vary. The views of the three teachers whose cases were investigated for this research are presented based on classroom observations and interviews with the three teachers.

The teachers and the Aims, Goals, and Objectives of the Intended Curriculum. To begin with, the teachers did not talk a lot about the main aims and goals of the intended curriculum. The reason for that might be teachers' lack of information about the aims goals and objectives of the curriculum. The teacher who mentioned the aims and goals of the intended curriculum the most was Mr. Smith. He did not mention them during the interviews but he did talk about them in classroom. For example, about scientific literacy, one of the primary aims of the intended curriculum, the teacher told the class: "your primary goal is national examinations, if you get scenically literate, all the better". This sentence might show that his approach to the aim of the physics education: preparation for the national examination. If the students develop scientific literacy while they were preparing for examinations, it would not hurt. It seems that being scientifically literate people was a byproduct according to Mr. Smith. Mr. Smith also thought that there were some topics, not all, which were included in the intended curriculum for scientific literacy. If Mr. Smith thought that a topic was included in the curriculum for scientific literacy, he informed students that they did not have to learn it comprehensively. For instance, while covering a topic which was first included by the current intended physics curriculum, Mr. Smith used to inform students about why and how much they had to know that topic. An example of such an explanation given by Mr. Smith is presented below:

> It was a lesson in 11-C and the topic was "the structure of atom" under the unit "modern physics". The teacher talked about emission and absorption spectra briefly the session before.
>
> Mr. Smith: I do not expect you to fully understand the subject 100%. I just want you to have an idea. There was a man who was claiming that he invented a perpetual motion machine. I am not that stupid.
>
> Then he turned to the topic and said:
>
> Mr. Smith: We will solve the questions of important parts. (From field notes on 03.05.2012)

In this excerpt, the teacher purported that the recently added topics "emission and absorption spectra of atoms" under the title of "the structure of the atom" were

not worth-learning topics; it would be enough for the students to just hear the terms. Then he mentioned a man, actually an engineering company, who claimed that he invented a perpetual motion machine which was impossible to achieve according to laws of thermodynamics. Then he added that he was not stupid. He probably wanted to say that he was scientifically literate enough to know that such a machine could not be invented. After that he turned to the topic by informing students that they would solve questions of some parts of the topic which he saw as important. Another example from the topics which were not important was "nature of physics". Mr. Smith called "nature of physics" as "flotsam and jetsam" to show how important the topic was for him.

As mentioned before, the teachers did not talk a lot about the aims goals and objectives of the intended curriculum. In addition to Mr. Smith, Ms. Brown once stated that "with the recently changed intended curriculum, scientific literacy was casted aside" while chatting with the researcher on break time. She explained why she thought so by saying that mathematical practices removed from the old curriculum. So the students cannot improve their mathematical skills and according to her they could not be scientists.

The intended curriculum has various objectives which were written in order to guide the teacher to reach the aims and goals of the curriculum. Unfortunately the teachers did not make any comments on the objectives written on the curriculum when the researcher asked for their views on the intended curriculum. Moreover, while talking with Mr. Doe, it became apparent that the teacher did not even look at the objectives written in the intended curriculum document published by MEB. Yet, they saw those objectives on the textbooks they use instead of official textbook. At the beginning of each topic, one or two subject related objectives appeared on the top. It was observed that the first thing that Mr. Doe and Mr. Smith did was reading or having a student read those objectives when they started a new topic.

All in all, the aims goals and objectives of the intended curriculum were among the things that the teachers were least interested in and knowledgeable about. In the

next section, teachers' views about the spiral structure of the intended curriculum are discussed.

The Teachers and the Structure of the Intended Curriculum. As explained in Section 4.2.1.1, the structure of the curriculum was spiral which means in every grade level the same units were covered but with a deeper content. The teacher stated that the spiral structure of the curriculum was useful for some points while it also might lead teachers to confusion. For example, according to Ms. Brown, the spiral structure of the curriculum was good for the students since they had to recall what they had learned the year before while it used to cause confusion for her to decide where to start and where to stop in previous years:

> There is a spiral structure in the transition period. You teach a subject in the 9th grade, and redo it in the 10th grade, and then again in 11th grade. When you teach it in 9th grade, where are you supposed to stop, it was not that obvious at the beginning. For instance, in the first unit in measurement of mass, is the subject of balance scale to be covered or not? This was not clear, even today it is not that clear. In the beginning we had a lot of trouble deciding where to stop in subjects. (from interview with Ms. Brown on 08.06.2012)

According to this quotation Ms. Brown thought that the boundaries of the intended curriculum were not clear before and then which led teachers to confusion.

Mr. Smith also did not like the spiral structure at all. He was very glad to learn that the curriculum would change in fall 2013 and the future curriculum would not be in spiral structure:

> The new physics curriculum seems logical at first sight. The spiral structure of the recent curriculum, despite making sense at first sight, presented problems to us at the enactment stage. There were problems in the 10th and 11th grades, so I am not very satisfied with the recent curriculum. I think the curriculum developers realized that the spiral structure did not work, so they created a new version of the new version. The same topics are all there in the 9th 10th 11th grades, and that is not good. Classical physics, modern physics, and so on. So they realized this would not work, and they fixed it, as far as I understand of course. They removed

> the spiral structure and separated modern and classical physics to be taught in different grades. (from interview with Mr. Smith on 08.06.2012)

Mr. Smith stated that the curriculum developers realized that the spiral structure of the intended curriculum did not succeed as they had predicted so they would change it. He liked to teach the topic at once, by presenting the topic in detail and leaving students to study the topic on their own when they had to recall it.

In summary, the teachers have difficulty understanding the boundaries of the intended curriculum because of its spiral structure. This might be due to the fact that the teachers were not informed enough about the structure of the curriculum. Ms. Brown stated that possibility during the interview by saying: "When people see the titles of subjects, they think they should cover everything, and try to do so, but that is not true. They fail to get it because the essence of the curriculum has not been explained to them." On the other hand, Mr. Doe and Ms. Brown believed that the spiral structure of the intended curriculum is useful since it enabled students to recall what they had learned at previous grade levels.

Teachers and the Content of the Curriculum. When the researcher asked the teachers to give their views on the intended curriculum, the first things they said were about the content of the curriculum. The teachers generally find the density of the topics they had to cover in a year very high. Moreover, the teachers had difficulty while teaching the recently included topics in the intended curriculum. They were also complaining about the removal of the dense mathematical calculations from the intended curriculum.

The teachers thought that there were many topics to cover in a very limited amount of time. Because of that they had to cover the topics very fast by not letting students understand them thoroughly. Mr. Doe stated this problem as below:

> The program is too crowded. There are so many topics in the 10th grade, that although there

> are three class hours per week, I can barely keep up with my annual plan. Last year, there were only two class hours, and we were not able to cover the last subject. The waves unit could not be finished. Most of my colleagues could not finish it. Those who could probably sped through it. That is how it could have been covered, without going into detail. The program is too dense, that is a bit of a problem.(from interview with Mr. Doe on 08.06.2012)

Mr. Doe stated that the two hours set aside for physics courses per week were not enough to cover all the topics written in the intended curriculum so they added one more hour by including a selective physics course in the students' schedule. Even if they had one more class hour, the teacher stated that they hardly cover the curriculum. He also claimed that if some of the physics teachers stated that they had covered it, they probably said lie or they might have skipped the details of the topic very quickly.

Another point that the teachers criticize the most about the content of the curriculum was the recently included topics. Those topics were presented in Section 4.2.1.1 The teachers stated that they had difficulty teaching those topics since they did not know those topics well. Mr. Doe stated that he had difficulty while teaching the recently included topics:

> This somewhat depends on how many times you have taught it, or whether you have taught it or not. If I were to teach the "Starts and Quasars" unit, or the "Subatomic particles" unit, I would have a hard time, because both times we could not get to those topics. When you do not teach a topic, you certainly cannot understand it fully. You realize your shortcomings regarding a topic when you teach it, and then you go home and look them up and figure them out. (...) This is how it works, you cannot learn it without teaching it. (from interview with Mr. Doe on 08.06.2012)

Mr. Doe stated that he might have difficulty teaching the recently added topic such as "stars and quasars" and "subatomic particles" He added that he could not actually learn the topic if he did not teach it in the classroom. He thought that the more a teacher teaches a topic, the better she/he learned that topic. Through teaching, the teacher learns the points that she/he has difficulty in understanding and then studies those points to catch up.

The topic that was the most problematic to teachers was the Modern Physics unit, especially the "Structure of the Atom" topic under the title of that unit. Mr. Smith admitted that he and his colleagues had difficulty teaching modern physics because actually they did not know the topic very well. He said:

> They cannot develop a deep understanding of modern physics anyway, even we teachers cannot understand it when we talk among ourselves. (. . .) We too have shortcomings when it comes to teaching it. MEB has shortcomings; teachers do not fully understand the topic (from interview with Mr. Smith on 08.06.2012)

Recently added topics were generally regarded by the teachers as unnecessary. For instance, while Mr. Doe was talking about the high density of the topics in the curriculum, he complained about the topic "stars and quasars":

> They introduced a new subject from astronomy, this topic was not there before. We were already experiencing an excess of topics, and they went ahead and added more. I guess they want them to be covered superficially, just to introduce what they are maybe, I do not know, but it still creates a problem. Another effect of the curriculum on the teachers is. . . this is one of the reasons that teachers do not change their ways, they find it hard to sit down and study a new topic, to learn all that after a certain age. It is really hard (from interview with Mr. Doe on 08.06.2012)

In this quote, Mr. Doe was complaining about the number of topics included in the curriculum. He thought that the old curriculum had already been dense, by adding more topics to it in the new curriculum had made it denser. He gave the example of the unit "stars and quasars" which was planned to be presented at the end of the 11th grade. He did not actually know how deep it was expected to be covered but he predicted that it would not be very deep. He also claimed that the teachers did not want to study for the new topics; hence they could not cover them in classroom. Mr. Doe purported that one of the reasons why the alignment between intended and enacted curriculum was so weak was the teachers' unwillingness to study physics.

Another feature of the intended curriculum which the teachers talked about was

the removal of mathematical calculations from the content. While the previous curriculum expected from students complicated calculations, the intended curriculum included statements like "do not go into mathematical calculations" as a warning. Those warnings were presented next to the specific content objectives of the intended curriculum. The teachers were not very content about this regulation since they thought without any calculations the topic would remain too shallow for the students:

> We went to that seminar at a university, the instructor there told us that there would not be many mathematical equations or things of this sort, but what she said was contrary to what we teach in class. If we teach it like that, it will be too shallow. (from interview with Mr. Smith on 08.06.2012)

In addition to what Mr. Smith said, Ms. Brown also claimed that with the removal of mathematical calculations, educating scientists would be very hard.

In summary, the teachers were not very satisfied with the content of the physics curriculum, because it was dense, they were not well-versed in new physics topics included in the recent curriculum, and the removal of the mathematical calculations caused the topics to become shallow.

The Teachers and Teaching Approach of the Curriculum. It was explained in Section 4.2.1.1 that the intended curriculum does not only consist of a list of topics; it also provides guidance to the teacher on how to present the topic to the student. Since the center of the education shifted from the teacher to the student with the new intended physics curriculum, students are expected to be active learners where teachers are expected to be guides who help students in their learning process instead of "teaching" them. In order to be active learners, students should be engaging in hands-on activities, conducting experiments to develop scientific literacy. The teachers should help the students reach the information but not provide it directly. This means a great difference in teachers' teaching habits since they had learned and been teaching physics in a traditional way. The three teachers at the research site were aware that the

teaching approach of the current intended curriculum has changed yet they did not have comprehensive information on what they should actually do in the classroom, except for Ms. Brown. Since she was a doctoral student in the field of education, she knew the teaching approach of the intended curriculum more than the two other teachers. As described during the entire section "The Enacted Curriculum", the teacher did not internalize the teaching approach of the recent physics curriculum. For instance, Mr. Doe listed reasons why they could not make their courses more student-centered:

> It is absolutely impossible to apply a student centered approach. I do not think it can be applied, because this is a hard topic to understand. So the students has to study himself/herself , or rather, the student centered teaching is too time consuming, two class hours do not suffice and you have to cover all the topics in time. I think these are the problems in general. It is also the students' choice, they do not want to delve deeper into it. This is also because they are not used to it. These activities for instance, they are the predominantly featured in the new curriculum. Especially in the first two units of the 9th grade, since they were more qualitative, subjects like the nature of physics, the definition of physics. In the first unit of 10th grade there was matter and its properties; there was capillary action. We set out to carry out the activities when teaching these subjects, and we started, but we are having trouble doing them to be honest. I tried to demonstrate the experiment where water rises or falls because of capillary action, but these could not be observed. When the experiments do not work, the students make fun of them, and ask "Is this the lecture? Is this how physics lessons are?". When I started working here last year, I learned that my co-worker before me had done experiments in the classroom, and he was criticized by the parents with arguments like "How can you teach physics sitting down? Can you not solve questions on the board?". These are problems. Teaching differently when others all follow the same method is another problem. Everyone is afraid to transition to this kind of teaching. (from interview with Mr. Doe on 08.06.2012)

Mr. Doe presented many reasons why they could not implement a more student-centered curriculum. First of all he stated that physics is a though discipline, the students had difficulty understanding physics. So trying to help the students learn the topic is much harder than directly explaining the facts and solving questions. Another reason was the lack of time. Since the allotted class hours for physics per week was only two hours, the teacher believed that he cannot include activities in his lessons. Other teachers also presented the same reason. Moreover, Mr. Doe stated that the students did not want to participate in such activities since they are not used to doing activities.

With other teachers, he said, they tried to perform the activities when they first met the curriculum but they could not succeed at getting the expected result. When the teachers cannot observe the expected results, Mr. Doe told that the students used to mock the teacher by saying "teacher is this physics?" which was very frustrating for the teachers. This might be due to the fact that the teachers' laboratory skills were not very developed since they have very little interaction with the laboratory equipment. The last reason that the teacher presented was the pressure of other teachers and the parents on the innovative teacher.

Another problem frequently stated by the teachers about the classroom activities was the lack of equipment. While the school had a physics laboratory and various kinds of equipment, the teachers did not prefer to use them. They claimed the equipment they had was not useful or in good condition. Even if there were items that could be useful, the teacher stated that they did not know how they use them.

> Now all those activities are things that have to be done in the laboratory. Most probably, the majority of physics teachers, including me, do not know how to use the laboratory. Most school laboratories are not that useful either. There are good ones, like the "Foreign High School" laboratory, but they have ties to a foreign country so they have a lot of equipment. I went there and examined their laboratory... They had sent us devices, something like a computer or a tablet, last year. They sent those to others schools as well. To this day, no one knows what they are for or how to use them. They tell us that the experiments are installed in them, but we do not know. The principal tells us to use them, but we ask around and no one knows how. I have a friend who works for the state, he said that there would be in service training on what these devices are and how to use them, but a year has passed and nothing has been done. Believe me they are not cheap, they look expensive, but we do not know what they are for. It is pretty funny. (from interview with Mr. Doe on 08.06.2012)

In this quote, Mr. Doe first claimed that most of the physics teachers did not know how to use laboratory equipment. He added that even if they knew it, the conditions of the laboratory were poor. Then he told that laboratory equipment sets including tablets were distributed to some of the schools in Istanbul. Those tablets were designed to help students collect and analyze the data they would get from the experiments they conducted. (See Section 4.1.1.3.) Mr. Doe complained that the

principal was forcing them to use these tablets but they did not know how to use them because no one had shown them how. He had heard that there would be training about it but no training was given to the teachers.

Another reason why the teachers did not prefer conducting activities was that the teachers did not perceive those activities as valuable learning experiences. As Mr. Doe, Ms. Brown stated that they tried to conduct the activities in the classroom in the first year of the physics curriculum but then they decided not to since the activities were designed to help students learn very simple concepts that they could understood by simply telling it:

> Since the students remember what they did, conducting experiments has been helpful. It should be done of course, but it requires time, sufficient time is not set aside for physics classes, they would remove physics completely if they could. We do not have the means to prepare experiments and do them with this much content. You spend 15-20 minutes for that experiments, and the only thing they learn from that is , say, that the period does not change with amplitude. This is what they learn, 20 minutes is too much time to teach just that. (Laughs) (from interview with Ms. Brown on 08.06.2012)

Ms. Brown gave the example of an experiments she wanted 9th grade students to conduct in the first one or two years of the new curriculum. She wanted students to determine the factors that affect a period of a pendulum. The aim of that activity was having students understand that the period of the simple harmonic motion of a pendulum do not depend on its amplitude. According to the teacher, they had to use the time wisely so they could not allocate 20 min. (half a class hour) to learn only one simple fact. Hence, the teacher thought that activity was a waste of time. If the activities were designed in a way that help students learn more complex concepts, the teachers might prefer to do them. Mr. Smith also stated that the activities were very simple that he might not drove students' attentions.

All in all, the teachers did not agree that the student-centered teaching approach of the intended curriculum as applicable to physics since it was a tough discipline, they did not have time for hands-on activities, the students were not used to conduct

experiments, they did not know the student-centered approach very well, the equipment in the laboratory was not in a good condition and they did not know how to use laboratory equipment.

Teachers and the Implementation Process of the Intended Curriculum. In this section, the implementation process of the intended physics curriculum, what had and had not been done to help teachers internalize the new physics curriculum is discussed. During the interviews with the teachers, they complained about the inadequate number and inefficiency of in-service training. They stated that they felt alone in trying to adapt to the new curriculum.

The teachers stated that the physics curriculum was continuously changing and the teachers generally did not put very much effort to adapt to the new curriculum because they thought that curriculum would change in a year or so. Mr. Doe ascribed this to Turkey's lack of a well-established educational policy.

> People are also worried; will they revert back to the old system? Is this transient? Since our country does not have an education policy, and people think yet another new curriculum will come and this one will be thrown away, so they cannot embrace it readily to be clear. They do not think this will last, and this has been an important factor in why the curriculum has not been actively implemented. They think, it is temporary, it is bound to change some time, some people even think the minister of education will change and the curriculum will change along with him. (from interview with Mr. Doe 0n 08.06.2012)

The teachers, especially Mr. Smith, stated that they did not know the recently added topics to the new intended curriculum as discussed in section "Teachers and the content of the curriculum". The teachers also complained about the lack of support provided for teacher about how to present new content in the curriculum to the students. For instance Mr. Smith mentioned this issue during the interview:

> There are new topics that we did not learn in our undergraduate education, for example adhesion and cohesion. In 10th and 12th grades, there are similar topics which were introduced. I mean what we do is, we study them and teach them, like in the 11th grade there is a unit called "stars

> and quasars". I personally do not know anything about it. How do I teach it? I sit down and study, and try to understand it. There should be an official that we can consult as to how to teach these topics. This is necessary.

Mr. Smith admitted that he did not know the new topics; he did not learn them in the university. He felt difficulty while trying to figure out how he should teach the topic too. He read the textbooks to understand the topic but he expected MEB to support the teachers especially on the new content of the curriculum.

In the intended curriculum, it was expected from the teachers to conduct experiments and classroom activities to help students learn the concept. Yet some of the teachers stated that they did not feel themselves competent enough to conduct experiments in the laboratory. For example, Mr. Smith stated that he did not know how to conduct experiments so he first needed to see the experiments that he was expected to conduct:

> When doctors acquire new equipment, someone instructs them on how to operate it. I think a similar thing should be done with physics laboratories, there should be an institution that we can go to where they will teach us how to do the experiments, or they will come to the school and set the experiments up for us, I think such a thing should be done. So it is not quite possible to do all those activities. (from interview with Mr. Smith on 08.06.2012)

Mr. Doe and Ms. Brown also stated that the new curriculum could not have been introduced adequately to the teachers and teachers were not informed about the new aspects of the curriculum:

> What everyone is thinking, which is also what I am thinking, is that this program has not been sufficiently explained to the teachers. It has not been sufficiently explained, or those who explained did not understand it fully, let me put it that way. They held a seminar, and if you say this program has not been explained, they will say "we held seminars, did you even attend them?" When those seminars were given, I was not teaching physics, but those who did attend were complaining that the instructors at the seminar were not knowledgeable enough and that the seminars, for that reason, were held just for appearance's sake. (From interview with Mr. Doe on 08.06.2012).

