THE EFFECTS OF A PROFESSIONAL DEVELOPMENT PROGRAM ON PHYSICS TEACHERS' CLASSROOM PRACTICES

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

BY

ÖZLEM OKTAY

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

OCTOBER 2015

Approval of the thesis:

THE EFFECTS OF A PROFESSIONAL DEVELOPMENT PROGRAM ON PHYSICS TEACHERS' CLASSROOM PRACTICES

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ABSTRACT

THE EFFECTS OF A PROFESSIONAL DEVELOPMENT PROGRAM ON PHYSICS TEACHERS' CLASSROOM PRACTICES

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October 2015, 404 pages

The purpose of the study is to examine the effects of a professional development (PD) program on in-service physics teachers' classroom practices. Changes in teachers' practices were investigated in terms of four dimensions: content/skill/ misconception, teaching strategy, material/technology, and assessment.

Qualitative research methodology was used in the study, and a case study was combined with action research. Data were collected from seven participating teachers (1 male, 6 female) and their 9th grade students in Ankara. The study was conducted in 2012-2013 academic year during the long term PD treatment. Since the physics curriculum was updated in 2013, in-service physics teachers' classroom practices were assessed on the common topics of the two units: Nature of Physics Unit (NOP) in 2012 and Introduction to Science of Physics (ISOP) in 2013. Teacher survey on the NOP unit PD program (TSNOP), observation form (OF), student group interview protocol

(SGIP), documents, treatment fidelity expert opinion form (TFEOF), treatment verification opinion form (TVOF), and professional development program evaluation interview protocol (PDEIP) were developed as measuring instruments for the study. The PD model framework has four main components; analysis, planning, implementation and evaluation. Twelve PD characteristics were integrated in the new PD model framework. The process of the PD program was explained in the following five phases: Before Workshop I, during Workshop I, between Workshop I and Workshop II, During Workshop II, and after workshop II.

Thematic coding was utilized under each dimension. The data were evaluated by using frequency analysis and displayed by tables. The impact of the PD program in each dimension was associated with the level of teacher participation rate in the PD program. This rate was calculated considering the total time of face to face and non face to face interactions for each teacher.

The results yielded that, the PD program had positive effects on teachers' classroom practices. The more participation to the PD program in each dimension the more positive change was observed in lesson applications of the teachers. All teachers positively changed due to delivery of the common topics after the PD program. A positive development was seen in the Physics-Technology-Society-Environment (PTSE), Information and Communication Skills (ICS), and Problem Solving Skills (PSS) objectives. Misconceptions were eliminated and cautions were paid more attention in the lessons after the PD program. When the results were examined in terms of the use of teaching strategies materials/technologies, and assessment techniques for different purposes, it was seen that there was an increase in number, variety, and quality usage in these dimensions.

Keywords: Physics Education, Professional Development, Physics Teacher Practices, Qualitative Methodology

ÖZ

BİR MESLEKİ GELİŞİM PROGRAMININ FİZİK ÖĞRETMENLERİNİN SINIF UYGULAMALARI ÜZERİNE ETKİSİ

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Ekim 2015, 404 sayfa

Bu çalışmanın amacı bir mesleki gelişim (MG) programının fizik öğretmenlerinin sınıf içi uygulamaları üzerine etkisini incelemektir. Öğretmenlerin uygulamalarındaki değişim dört boyutta; içerik/beceri/kavram yanılgısı, öğretim stratejisi, material/teknoloji ve değerlendirme bakımından incelenmiştir.

Çalışmada nitel araştırma yöntemi kullanılmış, durum çalışması ile eylem araştırması birleştirilmiştir. Veriler Ankara'da yedi katılımcı öğretmen (6 kadın, 1 erkek) ve bu öğretmenlerin 9. sınıf öğrencilerinden toplanmıştır. Araştırma, 2012-2013 akademik yılında, uzun dönemli MG uygulaması boyunca yapılmıştır. Çalışma esnasında öğretim programı güncellendiği için fizik öğretmenlerinin sınıf içi uygulamaları 2012 yılında Fiziğin Doğası (FD), 2013 yılında ise Fizik Bilimine Giriş (FBG) ünitelerindeki ortak konularda değerlendirilmiştir.

Çalışma için ölçme araçları olarak; Hazırlanacak olan "Fiziğin Doğası" Konulu Eğitime Yönelik Öğretmen Görüş Anketi (FDÖGA), Gözlem Formu (GF), Ders Değerlendirme Öğrenci Görüşme Formu (DÖGF), Dökümanlar, Mesleki Gelişim Eğitiminde Yapılacaklarla İlgili Uzman Görüşü (MGUG), Mesleki Gelişim Eğitiminde Yapılanlarla İlgili Öğretmen Görüşü (MGÖG) ve Mesleki Gelişim Eğitiminin Değerlendirilmesi ile İlgili Öğretmen Görüşme Formu (MGÖGF) geliştirilmiştir. MG modeli: Analiz Etme, Planlama, Uygulama ve Değerlendirme olarak dört ana bölümden oluşmaktadır. 12 MG özelliği, yeni geliştirilen modele dahil edilmiştir. MG programının süreci beş aşamada açıklanmaktadır: I. Çalıştay öncesi, I. Çalıştay sırasında, I. Çalıştay ve II. Çalıştay arasında, II. Çalıştay sırasında ve II. Çalıştay sonrası.