In this quote, Mr. Doe asserted that teachers were not informed comprehensively. Some seminars were conducted but since he was working in elementary school he did not attend those seminars. But what he heard from those who participated in those seminars was that even the instructor who came there to inform and train the teachers about the new curriculum did not know what he was trying to teach.

Ms. Brown highlighted the importance of in-service training for the teachers to help them enact the curriculum as intended and stated that the implementation process was different in elementary school science and technology curriculum reform:

> The Researcher: Have you had the opportunity to attend in-service training about this curriculum so far?
>
> Ms. Brown: No I have not. I see this as a major shortcoming. When I was working in elementary schools, they held really nice seminars when the curriculum changed, and everyone started off, having understood the essence of the curriculum. That has not happened here, I even witnessed that teachers were not even aware of the curriculum change at the beginning of the year.
>
> The Researcher: When you say the beginning of the year, at the beginning of which year?
>
> Ms. Brown: The year when the change was introduced. The term started, and there were teachers who were unaware that the curriculum had changed and were teaching the old one. People have not even been alerted to that; there should have been seminars at the beginning. There were not any, I could not attend any.
>
> The Researcher: There was not even one? I mean, you are already familiar with for instance new teaching approaches...
>
> Ms. Brown: I did not attend any, there were not any seminars, but there were some programs that dershanes arranged, I had gone to one of those. I attended it of my own accord, out of curiosity, I could have chosen not to attend, but there were not any seminars offered by MEB. (from interview with Ms. Brown on 08.06.2012)

Ms. Brown was a teacher who witnessed both the elementary and the secondary

school science curriculum reforms. She stated that she could not attend any in-service training and that was a major shortcoming. She indicated that before teachers began to enact the elementary school reform, informative seminars were conducted and the teachers started to enact the curriculum with a better understanding of the aims and goals of the science education reform. She could not say it for secondary school physics curriculum reform. The teachers were so clueless in the first year of the curriculum that some of them were not aware that the curriculum had changed. She stated that there were some seminars conducted by private institutions and that she had participated in those seminars of her own accord. Even though she was enthusiastic about seminars, she could not participate in any of the seminars that the MEB conducted.

4.2.4.2. The Teachers and the Enacted Curriculum. Teachers were observed as the most important agents that play role in the shaping of the enacted curriculum in this study. All the other agents affect the enacted curriculum indirectly while the teachers can affect it directly. The teachers decide how to teach, when to teach, where to teach. Nevertheless, other agents, which are the intended curriculum, the national examinations, the textbooks, and the students, may influence the teachers during the process of the enacted curriculum. The three teachers and the differences of the enacted curriculum in each of the three teachers' classes are discussed throughout this section.

The Case of Mr. Doe. In this section the curriculum that Mr. Doe enacted is described and discussed by referring to the classroom modes that were observed in his lessons.

Mr. Doe prefers to teach in the physics laboratory of the school which was described in Section 4.1.1.3. He sometimes had his lessons in the students' own classrooms if Mr. Smith had lesson in the laboratory. This laboratory was tidied up by Mr. Doe with the help of intern teachers in the year that Mr. Doe began to work as a teacher at the research site. Even this was a huge step for conducting more student-centered lessons. Without a laboratory, it would be very hard for the teacher to prepare

classroom activities in the students' own classrooms. He was continuously using the projector while lecturing. He did so not only for using visual materials more, but also for solving many questions by not losing time while writing the question or drawing the figures on the board.

When Mr. Doe would start a new topic, he first conducted short presentations about the topic. He opened the scanned version of the textbook on the computer and projected it onto the board. From time to time, he read the objectives related to that topic which were written in the book. During these short presentations, he sometimes asked one of the students to read aloud what was written on their textbook. Sometimes he preferred to explain the topic to the students. Very rarely he wanted students to write down what he said or wrote on the board. He stated that this was what the students requested. Yet, in one of his lectures, he had students write down what he read from textbook other than their classroom textbook for a whole class hour. Later, he explained to the researcher that since he did not know the topic well, because it was one of the recently included topics in the new curriculum, he read the related chapters from the textbooks and decided to have students write down from one of those textbooks. While trying to explain a concept, Mr. Doe usually gave examples in order to relate the topic to everyday life. He sometimes explained the applications of the principles in real life. By doing so, he managed to attract the students' attention and they started to listen to what he was saying. Yet every time he presented an example, his attempts ended with a couple of questions that came from the students. Most of the time he gave binary, yes or no, answers to their questions and from time to time he confessed that he did not know, and sometimes he ignored the questions. If the questions were serious questions that the teacher could not answer, Mr. Doe would research the answer of the question later. A similar situation took place in one of his lectures:

> It was Mr. Doe's class for 11th grades and the topic was sound waves. Mr. Doe was trying to explain the conditions needed for echo to be occurred.
>
> Mr. Doe: in order for echo to occur there should be 17m distance between the sound source

and the surface where the sound wave was reflected from.

Student: Teacher, why there has to be 17 meters for echo to occur? It can also happen in a small, empty room?

Mr. Doe: There has to be 17m OK? The book says so, not me.

Student: Does the intensity of echo increase with increased distance?

Mr. Doe: I do not know in that much detail. That much detail is an engineer's concern.

Student: Teacher haven't you learned these in university? Is this topic one of the recently added topics?

Mr. Doe: Yes.

The class started to laugh (from field notes of 10.05.2012).

In this excerpt, the teacher could not explain why there should be 17m distance between the sound source and the surface that the sound waves reflected form. However, this was briefly explained in the classroom textbook. It seemed that he did not even read the classroom textbook once. Mr. Doe said that it was written on the book. Then the students slightly mock the teacher by asking him if he did not learn that topic in university and if the topic was one of the recently included topics to the new curriculum. Then in another classroom, while he was covering the same topic, he explained the students why it had to be 17m. He said that the human ear can distinguish his own sound if he heard it after at least 0.1 sec and then he calculated that the least amount of distance between a human and the surface should be 17m for the human to hear his own sound. He explained that without waiting for a student to ask why there had to be 17m.

After short presentations, Mr. Doe started to solve questions. He solved some exemplary questions after the end of subsections which were usually from the classroom

textbook and involves formula applications. After the short presentations, at the end of each chapter he solved many questions regarding that topic. Again those questions might be from the classroom textbook while he chose questions from other textbooks as well. At the end of the modern physics unit in 11th grades, Mr. Doe prepared a collection of questions from different textbooks and copied and distributed the questions to the students. He also shared what he had prepared with Mr. Smith who was also teaching 11th grades. He assigned homework to students from their classroom textbook. After a week he checked the homework and gave the chocolate penalty to students who did not do their homework. From time to time Mr. Doe also asked a student to come up to the board and solve a question. If the question was a little hard and if the student managed to solve it without any help, the teacher sometimes gave him a high oral mark.

Mr. Doe made use of videos provided by one of the publishers of other textbooks to help students visualize the concepts related to modern physics in 10th grade. He had also similar videos for other units yet he preferred showing only that one about modern physics. It might not fully help him to make students understand the concepts but probably the students had an idea. Mr. Doe is the only person whose demonstrations were able to be observed by the researcher. While covering the topic spring waves in 10th grades he used springs to demonstrate transverse and longitudinal waves and also the relation between the speed of the wave and the tension on the spring. Then he gave the springs to the students to repeat what he did. Before he presented the demonstration in class, Mr. Doe tried it on his own and made sure that what he wanted to show to the students could actually be observed. What the teacher did cannot be called “experiment” but it was something that drew students’ attention. Mr. Doe and the students told that he conducted such a demonstration while he was covering the electricity and magnetism unit. The teacher also reported that he tried to conduct more demonstrations before but they could not observe what was expected.

Apart from other two teachers, Mr. Doe was the one who only had a classroom management technique previously introduced as “chocolate penalty”. When Mr. Doe saw a student interrupting the lesson or not listening to the teacher, first he warned

the student that she would get chocolate penalty. If the student continued what she was doing, then the teacher gave her a chocolate penalty which means at the end of the semester she would buy a chocolate and bring it to the classroom to share with her friends. He used to give students the penalty when a student did not do her/his homework too. It seemed that chocolate penalty system worked well to reduce interruptions in the classroom. Moreover, the students reported that they loved chocolate penalty because it helped build an intimate relationship between the teacher and the students.

As off-task activities Mr. Doe let the students study for other exams for one or two class hours. When asked what he would change in the following year, Mr. Doe mentioned the time he wasted by letting students study for other courses' examinations. He said: "For instance in the examination week, there are classes in which we give students permission to study for other exams, if we could reclaim that time, I could manage to cover all topics." There were also some technical problems with the computer or with the projector that prevented the teacher from using time efficiently.

Even though the teachers' enactment the curriculum was more or less the same, there were some considerable differences as well. Despite of his traditional teaching methods, Mr. Doe was the most innovative teacher among the three teachers. He rearranged the laboratory, he tried to conduct demonstrations, tried to find different examples from daily lives of the students while explaining a concept, had a classroom management method which also helped students build positive attitude towards the lesson, and so on. Yet he could not give up the traditional teaching methods, mostly because of the national examinations but there were other reasons as well.

The Case of Mr. Smith. In this section the curriculum that Mr. Smith enacted is described and discussed by referring to the classroom modes that were observed in his lessons.

Like Mr. Doe, Mr. Smith also preferred teaching at the physics laboratory. Mr.

Smith preferred to use projector in order to enrich visual materials and also in order to increase the number of questions he could solve in a session.

At the beginning of each session, Mr. Smith used to open the computer, open the scanned version of the classroom textbook or one of the other textbooks. If he would start a new topic he turned to the corresponding page from the textbook and asked a student to read the objectives of that topic if the textbook. Then either he asked one of the students to read aloud the content from the textbook or he explained the concept by following the textbook. Sometimes, for the points that he considered important, he warned the students and reminded them to jot down what he said in their notebooks. Some of the students wrote down while some of them did not. The important points were usually the formulae the students needed to use in order to solve the questions. An excerpt from Mr. Smiths' lesson is presented in order to illustrate this:

> It was a lesson in 11-D and the topic was Heisenberg's uncertainty principle. Mr. Smith opened the textbook from the computer. First he read the two objectives written on the book.
>
> Mr. Smith: We will just read out loud what is written on the book and move on. There is only one formula related to this topic.
>
> Then he wanted a student to read aloud what was written on the textbook about Heisenberg's uncertainty principle. After she had read it he scrolled down to find the formula while he was searching it, he saw a figure that illustrates what was happening when a device was trying to measure the momentum a particle.
>
> Mr. Smith: Let's skip the figure. Aha! Here is the formula. This is it.
>
> He wrote down the formula on the board and moved on by giving students homework about quantum numbers.

In this excerpt, Mr. Smith first read the objectives of the topic and then wanted one of the students read out loud what was written in the book. Without further explanation, he continued by showing the formula related to Heisenberg's uncertainty principle. While he was searching for the place where that formula was written, he

saw a figure illustrating the observer effect and said "let's skip the figure" because he was in a hurry, he had to cover many topics until the end of the school year. What he was interested in was the formula because the students might need the formula when an uncertainty question showed up in LYS.

Unlike Mr. Doe, during short presentations, Mr. Smith did not usually prefer giving examples from the daily life. So the students could not ask further questions about the examples. The students very rarely asked Mr. Smith questions on the points they did not understand. When they did he sometimes ignored their questions. There were two possibilities why the students did not pose questions to their teacher: either they understood the topic well or they did not figure out what was going on in the classroom. Since the average grades of the physics examinations were not very high, it could be predicted that the latter was more likely to be true.

After short presentations, Mr. Smith began to solve questions just as Mr. Doe did. Those questions might have come from different textbooks. He usually chose the ones that involved mathematical calculations. He tried to solve as many questions as they can and he used to emphasize the importance of solving many questions for national examinations. After he solved some questions, he used to turn to class and ask one of the students solve the next question. From time to time he preferred picking a student from among those who did not seem to be listening.

Mr. Smith's preference of not conducting demonstrations conflicts with what Mr. Doe practiced. No demonstrations or classroom activities were observed during his lessons. He also stated that he did not present demonstrations for students since he did not know how to use any of the laboratory equipment. None of the students remembered any demonstrations or any other classroom activities throughout Mr. Smith's lessons. The only thing that he did was showing videos to students, especially about modern physics.

Classroom management techniques were not used by Mr. Smith; in his lessons the students stayed calm. This was also a point where Mr. Doe and Mr. Smith's styles

differ. Unlike Mr. Doe's students, unfortunately Mr. Smith's students did not show enthusiasm for physics lessons.

Like Mr. Doe, Mr. Smith also let students study for examinations of other courses. At those moments half of the students were actually studying for the exam while the rest of them were doing something other than studying such as chatting, napping, and drawing. There were also technical problems with the computer or projection machine which caused loss of time.

The Case of Ms. Brown. In this section the curriculum that Ms. Brown enacted is described and discussed by referring to the classroom modes that were observed in her lessons.

Ms. Brown preferred teaching in students' classrooms. As much as observed, she did not use the school laboratory once. Moreover, she was not using projector and when asked why she preferred not using it she explained that there were many technical problems which led her lose time when she tried to use them:

> The Researcher: In general, your classes were taught on the board as well, but other teachers only used the projector.
>
> Ms. Brown: The projector, it requires effort to set up, like if the cable is working or not, I do not bother.
>
> The Researcher: So it is easier?
>
> Ms. Brown: Yes. There are different problems in each classroom, and not enough time to spend on them. I did not bother with that, I just used the board. (from interview with Ms. Brown on 08.06.2012)

When Ms. Brown started a new topic, she wrote on the board the name of the topic that she would be covering during the lecture and she made a brief introduction

about that topic. She wrote the definitions of terms on the board. For instance, she wrote the terms such as resistance, battery, ammeter, voltmeter, rheostat and their definitions and drew their symbols on the board. She sometimes drew concept maps to summarize the topic and to show the relations between the concepts yet those concept maps were not covering the whole unit. She continuously wrote down what she said and asked students to copy what was written on the board. This is one of the points that her style of teaching differed from the other two teachers. This was one of the things that her former students appreciated. While lecturing, she was not frequently providing examples from daily lives of the students. Hence, students could not pose interesting questions to the teacher as the students from Mr. Doe's class did. The students were asking questions but those were about the questions the teacher solved during the lesson.

In none of the observed lessons did Ms. Brown conduct demonstrations. During the interview, she also confirmed that she could not use demonstrations or conduct classroom activities in order to help students build conceptual understanding. Yet, according what the students and the teacher said, like Mr. Doe Ms. Brown also tried to conduct classroom activities during the first year of the intended physics curriculum. Yet, since the teacher had very limited time in 9th grade, she thought it was not worth it.

If there were any formulas related to the topic, she wrote them down and wrote the names of the symbols given in the formula. Then she solved an exemplary question to show how to apply the formula when asked in a question. At the end of the whole unit she started to solve questions like Mr. Doe and Mr. Smith did. Since she had only two class hours in 9th grade, she could not solve many questions. Nevertheless, the time allotted for question solving is more than the time allotted for short presentations. For instance, Ms. Brown left three and a half class hours for the unit electricity and magnetism (in the intended curriculum it was 10 class hours) she conducted short presentations for one and a half hour and 2 class hours for solving questions. She had to allocate such a short period of time for electricity and magnetism unit probably because she could not use her time efficiently while covering the previous units. Her

lessons might also be lost due to other reasons (holidays, extracurricular activities, and so on) and she could not allocate enough time for the final units. Ms. Brown gave homework to students to help them practice. She checked the homework of the students in the first session. Then she asked students to tell her the questions that they could not do in their homework and wrote the number and page of the questions on the right side of the board. After she listed all the unsolved questions on the board, she started to solve them. Usually it was Ms. Brown who solved the questions. When she saw a question that was easy though, she asked a volunteer student to come and solve it on the board. She crossed out the questions that she solved from the list she created at the right side of the board. She might have used the same method in university.

Unlike Mr. Doe, Ms. Brown did not have classroom management techniques. During her lessons, the students seemed to be very bored. It was the last two hours of the day and students seemed tired during Ms. Brown lessons. This might be the reason for students' boredom. The teacher did not have technical problems since she did not use any technical equipment. So she did not lose time because of the technical problems.

Teachers and their views on the Enacted Curriculum. In this section the teachers' views on how they enact the intended curriculum and why they enacted in that way are discussed.

To begin with, the teachers were aware that what they did in the classroom is not what was expected in the intended curriculum. For instance, Mr. Doe summarized what they had usually done in the classroom as follows:

> It would be untrue if we claimed that we cover it to its full extent, because we certainly do all of it. Moreover, I said that I approve of the removal of question solving with heavy mathematical calculations but in 9th grade I continue to solve questions. (...) We tend to place more emphasis on application in examinations, because the questions we ask generally require reasoning, and require not numerical calculations but expressing the answer in terms of symbols. We too started using that method, but the student centered approach certainly cannot be applied

(From interview with Mr. Doe on 08.06.2012).

Mr. Doe was aware that they did not fully follow the intended curriculum. For example, he was aware that he should not go into mathematical calculations in 9th grade yet, he still solved questions that involve mathematical calculations. Mr. Doe purported that the only thing that was done according to the intended curriculum was the questions they asked in school examinations. He said that they asked questions which did not involve numerical problems but involved working with symbolic expressions. He added that the student centered approach of the curriculum could not be adapted.

Mr. Smith described what they were doing in the classroom as follows:

> Here is how I teach classes. I cover the topics in the old curriculum; I solve questions from the old curriculum that may be asked in the national examinations. In the remaining time, I teach according to the new curriculum. I do both, I do not want the student to suffer the consequences of the transition period. I try to use visual materials when I teach in accordance with the new curriculum. There are pre-made compacts discs; I use them so as to enrich the visual aspect when I teach (Form interview with Mr. Smith on 08.06.2012).

The teacher admitted that he taught the topics which had already been in the old curriculum with traditional methods, by solving questions for the national examinations, and he tried to teach the recently included topics with in a more modern way, such as by enriching with the visual materials. Mr. Smith might have thought that the recently included topics would not be asked in the national examinations; it appeared that he was right though.

Ms. Brown also summarized what they were doing in the classroom noting that nothing had changed except the sequence of topics: “The teaching techniques have not changed that much actually. We still teach the topic and solve questions like before. We do drill and practice, and etc. Nothing has changed, except the order of the topics”.

The common point that the teachers made about what they were doing in the

classroom was question solving. It is the most important and most frequent activity they did in the classroom. The importance of questions solving came from the emphasis on national examinations; this is discussed in Section 4.2.4.3. Another point that the teachers mentioned while talking about the enacted curriculum was how much and how deep they covered the topics included in the intended curriculum. The most important problem about covering the curriculum was the limited time provided for physics. The teachers complained that there were too many topics and too little time to cover the whole curriculum. It was the last units which were skimmed through or omitted because the teachers had no time to cover them. For instance, Mr. Doe was pleased that he almost covered all of the topics in 11th grade the curriculum while he was reviewing the year:

> It went very well with the 11th graders especially, we did very well. We did quite well even though it was my first time teaching the 11th grade. In the 11th grade, again if we had more class hours I could cover all the topics, like I could not get to the "stars and quasars" unit. There was a PowerPoint presentation where the students presented the general characteristics of stars, and the universe. I gave term homework to students, and deliberately chose more of them to be on those topics. That did not appeal to their attention since it was put off until after the examinations. So for these reasons, we should go faster.

Mr. Doe was content that he had covered almost all of the topics in the curriculum since he had four class hours per week instead of three. The "stars and quasars topic" was not comprehensively covered though, as Mr. Doe stated. The teacher assigned term homework to some of the students to present the topic in class. Yet, the topic was covered after the final examinations; the students did not pay much attention to what their friends presented. Mr. Doe asserted that he would try to cover this topic more comprehensively the following year. When asked how he could manage to do that, he said that he would try to reduce the number of lessons that were wasted because of free periods or when he let the students study for other examinations.

The teachers stated that they were trying to stick with the intended curriculum while covering the topics, yet there were some points which they spent more time on. Those topics were the ones the teachers predict that could produce national examina-

tion questions. Mr. Doe explains this situation as stated below:

> What do we cover more extensively? Ermm... Usually... I mean... We cover almost all of it, although of course we consider past exams when cut a topic short or cover it superficially. For instance, in photoelectric effect, there are two types of questions. There are usually two plots. And then there is the energy of light. We skip the other parts. I mean, we go a little faster. Or... For example there are power questions, questions asking the number of photons... We skim through them, because those have not been asked in the national examinations before. There is also the calculation of the wavelength corresponding to the maximum intensity in blackbody radiation. There is a plot and wavelength calculation, and a formula, I mean, no such question has appeared in the examinations. We did cover them, but we did not spend too much time. What has been asked in the LYS and OYS before, which topics have been emphasized? We too emphasize them. (From interview with Mr. Doe)

Mr. Doe admitted that there were some points which they were not focusing on much. He especially spent more time on the topics that were covered in the previous national examinations. He gave an example from the unit "Modern Physics". The teacher claimed that there were two specific question types that ÖSYM prepared about the unit Modern Physics. (An example for these question types can be seen in Section 4.1.1.2. One of those types was about the energy levels and the other type was about calculation of energy of a photon. He skimmed through the other topics such as blackbody radiation, Wien's Law, the wave property of particles because they had never been asked in the national examinations. The interesting point is that there was no national examination that had ever been conducted after the physics curriculum reform.

The teachers were not feeling confident while covering the recently included topics so they studied them when they would teach them in the classroom. Yet, according to Mr. Doe, the teachers, especially the old ones, were not very enthusiastic about spending time by studying physics. He said:

> "The reason that teachers do not change is that since there are new topics, they find it hard to sit down and study, it is difficult to learn that stuff after a certain age. It is really difficult. I am 36 years old. If I find it hard right now, I do not know, would I do as they did at 45-50?"

(From interview with Mr. Doe on 08.06.2012).

"The reason that teachers do not change is that since there are new topics, they find it hard to sit down and study, it is difficult to learn that stuff after a certain age. It is really difficult. I am 36 years old. If I find it hard right now, I do not know, would I do as they did at 45-50?" (From interview with Mr. Doe on 08.06.2012).

The Researcher: What do you think about student centered teaching?

Ms. Brown: That is what the students want. The students definitely like it a lot. Yet most of us physics teachers continue to teach in a teacher centered approach. Why? To easily teach how to solve puzzles. So that they are fast at solving puzzles. I for instance hand out papers at the end of the term and the end of the year for them to write down what they want, where they feel we fall short, etc. They write "We want to come up to the board, to solve the questions ourselves, we want you to step in when we get stuck, we want to make things more concrete by being in the laboratory." They want these, and we want to do that for their own good, though I am not sure how well that works out, but even though we try to do that we feel that it is a waste of time, and most of us think that, and so we run things the teacher centered way. (From interview with Mr. Smith on 08.06.2012).

Mr. Smith admits that his lessons were more teacher-centered than student-centered. He claimed that most of the physics teachers did the same by helping students solve as many questions as they can, by "teaching them how to solve puzzles". Although the students reported that they want to be more active during lessons, Mr. Smith stated that he could not do that for students' own sake. He probably thought that if he did not teach the students how to solve physics questions that might show up in the national examination, the students' future would be ruined.

Ms. Brown also mentioned that she tried to conduct classroom activities as written on the official textbook in the first two years of the curriculum but then she gave up:

The Researcher: The students mentioned some things, but how big a role did experiments play in your lessons?

Ms. Brown: We did not conduct any experiments.

The Researcher: The students mentioned a pendulum experiment in the 9th grade...

Ms. Brown: Oh, right, we had, with students in that term.

The Researcher: What was it like?

Ms. Brown: Well, I do not remember much, but yes we had done the activities in the book in the first units. The pendulum was among those, and the students had prepared the set up and brought it to class. We had asked questions as to whether the period would or not in class, we did that and apparently it stayed in their memory...

The Researcher: What did you think of it? Did it contribute to their learning?

Ms. Brown: Of course, if they remember it, and they say they remember it so obviously it has been helpful. It should be done of course, but these things require time, and not enough time is allotted to physics. We do not have the means to prepare experiments and do them with this much content. You spend 15-20 minutes for that experiments, and the only thing they learn from that is , say, that the period does not change with amplitude. This is what they learn, 20 minutes is too much time to teach just that. (Laughs) It would work if the number of class hours increased; there is a serious time shortage.

The Researcher: How much time would be sufficient, that you would say "OK, we can cover everything", maybe at least another hour every week...

Ms. Brown: Two hours for the 9th grade, two hours does it, there has to be two more hours. There have to be four hours, so that can also do experiments, because conducting experiments is no easy task, it is not something that you can show quickly and leave behind. You have to draw the students' attention, carry out the experiment, and then ask questions to improve their understanding, evaluations... You have to tidy up (laughs), these all take time. There have to be at least 4 hours outside of regular class hours so that you can do all that. You also have to choose the experiment carefully, and think is it worth it? There are experiments in the 9th grade textbooks for instance, and some are really not worth doing. The result is something that the students can understand even if you do not show them the experiment. There are such simple experiments. The experiments in the textbooks should be more instructive, they should be worth the time.

The Researcher: What made you decide to carry out the pendulum experiment?

Ms. Brown: Oh, that was a good one, it was appropriate for explaining the amplitude relation, it could be observed. I do not remember the details right now, since I did not teach 9th graders this year, we did not do anything like that. At the time it was appropriate. We had done other experiments as well, with the new curriculum I think, which year was that, the first one? (from interview with Ms. Brown on 08.06.2012)

When the researcher first asked Ms. Brown if they had conducted any classroom activities, such as experiments, the teacher claimed that she did not do such things. Then she remembered that she had tried to employ some of the activities written in the textbook in the first one or two years of the curriculum. She said that she wanted students to measure the period of a pendulum and demonstrated that the period of the pendulum did not change with the increase or decrease of the amplitude. The teacher conducted that activity since she thought that it would worth it. Ms. Brown also stated that conducting such activities was time-consuming and they did not have much time, especially in 9th grade. Moreover, she thought that some of the activities were so simple that the students could grasp the concept when the teacher told them without any demonstrations. Another important criteria while selecting the experiments was that the observability of the experiment. Mr. Doe also mentioned that while talking about the teaching approach of the physics curriculum.

During the interviews, Mr. Doe stated that the student-centered teaching approach of the physics curriculum could not be adapted in his physics lessons. When asked why, he presented various reasons:

This is already a hard to understand topic. For that reason, it is very time consuming to have the student study it alone or teach it in a student centered approach, two class hours are not enough, you have to finish the topic, these are the reasons. It is also the students' wish; they do not want to learn about it in depth. It is so because they are not used to it. These activities for instance, they are the predominantly featured in the new curriculum. Especially in the first two units of the 9th grade, since they were more qualitative, subjects like the nature of physics, the definition of physics. In the first unit of 10th grade there was matter and its properties; there was capillary action. We set out to carry out the activities when teaching these subjects,

> and we started, but we are having trouble doing them to be honest. I tried to demonstrate the experiment where water rises or falls because of capillary action, but these could not be observed. When the experiments do not work, the students make fun of them, and ask "Is this the lecture? Is this how physics lessons are?" When I started working here last year, I learned that my co-worker before me had done experiments in the classroom, and he was criticized by the parents with arguments like "How can you teach physics sitting down? Can you not solve questions on the board?". These are problems. Teaching differently when others all follow the same method is another problem. Everyone is afraid to transition to this kind of teaching. They do not want to take a step, or are hesitant to do so. Or they do not know. We do not know, this is the truth. When we say we do not know, we are talking about ourselves, we do not know. Since we do not know, we find it hard to learn. We are slowly getting there, we hold department meetings, we discuss how we should do this, or for instance someone does it and we learn from them, and this is how it goes forward.

As discussed in Section 4.1.1.3 Mr. Doe provided many reasons why they could not conduct classroom activities or experiments in his classes. The first reason was that physics was a tough discipline. Many students had difficulty in understanding physics. So with a very limited time helping students develop their own understandings of physics topics was almost impossible according to Mr. Doe. The teacher also alleged that students' dissatisfaction with the experiments was another reason for not conducting experiments in the classroom. It would be a problem for the teacher if the result of the experiment could not be observed as expected. He also asserted that parents also complained when the teachers did not leave time for preparation for national examinations. What other teachers did in the classroom was also another obstacle for students-centered lessons. Teachers might have felt pressure if his teaching strategies did not match with other physics teachers. Mr. Doe claimed that other teachers were afraid of changing their teaching approach. This might also be due to the fact that they were not confident with conducting experiments in the laboratory. The teacher stated that by sharing their experiences during the meeting with other teachers, they could overcome their fear with time.

4.2.4.3. The Teachers and the National Examinations. The characteristics of national examinations and their importance in students' lives were discussed in Section 4.2.2.1

In this section, the influence of national examinations on teachers hence, the enacted curriculum is discussed.

The teachers frequently stated that the primary goal of physics education in secondary school was preparation for national examinations. About this issue, Mr. Doe said: "No matter how much we have taken up the goal of imparting scientific literacy, the primary goal in high schools is LYS. Until this goes away, until the university entrance system is like this, it will continue." (From interview with Mr. Doe). All of the three teachers agreed that the students' only focus was the national examination. Mr. Smith mentioned this aim of the students and stated that the teachers could not focus on scientific literacy in schools:

> What is this student thinking? He is thinking of the university. I finished this first unit, what sort of questions will come from this unit? He is thinking, what is the examination going to be about? They are studying towards a university examination goal. You cannot say to him, "You can study for the examination later, come let us learn science." (From interview with Mr. Smith).

The teachers complained that the students were not interested in any topic that would not be asked in national examinations. For instance, Ms. Brown described how much the enacted curriculum was influenced by the national examinations with these words:

> It does have an effect in the 12th grade. In the 12th grade, they do not want to listen to the topics we teach the first term, because they are studying for the YGS and we are teaching LYS topics. They completely ignore LYS topics; they do not want to pay attention. We try to get them to listen, by repeatedly saying, you will not have to spare later because of YGS, you will need these too, and etc. In the other grades, we are forced to solve national examination type questions, and present the physics content accordingly, that is bad. Apart from that, the examination motivates students, they listen and pay attention because of the examination, that is good, but it is bad that we are forced to solve exam type questions. They also do this: if the question is likely to come up in the examinations, they pay attention, if not, they do not pay attention. They are reluctant to work on questions that involve long mathematical calculations, because those types of questions are not asked in the national examinations. (From interview

with Ms. Brown).

Ms. Brown stated that the students could be focused on one of the examinations so much that they ignore the other one. Ms. Brown talked about this interesting behavior of the students in order to show how much she felt difficulty covering the topics which might be covered in LYS. She also said that she had to solve questions the format of which resembled the ones asked in national examinations. On the other hand, she believed that the national examinations influence students by motivating them to study physics. She added that the students were only interested in the topics or questions that might be covered in the national examinations. For instance, they did not want to solve questions that involve heavy mathematical calculations predicting that such a question could not be asked in the national examinations.

Even though the teachers claimed that they were the students whose focus is the national examinations, the teachers periodically reminded the students that their primary aim was (or should be) the national examinations. For instance, in one of the classes of Mr. Smith, he said "your aim is to be placed in a prestigious school. Yet, if you don't solve many questions you can't get into in any program" (from field notes on 26.04.2012) to emphasize the importance of question solving.

When the researcher asked the teachers how much the intended curriculum and national examinations were in alignment, the teachers said that they were not in alignment so far. For instance, Mr. Doe complained that ÖSYM had not yet gotten used to the intended curriculum and stated that they were waiting for the LYS examination to see how much the examination would be in alignment with the intended curriculum. If the question formats of the national examination would not change, they would continue to teach according to the old curriculum:

> After all, ÖSYM operates under YÖK, not MEB. If they are not communicating well, or if they are inexperienced, they asked old style questions. YGS was like that. There were no questions that were not of the old style. You could have given this ten years ago, and it would have been the same, but it could change, and it certainly should change. Extreme topics were added to

> the curriculum, if they do not ask questions from these in the examinations, these topics will be skipped in schools after a while (from interview with Mr. Doe on 08.06.2012).

Mr. Doe was afraid that since ÖSYM operates under YÖK (Higher Education Council) and not MEB, the people who had prepared the questions might not even be aware that the secondary school physics curriculum has changed. Another possibility was that those people would not try to prepare an examination that would be in alignment with the current curriculum. Mr. Doe asserted that if the examination would not be in alignment with in the intended curriculum, the teachers would not cover the recently included topics after a few years.

During the interview Mr. Smith reminded what had happened during the period when the national examination covered only a part of the intended curriculum:

> Before ÖSS, there was information overload; students had problems dealing with it. There were complaints that it was too intense, and what they did in a certain period was that they narrowed everything down to ÖSS, but this time universities started to complain students would arrive too under-equipped, not knowing anything. It was almost that only the 9th grade portion of the curriculum was asked in the ÖSS. So teachers in high school did not teach most topics of the 10th and 11th grades. So what were we teaching? Things like pressure, etc., topics that were outside the curriculum. So after a while, the teachers forgot those topics, and the students went to university not knowing those topics, that was a problem. The physics portion of the examination is changing, and the teachers are finding it hard to predict what is going to be asked. (from interview with Mr. Smith on 08.06.2012)

Mr. Smith presented the example of the change of national examination system to illustrate how much those examinations affect the enacted curriculum. Since the ÖSS examination was not in alignment with the intended curriculum, the high school teachers started to cover only the topics which would be covered in ÖSS. After the students who were placed in higher education institutions with ÖSS, the professors realized that the students did not know the things that they should have learned in high school. During that time, the teachers had forgotten the topics in the intended curriculum since they taught students the topics that were covered only in ÖSS but

not the topics in intended curriculum.

The teachers stated that since the only goal of students was preparation for the national examinations, what and how they teach topics very much related to the national examinations. They were focusing on topics that might be covered in national examinations and skimmed through the points which the teachers thought that might not be asked in those examinations. For instance, while covering the topic modern physics in 10th grades, Mr. Doe especially focused on how to find gamma and how to use it to calculate the length contraction or time dilation. When he was sure that the students had understood how to do that, he said: "you have guaranteed one question in LYS". The teachers also stated that they would reshape their teaching after they saw the national examinations.

When asked Mr. Doe how he would teach if there were no examination, he replied:

> In that case, we would put more emphasis on variables, and teach what they depend on, rather than trying to solve different types of questions. We would try to do experiments as much as we could, but this still requires a long transition, it is hard for us to switch to that instantly. It is hard for man to accept change instantly, and change becomes harder especially after a certain age. So this change will be brought about by the new generation of teachers, and by people who are open to change and improvement. Even if you removed the examination, the teachers over the age of 40 would not change, but those younger than 40 and the new teachers who just graduated from university could bring about the change. (from interview with Mr. Doe)

Mr. Doe stated that he would talk about the variables to understand the nature of science and prefer to conduct many experiments in the classroom instead of solving questions. Yet, he said that even though there would no longer be national examination the teachers would not begin to include hands-on activities in their classrooms since changing the habits would be hard for people especially when they were over 40. This might mean that even though the teachers were blaming the national examinations, their teaching habits were also another obstacle for the curriculum to be implemented as intended.

4.2.4.4. The Teachers and the Textbooks. Textbooks were the main resources the teachers use at the research site. In Section 4.2.3. what kinds of textbooks were and were not being used in the classroom and how they were being used was discussed. In this section the teachers' views about the textbooks are presented in order to understand teachers' use of those textbooks.

As described in Section 4.2.3 the textbooks that the teachers and students had grouped into three: the official textbook, the classroom textbook, and other textbooks. First of all, the teachers' views about the official textbook are presented and after that their views on the classroom textbook and other textbooks are presented.

The teachers generally did not like the design of the official textbooks. Since the primary aim of physics education in high school was preparation for the national examinations, what was expected from a textbook was providing many questions in order to help students prepare for those examinations. The teachers stated that the official textbook did not provide many exemplary and practice questions for the students, so they did not prefer to use them in classroom:

> Mr. Smith: [The teacher picks up the textbook] Let us say, I am to teach the energy topic at the end of unit two. Here are the things I am supposed to cover regarding energy... They ask us to teach about energy in 9th grade, OK let us see, moving on moving on [turns the pages of the book], here, as far I understand they want us to cover energy conversions superficially. Look, we are asked to teach heat, light energy types, etc. [turns the pages] we will see the example questions and solutions, [continues to turn the pages] here we see nuclear energy, renewable or non-renewable energy sources, etc. superficial things like these, have you seen any calculations or formulae?
>
> The Researchers: Right, there are not calculations.
>
> Mr. Smith: Have you seen any examples?
>
> Mr. Smith: Oh look it is over, the unit is over. On to matter and its properties. This is energy. This is how we are supposed to cover it. Let us look at the examples. When we look at the examples, there are fill in the blank questions, true/false questions. There are questions

> that require students to express in their own words their interpretation. For example there is a question that asks the student to explain whether or not a force that is not parallel to the direction of motion does any work and why. There is another question that goes: Force times displacement equals work. The formula is there, but is there an angle between the force and the direction of motion involved? No. Is there an inclined plane? No. (from interview with Mr. Smith on 08.06.2012)

In this dialogue, Mr. Smith was looking at the energy unit of 9th grade official textbook to show the researcher the book did not involve exemplary or practice questions. Probably the teacher was not very satisfied with the depth of the textbook while covering the energy unit.

Besides the limited number of questions included in the official textbook, the teachers also complained about the official textbook's presentation of the subjects to the students. As described before, in the official textbook there were stories related to the topic in order to introduce the topic to the students. Mr. Smith thought that the students would only laugh at such a presentation:

> I sometimes force myself to teach according to the new curriculum. [Shows the official textbook] Here you see something like "Oh how lovely the rain is..." Believe me, the students laugh at these kinds of stories. [Laughs and turns the pages] There is another one like that, yes here it is, Naz, let us read the story of Naz: [reading from the book] "Naz is a hard-working, smart and curious student, and hence scores high in the SBS and is placed in a science high school, with ease. She spends her first year getting to know her school and her schoolmates. In her second year, Naz is in a familiar environment. She decides to learn tennis." It mentions some things about tennis rackets, and then says something about how the ball slows down and stops as it hits the racket: "The ball slows down and stops, and the part of the racket touching the ball deforms into a curved shape, and the ball leaves the racket with great speed. This excites Naz very much." This book could excite, but it indeed incites laughter. [Laughs] (from interview with Mr. Smith on 08.06.2012)

The teacher read one of the stories in the official textbooks written in order to introduce the students to force and motion unit. He sarcastically said that the story would excite the students. Mr. Smith said that the students will mock the teacher if

he hesitated to read them in the lecture.

Another characteristic of the official textbook criticized by the teachers was the classroom activities included in the book were not worth doing. For instance, Ms. Brown stated that some of the classroom activities were so simple for the students:

> You have to be careful with your choice of experiments. There are experiments in the 9th grade textbooks, but some are really not worth doing. It is something that the student can understand without doing the experiment. There are such simple experiments. The level of sophistication of the experiments should be more appropriate. They have to be experiments that should be worth your while. (From interview with Ms. Brown on 08.06.2012)

According to Ms. Brown, not all of the classroom activities were worth doing. Since the teacher had very limited time she had to pick up some of the activities which might be useful for the students.

Since the teachers did not find the level and questions of the textbook very satisfactory, they decided to use textbooks published by private institutions called "dershane". Those textbooks were designed not only for helping students for school but also for preparing them for the national examinations so they involve many questions as discussed in Section 4.2.3.3 Mr. Doe purported that "The other textbooks should not be underestimated in my opinion, they should be taken seriously. After all, among the questions they feature are ones that are very similar to YGS questions." So the textbooks prepared by dershanes were a useful guide for teachers and students to follow in the classroom. There were various textbooks of that kind and teachers usually preferred one of them and recommend that textbook to students. Two important criteria were expected for textbooks to meet: it had to be in alignment with the intended curriculum and the number and quality of the questions should be high. For instance, the classroom textbook determined by the teachers that year was chosen since it was in a good alignment with the intended curriculum. At the end of the year, they realized that both the teachers and the students were not very satisfied with the quality of questions of that textbook. So they started to use other sources to solve

questions in the classroom. Yet, the textbooks were covering different topics and the teachers got confused how much they should cover. Ms. Brown complained about this instability of the textbooks.