Her bir boyutun altında tematik kodlama yapılmıştır. Veriler frekans analizi kullanılarak değerlendirilmiş ve tablolarla sunulmuştur. Her bir boyutta MG programının etkisi öğretmenin programa katılım oranı seviyesi ile ilişkilendirilmiştir. Bu oran her bir öğretmen için yüz yüze ve yüz yüze olmayan etkileşim zamanları göz önünde bulundurularak hesaplanmıştır.

Sonuçlar, MG programının öğretmenlerin sınıf içi uygulamalarına olumlu etkileri olduğunu göstermektedir. Öğretmenlerin her bir boyutta MG programına katılımları ne kadar fazlaysa, ders uygulamalarındaki olumlu değişim de o kadar fazla olmuştur. Bütün öğretmenler MG programından sonra ortak konuları verme bakımından olumlu değişim göstermişlerdir. Beceri açısından bakıldığında; Fizik-Teknoloji-Toplum-Çevre (FTTÇ), Bilişim ve İletişim Becerileri (BİB) ve Problem Çözme Becerileri (PÇB) kazanımlarında olumlu gelişim görülmüştür. MG programından sonra kavram yanılgıları giderilmiş, uyarılara derslerde daha fazla dikkat çekilmiştir. Sonuçlar öğretim stratejileri, materyaller/teknolojiler ve farklı amaçlar için kullanılan değerlendirme teknikleri bakımından incelendiğinde ise, bu boyutlarda kullanım sayısı, çeşitlilik ve kullanım kalitesinde bir artma görülmüştür.

Anahtar Kelimeler: Fizik Eğitimi, Mesleki Gelişim, Fizik Öğretmenlerinin Uygulamaları, Nitel Yöntemler

Dedicated to my family, myself

ACKNOWLEDGMENTS

Without a doubt, the biggest thanks to my advisor Assoc. Prof. Dr. Ali Eryılmaz for his guidance, effort, help and patient during my thesis process. I was very lucky to work with him and got his valuable feedback until the end of my thesis. He acted me always positive and supportive. Our face-to-face meetings were always motivating and challenging.

I am thankful to my examining committee including: Prof. Dr. Bilal Güneş, Prof. Dr. Mehmet Fatih Taşar, Prof. Dr. Ömer Geban and Doç. Dr. Ömer Faruk Özdemir. I offer thanks to Prof. Dr. Giray Berberoğlu and Prof. Dr. Ahmet İlhan Şen for valuable insights to improve my thesis.

I would like to thank the participating teachers who gave their time and efforts to this thesis. Thank you so much to be a part of this enjoyable and fruitful research. You gave me more contributions. I hope you found much benefit from the study. I am also thankful to all students for their participation and their school boards to provide me collecting data.

I would also thank Ministry of Education to give me support for conducting professional development program. I acknowledge The Scientific and Technological Research Council of Turkey (TÜBİTAK) for the 2211 and 2214/A programs, in addition to Faculty Development Program (ÖYP) to financially support me.

I express my thanks to all members and my friends of Department of SSME at METU and Eric Mazur with his group members at Harvard University for their support.

Many thanks also go to my family who gave me endless support and love. I am very lucky to have such a wonderful parent; my father Murat, mother Sözen and brother Ümit. You believe and encourage me anytime. I could not have finalized this thesis without you. I love you so much!

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

PD: Professional Development

PISA: Programme for International Student Assessment

TIMMS: The Trends International Mathematics and Science Study

OECD: Organisation for Economic Co-operation and Development

MoNE: Ministry of National Education

NOS: Nature of Science

NOP: Nature of physics Unit

ISOP: Introduction to Science of Physics Unit

ÖYGM: The Directorate General for Teacher Training and Improvement

O: Common Topics

PCK: Pedagogical Content Knowledge

VOSTS: Views on Science, Technology and Society

ANOVA: One-way Variance Analysis

TSNOP: Teacher Survey on the NOP Unit PD program

OF: Observation Form

SGIP: Student Group Interview Protocol

TFEOF: Treatment Fidelity Expert Opinion Form

TVOF: Treatment Verification Opinion Form

PDEIP: Professional Development Program Evaluation Interview Protocol

PTSE: Physics-Technology-Society-Environment

ICS: Information and Communication Skills

PSS: Problem Solving Skills

CHAPTER 1

INTRODUCTION

Teacher is a vital component of education. Teacher and student are not separate from each other. Teachers have large effects on their students' success and failure. They have a role for preparing students to life to become capable adults. They are responsible for implementing the curriculum. They have control over to create effective learning environments for students by using suitable teaching strategies, technology, materials and assessment techniques to improve content understanding. Therefore, high-qualifield teachers are necessary in educational settings. Teacher practice contributes more to the classroom learning. According to Wenglinsky's (2002) study, teacher classroom practices has the first significant (effect size= .56) predictor variable for students performance.

1.1 The Need for Professional Development

Teachers need to be lifelong learners so professional development (PD) is a strong mechanism for improving in their career. Teachers maintain to have developmental needs in their teaching. Initial teacher education is not enough for teachers in all their career. They must grow and increase in their experiences by practicing. This development never ends and has continuity. Teachers keep track of new changes in their profession and update their teaching. Reform initiatives can not be succeeded without teachers' involment. Teachers should analyze and internalize the changes and then transfer them into their classroom teaching. Reform efforts support PD programs to see possible outcomes about changing teacher practices, learning and impact on economy and educational foundations. PD of teachers is one of the biggest investments in education. PD introduces to learn contents deeply and offers appropriate tools associated with curriculum and student needs. Especially for science teachers, PD is significant because science has more abstract concepts and require strong scientific knowledge. Teachers need to have current innovations in science and prepare themselves for using new peadagogical approaches. They should be educated in some ways that are compatible with goals and standards (Darling-Hammond, 2000). Sparks (2002) has an idea that PD correlates with teacher quality and that is significantly related to student achievement. This idea has also been supported by some researchers (Carey, 2004; Darling-Hammond, 2000; Elmore, 1997; Guskey, 2011).

A longitudinal research result showed that "students assigned to the most effective teachers for two years could boost the scores of their low achieving students up to 50 percentile points compared to similar low achieving students who had ineffective teachers for two years" (Sanders & Rivers, 1996, p. 7). Therefore, special attention should be paid to teachers' quality to improve education.

1.2 Characteristics of Ineffective Professional Development Programs

Undoubtedly, high quality PD programs can affect teachers' practices and positively influence student learning (Borko, 2004). For improving teacher effectiveness, any initiatives under the name of PD must be well planned and organized. Teachers are more familiar "sit and get" traditional style PD programs in which there is no clear goals or purposes. Mostly are one-day workshops that a presenter comes and explains more general things (e.g., educational theories) without any connection to real classroom practices. These are not directly linked to issues and areas within the context of discipline. Effective teaching requires using proper instructional practices, content understanding and then to integrate content and pedagogy in teaching (Ball, 2000). Teachers must learn in real life contexts like their students. Many of PD programs are ineffective because of some reasons as stated below:

- PD programs do not clearly explain the process of change and what motivates teachers to engage in PD (Guskey, 2002).
- PD programs fail to examine participant needs and explain how a PD program meets them. The adult learning literature support the importance of considering needs (Knowles, Holton, & Swanson, 2005).
- PD programs do not give practice and implementation opportunities to teachers. Teachers are passive receivers to the knowledge in many programs. They need time to evaluate PD programs and find opportunity for their personal development (Hawley & Valli, 1999).
- Change needs time so the duration of PD is an important indicator of effective programs. It needs to be periodic. One-shot (top down) and no sustained, no follow-up designs are not perfect models of PD (Cranton & King, 2003).
- Mostly teacher PD programs are non-collaborative and no any interactions among participants (Roberts, 2010).
- PD workshops, that are not hands-on, do not encourage networking with other teachers, are not useful (Meichtry & Harrell, 2002).

In this area, research in science on PD is complicated and difficult because it has number of related elements. In addition, practical difficulties can appear because of many components such as the length of time for teaching practice and requiring rich research techniques must be needed. When designing framework for PD, it has some basic factors that professional developers should be considered. These are respectively as indicated by Lederman (2007):

− Set of context factors affecting PD (Professional developers have to know teachers and their learning needs, teachers' students, the standards of expecting achievements, local curriculum, instruction that teachers use, assessment techniques, teaching and learning environments).

− Critical issues in the designing PD (such as finding time for PD, equity, building of professional culture, leadership, sustainability, scaling up and collecting public support).

− Strategies for professional learning.

Literature emphasized that studies in this area are not adequate. Thus, lots of studies need to show large picture of this field. Because of the complexity of teacher PD in science and its systematic nature, not only the people involved in, but also systems in which programs should be included in the PD. Evaluation process is also valuable to show the PD effectiveness. Developers can make decisions to extend or stop the programs depend on their results. All process is difficult to achieve, so assessment of PD should give evidence that time and efforts are not wasted. Detailed evaluation can provide more advancement in the discipline (Archibald, Coggshall, Croft, & Goe, 2011). When assessing the PD programs, it should be taken into account the outcomes of the PD programs, the processes and the systems, effective communication of all participants in the system and their evaluations.

Some of the international assessments such as PISA (Program for International Student Assessment), and TIMSS (The Trends in International Mathematics and Science Study) rank and measure student achievement. These are valuable data to give information for assessing educational systems and their impacts on student performance among countries (Hanushek & Woessmann, 2010). Recent data from 2012 PISA results showed that top performers are Shanghai-China, Singapure, Korea, Hong Kong, and Japan on mathematics, reading and science tests among 65 countries. Organisation for Economic Co-operation and Development (OECD) 2013, noticed that Asian countries focus more on teacher training and quality of teachers. Teachers spend their time working with other teachers to improve their practices in these countries.

Unfortunately, Turkey had poor results compared to other countries. For example, Turkey has lower scores on problem solving and science literacy in PISA 2012 (OECD, 2013). Turkish students had difficulty in solving problems and lack of making cause-effect relationships. Results inferred that students are not well educated to use reasoning skills when they met real-life issues. They did not make right connections between daily life experiences and abstract concepts. They were not familiar with this type of questions requiring critical thinking skills. Most students perceive science in a wrong way. Indirectly, this unsuccessful result may be from transferring knowledge to students by teachers. Teachers must translate their knowledge to students and properly use teaching approaches and strategies. If they do not have adequate knowledge, they are not able to teach effectively and so may remain lots of misconceptions related to concept. In addition, they must be qualified in terms of both content and pedagogical knowledge.