> It varies greatly, it still varies from textbook to textbook, and some of them cover certain parts of a topic in greater detail or extent. They may focus solely on that part, but the essence of the topic is something else. Some do not cover important aspects in sufficient depth; some cover those aspects in great extent. What they learn or do not learn from a textbook varies. We choose something that is in the middle, and go with it (laughs) (from interview with Ms. Brown on 08.06.2012)

It can be asked "why did the teachers rely on the official textbook and adjust how deep they would cover the subject according to official textbook?" Ms. Brown also stated that this was an important problem for the teacher since the students might encounter the topics they did not cover in school in other textbooks, or they might encounter with questions from topics that they did not cover in school in practice tests in dershanes. It would be difficult for the teacher when a student came and told the teacher that they could not solve the questions since they did not cover the topic related to it:

> We had a lot trouble at the beginning understanding where to cut things off in which grade. The other textbooks did not know exactly either, and neither did dershanes. Since we teach to prepare the students for the national examinations, we also consult practice textbooks apart from the official textbook, and we have to cover them too. We had problems discerning the boundaries of the content to be covered, because they vary from textbook to textbook. One textbook may include a topic, and the other does not. We do not follow those textbooks of course, but the students have dershane examinations, even district wide dershane examinations, those exams sometimes have questions that we may have not covered. So we have to cover a wide range, we had trouble figuring that out, there are no other problems. (From interview with Ms. Brown on 08.06.2012)

There was also another deficiency of other textbooks: since how the recently included topics would be covered in the national examinations was a mystery for everybody, the textbook writers did cover them in great detail. The questions related

to the recently included topics also were not very structured. Mr. Smith pointed this problem as below:

> We follow the curriculum when we teach a subject, whatever that might entail. Yet that is not how the students prepare for the national examinations. They are shaped by the other textbooks and practice tests in the market. The coverage of the new subjects in the other textbooks in the market is rather weak right now. That is because things are not clear yet. Why, how much? The topics are too deep, for instance "stars and quasars", there are many things in it. What could be asked, with which difficulty/depth? The book covers everything, it is very extensive (...) The MEB book features everything; there is a lot of detail. So, how are you to pull it off if you go into all the detail? Will it be enough if you just cover them superficially? I am not aware of many people who know enough about that. (from interview with Mr. Smith on 08.06.2012)

Mr. Smith stated that they were sticking to the curriculum but the students were influenced by other textbooks which might not be in alignment with the intended curriculum. Since the writers of the textbooks other than the official textbook could not know how the recently added topics would be covered in the national examinations, they skimmed through those topics like stars and quasars. The teacher possibly wanted to say that when the students saw the new topics were skimmed through by the textbooks which prepared them for national examinations, they might underestimate the depth of those topics.

In summary, the teachers did not like the design of the official textbook mainly because it did not include many questions related to preparation for the national examination. Yet, the unofficial primary goal of high school physics education was preparation for national examination and the textbooks should consider this goal according to teachers and also the students. Hence, the teachers preferred other textbooks which were designed to help students with the school and also with the national examination. In short, the teachers followed the curriculum from those textbooks believing that they were in alignment with the intended curriculum and believing that the questions in the national examination would resemble the ones in those textbooks.

4.2.4.5. The Teachers and the Students. In this section the teachers views about the students and the possible influence of students on the decision making process of the teachers are presented based on what the teachers said about their students.

About the general profile of the students, the teachers stated that their students were average compared to other schools in Istanbul. For instance, Mr. Doe stated that their average was between 50 and 60 when he had conducted a moderately hard examination. He also added that their students usually could not get all of the questions right in the national examinations. Mr. Smith also stated that about 80% of the students could enroll to a four-year program after graduating from high school. Ms. Brown also defined the students' level as "average". On the other hand, those students were top students in their class in elementary school. They were placed in this school on account of their SBS scores. Mr. Smith stated that the students in his school were smart but they did not have study habits so they fail in high school:

> These students here were among the top five from their respective schools. That is certain, the top five, they come here, and get their first low grade, because being smart was enough to get by, but being clever does not cut it in high school. High school requires studying and persistence (...) There are those who manage to pull themselves together, there are those who cannot. The students immediately start underperforming. Let me say this, it is sad, let us assume approximately 150 students are admitted to us, only ten students out of that, manage to get admitted to medicine, engineering ... but of course if we assume half of them are Turkish-Mathematics majors... Let us assume only 75 are science majors... I think only one percent of them are able to fully fulfill their goals. The others settle for what they can get (from interview with Mr. Smith on 08.06.0212).

Mr. Smith asserted that the students were the top ones in their elementary school. They usually fail in secondary school since they did not study regularly. He stated that even though the students were placed in a four-year program of the universities, those programs were not the ones that the students wanted the most, or ones their teachers appreciated the most.

From what the teachers said about their students, it is understood that they

cared about what their students thought. The teachers stated that what the student most cared about was the national examinations. So the enacted curriculum was mostly shaped by these examinations. The teachers worried that the students would think that their teacher did not put in enough effort to help them prepare for the examinations. This concern can be observed from the teachers' reflections on the intended curriculum and official textbook. For instance, Mr. Smith said:

> Think of a teacher, and a student. The teacher comes, teaches physics. Who is teaching what? If I taught this, the students would think "the teacher is keeping us busy". I mean, if I taught as the official textbook dictates, it might be good, but I don't know, I have reservations. The student would say "what on earth are you doing?" if I taught that. (from interview with Mr. Smith on 08.06.2012)

Mr. Smith stated that he was afraid of the students' reaction if he stuck to the intended curriculum and the official textbook. He thought that the students would think that the teacher was keeping them busy with useless stuff. A similar concern was voiced by Ms. Brown while discussing the inconsistencies between the intended curriculum and the textbooks other than the official one. She said:

> You cover a topic, and after it is done, a student comes up to you with an exam question and tells you that you did not cover it. You tell him/her that it is not part of the curriculum, but he/she wants to learn about it because it comes up in the dershane one way or the other." (From interview with Ms. Brown on 08.06.2012)

Mr. Doe also asserted that teachers cared what the students think about them. For instance, he stated that the teachers feel themselves uncomfortable in the classroom especially in the first years of their teaching. According to Mr. Doe, the fear of not knowing how to answer a question that a student asks was causing that feeling of discomfort. The teacher also stated that students' mocking the teacher when an experiment setup did not work caused teachers to hesitate to conduct demonstrations in the classroom.

To sum up, the teachers at the research site described the achievement level of

their students as "average". They thought that their students were smart but they did not study hard. They also showed some concerns about the students possible reactions' to what they had done in the classroom. Keeping in mind the teachers' lack of confidence regarding the new curriculum, their concerns over students' reactions may be influencing the enactment of the curriculum.

4.2.4.6. The Teachers and their Colleagues. At the research site, the teachers were constantly comparing their teaching with other teachers by following up what the other teachers did in the classroom. When asked teachers what they were doing in the classroom, they were always noting that that was also what the other teachers did or thought. For instance, Mr. Doe stated that when he compared his teaching with Ms. Brown he was relieved to see her doing the same things he did in the classroom:

> When we look at the 9th grade, I do not mean to criticize, but when I look at our friend who is doing a doctorate in physics education, the way she teaches, or the problem types she covers, not only do they have nothing to do with the new curriculum, but she is teaching in a way as if she does not want the students to understand. She supposedly is being trained in this, if she thinks like that, I think it is very normal for the rest of us to not change. If someone who is being educated by experts in this field is not doing anything different, it is normal for the rest of us or other teachers to fail to adapt to this fully. (From interview with Mr. Doe on 08.06.2012)

Mr. Doe thought that even though a teacher who was seeking a PhD degree in education were not applying what she had learned in graduate school, his resistance to change his teaching approach was very normal.

The teachers were also comparing their enacted curriculum with other schools as well. For example, Mr. Doe stated that if the other teachers or other schools were covering different topics, it would be a problem for them:

> The acceleration bit from the motion unit, I had mentioned earlier, I thought I would teach the acceleration topic first. There is only the definition of it, since accelerated motion is covered in the 10th grade. I asked my colleagues, they covered it. When I do not cover something and

> they do, or when I do cover something and they do not, that creates a problem for students. It creates a problem in common exams that they all take. So we understand, but we do not cover. (from interview with Mr. Doe on 08.06.2012)

Mr. Doe also asserted that what other teachers did was also an obstacle while trying to adapt the teaching approach of the intended curriculum. He said "When all the other teach the same way and you don't, it creates a problem. Or let me put it this way, everyone is afraid of transitioning into this kind of teaching".

Collaborative learning is a commonly employed teaching approach where the students collaborate in order to learn something by sharing what they know and what they experience by interacting with each other. While trying to implement the new curriculum, the teachers also use this strategy to learn the aspects of the intended curriculum. For instance, when the researcher asked Mr. Doe "What would you do when you had trouble with a topic in physics?" he answered:

> Mr. Doe: When I get stuck on something, we colleagues talk amongst each other, with Mr. Smith and sometimes with Ms. Brown (laughs) these subjects. We talk with our friends who teach at universities, when we have the chance, for instance I have this friend, sometimes I get the chance to talk to him, he teaches at a university. I generally ask him questions on the energy topic, because he works at an energy institute, but I always reach a solution.
>
> The Researcher: What or who do you consult first when you get stuck?
>
> Mr. Doe: I consult Mr. Smith in recess or if I can't, I check the book, and if I still can't get anywhere... For example, we had a bit of a problem with the blackbody topic... When I say problem, the textbook described light coming out of a hole, but not clearly enough. The description was not good enough to be clearly understood by a student, I mean it talks at great length, but it serves nothing but to confuse the student. We went ahead and asked our other friend to explain it to us, and I asked another friend about where to apply the radiation concept, you know the electron excitation in the structure of the atom topic, how and where it is applied. That friend of mine I mentioned, he said it is used in soil analysis, and I also learned from him that it is used in forensics to analyze and determine after death what a person had eaten, like maybe he ingested something poisonous. (From interview with Mr. Doe on 08.06.2012)

The teacher stated that he would first consult Mr. Smith or Ms. Brown when he had problem about physics. If he could not get satisfactory answer from the physics teachers in school, he used to consult his friends who were instructors in universities in the field of physics or physics education. For instance he learnt from one of his friends about the use spectroscopy in forensics or in agriculture and then share what he had learned with the students.

The teachers also learn from each other about the teaching approach. For instance, during the meetings of the physics teachers from the same district, the teachers had the chance to see the laboratories of different schools and see some demonstrations if they were lucky. But these moments were very rare so the teachers could not share their experiences thoroughly. During these same meetings the teachers not only share ideas, knowledge, and experiences but they also share instructional resources and materials with each other. For instance, Mr. Smith told that he shared the scanned version of the textbooks he had and then other teachers started to share what they had:

> I had this year's textbooks scanned. Mr. Doe and I shared them, we had the previous works too, about 7 GB worth of them, all scanned, we had in our possession all the important books in the market. It is convenient, for instance you are going to describe a generator, you project the book, how else am I supposed to do sketch a drawing of a generator. Why should I waste time? I show on the image when I explain how it works, and quickly get it over with. I told them that we have a collection of digitized books, copy them from my flash drive. I did this, and I saw that others came forward and shared what was in their possession. So a helpful community emerged, and I said ok let everyone dump the things they find interesting or useful in this, and let us all take advantage of them. We also shared phone numbers, we should be in touch, and interact. (from interview with Mr. Smith on 08.06.2012)

The teacher shared his moment of developing a positive interaction with teachers from other schools. When he started to share something, the other teachers also started to share what they had. By way of this sharing the teachers feel themselves more connected.

All in all, the teachers constantly compare their own teaching with other teachers. They stated that they felt comfortable if they knew that they did more or less the same thing with the others. Doing more was a problem as well as doing less. Moreover, the teachers were learning the intended curriculum by collaboration. They share ideas, experiences, and materials in order to improve their teaching.

4.2.5. The Students

4.2.5.1. Students and the Intended Curriculum. Considering that some of the teachers had not seen the curriculum or not had read it in detail, the probability that the students had seen or read the curriculum is very low. Since the students did not have direct access to the intended curriculum, what they know about the curriculum is based on what they hear from their teachers, read from their textbooks, or from their experiences inside the classroom; in other words, from the enacted curriculum. In this section, students' views about the current physics curriculum are presented mostly from the focus group interviews conducted with them. Since the students could not distinguish the differences between intended and enacted curriculum those views are classified by the researcher.

To begin with, the students' views about the aim of the physics education are intended to be presented. When the researcher asked the students "what is the main aim of the physics education in secondary school?" the students presented different aims. The primary given answer was "to prepare students for the national examinations". Fortunately it was not the only answer. Below is a debate between the students on the aims of the physics education:

> The Researcher: Why do you learn physics, for instance in 9th grade, why do you think they teach you these things?
>
> Student: For the examination.
>
> (They laugh)

Student 2: I had asked our mathematics teacher, he/she said we learn those things so that our minds are sharper.

Student 3: Exactly, those calculations and things in mathematics, they improve your intelligence.

Student 2: We could employ physics to, erm, like help us when measuring things.

Student 4: Actually to use in real life, for instance an electrical malfunction occurs in your home, to fix that.

Student 2: We learn about the resistance, but how many volts...

Student 4: Like in Atwood machines...

Student 2: Atwood machines could come in handy, or to judge how much weight is required to lift how heavy a load...

Student 5: I think to help us build machines, we even learn about electricity for that. (From focus group interview with 9-C).

In this excerpt, three main answers to the question "why do you learn physics?" were presented. The immediate answer was for national examinations. When the students gave a little more thought to the question, different answers were given such as "to improve our intelligence" or "to help our daily lives". Another quotation is given below, this time from a focus group interview with one of the 11th graders:

Student 1: You would never hear something like, in photoelectric effect oh look light shined on this and an electron was ejected from here, in public.

Student 2: What do we encounter in the ÖSS?

Student 1: No, it does come up in the exam, but I was giving that example because they mention scientific literacy. Other than that, these are all tools to improve our intelligence; I mean they sharpen practical skills, mathematical calculations and stuff.

The Researcher: So we actually learn about physics to sharpen our minds in high school?

Student 1: That is my opinion. That is what I have heard from teachers too, so that it improves our intelligence. I am not going to use these things except perhaps dynamics in real life, as long as I do not become an engineer, and even if I studied engineering I would not see dynamics at this simple a level. These calculations and stuff are there so that it sharpens our intelligence a little.

Student 3:To give us a little more perspective I think, for us to not look at things from only one perspective, that could be it.

The Researcher: What perspective could physics help you to observe from?

Student 3: How to put it? What kind of perspective? You could look at a lamp and just say it is a lamp, and then there is looking at a lamp and knowing that there are electrons there. You could calculate stuff, you have things you are curious about, we are human we are curious about things, and then there are those who just stand there, I do not know about them. So I think it is also to improve us as people. (From focus group interview with 11-B).

The discussion presented above started with one of the students' thoughts about some topics which were included in the curriculum for scientific literacy. Then the researcher asked if the other topics could not be given as scientific literacy. One of the students answered that photoelectric effect could not be a topic that could be discussed in a conversation between friends. This student might think that scientific literacy is for developing the conversations among friends. He thought that what they learn in physics courses cannot be for scientific literacy because he thought that some of the topics they learn were not the things they might encounter in their daily lives. Instead he thought that the topics that were included in the physics curriculum, especially the things that require calculations were for improving their intelligence. A similar opinion was also shared by a ninth grade student in the previous excerpt. These two students stated that this is what they heard from their teachers. The same student eliminated the choice of learning physics for preparation for higher education since he found the things they learned to be too simple for higher education. The only logical choice left for him was learning physics for developing the students' intelligence. Another student

stated that they learn physics in high school in order to gain different perspectives, to present students the necessary information to find answers to questions they wonder regarding physics they encounter in their daily lives.

Last but not least, another reason provided for the question "why do you learn physics in high school?" was to prepare students for higher education. One of the students claimed that her thought about the primary aim of physics education contradicts with her teachers':

> The general impression that the teachers here give us is that they feel "the grades you get are not important to us, what matters to us is that you develop a good understanding of the topic, and get good scores at the YGS and LYS." So I that leads me to think I am learning this just for YGS and LYS. Yet they have to teach me this: you are going to study for this occupation, you will get an education in university for this job and you have to learn the foundations here one way or the other. This is not stated, but rather I am led to believe that I am learning all these to get high scores in LYS and YGS, and that I am only learning these for LYS and YGS (from focus group interview with 10-C).

The student whose quotation was presented above stated according to her teachers' the primary aim of physics education was preparing them for the national examination. The teachers' statements approved the students' opinion. According to the student, instead of preparing students for national examinations, the real aim of the physics education is preparing students for their higher education and for their career.

The students also share their views on the topics covered in the intended curriculum. As explained in Section 4.1.1.2., the students classified the questions they solve as qualitative and quantitative. They also use the same classification for the topics covered in the intended curriculum. They call the topics that do not require many formulas and questions that require complicated calculations as "qualitative". Popular examples for those topics came from the units "the nature of physics", "modern physics", "from stars to quasars", "waves" and so on. On contrary the students call the topics that involve many formulas, and questions that require complicated calculations as "quantitative". Some of those units are "force and motion", "electricity

and magnetism", "matter and its properties" and so on. Some examples from students statements about the distinction between qualitative and quantitative topics are presented as below:

> Student 1: The "waves" topic is qualitative.
>
> The Researcher: What does qualitative mean? You keep saying qualitative amongst yourselves.
>
> Student 1: It does not require many calculations. It can be solved without complex reasoning.
>
> Student 2: For instance the teacher at the board...
>
> Student 1: There are three or four concepts, when we develop a good understanding of those concepts, the questions are easily solved, even when they are calculation heavy. They are questions that do not require heavy reasoning. (From focus group interview with 11-B).

In this excerpt, the student presented waves as an example for a qualitative topic. When asked what qualitative topic mean he explained that topics that involve less calculations are qualitative topics. The questions of that topic were not very complicated and can easily be solved.

> Student 2: Qualitative things, like the Bohr atom model.
>
> Student 3: Those that do not require mathematical calculations.
>
> Student 1: Modern physics.
>
> Student 4: Modern physics. We have done calculations up to now, we are used to calculations. These have rules....
>
> Student 1: You have to memorize.
>
> Student 4: For instance the first orbit has a rule, the second or third orbits for instance, they have rules and it is more memorization than anything. In the other one, we at least learned how to derive them. For instance in magnetism, if you listened at the beginning of the subject, you

could understand how to derive it, but that is not the case with the atom unit. So a statement is given, and then in the next topic we learn something that is the exact opposite of that.

Student 1: Photoelectric effect is like that, that wavelength and stuff, it was all memorization, there were graphics for instance. (from focus group interview with 11-E).

As can be inferred from what students said, the qualitative topics were the ones that the students feel they have to memorize. One of the students stated that even if the qualitative topics have formulas and calculations, they did not know where the formula comes from, so they simply memorize it. In quantitative topics, however, students do not memorize the formulas because they know where they come from.

The students think that the teachers have to focus on quantitative topics since they think they can understand qualitative topics by studying on their own and they cannot understand the quantitative topics if the teacher does not teach them. They also think that qualitative topics were included in the curriculum to help students develop scientific literacy and they would not encounter questions from those topics. Hence, the students think that qualitative topics are not worth learning in school since they predict the qualitative topics will not be asked in the national examination and even if they were asked they can study them on their own. For instance, one of the students stated that it would be better if those topics can be included in the second semester of the 12th grade:

The Researcher: So what do you think of those qualitative topics? Do you think they are easily understood? Or...

Student 1: I think they are very unnecessary.

Student 2: Exactly, I think they are very unnecessary.

Student 3: Those are the topics that should not be covered at length.

Student 4: I think they could be taught as scientific literacy.

Student 3: If it were up to me, I would have them taught in the second term of 12th grade, so that the students could have a lighter load.

Student 2: No one comes to school; let them go home and study there.