The Turkish Ministry of National Education (MoNE) has started wide curriculum reform in education for all levels. Before education reform in Turkey, science education curriculum was criticized; because it had mostly theoretical concepts with less emphasis on student-centered activities. The teacher was the provider of information considering the curriculum. This situation entails memorizing rather than meaningful learning (Ekiz, 2001). Since the year 2005, Turkey has started to national curriculum reform in all discipline to consider classroom instruction and student performance (Akşit, 2007). Then, reform continued with high school curriculum. The reform movement led high school education in Turkey to become four years (grade 9 to 12). Turkish curricular reforms now put more emphasis on Nature of Science (NOS) and Scientific Literacy as central curricular themes. Basically, NOS refers as a way of knowing (epistemology of science), or the values and beliefs for developing the scientific knowledge. Although there is no consensus among researchers on the universal definition of the NOS, scientists and philosophers have agreed on the some characteristics of NOS (Lederman, 2007), which relate to the scientific knowledge as following:

(a) Tentativeness (subject to change). Scientific knowledge is provisional. When the new observations and investigations are done, this knowledge can change.
(b) Empirically based. It is derived from observations of the natural world.
(c) Subjectiveness (theory-laden). It is affected by prior knowledge and theoretical backgrounds. Accepted theory and laws are important for scientific knowledge.
(d) Formed by human inference, imagination, creativity, explanation, reasoning.
(e) Socially and culturally grounded. It is produced by human so; social and cultural values affect it.

(f) Differences between observations and inferences. Observations are collected through human senses; on the other hand inferences are interpretations of observations. However, both of them are necessary for science.
(g) Differences between scientific theories and laws. They are different types of knowledge. Theories are used for describing why certain laws work. It has general explanations; whereas law shows relationships of observed or perceived concepts without asking how and why. They do not track each other in a hierarchical line.
(h) There is not step-by step scientific method and one way to do science.

Scientific literacy is the understanding of the scientific processes, concepts, developing the personal decision making about the natural world, the ability to use of scientific knowledge, economic productivity, participating in cultural events, having specific types of abilities to draw a conclusion about the scientific issues, the relationship science, technology and society (Atkin & Black, 2007). That is, students should know science, content of science and science-related issues.

As well as other disciplines, physics education curriculum renovated in the light of curriculum efforts. In 2007 physics curriculum emphasized context-based approach including more daily life and student centered examples. Focused on the importance of NOS, 2007 physics curriculum included the Nature of Physics Unit (NOP) in the 9^{th} and 12^{th} grades. Depending on the feedbacks, 9^{th} grade physics curriculum was revised in 2011. After the new reform movements, again the curriculum has changed in 2013. New curriculum emphasizes on NOS, scientific literacy to acquire students' problem solving skills, and inquiry. New physics curriculum still has the NOP concept renamed as Introduction to Science of Physics (ISOP) Unit in the 9^{th} grade. It also includes some activities based on history of science into the some physics contents. In terms of NOS aspects given above, most of pre and in-service science teachers have some misconceptions and believe that scientific knowledge is absolute, if theories are supported, they become laws, there is step by step scientific process, models represents reality, technology and science are the same things, etc. (McComas, 1998). Some of NOS related tenets are in NOP unit and be given correctly by teachers.

This new challenge leads to implement curriculum more effectively using correct teaching methods, approaches, and taking care of students' needs, attitudes and interests in science education. Traditional teaching methods do not seem to be effective and feasible for today's children (Battista & Clement, 1999), and that, they are not useful for promoting meaningful learning. With the current reform, special attention must be given to teachers. Teachers cannot teach if they do not understand the content, thus students do not learn necessary concepts and skills. They should experience new curriculum advances themselves instead of just telling them what to do in classroom.

Also, in 2011 Ministry of National Education published special competencies of physics' teachers (MEB, 2011). They consist of three main parts: (a) physics content knowledge, (b) physics education knowledge, and (c) physics literacy knowledge. Teacher should know the core subjects, ideas of physics, misconceptions and skills. They need to have necessary knowledge and skills to convey their students. They should know the science related issues, technological applications in the field of physics, use mathematics and mathematical modelling, and solve problems. NOS aspects are involved in the scope of physics literacy knowledge that a physics teacher should have in their profession. Therefore, helping teachers to acquire some skills and knowledge are essential for implementing new ISOP unit effectively. This can be achieved by designing well-equipped professional development programs for teacher improvement.

1.3 In-Service Training of Teachers in Turkey

The in-service training of teachers was undertaken by the Pedagogical Branch of Gazi Education Institute in the first years of the Republic and Visiting Teacher Trainers (Gezici Başöğretmenler) in 1937-1940s (Tekışık, 1998). In-service training activities, held in 1960, continued in evening and summer courses named "Seminars of Growing Teacher in Practice" given in teacher schools and high education institutions growing teachers (MEB, n.d). In the historical term, the Ministry of Education continues in-service training activities as follows:

In 1960 Office of Growing Teacher in Practice

In 1966 Directorate of Education Unit

In 1975 In-service Training Department

In 1981 General Directorate of In-service Training

In 1982 Presidency of in-service Training Department

Today, in-service training activities are within the duties of “The MoNE Directorate General for Teacher Training and Improvement (ÖYGM)”. In this context, in-service Training Centers were established due to Presidency of In-service Training Department on the date of 04.01.1995 (MEB, 2015).