Student 3: The 12th school curriculum is heavy, with regards to biology, mathematics, and physics. They cover optics for three to four months I think, I do not know exactly, but I would move those subjects to the second term. I would lighten the 12th grade curriculum, so that students could study for the 9th, 10th and 11th grade topics they have problems with. The qualitative topics are very easy, for instance we are doing the stars and quasars topic...

The Researcher: So you are saying you should not cover these at school?

Student 3: Well... yes we should not...

Student 5: We can tackle them by studying them on our own; we should not lose class hours.

Student 1: It is very unnecessary.(From focus group interview with 11-B)

Almost all of the students in this focus group agreed that the topics such as nature of physics, modern physics, stars and quasars which they call qualitative topics are unnecessary and time consuming. One of the students suggested that these topics could be presented for scientific literacy which means that they do not want to be responsible for these topics in school examinations. Another student, as mentioned before, suggested that the curriculum makers should replace these units by covering them in the second semester of the last year. In 12th grade, the students did not come to school, they have permission of not coming for 45 work days, they prefer going to dershanes or staying at home to study. However, the curriculum designers did not take into consideration the absence of the 12th grade students and pretend that they would come to school until the end of the second semester. Since the students think that the qualitative topics are not worth learning in school, they suggest placing them at the second semester of the 12th grade. By doing so, in school, the students would have more time for more important topics which they cannot understand by studying on their own.

As mentioned in the section "The Intended Curriculum", the intended curriculum has a spiral structure which means a specific topic is covered in all four grades but with different depths. Even if the students know the exact name of this characteristic of the intended curriculum, they are aware they see the name of specific units over and over again in every year. The students were not very content with the spiral structure of the intended curriculum:

> Student 1: There are so many topics. If there were only four topics in one year, and each topics were to be taught at depth, we could understand them, but this way there are too many topics and it gets confusing.
>
> Student 2: There are too many topics in the 11th grade.
>
> Student 1: In foreign countries, do they? I heard they teach everything including the derivations, I think that is the way it should be, I think that tis why they are more successful.
>
> Student 3: For example the "waves" topic, in both 9th and 10th grades, it becomes cluttered I think.
>
> Student 4: We cannot make it to that topic; we are not going to be able to cover it.
>
> Student 3: We covered sound, it is always the "waves" topic. It is the same with other courses, there are too many topics, and not all can be covered in time, and half of them do not even come up in the examinations.
>
> Student 5: We learned part of modern physics last year, and will learn about another part this year, another part the next year, but we cannot remember them. Most of us do not remember the formulae from last year, since it is a qualitative topic...
>
> Student 4: They assume we remember and try to build on that.
>
> Student 7: For instance I cannot remember anything from last year, I want to learn it again this year, let him teach like that, but that does not happen.
>
> (...)

Student: If they confined modern physics to one year and if it were taught properly that year, it would be a lot better for us I think. (from focus group interview with 11-E)

The students stated that they did not remember what they had learned the year before. This might show that the students actually did not understand the physical phenomena under discussion. Some of them had not listened to their teacher where some of them did not remember the formulas they memorized even if they were convinced that they had learned the subject. Hence, they had difficulty understanding the topics of the current grade unless their teacher had reviewed what they had learned the previous year. The students also stated that by not focusing on the topics deeply, they had to focus on different topics at the same time while studying their exams. They felt that they did not learn the topic comprehensively.

The students were also aware that the teaching approach of the intended curriculum had changed with the current education reform. They knew that the new approach was student centered instead of teacher centered but they also thought that their teacher could not adapt student-centered approach which will be discussed in the next section titled "students and the enacted curriculum".

4.2.5.2. Students and the Enacted Curriculum. The enacted curriculum is described in detail in Section 4.1. In this section, the students' views about the curriculum enacted in the classroom are discussed.

Some of the students think that they cannot understand physics because it is very difficult and sometimes very abstract. Because of their prejudice about physics, they fear that they will not understand it in the future so they get bored and quickly distracted. One of the students shared her feelings as she was going to her physics class:

Student 1: We do not fear the teacher, but the subject of physics.

The Researcher: Oh, so it does not matter if this or that teacher teaches it.

Student 1: Yes. When I am going up to the laboratory, I feel: "Ugh, it is the physics class again, I am going to be bored" or "I am not going to understand anything".

Student 2: Or "I am going to sleep". (from focus group interview with 10-C)

One of the students stated that they have an aversion towards physics. The student fears that she will not listen because she will get bored, even if she manages to listen she cannot understand what the teacher is trying to teach.

When the researcher asked students how they would teach physics if they were teachers, they persistently claimed that they would not project the scanned textbook onto the board. The students also stated that they would understand physics more easily if they could conduct experiments. They were also complaining about the teacher-centered approach of their teachers:

Student 1: The student is not active at all in this school. The teacher writes on the board, the teacher solves.

The Researcher: I am not talking about solving questions; you conduct the experiments and collect data yourselves.

Student 2: The teacher does that too.

Student 3: We do not do that either.

Student 4: The teacher carries out the experiments.

Student 5: Since there is no experiment, there are no data.

The Researcher: What about in elementary school, did you not do the experiments yourselves?

Student 5: No, we did do them in elementary school.

Student 6: In general, they say "This is from now on student centered" but it is not, not much

is expected of us. The only expectation of us is for us to solve tests, read books and study. There are no experiments or team work that we are expected to carry out. Maybe in chemistry, but as I said more is expected of us but all that consists of is pasting them on cardboard, no student thinks let me do an experiment let me research something. Maybe it is because of students, there is no investigative initiative.

Student 5: Maybe it is because of time constraints that these do not happen.

The Researcher: When you say time, do you mean you have too few class hours?

Student 5: We have three class hours, but that is still not enough to fully understand the experiment.

Student 2: It has nothing to do with that, in mathematics we have a pretty solid curriculum, but this year we are about to finish all the subjects.

Student 6: Other schools offer two class hours while we have three, so we have time. We could do it if we wanted actually, but we do not. (From focus group interview with 10-B).

In this excerpt, Student 1 claimed that the students in his school were not very active learners. The teacher was still at the center. This was also what the researcher observed during classroom observations. Since almost the only thing that they were doing in the classroom was question solving, the student said "it is the teacher who writes on the board and solves". They did not conduct any experiments, even if there were some experiments presented in the classroom, it was the teacher who conducted and demonstrated it. However, the students were aware that the focus of learning shifted from teacher to student which means students have to be active learners in the classroom. They agreed that they were not active learners during physics courses. They also thought that they were more active at elementary school; at least they were conducting experiments on their own and sometimes gathering data. Student 6 stated that in modern education the education should be student centered, yet in reality, students were expected to "solve questions, read books, and study" in a passive manner. Attempts were made to make students more active by assigning projects to students yet those projects were composed of mere text and pictures printed out and

pasted onto a piece of cardboard. The student also stated that the passive role of the students may also result from the students' approach to education claiming that the students were not very enthusiastic about conducting research on something they were curious about. Student 5 asserted that lack of time could be an explanation for the teacher-centered approach. Since they have not sufficient time to conduct experiments and help students develop conceptual understanding, the teachers prefer a faster way to teach physics. However, another student stated that they have three hours per week and that it should be enough to conduct experiments, considering how some other schools have just two hours per week for physics lessons.

Time management was presented as an important problem for physics courses. Even if the school administration increased the number of class hours per week by offering selective courses such as advance physics, the students stated that they passed on the topics very quickly so they could not understand the topics well. Even if the teacher went so fast by making explanations and solving problems quickly and by conducting very little number of demonstrations and activities they could not cover all the topics in the curriculum until the end of the school year. For instance they had to cover the last unit called "waves" very quickly since the teacher had no time or since most of the students did not come to school after final examinations, they did not learn about stars and quasars in 11th grade.

The students are affected much more by the enacted curriculum than they affect the enacted curriculum. The other agents play a more important role in the shaping of the enacted curriculum.

4.2.5.3. Students and the National Examinations. In a country where hundreds of thousands of students are graduating from high school, providing higher education options for the students who want to continue their education to find a job is a hard task to manage. Last year, approximately two million students applied to YGS where total number of students enrolled to a program in 2012 was less than 900,000. This means more than half of the students could not continue their education whenever they

want which makes enrollment to a higher education institution highly competitive. So students put a lot of emphasis on national examinations because of the high influence it has on the students' futures. Being enrolled in a prestigious major of a prestigious school increase the students' eligibility for a prestigious job which means making more money and live in prosperity. This is the most important thing for students' parents as well as students:

> The Researcher: Who among you wants to choose a science major at high school?
>
> (All hands go up)
>
> Student: I am good at verbal/qualitative courses, but my parents push me a little towards the science major.
>
> Student: Actually I too want to choose Turkish-Mathematics too, but ...
>
> Student: I personally have to choose science-mathematics, because that is what the university major my family pressures me to study requires. They pushed for medicine; I tried really hard and convinced them to let me study mechanical engineering.
>
> Student: The mechanical engineering department admits with very high scores. There aren't many jobs I heard. (Focus group interview with 9-C).

The students in this focus group were in ninth grade yet they had already decided what they would do the future. According to what students said about choosing a profession, parents play an important role in the decision making process. They want their children to get a well-paid job. One of the students said that she hardly convinced her mother for mechanical engineering for her future career whilst her mother really wanted her to be medical doctor. In higher grades the students confessed that they choose science major because they have to do well in science in the national examination to get the education they need to work in the profession they like.

> The Researcher: So imagine you have physics lessons, but no university examinations, I mean imagine there is nothing you are responsible for. What would you truly want to learn?

Student: I would switch courses. History, literature, Turkish, English, those would be my choices.

Student: I would study those to learn them really well, but I would study for the physics, chemistry and biology courses just to pass.

The Researcher: So why did you choose to the science major?

Student: I will be tested on science in the examinations, so I have to learn this.

The Researcher: But if you had chosen the literature major, or language major, they would not have done that.

Student: I want to study medicine, so I have to choose the science major. So the system pushes it on us, I am not too thrilled about learning physics, chemistry, biology and mathematics.

Student: Me too, I am not too excited about them, I mean, I never feel "Oh let me solve a chemistry test".

The Researcher: So have all of you chosen the science major voluntarily? Or what has been effective in your choice?

Student: I chose it because I have to, to study the thing I want.

Student: What are we going to choose if not the science major?

Student: Yes, he is right.

The Researcher: Why? There are language majors, Turkish-Mathematics...

Student: There is language, Turkish-Mathematics, but ...

Student: I did not choose a language major because I do not want to become an English teacher.

Student: Me too, personally I do not want to study Translation and Interpreting.

Student: I did not choose a language major because language related jobs are not my preference.

Student: Me too.

The Researcher: Because of occupational preferences.

Student: Yes.

Student: We chose an occupation first, and then chose the major depending on that. We did not choose our jobs to fit the majors we had chosen.

Student: That defined it well.

The Researcher: So do you think you will be able to be admitted to the program that you want?

Student: I hope so. (from focus group interview with 11-B)

When the professions that the students like and the courses that students like are compared it is interesting to see that the students did not want to acquire the knowledge or skills they need to do the profession they like. This might show that while deciding what to do in the future, some factors other than the interest of the students influence their decision. Those factors might be their parents, friends, teachers, or the people they admire, but not their skills or interest.

Due to the pressure on the students to get a well-paid prestigious job, and hence to score high in national examinations, the focus of secondary school education inevitably becomes the preparation of students for national examinations. Usually starting from the 11th grade (sometimes from the 9th grade), students enroll in educational institutions called "dershanes", the primary aim of which is preparing students for the national examinations. In lower grades, they also provide support for students on their schoolwork in order to attract more students. Since these are private institutions, the parents have to set aside money from their budget for national examination prepara-

tion. Almost all of the students go to dershanes in 12th grade. Other students who are in lower grades go to dershanes not only for preparation but also for getting help with schoolwork:

> The Researcher: How much do the examinations affect you? The ÖSS exam? You recently took the SBS...
>
> Student 1: We do not care at all, we are not doing anything.
>
> (...)
>
> The Researcher: So when are you thinking of starting to study for the examinations?
>
> Student 3: At the end of 10th grade.
>
> Student 4: Me too.
>
> The Researcher: At the end of 10th grade... You are going to dershane though, why are you going to dershane at this grade?
>
> Student 5: To help with schoolwork and school examinations. It is over now anyway.
>
> The Researcher: So you attend dershane so that it helps with your courses, more so than helping you prepare for national examinations? Do the lessons at school not suffice? What kind of, or how much of a difference or contribution do dershanes have towards your schoolwork?
>
> Student 3: It serves as reviewing.
>
> Student 5: It depends on the course, if the teacher cannot teach articulately, you can understand the topic at the dershane, because not all teachers teach at the same level, or we cannot understand them, so dershane contributes.
>
> Student 2: I normally never go over any courses or topics, when I come home I just toss my bag aside. In the 8th grade, when we were attending dershane, we were reviewing, and that helped us remember. (from focus group interview with 9-C).

When the researcher asked 9th grade students when they would begin to prepare for the national examinations that they would enter three years later, about which students had expressed a lack of concern, they said they would begin to prepare in the second semester of the 10th grade. Even though they do not care the national examination, some of the students prefer going to dershanes. They claimed that it would help with their schoolwork. Probably they felt themselves comfortable by going to dershanes since knowing that they would understand the topic in dershanes if they could not understand it in school was preventing them from panic. Another student stated that going to a dershane help him make reviews of what he had learned in school. He could do it himself but probably he had little auto-control and someone had to force him to study. Another student who was going to a dershane in 11th grade stated that he was going to dershane since he wanted to build a strong background for national examination so that in 12th grade he would not feel difficulty while trying to review whole four years.

The Researcher: You are going to cover everything in dershane next year, then why did you go to dershane this year?

Student 1: We will be covering everything next year, but we will be doing it quickly.

Student 2: It will be covered just enough to help us solve questions.

Student 1: They are not going to spend as much time as they do right now on topics, and the teachers are outright saying this to us. For instance there are topics that take a month to cover, maybe I am exaggerating when I say month, but for instance trigonometry is a very broad topic.

Student 2: It took about four class hours.

Student 1: Yes, I mean, it is very hard for someone who does not know anything.

Student 3: It takes one a lot of time to learn a topic from scratch. When you look at it, there are 31-32 topics in physics, 17-18 in LYS mathematics, 21-22 in YGS mathematics. If you wanted to learn all of these from scratch, you would have to spend two years. One should lay

foundations in the 10th and 11th grades. (from focus group interview with 11-B).

The students in this focus group interview talked in a way that they had not learned anything at school but they would learn everything in the dershanes. One might think that the students might be talking about practicing for examinations yet their teachers' primary aim was preparing students for national examinations as dershanes do. They allocate most of their time solving questions to show students different question types they would encounter in the national examinations. It seems that the students did not agree with their teachers.

The students were focused on national examinations so much that they could not bear to learn anything that would not be asked in the national examinations. For instance, some of the students stated that they did not want to conduct experiments in the classroom if they would not ask questions related to experiments in the national examinations.

Student 1: What is our education system built on? The YGS and LYS exams we are to take the last year. If there will be questions in YGS and LYS about the experiments, then let them show us experiments. If there won't be questions from them, then I feel "How will experiments help me?". Most people probably feel that way.

Student 2: I think experiments would help us understand the topic, and hence help us solve questions.

Student 3: Let us consider biology for instance. Biology questions require memorization; they say biology requires a lot of memorization. Biology is a quantitative course too, the essence of biology is experimentation, and the interpretation questions that come from biology in the national examinations are all about experiments. If we were to do experiments in a course like biology, that would be helpful. Such topics exist in physics too, there were no questions this year, but there may be next year. So if we did experiments that may be asked about in the national examinations, it would certainly be helpful, because for instance when we encounter interpretation questions in biology, no one can get them right because we do not know anything about experiments. If we had done a few experiments and were able to interpret them, it could be more lasting. (From focus group interview with 10-B).

In this excerpt, Student1 thinks that they do not need to conduct any experiments if they would not ask any related questions. Student 2 do not think that conducting experiments only help them while solving questions that involve experiments, he also thinks that this helps them solve questions which were not about experimenting. Student 3 gave example from biology. In biology questions on experiments were asked frequently previous years and the student thinks that especially in Biology they need to do experiments in order to solve those questions. If the format of the physics questions in the national examinations resemble that of Biology questions students would want to conduct experiments much more willingly.

In summary, national examinations have a great importance in students' lives so the main aim of physics education according to students was preparing for the national examinations. They went to dershanes in order to build a strong background and to practice more. They did not want to learn any topics or conduct experiments if those things would not help them increase the number of questions that they answered correctly in the national examinations.

4.2.5.4. Students and the Textbooks. As explained in the section "Textbooks", there were mainly three kinds of textbooks that the students and the teachers may use: classroom textbook, other textbooks, and official textbook. The textbook that the students used the most was the classroom textbook which was recommended by their teachers to study. On the other hand, the students have other textbooks at home. The students also have the official textbook which has not been seen being used by any student. In this section the students' views on the three textbook types are discussed.

Generally, the students did not like the classroom textbook much. They thought that the classroom textbook fail to cover different question types that the students might face in the national examination. This is what they usually complained about their physics teachers: the teachers did not show various kinds of questions, they just show how to solve application questions (see Section 4.1.1.2.). They thought that other textbooks which were prepared in a similar format with their classroom textbook

involve many different types of questions like questions that assess analysis skills as well as questions that assess comprehension and application skills and knowledge:

> Student 1: In the text book, most questions hinge on application of formulas. The formulas are not important, the logic behind them is important; we will forget the formulas in two or three years. In schools we are taught formula application, since we will be taking the national examination, like the formula is like this, you can apply it here, etc. There are many so many question types. Then sometimes, we fail to do well in school exams.
>
> Student 2: In LYS physics, especially with the physics topics this year, you definitely get the question right if you know the formulae, but you definitely fail to get the answer if you do not. The questions are based solely on memorization and formulae, there is no interpretation involved.
>
> Student 3: And that is true here in this school, but not outside. For instance, other textbooks in general feature interpretation questions. That is true for all courses, including physics, but we learn in school is memorization based, if you know the formula you get it right, if you do not, you fail to get it right, and we will forget all of it next year.
>
> Student 4: We are given questions where we only have to use the formulae, we do not spend much time on interpretation questions, I mean, we do not solve different questions. (from focus group interview with 11-C)

The students were complaining that the questions they solve in the classroom merely consist of application. If they know which formula they use, they easily find the right answer. These were the type of questions the students thought their classroom textbook mostly had. So the students preferred to study both for school examinations and national examinations from other textbooks which covered different kinds of questions.

The students did not mention very much about the official textbook. Only once, when the researcher asked about their views on the experiments a student stated that he examined the official textbook and there were nothing but experiments in that book:

> The Researcher: But the government pays for your books actually, the official textbooks?

Student 3: Those books have nothing in them.

Student 4: I examined the book once, it has too many experiments.

Student 3: The necessary materials are not there.

Student 4: We need materials to conduct those experiments. Further, two class hours does not suffice. Should we do the experiments, or try to grasp the topics?

Student 3: Exactly.

Student 4: There should be 6 class hours. (From focus group interview with 11-B)

He was complaining about the official textbook involving too many experiments. According to the student the official textbook have nothing but experiments. As his physics teacher he stated that they did not have materials to conduct those experiments. They did not believe that their school would provide the materials needed to conduct the simple experiments presented on their official textbook. He added that even if they have sufficient materials they did not have sufficient time for conducting those experiments. They said that the physics courses should be six class hours per week instead of four.

In summary, since the students were very focused on the national examinations they expected their textbook to be useful for preparation for those examinations. They wanted their textbooks involve tremendous numbers of questions and want those questions be in various kinds of format.

4.2.5.5. Students and the Teachers. In the research site there were not any serious conflict between the students and the teachers observed since the students were usually raised to be obedient and respectful to their teachers. Yet, while discussing the enacted curriculum during focus group interviews, the students mention some points they want their teachers to change. In this section, the students' general views about

their teachers and the definition of o good teacher described by the students will be discussed. First, teachers' expectations from students according to students will be presented. Then, what students did and did not expect from their teachers will be discussed.