Throughout the country, there are seven In-service Training Institutes and Evening School of Arts (ESA):

1. Ankara In-service Training Institute and ESA
2. Aksaray In-service Training Institute and ESA
3. Erzurum In-service Training Institute and ESA
4. Mersin In-service Training Institute and ESA
5. Rize Çayeli In-service Training Institute and ESA
6. Yalova Esenköy In-service Training Institute and ESA
7. İstanbul Ataşehir Zübeyde Hanım In-service Training Institute and ESA

Teacher-focused in-service training activities in Turkey used to be performed centrally. However, in order to solve the problems faced and to meet education need in time and place, the Presidency of In-service Training Department has authorized the provincial authorities to regulate in-service training activities in addition to the central in-service training activities in the year of 1993. Thus, the local in-service training application has started in addition to the in-service training activities made by the Presidency of In-service Training Department (Abazaoğlu, 2014).

The Ministry of Education makes coordination and cooperation with ÖYGM in vocational training activities to be given to the teachers. A teacher can make an application to maximum five central training activities in a year, but except for the obligatory activities, they can join only one of those approved by the center.

The researches reveal that there are some problems in in-service training activities. The contents of seminars given by the Ministry of Education are thought to be ineffective due to the fact that they were prepared without considering the in-service needs of teachers working in centers and the branch differences (Gökdere & Küçük, 2003). The main problems determined in the in-service training in Turkey are mentioned as not planning the education needs scientifically, not making sufficient investment for in-service trainings, wrong usage of expert staff in institutions and not making effective assessment in in-service training activities (Pehlivan, 1997).

In the study made by Aydoğan (2002), it was revealed that the views of teachers and directors on applied in-service trainings are generally negative, purposes of in-service training programs are sufficient in medium level according to both teachers and directors and they are not satisfied of the applied in-service training activities.

1.4 Purpose of the Study

There are two main purpose of the study. One of them is to design an effective PD program. The other is to examine the effects of this PD program aimed at improving in-service physics teachers' practices. Changes in teacher practices in four dimensions (content/skill/misconception, teaching strategy, material/technology and assessment) are investigated in teachers' classrooms.

1.5 The Research Questions

This study consists of a major and following specific questions, each of which addresses separately in the study.

Major Question: What is the effect of the PD program on in-service physics teachers' classroom practices?

SubQ1: To what extent are the common topics and skill objectives delivered, and content specific misconceptions/cautions emphasized by in-service physics teachers in physics classes before and after the PD program?
SubQ2: What and how frequently and effectively teaching strategies are used by in-service physics teachers in physics classes before and after the PD program?
SubQ3: What and how frequently and effectively instructional materials/technologies are used by in-service physics teachers in physics classes before and after the PD program?
SubQ4: What, for what purposes, how frequently, and effectively assessment techniques are used by in-service physics teachers in physics classes before and after the PD program?

In-service physics teachers' classroom practices were assessed by systematic observation data in the fall term of 2012, before the PD program and the following fall term in 2013, after the PD program. Group interviews with students and classroom documents were also used to provide evidence for teachers' behavioral changes in their classrooms. Teachers evaluated themselves to see their changes after the PD program. In addition, they gave opinions about the strengths and weaknesses of the PD program.

1.6 Definition of Important Terms

The terms used in this study can be defined as follows:

1. Teacher Professional Development

It is a development process of intellectual, pedagogical growth, knowledge abilities and required learning situations for teachers on the job (Lieberman & Miller, 1992). PD has some experiences for in-service teachers by engaging them into active learning to improve their knowledge, ability and understanding (NRC, 1996).

2. Teacher practices

A broad definition from Goe's (2007) states that practice is teachers' actions doing in the classrooms with their students. Practice must be observable in the class and can be different in specific disciplines.

3. Common topic

It is a common objective which is included in both 2011 revised physics curriculum and 2013 physics curriculum. Fifteen common topics were determined to compare the teacher changes in four dimensions due to the PD program, and were labelled with the letter “O” in the study.

1.7 Significance of the Study

Teachers have a chance to develop and revise their understandings and pedagogical developments by participating PD programs. It gives a support and provides feedback for building their teaching models within the physics content. We expect teachers to develop effective classroom practices. They are able to share teaching strategies and knowledge with colleagues. What is more, this study easily identifies the strengths and limitations of teachers’ implementations. PD program also aims at overcoming common misunderstandings related to the content. Most of the studies continue to offer traditional one-shot PD programs. Instructors passively give knowledge to the learners and then they hope them to absorb this knowledge and easily transform it to their classroom. This PD involves face to face and non face to face interactions between participating teachers and experts in the field. Teachers are actively engaged activities working in small groups. They assess, select, revise, develop and modify materials for their implementation. They oriented to the first unit of new physics curriculum and enriched their practices.

They access many sources related to the ISOP unit. Most PD does not meet the individual needs of teachers (Walker, 2013). This model identifies the needs of teachers before the implementation of the PD program. During the PD, they expand their content knowledge, the use of materials/technologies, teaching strategies and assessment techniques.

PD research is more complicated, and it has many variables. Design process has many concerns and questions as well. To combine teacher needs, program structure, design, implement and evaluate seems extremely important, but at the same time tough work.

One of the drawbacks is duration and contact time of PD programs. There is also little time for participants to internalize what they have learned during the PD programs. I design long-term sustained program so that teachers are aware of what is going on and find enough time to prepare their lessons. Program offfers two workshops distributed over time. There is enough time for teachers to adapt and reflect their learning. As indicated by National Staff Development Council (2008) more research needs to be done related to teachers' experiences to show PD research quality (as cited in Jackson, 2014). Very few studies have been able to follow teachers' practice after they have engaged in PD programs. This study intented to do this as much as possible. How teachers reflect what they have learned during the PD program on their teaching practices is the core of this study. The transfer of learning from PD environment to the classroom is an indicator of the PD success. In this study, teacher practices are examined through teachers' knowledge base which includes content, skills, and misconceptions; the use of teaching strategies; the use of materials, technologies; and the assessment techniques for different purposes.

This research incorporates qualitative designs with multiple data collection techniques. Manzaro and Toth (2013) recommended that data regarding teacher practices should come from different sources. I provide as much as evidence about classroom implementations and their effects. Different data collection tools such as need-based survey, observation form, interview protocols, and documents were combined for this study to gauge teachers' practices. One of the important points about the PD studies that there is no study to unify effective PD characteristics within a long term PD program and examine classroom practices in the domain of physics in Turkey. Most of studies have investigated the opinions of teachers' PD experiences and short term PD effects. There is limited research to look into both teachers' practices in a long term PD implementation (Darling-Hammond & Richardson, 2009). This research is also unique conducting PD research in physics education. The findings of this study intend some implications to teacher education reform, and teacher preparation programs. It is hope that this research gives significant results for researcher and evidence for successful PD applications. It might offer an example of different design and alternative process for current PD programs. Its findings will make a contribution to physics education literature and PD research.

Study finds out and explores the actual classroom practices before and after the PD program. Lots of studies are needed to depict the large picture of this field**.** This study results have a practical significance those who want to develop teacher training programs as a sample model and for practicing teachers who need professionally development.

CHAPTER 2

REVIEW OF THE LITERATURE

The purpose of this review is to build a theoretical framework in order to support for the results of the study. I present the body of the literature that is all relevant in line with my research questions. Review consists of eight parts. First, some definitions of Professional Development (PD) are given. Then, PD concept is explained underlying the adult learning theory. Later, PD studies are overviewed in general. Different PD models/forms/types/approaches are examined. Following, characteristics/features of effective PD programs are discussed. Studies with PD and teacher practices, and practices with other combinations of PD outcomes are examined to see the existing international PD research. Next, only conducted studies in Turkey are presented to display current situations of PD research in national literature. Last part includes summary of literature review.

In the literature, teacher PD appears in some names such as in-service training, career development, teacher training, staff development, and teacher development that all of which are often used synonymously. Although these names have nearly similar meanings, I used professional development during the study. I reviewed studies which were conducted on science and mathematics education and their structural and PD characteristics were explicit. I excluded some specific PD research studies such as online PD, and school-based PD, some particular research types used in PD research like action research, lesson study, as well as PD studies with pre-service teachers.

2.1 Definition of Professional Development for Teachers

As a general term, PD is a process to increase people capacity to develop new knowledge, skills and provide support for participants in the long term and continuous way (Campbell, 2004; Holmes, Signer, & MacLeod, 2011). During the thesis process, I will focus on teacher professional development and its applications. PD has current importance for science teachers to apply effectively learner-centered instruction. This instruction points out what learners should know and do in the learning environment. Teacher PD in science is defined by Hewson (as cited in Abell & Lederman, 2007) in a detailed way as following:

> First, it is about teachers and their teaching activities involving curriculum, instruction, and assessment; about their students and their learning; and about the educational system in which they practice. Second, it is about teachers being professionals who have an extensive knowledge base of conceptions, beliefs, and practices that they bring to bear on the unique complexities of their daily work lives, a knowledge base that is shared within a professional community. Third, it is about teachers as adult learners who have an interest in and control over the continuing development of their professional practice throughout their working lives, a process that is greatly facilitated by working in community with their peers. Finally, it is about science and the epistemologies, methodologies, and bodies of knowledge about the natural world that give scientific disciplines their distinctive character (p. 1181).

Another definition by Guskey (1986) documents PD as an organize initiative for change. Change can be in teachers' classroom implementations, attitudes, beliefs, or student learning. PD includes various activities in the specific disciplines to contribute teachers' learning. Workshops, seminars, courses, conferences, action research, mentoring, lesson study can be used as PD attempts. It has formal and informal procedures and intends continuous improvement. No Child Left Behind Act (2001) states PD activities which are not short term workshops and design for increasing teachers' subject knowledge and practices bring about student achievement.

2.2 Adult Learning Theory as a Professional Development

PD as a concept is explained by adult learning theory. How people learn is critical issue to understand learners and learning. Actually any change in teaching requires the new learning and puts them existing one. Learning happens in an active environment and meaningful context. Change requires process in which knowledge is built. Experiences are important to the knowledge construction. Interaction among learners supports learning (Bransford, Brown, & Cocking, 1999). Some adult learning frameworks associating with PD are given as an example below. Researchers support to the use of these strategies that may be the key elements to develop effective programs.

Andragogy

The word “andragogy” means “the art and science of teaching and helping adults based on learner characteristics” (Knowles, 1980). When designing a PD program for teachers, some researchers use the methods and techniques considering to how adults learn. For example, Gordon (2004) stated that motivation to learn comes from the needs and interests of learners. It is a good way to identify needs, concerns, experiences and culture in working lives. Every teacher comes with previous experiences. If they find opportunity to be actively engaged in the PD context and share their experiences, they adapt and learn more conceptual. Learning requires transfer, so PD designers should be aware of the given enough time and sources for change.