According to the students their physics teachers' primary aim was preparing students for national examinations. So they want them to solve as many questions as they can from physics. For instance, one of the 10th grade students claimed that their teachers said "The general impression that the teachers here give us is that they feel "the grades you get are not important to us, what matters to us is that you develop a good understanding of the topic, and get good scores at the YGS and LYS." ". Another student stated that what they were expected was consisted of solving questions and reading books but not designing experiments and conducting research. As discussed before, during interviews, the teachers did not deny that their primary aim was preparing students for the national examinations. This was also what had been observed during classroom observations.

About what the teachers did in the classroom, the students sometimes criticize but sometimes admit that they were right for some reasons. First of all the students stated that expecting everything from their teachers would be a mistake. One of the students said that "we cannot blame the teachers for our failure. If the student does not work, it is very normal to fail". The students also did not think that the teacher has to know everything related to physics. Especially about the recently added topics in the intended curriculum, it was normal for the teacher not to know the topic comprehensively. For instance, one of the students from 10th grades said that:

> I am under the impression that the teacher would not be able to explain certain topics without brushing up first, if he has not taught it in years. A new curriculum comes along, the topics to be covered are outlined, and he does not step outside that boundary. Yet he is human, he forgets after a while, no one can remember everything. (from focus group interview with 10-C)

This student thought that their teachers who teach the same things for years

would eventually forgot what they had learned in university. She found it normal that the teacher cannot explain a situation if it was not from the curriculum. On the other hand, from time to time, students mock the teacher when he cannot provide satisfactory answers to students' questions. A similar situation occurred in one of the 11th grades:

> It was Mr. Doe's class for 11th grades and the topic was sound waves. Mr. Doe was trying to explain the conditions needed for echo to be occurred.
>
> Mr. Doe: in order for echo to occur there should be 17m distance between the sound source and the surface where the sound wave was reflected from.
>
> Student: Teacher, why there has to be 17 meters for echo to occur? It can also happen in a small, empty room?
>
> Mr. Doe: There has to be 17m OK? The book says so, not me.
>
> Student: Does the intensity of echo increase with increased distance?
>
> Mr. Doe: I do not know in that much detail. That much detail is an engineer's concern.
>
> Student: Teacher haven't you learned these in university? Is this topic one of the recently added topics?
>
> Mr. Doe: Yes.
>
> The class started to laugh (from field notes of 10.05.2012).

In order to give an example for reflection of sound, the classroom textbook gave the example of echo and reverberation. It was written in the textbook that in order for echo to occur, there would need to be a 17m distance from the sound source and the surface where the sound is reflected from. The textbook also mentioned reverberation which is the reflection of sound from a surface when the sound source cannot distinguish her sound which is usually occurs when the source of sound is in a room. This detail was

not mentioned neither in the intended curriculum nor the official textbook. Probably the teacher did not hear any information like that before if he had not read the textbook. When one of the students asked a reasonable question ", why there has to be 17 meters for echo to occur? It can also happen in a small, empty room?" Since the teacher did not know the answer, he admitted it. He said it was written on the book. This might show the level of teachers' dependence on the textbook. Then another question about the same topic was posed by one of the students and again the teacher said he did not know in that great detail. Another student asked the teacher if they had not learned it in college and if these topics were from the recently added ones and the teacher said "yes". This might be a genuine question while it might also be asked purposefully to mock the teacher since he did not know the answer to the question which had been explained even in the textbook. Even the students stated that they did not expect their teachers to know everything; they probably expected them to at least read the book once. This example also shows how unprepared the teachers were. He did not even read the textbook once and asked himself the question that the first student had asked.

Whilst the students do not expect their teachers to know everything about physics, they probably expect them to look up the things that he could not answer. For instance one of the students in the 10th grade recounted a memory of hers with her teacher:

> Student: For example, I got stuck when solving a problem and Mr. Doe too was unsure, but I know Mr. Doe went ahead and looked it up and I too looked it up. That is how we managed to solve it.
>
> The Researcher: What was it about?
>
> Student: It was about electrostatic induction, I had a different approach. The object was both grounded, and was affected by induction. We got stuck, I do not recall clearly, but the teacher and I were both unsure. That is why I feel it is wrong to assume teachers know everything, because they are indeed human and may forget. (From focus group interview with 10-C)

As can be understood from the quotation, the students appreciate their teachers' effort to research if they did not answer any questions that the students ask. It was not very important if they did not answer the question at the first hand. On the other hand, they believed their teacher knows the topic well especially if it was also included in the old curriculum. They also thought that since the teachers know the topics well they move on to another one very quickly, not realizing that the students could not internalize the topic not as fast as themselves. The students mentioned the same problem in different focus groups and in different grades. In one of those focus group interviews, a group of students also stated that since their previous teacher (Ms. Brown) was also working in university as a part-time physics instructor, she moved on very quickly, not letting the students comprehend what she was talking about:

> Student 1: I did not like my teacher at all, last year. We did not like physics, so last year was bad.
>
> Student 2: It depends a lot on the teacher.
>
> Student 3: Our teacher was also a university instructor; we went a little fast, since she teaches that way at the university. My grade the first term was one, I got a five the next term. I managed to keep up after a while; many students could not keep up with the teacher. (. . .)
>
> Student 3: She went too fast when she was teaching, and when she ran out of space on the board, she quickly erased other things. Since she was also a university instructor, she taught three days a week at the university, and two days at our school. (From focus group interview with 11-E).

The students thought that they had not understood the physics topics in 10th grade since their teacher could not adjust her speed while lecturing according to the students' level. She pretended she was in one of the classrooms she was teaching in university. So according to the students, they could not learn as fast as their teacher thought. This also lead students not like the teacher and physics either.

The students also thought that the teachers were too accustomed to the old-

fashioned teaching approach. They were aware that breaking-up old habits was a hard thing to accomplish. Below there was a quote of a student who was thinking in that way:

> Student 1: For instance, Mr. Smith told us at the beginning of this year that they had gone to a university and that they had been told there to teach like this and that. I mean, there are some things in theory, but there is nothing to show for it in practice. We are not doing any activities. We may be using the projector, but we are trying to understand something that we cannot visualize or see. As my friend pointed out, we may be able to understand some stuff in classical physics, but the possibility of us understanding things in modern physics decreases.
>
> The Researcher: Why do you think that is? You said new approaches or methods are not used, why do you think that is true?
>
> Student 1: I mean, the teacher went to a conference, but...
>
> Student 2: The teachers are used to the old style of teaching.
>
> Student 1: Right, since they are accustomed to the old system, they have to be sharpened a bit (laughs). There are no problems about the teaching, but the system has not been established fully and naturally the way he lectures is different. He is used to the old teaching methods and approaches of the old system, and when the new system comes along... This new system is one or two years old. When he tries to teach in this system, naturally the coordination between the teacher and student falls apart. (From focus group interview with 11-C).

Student 1 from the quotation above stated that his teacher (Mr. Smith) told them that at the beginning of the school year they had participated in a seminar that was designed for introducing the new physics curriculum and its new teaching approach. Mr. Smith explained how they should teach according to the intended curriculum. Yet, according to what the student experienced, the new teaching approach was not internalized by their teacher and their physics courses was not like what was told by their teacher. The student said that understanding especially the abstract topics was very hard for them with direct instruction and without any classroom activities. The student thought that the teachers were got used to the old teaching method so much

that they could not leave them in a short period of time.

The students also thought that the teachers study habits might affect their teaching approach while some of them thought that they were teaching in that way because they wanted to take the easy road by just giving the formulas and wanting students to memorize them and apply when they needed in questions.

> The Researcher: Why do you think there are such differences between teachers? When one teaches the logic of it, why do you think the other does otherwise?
>
> Student 1: The educational background; depends on what type of educational background they come from.
>
> The Researcher: Why, do they not come from the same educational background?
>
> Student 1: For instance our teacher at the dershane is younger.
>
> The Researcher: Young?
>
> Student 1: Yes.
>
> Student 2: So teachers take the easy way out, they just present a pre-made thing.
>
> Student 1: He gives the formula, and steps aside. Maybe he does that too, maybe he moved up by doing that, not with logic or reasoning but with formulas. I mean, there are those who just use formulas, and those who actually understand the logic behind it. Maybe, this teacher teaches that way because he himself learnt that way.
>
> Student 2: The teaching styles could be different, maybe the teacher solves like that in high school , I mean in the university some people write things down to study, others... Maybe this teacher studied like that, so he wants us to study the same way, he teaches in accordance with that, that could be it.
>
> The Researcher: So, to reflect his own study style on you... (from focus group interview with 11-C)

At the beginning of the conversation, the students were talking about the different teaching styles of teachers. The researcher asked why the teaching styles of those teachers might differ. One of the students stated that those teachers might come from different teaching backgrounds. He compared his young physics teacher at dershane who was trying to help students understand the logic behind the topic and his school teacher who preferred giving the formulae and wanting them to memorize those formulae. According to the student age was the main difference that causes the students prefer different teaching styles. Another student suggested that the teachers might have different study habits that reflected their teaching styles.

Loving the physics teacher might help the students develop a positive attitude towards physics and be more successful in physics. Students voiced the importance of building a positive relationship with their teacher in different focus group interviews. For example, in one of those interviews while comparing their current physics teacher with the previous one she stated that "Our own physics teacher is listening to us this year. (...) I am pleased with my teacher this year with regards to that, because the lesson appeals to me more. Last year, I hated physics, this year I began to like it and as I do well in physics I am building confidence." (from focus group interview with 10-C). This means that the different approaches of the teachers affect this students' attitude and confidence in physics.

When the researcher asked what characteristics a good teacher might have, the students provided different answers. Some of the ideas came while they were giving examples of successful teachers:

> Let me give an example, I had personally witnessed this when my older sister was in high school. I had sat in on one of their lessons at the dershane, the physics teacher walked in without a textbook. The woman was really good at it. When she spoke, we paid attention and listened. She would go over a topic, and then solve one or two questions. Even though it was a dershane, she involved the student in the lesson. She would ask students to guide her as she solved a question or she would make students come up to the board and solve the question. I think this is very important, instead of asking students if they have solved or understood the question, a teacher should be able to say "Even if you could not solve the question, come up to the board

and I will help you to solve it". (from focus group interview with 10-C)

The owner of the quotation highlighted different characteristics of a teacher who the student defined as successful. First of all she mentioned that she did not bring any textbooks with her. This might have left an impression on the student that the teacher did so because she was knowledgeable enough not to need any textbooks. The teacher had been also successful at drawing the students' attention: when she talked everybody listen to her. After she summarized the topic, she solved a couple of questions and then she wanted some of the students come and try to solve more questions on the same topic. When the students were hesitant to come to the board, the teacher encouraged them by promising that she would help them if they could not solve the question. This attitude of the teacher impressed the student the most. Actually, the student was talking inadvertently about early stages of scaffolding. In the early stages of scaffolding, the teacher invites the student to make contributions to integrate her to the learning process and then guide her while she was dealing with the task.

When asked as to the characteristics of a good teacher, the students also stated that knowing the content well would not be enough to be a good teacher; a good teacher should also explain adequately what she knows:

Student 1: Some people do not explain, for instance I sometimes cannot explain something that I understand well, I cannot find the words. We had a physics teacher in 9th grade; he had attended a science high school, but did nothing in class.

The Researcher: Is it because he did not explain?

Student 2: He did not have the ability to teach. He can secure admittance to a science high school by solving the questions in the examination, but that was of no use.

Student 3: Or maybe he did not bother to try to explain.

Student 4: Maybe the things he taught us were too easy for him.(from focus group interview with 11-E)

The students gave an example of a teacher who did know physics well but who had not the skills required for a good instruction. The students knew that the teacher was well-versed in physics since the teacher moved to a more prestigious school (science schools) where the teachers had to pass a test in order to be a teacher. This means that the students might see teaching as an art.

Another important characteristics that showed up while students were talking about their good teachers that the teachers' positive relationship with the students. For instance the students from Mr. Doe's classes talked about their teacher's ability to build a positive relationship with them. The chocolate penalty system of Mr. Doe is the most frequently appreciated classroom management method by the students which also help the classroom and the teacher build a more intimate relationship.

Students show their love and respect to their teachers by solving questions. When asked a focus group how they define a good teacher, one of the students gave examples of two different teachers:

> I will give two examples. Our chemistry teacher, whose name I will not say, walks into the classroom, sits at her desk, opens the textbook, makes us write things down, and leaves. We have a chemistry practice textbook, everyone's book is empty, and it is a thin book too. On the other hand, we have a mathematics teacher, he walks into class and is always at the board moving and talking, I have never seen him sit down at his desk in class. Our mathematics practice textbook is thick, but it is filled with our work (from focus group interview with 10-B).

This students' example show how they show their love to their teacher. He complained about his chemistry teacher who used to come to the classroom, sit on her chair and have students write down what she says with very little interaction with the students. On the other hand, their mathematics teacher was very active; he did not even sit down contrary to their chemistry teacher. The mathematics teacher also was posing questions unexpectedly in order to help them focus on what he was telling.

4.3. Summary of the Findings

To sum up all the findings in one paragraph, the enacted curriculum is in alignment with the intended curriculum on the basis of the order and inclusion of topics, yet the same alignment is not present with respect to the teaching approaches of the teachers at the research site. There were mainly five agents which may influence the shaping of the enacted curriculum; the teachers, the students, the national examinations, the textbooks and the intended curriculum. The interactions between the enacted curriculum and its agents were summarized in Figure 4.13. Since the students were so fixated on the national examinations, they may have put pressure on their teachers to focus on preparing them for national examinations. Due to this pressure, the activities performed in the classroom were almost always related to the national examinations. Hence, the teachers did not prefer to use the official textbook, which was in alignment with the intended curriculum but was activity heavy. Instead, they chose to use the textbooks published by dershanes, the main aim of which was to prepare students for the national examinations and which were, for this reason, question intensive instead of activity heavy. Those textbooks were influenced by the intended curriculum, though only on the basis of included topics.

5. CONCLUSION, DISCUSSION AND SUGGESTIONS

5.1. Conclusion and Discussion

The current research study had two main purposes. The first purpose was to describe the physics curriculum being implemented by the three teachers at the research site. The second purpose was to understand the possible interactions between the enacted curriculum and the agents that might shape the enacted curriculum. In this section, the conclusions based on the findings are discussed by comparing them with the findings of the previous research studies.

The enacted curriculum and the intended curriculum had several alignment issues. The intended curriculum is partially aligned with the enacted curriculum. The teachers are trying to cover the topics according to the intended curriculum yet they cannot manage to adopt the teaching approach of the curriculum. All of the three physics teachers whose classes were observed still use traditional teaching methods and the lessons are far from being student-centered. In order to describe the enacted curriculum, in the following paragraphs the teaching and assessment methods used by the teachers are summarized briefly.

When one of the teachers would start to discuss a new topic in physics, the first thing s/he did was presenting the topics as short presentations. The frequently used short presentation techniques were "instructing by reading", "instructing by note taking", "instructing by giving examples", "student presentations". During those short presentations, the students asked questions and some of those questions were answered by the teachers. Taşçı (2011) also stated that direct instruction was one of the strategies used by the teachers.

Throughout the classroom observations, it was realized that the teachers used the strategies instruction by reading, instruction by writing, and having students present the topic when they feel incompetency while explaining a topic. Those topics usually

corresponded to the ones that were recently included in the intended physics curriculum. In addition, the topics that the teachers assigned students to present as term homework were the ones which were also included for the first time with the current curriculum. These topics were the ones that the teachers frequently stated that they did not know. The teachers also predicted that the recently included topics would not be included in the national examinations. So they could assign those topics for student presentation since they did not have to take them seriously in the classroom.

Especially one of the teachers frequently gave examples from daily life while explaining a phenomenon to students. The student's attention was captured when the teachers presented such examples, probably since they started to understand the phenomenon under discussion. They started to ask what if questions by presenting other examples. A similar conclusion was drawn in the study of Taşçı (2011).Taşçı stated that the students were enthusiastic about relating the phenomenon they were learning to their daily lives. They were trying to find other examples that can match the situation and pose questions when the teacher presented an example about the topic under discussion. Kapucu (2012) also stated that the teachers were giving examples from daily lives of the students and that helped students to make connections with the physical phenomena and real life. This may show that the students were trying to develop a deeper understanding by posing questions and they were interested in the phenomenon when it was related to daily life.

Relating daily life with the topics in physics is an important aspect of the intended curriculum and of the official textbook. In many research studies, this aspect of the intended curriculum was mentioned by the teachers. For example in the study of Kapucu (2012), three of the four teachers stated that relating physics to daily lives of the students is an important facet of the intended curriculum. Ayvacı (2010) reports that the teachers present examples from daily life while covering especially "Force and Motion", "Energy", "Electricity", and "Density" topics. In this study the teacher who used the method "example giving" can also give examples about other topics like "the excitement of atoms" or "sound waves". Other studies which investigate teachers' attitudes towards the physics curriculum frequently reach the conclusion that most of

the teachers are aware of the emphasis on building a strong relationship between the students' daily lives and physical phenomena covered in the intended curriculum and they appreciate that (Akdeniz and Paniç, 2012; Ergin, 2010; Karal, 2010; Sadi and Yıldız, 2012; Tortop, 2012). The finding noted in previous studies and in this study that teachers have embraced and are trying to adopt in class the "relating the topic with real life" aspect of the curriculum is a promising development in the enactment of the curriculum as intended.

Not all of the questions could be answered by the teachers when a student posed a "what if" question after the teachers' presentation of an example from daily life. The problematic point is the teachers did not try to encourage students to conduct research in order to find their unanswered questions. Taşçı (2011) notes a similar problem stating that while elaborating the examples from daily life teachers failed to encourage students learn the phenomenon under discussion.

Students asked questions that they were curious about while the teachers were presenting examples from daily life or explaining a phenomenon. Some of those questions were genuine while some of them were asked to mock the teacher. The teachers responded to students questions differently. Sometimes they ignored the questions. It might be because they did not want to lose time with questions or they did not know the answer or they thought the students could not understand the explanation since it was beyond their knowledge. The answers they gave were binary or one-sentence long, hence were not very satisfactory.

From time to time, the teachers admitted that they did not know the answer to the question. It cannot be expected from the teacher to know everything. The important problem is the way the teachers handled the questions. Throughout the classroom observations, the teachers never encouraged students to search for the answer of their questions. Even the teacher herself usually did not try to find the answer to the question that she admitted she did not know in the classroom. Yet, they searched for the answer if the question came from a textbook. This might show that answering the questions about national examinations is much more important for the teachers than

satisfying the students' curiosity and attempt to better understand the phenomena.

Question solving was the most frequently used technique by the teachers. They devoted most of their time to this activity. Both the teachers and the students were convinced that a topic is learned if the students could solve the questions correctly. The teachers solved exemplary questions at first, then they showed typical question types that the students might encounter, which was followed by having students solve questions on the board or on their own, and assigning homework questions to assure that the students had practiced enough to understand the topic. The teachers stated that the questions they solved during physics courses resembled the ones that were asked in previous national examinations, however, the students did not agree with their teachers. The students thought that their teachers were solving only questions on application of formulas and they did not solve many interpretation questions, which they thought they had difficulty in solving. The method of question solving was also mentioned by the teachers in other research studies (Engin and Bülbül, 2009; Kapucu 2012; Taşçı, 2011). According to the findings of Engin and Bülbül (2009), 38% of the teachers stated that question solving is the most frequently used method in their classes. This means that more than one third of the teachers use a method that was never taught in teacher training institutions. "Question solving" is literally a method that was frequently employed by the teachers at the research site. The most probable reason that leads teachers to use a method that they invented is the national examination. The teachers felt themselves responsible for students' success in the national examinations. They were trying to do their best in a very limited time: instead of helping students construct a conceptual understanding, they prefer showing as may question types as they can so that students would be familiar with the question and remember its solution in the national examination. Taşçı (2011), in her thesis, highlight the same problem of teachers' devoting most of their precious time to question solving in order to prepare students for national examinations.