Learning transfer

It means to be aware of a need for transit and modify new learning with existing ones (Knight, 2002). Namely, it has constructivist assumptions. Mostly, it is explained as an influence of PD into classroom practice and student achievement. The learning transfer from PD environment to the classroom is vital for program success. Therefore, PD transfer has a worth and can be directly observed and measured to show the overall effects. Transformative learning is expected to occur during and after the PD program.

Self-Directed Learning

Learners are motivated to take responsibility and control over their learning. They realize their needs and analyze opportunities in learning environment (Merriam & Cafferella, 1999). They are more flexible to find their development demands. Social context needs to be appropriate for learning sources to constitute knowledge. It is important to have opportunity to work individually or in small groups during the PD. To provide meaningful learning, teachers can a role as researcher, instructor, mentor, and student.

Learning opportunities

Craft (2000) classified the learning opportunities in the way of the duration of engagement. Long term opportunities (one to three years in time intervals) can include school improvement. Short term opportunities can consist of one-time courses, or seminars. Incidental opportunities are one day or meetings like conferences. The researcher also documented learning opportunities during the PD experiences from classroom, learning by testing experiments and ideas, learning through reflection, and learning by conceptualizing. If teachers have multiple learning opportunities in long term duration, they can construct strong knowledge base.

Reflection

Reflection is a key role before, during and after PD attempts. Teachers needs to reanalyzing and rethinking of their practices. They try to examine their teaching and find solutions for some missing parts. To spend time for thinking of learning experience and discuss collaboratively with others gain learners new perspectives on their practices. It is an active engagement into the process and leads development. PD programs can do this by using teachers' diaries or feedback mechanism (Adey, 2004). Reflective discourses and actively discussions make learning more effective.

2.3 An Overview of Professional Development Studies

At 1950s, PD programs had a role by giving teachers some directions and then expected teachers to follow these directions. After that, the concept of PD has started to change and adapt sociocultural theories in education. Researchers began to propose collaborative strategies for PD (Lieberman & Miller, 1992). PD research shifted from descriptive and theoretical to experimental and correlational in the early 1980s. With the educational reforms, a process-product view has dominated in PD research (Sparks & Loucks-Horsley, 1989). By 1990, different PD forms have been used to improve teachers' different knowledge base and student learning. National and individual attempts have been increased since 1900. PD researchers still work on different design and approaches to get more effective PD results for teacher quality. They define some characteristics of PD and combine different forms/types (e.g., networking, lesson study, inquiry, study groups) into PD programs. I categorized PD research conducted in some areas based on literature review as:

- Technology–based professional development programs (e-learning and online, hybrid, blended approaches)
- Evaluation of PD studies (changes in teacher practice, subject-matter knowledge, pedagogical content knowledge, self-efficacy beliefs, attitudes, student achievement)
- School-based PD programs (professional development schools)
- Different forms/types of PD that makes different in teaching (action research, study group, lesson study, mentoring, coaching, peer assistance, leadership, etc.)
- Studies that use different characteristics of PD programs or combine some of them (collaborative, active learning, content specific, sustained, coherence, etc.)
- Teachers' perceptions and opinions about PD programs (experiences)
- Some PD approaches (evidence-based, need-based, job-embedded, laboratory-based, inquiry based, research-based, data-driven, etc.)

- The effectiveness of PD programs on different sample (with beginning teachers, pre-service teachers, teacher educators, etc.)

2.4 Models/Forms/Types/Approaches of Professional Development

In the PD literature research, sometimes model, form, type and approach are used in the same meaning and interchangeably. I prefer to give the same way, depending on how these terms are used in the studies. I introduce some common and some specific models proposed by some researchers. Then, I give information about some different types and or forms of PD. Literature mostly agrees on the effectiveness of reform type (e.g., lesson study) rather than traditional (e.g., seminar) PD activities (Porter, Garet, Desimone, Yoon, & Birman, 2000). Many different types can be used in the teacher development such as action research, working with colleagues (collaborating and cooperative strategies, peer observing, teaching, and study groups), adding teaching useful activities, reading the professional literature (Harmer, 2002).

One of the well-known models is Bell and Gilbert's (1996) PD model. This model includes personal, social and professional development. If progress became, three types of development have to be addressed by the PD programs. There are three phases, and all phases include three types of development. In the first phase, teacher realizes some parts of their practices are problematic. Then, teachers look for another ways in order to address the problem. Personal development requires solving the problems in teaching. Social development includes the collaboration with other peers. During this phase, teachers start to relationship with the colleagues. Then they search different development opportunities that are relevant to the PD. In the professional development phase, PD emerges from developing more consistent practice. Teachers are prepared to implement new activities in their class. It should be considered that this model is not a stage model.

Guskey and Sparks' (1996) model has tree factors that effect on the quality of PD programs. Content factor is the "what" variable. It is related to the new knowledge, skills acquired, subject matter and understanding of pedagogical knowledge during the PD, and involving parents to support student learning. Process refers to "how" variable considered when organizing and implementing the PD. The last one is context factors in which “who”, “when”, “where”, and “why” variables such as institute, society and system.

Content-focused coaching is another type of model working with a coach and teachers. Coach role is to help teachers to learn new subjects, new curriculum materials, teaching methods, and find available resources in a content area. Coaches need to have high quality characteristics such as deep content knowledge, pedagogical knowledge, leadership skills, and communication skills. Coach guides teachers and facilitates them for PD development (West & Staub, 2003).