According to the intended curriculum, the teachers should conduct hands-on activities in order to help students build conceptual understanding. However, at the research site, no hands-on activities not observed by the researcher even though the

school had a physics laboratory and some equipment. Demonstrations that the teacher performed was the closest activity to hand-on activities. Apart from what was observed in the classroom, the students and the teachers stated that they performed some other demonstrations in the classroom. Akdeniz and Paniç (2012) stated the teachers conduct experiments as demonstrations and there were not any hands-on activities. The same situation is true for this study. Taşçı (2011) stated that the four teachers she observed did not conduct any hands-on activities. Kapucu (2012) also reached a similar conclusion that the experienced teacher he observed did not conduct any hands-on activities but first-year teachers tried to integrate such activities in their lessons. A similar situation is also true for this study. The most experienced teacher was not observed while conducting any classroom activities. The same teacher also stated that he did not even try to conduct hands-on activities since he did not know how to do that. On the other hand, the two teachers stated that when the intended curriculum was first put into action, they tried to conduct the hands-on activities especially in the ninth grade, yet they gave up in the following years. The teachers stated that the time they spent on one activity was too long and what the students learned from that activity was too little. Very interestingly, the same experience was shared by the teachers in the study of Taşçı (2011). The teachers in Taşçı's study stated that they tried to conduct the hands-on activities but then they gave up. There are also other studies reporting that the majority of the teachers do not employ hands-on activities in their classroom (Ayvacı *et al.*, 2012; Sadi and Yıldız, 2012). The students also did not want to spend too much time on such activities even though they wanted to conduct experiments. In short, the teachers did not prefer to conduct experiments or hands-on activities or even demonstrations because of lack of time, lack of equipment, the pressure of national examinations and students' lack of enthusiasm.

In addition to demonstrations, from time to time, two of the teachers showed videos or presentations to students about special relativity. Nevertheless, none of the teachers ever used animations or simulations to help students better understand the concepts even though they had computers and projectors. In the study of Taşçı (2011) only one of the teachers used an animation only once during her classroom observations, which also show the frequency of the use of technology to facilitate student learning.

According to what the teachers stated in the study of Akdeniz and Paniç (2012), the teachers presented using computer technology while covering topics that were difficult to understand. This may again be due to teachers' lack of content knowledge on the recently included topics, which is also in accordance with the findings of Akdeniz and Paniç (2012). According to the survey results of Engin and Bülbül (2009) 15% of the teachers stated that they are frequently integrating computer technology in their lessons but no information was given how they integrate it. In this study, two of the teachers use computers in every class yet it was only used for projecting questions to solve them faster. The same situation may be true for Engin and Bülbül (2009).

The formative assessment techniques used by the teachers were very limited and occurred unplanned. The teachers decided if a topic was understood by the students or not by posing questions to students throughout the lesson and asking students if they had understood the topic or not. The same situation is true for the study of Taşçı (2011) and Engin and Bülbül (2009). Taşçı (2011) stated that the misconceptions of the students were trying to be revealed by asking questions to students during lectures. Moreover, Engin and Bülbül stated that 52% of the teachers stated that question and answer is the most frequently employed formative assessment techniques.

The summative assessment techniques were conducted in a more planned way than formative assessment, yet the questions were cut and pasted from the textbooks prepared by dershanes and most of the questions were not even read or solved beforehand. The teachers preferred to ask questions out of their notebooks or classroom textbooks to prevent students from memorizing the solutions of the questions in their notebooks or textbooks. This finding is similar to the findings of Engin and Bülbül (2009) where one third of the teachers prefer to ask questions out of the notebook or textbook. According to Akdeniz and Paniç (2012), 66% of the teachers admitted that they did not know the assessment and evaluation techniques explained in the intended curriculum. In the studies of Baybars and Kocakülah (2009) and Ergin, İngeç, and Şafak (2011) it was stated that the alternative assessment techniques are not comprehensively understood by the teachers. Teachers' lack of knowledge may be one of the reasons why they did not employ alternative assessment techniques.

So far, the conclusions were drawn and discussed about the first purpose of the study: describing the curriculum being enacted at the research site. The rest of this section is devoted to conclusions and discussions about the second purpose of this study: describing the possible interactions between the enacted curriculum and agents that may shape the enacted curriculum.

The interactions of agents with the enacted curriculum are summarized in Figure 4.13. The agents that may shape the curriculum which are described and discussed in this study are the intended curriculum, the national examinations, the textbooks, the teachers, and the students. In the following paragraphs, the interactions of those agents with the enacted curriculum as well as their interactions between each other are discussed.

The intended curriculum is manifesting itself in the enacted curriculum mostly as change in content matter but not in teaching approaches. This means the teachers were following the sequence of topics in the intended curriculum, trying to comply with the boundaries of the objectives of the intended curriculum. However, the teachers were not adopting the teaching approaches stated in the intended curriculum, instead, their approaches were highly traditional. The skill objectives of the intended curriculum were not taken seriously by the teachers. Taşçı (2011) states that the teachers whose lessons were observed by the researcher, did not take the skill objectives into consideration while enacting the physics curriculum; only the knowledge objectives were taken into account. One of the possible reasons for the difference between the teachers' emphasis on different objective types is the pressure of national examinations on the teachers. The teachers cover the knowledge objectives of the intended curriculum in case the questions of the national examinations come from the topics covered in the intended curriculum. The teachers did not pay any attention to skill objectives since the national examinations cannot measure students' skills. Another possible reason might be that the teachers might not be aware of the skill objectives. At least one of the teachers at the research site was not even aware of the different knowledge objectives for the selective physics courses.

Preparation for the national examinations appears to be the main aim of secondary school physics education according to teachers and students. According to the teachers, the intended curriculum is not in alignment with the national examinations. The same findings were revealed in the studies of Akdeniz and Paniç (2012), Marulcu and Doğan, 2010, and Söğüt *et al.* (2012).

Since the primary aim of the physics education in high school is preparation for national examinations, not scientific literacy, and the national examinations were not in accordance with the intended curriculum, the teachers had to make a choice between national examinations and intended curriculum. The teachers chose the national examinations at the research site. They did not include anything in their lesson that did not directly contribute to the students' preparation for the national examinations. That is why they continuously solving questions in their lessons and did not perform hand-on activities in the classroom.

Kapucu (2010) stated that the students may be forcing their teacher to help them prepare for the national examinations and that could be the reason why the teachers are persistently trying to solve questions and show question types in the classroom. The findings of this study support Kapucu's conclusion that the students expect from their teachers to prepare them for the national examinations. Moreover, the students did not find the variety of question types that their teacher solved in the classroom satisfactory.

The textbooks were revealed to be another agent that may contribute to the shaping of the enacted curriculum. The teachers and the students did not like the design, the questions, and the activities of the official textbook. The reason behind this discontent was that the official textbook was not designed to prepare students for the national examinations. Akdeniz and Paniç (2012) stated that the teachers find the number and quality of the questions in the textbook insufficient. Moreover, according to the same study the teachers report that some questions do not match with the objectives in the intended curriculum. The teachers in this study show their discontent with the official textbook yet, they did not mention the misalignment of

the textbook with the intended curriculum. This was probably because the teachers did not try to match the questions with the objectives. Marulcu and Doğan (2010) found out that the teachers believed that the official textbook was not sufficient for the students since it did not prepare students for the national examinations and also it did not attract students' attention. Taşçı (2011) also stated that the teachers found the explanations in the official textbook insufficient and it did not contain enough exemplary questions for the students to prepare them for the national examinations. These findings are also in accordance with this study.

Since the teachers' primary aim was to prepare students for the national examinations and the official textbook did not meet the needs of the students for preparation, the teachers did not prefer using the official textbook. Instead, the teachers at the research site preferred using other textbooks published by dershanes in order to help students with the school courses and also to help them prepare for the national examinations. This finding is also in accordance with Akdeniz and Paniç (2012) and Taşçı (2011). The teachers chose one of the textbooks which is called "classroom textbook" in this study to cover in the classroom. There are two criteria in the selection process of the classroom textbook. The first criterion was that the textbook should be in accordance with the intended curriculum but the alignment condition applied only for content objectives. The second criterion was that the questions of the textbook should resemble the questions of the national examinations. There also should be various question types in the textbook so that the students could encounter all of them and learn how to solve them before the examination.

The other textbooks published by dershanes did not always stick to the curriculum. The teachers complained that to what extent a topic was covered by a textbook differed. A similar situation is also true for previously conducted studies (Akdeniz and Paniç 2012; Karal, 2010). Akdeniz and Paniç (2012) stated that there are some controversies between the official textbook and other textbooks. In addition, Karal (2010) stated that the teachers are complaining that the other textbooks and dershanes are not complying with the limitations of the intended curriculum. The teachers were displeased with this situation because they could not decide which of those textbooks

to use. Since the teachers believed that the national examinations were prepared according to the other textbooks, they felt themselves responsible for covering all of the things the textbooks cover. In addition to this, when the students saw the topics or question types that were not covered in the school, they thought that they were not covering everything that was included in the national examination. Hence the teachers were obliged to explain the parts that other textbooks covered in the classroom.

The teachers are the main agents that shape the curriculum. The other agents such as national examinations, textbooks, and students indirectly affect the enacted curriculum through the teacher. In this study, the intended curriculum, the national examinations, the textbooks, the other teachers, and the students influence teachers' decision making while shaping the enacted curriculum. In the following paragraphs the interrelation between the teachers and other agents that shape the curriculum is discussed.

The intended curriculum should be the primary guide for the teacher to decide what to do in classroom. Yet, the teachers in this study did not use intended curriculum at all while planning their lessons. Moreover, at least one of the teachers was not even aware that some of the objectives written in the intended curriculum are only covered in selective physics courses. This might show that the teachers do not read the intended curriculum in detail. That might also explain why the teachers did not mention the aims, goals, and objectives of the intended curriculum when their opinions were asked about them. It was stated before that the main aim of the secondary school physics education is preparation students for the national examinations. Hence, the aim of educating the students as scientifically literate was not one of the main aims of the teachers and the students. Throughout their classes, the teachers emphasized the importance of national examinations and talk about scientific literacy as a byproduct. There are other research studies which conclude that the physics teachers' main aim is to prepare students for the national examinations (Kapucu, 2010; Tortop, 2012).

About the spiral structure of the curriculum, the teachers at the research site shared opposite views. While one of the teachers thought that spiral structure was one

of the rare positive sides of the intended curriculum since it helps students to recall what they had learned in the previous years, another teacher was very happy to hear that the spiral structure of the curriculum will be removed from the intended curriculum starting from Fall 2013 semester. The main problem with the spiral structure of the curriculum stated by the teachers is that the boundaries of the intended curriculum were not clear-cut. The teachers have difficulty understanding where to stop while covering a topic. This problem may emerge from the possibility that the teachers did not read the objective thoroughly. According to the findings of Kapucu (2012) and Karal (2010), the teachers were not pleased with the spiral structure of the curriculum, adding that the teachers are not considering the limitations of the objectives. Akdeniz and Paniç (2012) also report teachers' complained that the spiral structure of the curriculum causes the students to forget what they learn in the previous grade so the teachers have to review what they learned before and this causes loss of time. Unlike the teachers in this study, the teachers in the study of Arslan *et al.* (2012) stated that the objectives are clear and the limitations of the objectives are understandable.

The teachers also showed some discontent with the content covered in the intended curriculum. They thought that the denseness of the topics and the limited time allotted for covering the topics in the intended curriculum lead teachers cover some of the topics very fast without letting students practice enough to deeply understand the topic. The same findings also emerged in some of the previous studies. For instance, Akdeniz and Paniç (2012) report that half of the teachers they interviewed are complaining about the denseness of the topics and lack of time to cover all of those topics. In addition, Arslan *et al.* (2012) stated that the teachers cannot cover all of the topics because of the denseness of the topics and lack of time. Balta and Eryılmaz (2011) report that lack of class hours is one of the major problems of the ninth and 10th grade physics teachers. On the other hand, Baybars and Kocakülah (2009) stated that the teachers found the time allotted enough for covering the ninth grade physics curriculum. The discontent of the teachers about the lack of time to cover all of the topics may be due to the problem about the spiral structure of the curriculum as stated by Akdeniz and Paniç (2012). Since the teachers had to review the topics when they started a unit which was also mentioned in the previous grades, they lost time. But since ninth grade

corresponds to the first year of the secondary education, the teachers do not have to review the previous years and have enough time to cover the topics.

Another problem stated by the teachers at the research site about the content of the curriculum is the recently included topics in the intended curriculum. The teachers did not think that those topics are useful and they will not be asked in the national examinations since they were not covered in the national examination before. The problem is, since these topics were first introduced with the new curriculum and the first students whom this curriculum were introduced to were graduating from high school and taking the national examinations at the end of the year at the time of this research, it was very normal not to encounter any questions about the recently included topics in the national examinations administered up to that time. So the most probable answer to the question "why the teachers are covering the recently included topics superficially?" is because they are not well-versed with those topics. Teachers also admitted that they did not know the new topics.

The unit "Modern Physics" is one of the topics that the teachers were complaining about in the previous research studies. For instance, in the study of Künbet (2010), the 10th grade teachers think that the objectives of the unit "Modern Physics" is not appropriate for students' levels. The same situation is true for this study. Moreover, according to the findings of Marulcu and Doğan (2010) only 38% of the students thought that the unit "modern physics" should be covered in the physics curriculum. This might mean that the modern physics unit needs a revision. In the revised physics curriculum which will be put into action in fall 2013, fortunately, the grade level that the modern physics is changed. After fall 2013, the modern physics will be introduced in 12th grade.

As mentioned before, the teachers at the research site did not use the teaching methods mentioned in the intended curriculum. Instead, they preferred traditional teaching methods where the teacher is at the center of instruction instead of the student. The teachers at the research site did not think that the teaching methods mentioned in the curriculum could be employed in their classes. The primary reason is the mis-

alignment of the national examinations with the intended curriculum. Other reasons are stated as the lack of time and laboratory equipment, teachers' lack of knowledge and experience about student-centered instruction. Students' lack of enthusiasm was also stated by the teachers while discussing the learning approach of the curriculum. The previous studies on physics curriculum also shared similar findings. In the study of Yolbaşı (2010) the teachers stated that time allotted is not enough to conduct hands-on activities. According to Baybars and Kocakülah (2009), more than half of the teachers agreed that the learning and teaching approach of the intended curriculum is not explained in detail. Moreover, Ayvacı (2010) revealed that what the teachers understand from context-based teaching is student-centered approach. On the other hand, there are also some studies which purport that the teachers are aware of the importance of hands-on activities on student learning (Akdeniz and Paniç, 2012; Baybars and Kocakülah, 2009; Sadi and Yıldız, 2012). Despite of the teachers awareness, some of the studies indicate that the teachers prefer traditional teaching methods with the alternative ones (Arslan *et al.*, 2012; Ayvacı *et al.*, 2012; Baybars and Kocakülah, 2009; Kapucu, 2010; Sadi and Yıldız, 2012). The same situation is also true for this study. Ms. Brown's situation is a specific example for the teachers' behavior. Ms. Brown was a doctoral student in the field of education so, she was aware of the philosophy, objectives, or teaching approach of the intended curriculum yet she continued to use traditional teaching methods in her class. She presented national examinations as a reason why she cannot use the teaching methods mentioned in the intended curriculum. Another reason was that she tried to conduct the activities yet they were not worthwhile. The students would acquire the objective of the activity when she summarized it in a sentence.

As mentioned many times before, the teachers admit that they did not feel themselves competent with the recently included topics in the curriculum as well as the new teaching methods. So they could not cover the topics in the classroom as intended. They skimmed through the new topics and present the phenomenon under discussion with the traditional teaching methods. It would be unfair blaming the teachers though, since they had not received any in-service training about the new learning and teaching approach of the curriculum or the new content of the curriculum. The only

in-service training was an informative seminar on the new curriculum which was also not enough for introducing such a radical change. According to the findings of Sadi and Yıldız (2012), 25% of the teachers did not attend any in-service training about the new curriculum although it had been four years since the curriculum innovation. Balta and Eryılmaz (2011) report that the teachers need in-service training especially about conducting experiments in the laboratory. The same researchers also suggest that the new topics should be taught to the teachers. Moreover, Akdeniz and Paniç (2012) share that the teachers are not competent with conducting experiments, alternative assessment techniques, the new content, and context-based teaching. Expecting teachers to learn all of those on their own is not wise or fair.

In addition to the limited number of in-service trainings, the quality of those trainings was another concern that was discussed by the teachers. Even though the teachers participated in only one informative seminar, they heard from their colleagues that the in-service trainings were not very useful for the teachers since the trainer was a teacher and was not informed enough to train the teachers successfully. According to the analysis of different survey studies, there was no significant difference between the teachers' views about the intended curriculum and whether or not they attended any in-service training (Baybars and Kocakülah, 2009; Yolbaşı 2010). This may show that in-service trainings was not successful enough to change the teachers' approach to the curriculum. Taşçı (2011) also stated that the in-service trainings are insufficient according to the teachers and the teachers demand example presentations of the new teaching approach. .

Ms. Brown stated that since she worked as a primary school teacher, she witnessed the curriculum implementation process at both elementary and secondary school level. She stated that the elementary school teachers were informed more decently than the secondary school teachers and this lead the elementary school curriculum internalized by the teachers more easily. The same finding that the teachers who worked as elementary school science and technology teachers were more informed about the curriculum than the secondary school teachers was also shared by Akdeniz and Paniç (2012). According to what the teacher said and the findings of the research studies,

the lack of informative seminars may be a reason why the physics curriculum cannot be implemented as intended. Tortop (2012) stated that the reason why more than half of the teachers stated that they could not get used to the new curriculum may be the insufficient in-service training.

In-service training may be one of the most effective ways to inform and improve the teachers' teaching skills yet it is not the only way to help teachers to improve their teaching. In this study the teachers mentioned that they were sharing ideas, experiences, and materials in the department meetings where the physics teachers in the same district gathered at the beginning of the school year. A similar finding was shared in the study of Ergin (2010). The teachers in the study of Ergin (2010) stated that they kept in touch with the other physics teachers. These interactions among the teachers might be used as a chance to help teachers improve their teaching by conducting them more frequently and more structurally.

Students were one of the agents that might have had a role in the shaping process of the enacted curriculum. As mentioned before their primary aim was preparation for the national examinations. Hence, they could not bear learning anything that would not be covered in the national examinations. Like their teachers, the students also found the recently included topics like modern physics, stars and quasars unnecessary to be covered in school. They thought that they could understand those topics by reading from their textbook. The students were expecting from their teachers to prepare them for those examinations by solving many exemplary questions, showing question types, and assigning and solving practice questions. Kapucu (2012) reached the same conclusion in his thesis stating that the students' might pressure their teachers to solve questions for the preparation of the national examinations. The students also wanted to conduct experiments but they should not take too much of their time. While some of the students stated that experiments help them understand the topic better and if they understand the topic better they can solve more questions in the national examinations. This also shows how much the students were focused on the national examinations.

To sum up, the secondary school physics curriculum was not being enacted as intended at the research site. The biggest obstacle was the students' aim of preparation for the national examinations. Since the national examinations are not in accordance with the intended curriculum in terms of content and teaching approach, it forces teachers to spend most of their time for preparing students for the national examinations. To do that, they invented a method called "questions solving", which is not taught at the universities and they spend most of their time with solving questions that the students may encounter in the national examinations. Because the number and quality of the questions in the official textbook are not enough for national examination preparation, the teachers use other textbooks which are published by dershanes. Those textbooks are claimed to be in accordance with the new curriculum yet, the teachers are complaining about the discrepancies between those textbooks and the intended curriculum. At points where the other textbooks do not obey the limitations of the objectives, the teachers prefer to follow other textbooks instead of the intended curriculum because the teachers believe that the questions will come from the textbooks that are published by dershanes.

Especially one of the teachers was trying to present examples from daily life to make the topics under discussion more attractive and meaningful for the students. When the teacher presented an example from daily life, the students started to ask interesting questions. The teacher most of the time spent a very limited time for answering those questions and when he did not know the answer he usually did not search for the answer. The teachers also did not prefer to conduct any hands-on activities in the classroom since they did not have much time and the students were not very enthusiastic about conducting hands-on activities. The closest activity they did was performing demonstrations. The number of demonstrations that the teachers conduct was also very limited. The students also did not want to spend much time on conducting hands-on activities thinking that they could not make any contribution to their YGS or LYS scores. The teachers tried to conduct the hands-on activities written on the official textbook but then gave up realizing that they are not worthwhile. Even though the school had a physics laboratory and in that laboratory there were some equipment, since the teachers did not know how to use most of the equipment they

preferred not to try to conduct much experiments. Moreover, in the laboratory, there was a computer and projector but the teachers did not use them to show students animations or simulations from the computer, instead they used them to solve the questions faster.

The teachers generally did not know the content and teaching approach of the intended curriculum. However, even though one of the teachers was a doctoral student in the field of education and knew at least the teaching and learning approach of the curriculum, she did not employ them in her classroom mostly because of the national examinations and lack of time. Teachers could learn from each other, if they wanted to, and they were continuously comparing what they did with other teachers to prevent themselves doing something that the others did not.

Even though the findings of this study paint a bleak tableau, with the recent revisions of the intended secondary school physics curriculum it is hoped that the gap between the intended and enacted curriculum will be closed. Some suggestions are given below to help policy makers improve their efforts to help teachers internalize the curriculum reform.

5.2. Suggestions

5.2.1. Suggestions for Policy Makers

Since the national examinations are at the center of the secondary school physics education, the national examinations should be prepared in alignment with the intended curriculum in terms of content and teaching approach. The recently included topics should be covered if it is expected from the teachers to cover them seriously in school. Including questions that assess students' experimenting skills is strongly recommended so that the teachers may feel an obligation to conduct more experiments.

It is obvious that the official textbooks are not used or rarely used by the teachers and the students. The official textbooks should definitely be revised, the classroom

activities should be designed considering the levels of the students and with more explanations on the application process keeping in mind that most of the teachers do not have any experience of conducting hands-on activities. Also the stories as well as the questions in the textbook can be improved to elicit students' attention.

Since the teachers are following the textbooks other than the official one, those textbooks especially the ones which claim compliance with the curriculum should be verified by MEB in order to reduce the contradictions with the intended curriculum.

The teachers stated that they share ideas, experiences, and materials with other teachers during the department meetings of physics teachers in the district. Those meetings may be conducted more frequently, once a month for instance, and planned and supervised to make it more structured hence, more beneficial to the teachers. The teachers who are well-versed with the content and the new teaching approaches should be encouraged to share their experiences with other teachers.

The number of in-service trainings should be increased. Those trainings should be especially about the recently included topics such as special relativity, the structure of the atom and the new teaching and learning approaches.

A teachers' guide book which includes comprehensive information about how to conduct hands-on activities and how they foster learning should definitely be prepared by the writers of the official textbook. In addition to the guide book a CD can be prepared which includes videos of examples of student-centered learning environments and how to prepare experiment setups.

MEB could consider tasking local supervisors and other official with inspecting teachers' compliance to the intended curriculum.

The philosophy, aims goals, and objectives of the new curriculum can be introduced to the students in order to convince them that with the new teaching and learning approaches they can build a conceptual understanding of the physical phenomena

instead of memorizing the facts.

5.2.2. Suggestions for Future Research

This study was conducted in only one high school, and that was an Anatolian high school. Other schools and school types (e.g. vocational high schools) should also be visited and observed, to gain wider insight into how the intended curriculum is being enacted.

The focus of this study was the 2007 physics curriculum, yet the enactment of the curriculum that will be put into action beginning September 2013 should also be investigated. Moreover the change of the enactment of the curriculum by the teachers, or lack thereof, should be explored by making comparisons with previous studies.

This study was carried out by observing the enactment of last three units taught in the last two months of the school year. Extending the period of observation to the whole year may help draw better comparison between the enactment of the old and new topics, as well as improve the overall picture of the interactions between the agents of the enacted curriculum.

5.3. Limitations of the Study

The number of sites in this study was limited to one high school because of time and resource limitations. But making generalizations about the situation was not included in the aims of this study. The purpose of this study was to understand only the three teachers' classroom situations, not making a whole conclusion. Another point is an inevitable one, the researcher could only gain information from sources who gives consent to do it. This limits the researcher to study only with participants who give permission to engage in this study.

Another point is about time. Because the researcher was not able to attend classes in for a whole school year, the observations were limited to the coverage of last two

units of the curriculum. It can be assumed that the teacher had enacted the curriculum in a similar way that she will do for the second semester. Moreover, most of the units were especially the problematic ones since some parts of the units are covered for the first time with the new curriculum so observations on the enactment of those topics gave more information about how the intended curriculum was internalized compared to older topics included.

The total period of observation was not same for the three teachers because of teachers' schedules. Ms. Brown's classes were observed the least followed by classes of Mr. Smith. Mr. Doe was the teachers whose classes were observed for the longest period of time so this was another limitation of this study.

Another limitation is about the observer effect. The teacher and the students can behave in the classroom differently when they are being observed by the researcher. In order to prevent this bias, the researcher tried to make the teachers and the students assure that what they do in the classroom was confidential. Also, teachers were carefully informed that the purpose of the study is not to judge the teacher's behaviors instead understanding their situation.

The last limitation was about data recording. The researcher did not take video records during classroom observations to prevent the change of behaviors of the teachers and students. Instead, the researcher wrote detailed field notes as much as she could by focusing especially on the research questions.

APPENDIX A: INTERVIEW QUESTIONS WITH THE TEACHERS

Questions which will be asked during the interviews with the teachers

(i) Generally, what you think about the new curriculum?

(ii) What are your experiences in the classroom regarding the new curriculum?

(iii) What are the students' approaches to the content and teaching methods that are stated in the curriculum? What do you think about their attitude towards the new curriculum?

(iv) What are the obstacles for the new curriculum to be implemented successfully?

APPENDIX B: INTERVIEW QUESTIONS WITH THE STUDENTS

(i) What comes up to your mind when somebody says the word "curriculum"?

(ii) What do you know about curriculum reform?

(iii) What do you think about the curriculum reform? What can be the negative and positive effects of the curriculum reform for physics education?

(iv) What are you doing at your physics classes? What are your experiences about your physics courses?

(v) In what ways does your physics classes in secondary school resembles your science and technology classes in elementary school?

(vi) How would you want your physics classes to be like? What would you want to learn? How would you like to learn?

REFERENCES

Akdeniz, A. R. and G. Paniç, 2012, "Teachers' Opinions about New Physics Education Program and its Implementation", *Milli Eğitim Dergisi*, Vol. 41, No. 196, pp. 290–307.

Akyüz, Y., 2008, *Türk Eğitim Tarihi M.Ö 1000 - M.S. 2008, 12th Ed.*, Pegem Akademi, Ankara.

Arslan, A., O. Ercan and A. Tekbıyık, 2012, "Fizik Dersi Yeni Öğretim Programına İlişkin Öğretmen Görüşlerinin Çeşitli Değişkenler Açısından Değerlendirilmesi", *Niğde X. Ulusal Fen Bilimleri ve Matematik Eğitim Kongresi*, Niğde Üniversitesi.

Atkin, J. M. and P. Black, 2003, *Inside Science Education Reform: A History of Curricular and Policy Change*, Teachers College Press, New York.

Ayvacı, H. Ş., 2010, "Views of Physics Teachers about Context Based Approach", *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, Vol. 15, pp. 42–51.

Ayvacı, H. Ş., E. Ültay and Y. Mert, 2012, "Determining the Teachers' Views on the Applicability of the Technology Design Objectives in 9th Grade Physics Curriculum", *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi*, Vol. 31, No. 1, pp. 20–43.

Balta, N. and A. Eryılmaz, 2011, "Turkish New High School Physics Curriculum: Teachers' Views and Needs", *Euroasian Journal of Physics and Chemistry Education*, Vol. 3, No. 1, pp. 72–88.

Baybars, M. G. and M. S. Kocakülah, 2009, "Evaluation of Grade 9 Physics Curriculum Based on Teacher's Views", *Procedia - Social and Behavioral Sciences*, Vol. 1, No. 1, p. 1121–1126.

Blank, R. K., 2009, "Using Surveys of Enacted Curriculum to Advance Evaluation of Instruction in Relation to Standards", *Peabody Journal of Education*, Vol. 77, No. 4,

pp. 86–121.

Bogdan, R. C. and S. K. Biklen, 2003, *Qualitative Research for Education: An introduction to Theories and Methods, 4th Ed.*, Pearson, New York.

Breen, R. L., 2006, "A Practical Guide to Focus Group Research", *Journal of Geography in Higher Education*, Vol. 30, No. 3, pp. 463–475.

Clarke, B., D. Clarke and P. Sullivan, 1996, "The Mathematics Teacher and Curriculum Development", A. J. Bishop (Editor), *International Handbook of Mathematics Education*, pp. 1207–1233, Kluwer, Netherlands.

Corrigan, D., J. Dillon and R. F. Gunstone, 2007, *The Re-Emergence of Values in Science Education*, Sense, Netherlands.

Creswell, J. W., 2003, *Research Design: Qualitative Quantitative, and Mixed Methods Approaches, 2nd Ed.*, Sage, Thousand Oaks.

De Boer, G., 2000, "Scientific Literacy: Another Look at Its Historical and Contemporary Meanings and Its Relationship to Science Education Reform", *Journal of Research in Science Teaching*, Vol. 37, No. 6, pp. 582–601.

Demir, S. and A. Demir, 2012, "New High School Instructional Programs in Turkey: Problems, Expectations and Suggestions", *Elementary Education Online*, Vol. 11, No. 1, pp. 35–50.

Denny, M., 2010, *Super Structures: The Science of Bridges, Buildings, Dams, and Other Feats of Engineering*, Johns Hopkins University Press.

Dülgeroğlu, İ., 2010, *The Evaluation of 9th Class's Course Book of Physics which was Prepared According to the New Teaching Programme with Considering the Views of Teachers: Example of Kocaeli*, Master's Thesis, Gazi Üniversitesi.

EARGED, 1997, *Ortaöğretim Kurumları Fizik Programı İhtiyaç Belirleme Analiz Ra-*

poru, Technical Report, MEB, ANKARA.

Engin, A. O. and M. Ş. Bülbül, 2009, "Ortaöğretimde Fizik Öğretimi Proğramının Öğretmen Görüşleri Doğrultusunda Değerlendirilmesi", *Kafkas Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, Vol. 2, No. 1, pp. 47–64.

Ergin, İ., 2010, *Teacher Views on Secondary 9th Grade Physics Course Curriculum*, Master's Thesis, Gazi Üniversitesi.

Ergin, İ., Ş. K. İngeç and M. Şafak, 2011, "Ortaöğretim Fizik Dersi Öğretim Programının Kazanımlar, İçerik, Öğrenme-Öğretme Süreci, Ölçme-Değerlendirme Boyutlarına İlişkin Öğretmen Görüşleri", *2nd International Conference on New Trends in Education and Their Implications Proceedings*, pp. 1476–1484, Siyasal Kitabevi, Ankara.

Evans, R., 2001, *The Human Side of School Change*, Jossey-Bass, New York.

Fullan, M., 2007, *The New Meaning of Educational Change, 4th Ed.*, Teachers College Press, New York.

Gay, L. R., G. E. Mills and P. Airasian, 2009, *Educational Research: Competencies for Analysis and Applications, Ninth Edition*, Pearson, Upper Saddle River, NJ.

Glasser, B. and A. Strauss, 1967, *The Discovery of Grounded Theory*, Adeline, Chicago.

Guba, E. G., 1981, "Criteria for Assessing the Trustworthiness of Naturalistic Inquiries", *Educational Communication and Technology Journal*, Vol. 29, No. 1, pp. 75–91.

Güneş, B., 2009, "Fizik Öğretim Programı", http://w3.gazi.edu.tr/ bgunes/fizik/index.html, Accessed in February 2013.

Gür, B. S., Z. Çelik and M. Özoğlu, 2011, "Policy Options for Turkey: A Critique of

the Interpretation and Utilization of PISA Results in Turkey", *Journal of Education Policy*.

Jonnaert, P., D. Masciotra, J. Barette, D. Morel and Y. Mane, 2007, "From Competence in the Curriculum to Competence in Action", *Prospects*, Vol. 37, No. 2, pp. 187–203.

Kapucu, S., 2010, "Fizik Öğretim Programının Uygulamasında Yaşanan Sorunlar ve Çözüm Önerileri", *Türkiye'de Fizik Eğitimi Alanındaki Tecrübeler, Sorunlar, Çözümler ve Öneriler*, pp. 30–37, METU, Ankara.

Kapucu, S., 2012, *Physics Teachers' Beliefs Related to Turkish High School Physics Curriculum: A multiple case study*, Master's Thesis, METU.

Karal, A., 2010, *Yeni 9 Sınıf Fizik Dersi Müfredat Programının Fizik Öğretmenleri Tarafından Değerlendirilmesi (Mersin İli Örneği)*, Master's Thesis, Gazi Üniversitesi.

Kraig, S. and S. Sharp, 2004, *What Counts as Knowledge in Teaching and Learning Processes? The Curriculum as Stated and the Curriculum as Enacted*, Edith Cowan University, Western Australia.

Krueger, R. A., 1994, *Focus Groups: A Practical Guide for Applied Research*, Sage Publications, Thousand Oaks, CA.

Kuiper, W., K. Boersma and J. V. D. Akker, 2005, "Towards a More Curricular Focus in International Comparative Studies on Mathematics and Science Education", K. Boersma, M. Goedhart, O. Jong and H. Eijkelhof (Editors), *Research and the Quality of Science Education*, pp. 41–54, Springer, Netherlands.

Kurnaz, M. A. and N. Yiğit, 2010, "Physics Attitudes Scale: Development, Validity and Reliability", *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, Vol. 4, No. 1, pp. 29–49.

Kurnaz, M. A. and S. Çepni, 2012, "An Evaluation of Changes to the Turkish High School Physics Curriculum", *International Education Studies*, Vol. 5, No. 5, pp. 92–108.

Künbet, S., 2010, *9. ve 10. Sınıf Fizik Öğretim Programları Hakkında Dershane Öğretmenlerinin Görüşleri*, Master's Thesis, Gazi Üniversitesi.

Lincoln, Y. S. and E. G. Guba, 1985, *Naturalistic Inquiry*, Sage, Newbury Park, CA.

Marulcu, İ. and M. Doğan, 2010, "Ortaöğretim Fizik Ders Kitaplarına ve Müfredatlarına Afyonkarahisar'daki Öğretmen ve Öğrencilerin Bakışı", *Sosyal Bilimler Enstitüsü Dergisi*, Vol. 29, No. 2, pp. 193–209.

MEB, 1985, "Lise Fizik Programı", *Tebliğler Dergisi*, Vol. 48, No. 2197, pp. 414–416.

MEB, 2005, *Basic Education in Turkey: Background Report*, Technical Report.

MEB, 2007, "9. Sınıf Fizik Öğretim Programı", *Tebliğler Dergisi*, Vol. 70, No. 2602, p. 964.

MEB, 2009, *MEB 2010-2014 Stratejik Planı*, Technical Report.

MEB, 2010, *Ortaöğretim 2009 ÖBBS Raporu*, Technical Report.

MEB, 2011, *Ortaöğretim 9. Sınıf Fizik Dersi Öğretim Programı*, Technical Report.

MEB, 2011, *Ortaöğretim 9. Sınıf Biyoloji Dersi Öğretim Programı*, Technical Report.

MEB, 2012, *Hizmetiçi Eğitim Planı*, Technical Report.

Mercan, F. Ç., 2012, "What has Changed for the Teachers? Enacted Curriculum in Secondary Physics, Chemistry, and Biology Courses", Unpublished manuscript, Boğaziçi University, İstanbul.

Merriam, S. B., 2009, *Qualitative Research: A Guide to Design and Implementation*, Jossey-Bass, San Francisco.

Miles, M. B. and A. M. Huberman, 1994, *Qualitative Data Analysis: an Expanded Sourcebook*, Sage, Thousand Oaks.

National Research Council, 2001, *Knowing What Students Know: The Science and Design of Educational A,,ssessment*, National Academy Press, Washington D.C.

OECD, 1998, *Making the Curriculum Work*, Technical Report.

OECD, 2003, *The PISA 2003 Assessment Framework*, Technical Report.

OECD, 2004, *Learning for Tomorrow's World - First Results from PISA 2003*, Technical Report.

Ornstein, A. C. and F. P. Hunkins, 2004, *Curriculum Foundations, Principles and Issues, 3rd Ed.*, Allyn & Bacon, Boston.

Osborne, J., R. Duschl and R. Fairbrother, 2002, *Breaking the Mould; Teaching Science for Public Understanding*, Technical Report, The Nuffield Foundation, STEU seminar paper.

ÖSYM, 2012, *2012 Lisans Yerleştirme Sonuçları*, Technical Report.

ÖSYM, 2013, *LYS-2 Fizik Soru Kitapçığı*, Technical Report.

Porter, A. C. and J. L. Smithson, 2001, *Defining, Developing and Using Curriculum Indicators*, Consortium for Policy Research and Education, University of Pennsylvania, CPRE Research Report Series RR-048.

Remillard, J. T., 1999, "Curriculum Materials in Mathematics Education Reform: A Framework for Examining Teachers' Curriculum Development", *Curriculum Inquiry*, Vol. 29, No. 3, p. 315–342.

Remillard, J. T., 2005, "Examining Key Concepts in Research on Teachers' Use of Mathematics Curricula", *Review of Educational Research*, Vol. 75, pp. 211–246.

Robitaille, D. E. A., 1993, "Curriculum Frameworks for Mathematics and Science", *TIMSS Monograph No 1*, Pacific Educational Press, Vancouver.

Sadi, Ö. and M. Yıldız, 2012, "Physics Teachers' Opinions on New Applied 11th Grade Physics Course at 2010-2011 Academic Year", *Kastamonu Education Journal*, Vol. 20, No. 3, pp. 869–882.

Sarason, S. B., 1996, *Revisiting "The Culture of The School and The Problem of Change"*, Teachers College Press, New York.

Schmidt, W. H., D. Jorde, L. S. Cogan, E. Barrier, I. Gonzalo, U. Moser, T. Shimizu *et al.*, 1996, *Characterizing Pedagogical Flow: An Investigation of Mathematics and Science Teaching in Six Countries*, Kluwer, Dordrecht, The Netherlands.

Strauss, A. and J. Corbin, 1997, *Grounded Theory in Practice*, Sage, Thousand Oaks.

Söğüt, Ö., D. Söğüt and H. Akay, 2010, "Fizik, Kimya ve Biyoloji Öğretim Programlarının İçerik Öğesi Bakımından Değerlendirilmesi", *Ahmet Keleşoğlu Eğitim Fakültesi Dergisi*, Vol. 29, pp. 95–112.

Tanuğur, B., F. Ogan-Bekiroğlu, C. Gürel and E. Süzük, 2012, "Yeni Ortaöğretim Fizik Programının Günlük Hayatla İlişkilendirilmesinin Öğretmen Görüşlerine Göre Değerlendirilmesi", *Yalova Sosyal Bilimler Dergisi*, pp. 167–187.

Taşçı, Ş., 2011, *Fizik Öğretim Programlarının Uygulanmasının Değerlendirilmesi*, Master's Thesis, Karadeniz Teknik Üniversitesi.

Tortop, H. S., 2012, "Fizik Öğretmenlerinin Yeni Fizik Programına Uyumları: Bir Durum Çalışması", *Adıyaman Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, pp. 419–438.

Ünal, S., B. Çoştu and F. Ö. Karataş, 2004, "Türkiye'de Fen Bilimleri Alanında Program Geliştirme Çalışmalarına Genel bir Bakış", *Gazi Üniversitesi Eğitim Fakültesi Dergisi*, Vol. 24, No. 2, pp. 183–202.

Wiles, J. and J. Bondi, 2007, *Curriculum Development: A Guide to Practice, 7th Ed.*, Prentice Hall, Upper Saddle River, NJ.

Yılmaz, A. and İ. Morgil, 1992, "Türkiye'de Fen Öğretimin Genel bir Değerlendirmesi, Sonuçları ve Öneriler", *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, pp. 269–278.

Yolbaşı, C., 2010, *Yeni Fizik Öğretim Porgramının Öğretmen Görüşleri Doğrultusunda Değerlendirilmesi*, Master's Thesis, Marmara Üniversitesi.