The Texas Regional Collaborative (TRC) for Excellence in Science Teaching (2009) proposed a model of PD for science teachers. Model includes scientific literacy, constructivism view, and integration of communication technology, standards-based instruction, equity and authentic assessment strategies. It focuses on collaboration between university and state education department. Teams consist of science/science education professors, specialists, and master teachers. Over 700 science teachers participated in this program. The project director studied 100 contact hours with teacher team. Needs assessment was conducted yearly to learn participating teachers’ special needs. This model implementation resulted in increasing teacher understanding and teacher confidence.

Lieberman and Wilkins (2006) defined Pathways model of PD consisted of three steps: needs assessment, determine PD pathways and reflection. Teachers asked needs based on the adult learning theory and development levels. Appropriate pathways means selecting PD activities associated with curriculum standards. Reflection stressed the PD and its effect on student learning. Model emphasized giving the enough time for teachers to adapt changes to transfer their teaching.

Kubitskey, Fishman, and Marx (2002) examined design approach model suggesting four pieces for a PD framework: planning, activities, community and structure. Planning should start to descriptions of PD and support to continuous PD assessment. Activities provide active learning of the subjects. Community leads to collaboratively work among participants from the same grade, discipline or school. Structure is related to classroom needs of teachers and their experiences. This iterative model as seen in Figure 2.1 proposes to improve teacher practices and student learning.

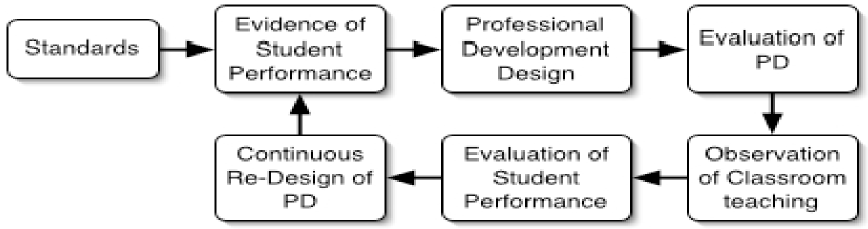

Figure 2.1 Professional development research design model (Fishman, Marx, Best, & Tal, 2003).

Problem based learning PD model explained by Clossen (2008) involves small groups to solve problems. There is a trainer or a group leader to present problem, and help to the others. Learning together view is mostly utilized to identify problems and reaches consensus. Teachers spend their time in a socially supportive environment to apply new knowledge and share their ideas.

Professional learning community model of PD aims to have a consistency of curriculum standards among teachers and schools. Schools allocate time for teachers to create and implement the curriculum. A culture is developed between community members inside and outside of the school. They decide what is taught based on the standards. Learning occurs in a socially environment. Learning from others is a main theme in this model (Lieberman & Pointer-Mace, 2008).

Five models are identified by The Northwest Regional Educational Laboratory (1998). These are:

- *Individually Guided:* Teachers are the master of their learning. They arrange their activities. They can attend courses, workshops or any other PD programs.
- *Peer Coaching:* Collaborative teams work together. Teachers visit and observe their colleagues.

- *Engagement in an improvement and development:* It refers school reform model of PD.
- *Training:* The district arranges an expert to present knowledge to teachers.
- *Inquiry:* Teachers prepare questions about their practices to find answers. Action research approach can be used in study groups or alone.

2.4.1 Professional Development Forms

Some PD forms are presented giving with explanations as follows:

2.4.1.1 Training Forms

Training as a model has some forms such as workshops, seminars, institutes, clinics, academies, individualized trainings, and courses (Gordon, 2004). Workshops are more flexible including some active components like discussions and applications. Seminars are small groups working with expert participation from the disciplines. Institutes more focus on intensive program. Clinics can be on specific problems by using expert coaching or demonstrations. Academies are programs mostly assisted by government agencies or institutions**.** Individualized training uses self-directed learning based on individual needs. Courses are the other forms of training and generally finish in a specific time. They have some credit hours including assignments, or any other requirements.

2.4.1.2 Collegial Development Groups

Participants come together and interact collaboratively with others. Responsibility is shared by all members around the specific common goals and interests. Study group, lesson study, partnership, and professional network are the forms of collaborative strategies.

2.4.1.2.1 Study Group

Study groups shape around a specific content or problems of participants about their teaching (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). Group size is limited and participation is mostly voluntarily. It may offer benefit to implement new teaching strategies, assessments, curriculum sources and materials working with colleagues by assigning group roles. They have structured regular meetings and each teacher is guidance in turn. It can be an online format depending on the technological facilities.

2.4.1.2.2 Lesson Study

It is a research type, teacher-directed study which started in Japan and gain popularity in the U.S. During the lesson study process teachers come together to develop a lesson plan. Then one teacher implements it in his/her class. The teacher teaches the lesson and the others participate to the lesson to observe and take notes of the progress. After that they meet again. A discussion begins into the group to revise and enhance the lesson. Teachers can use some students' work (e.g., portfolio) to collect evidence-based results. As an optional, teachers reteach the lesson again based on feedbacks. There is an advisor (not as a leader) in the group to provide information. Main focus is to learning from each other in lesson study groups. There are seven steps to success with the lesson study: improvement subject matter and knowledge of instructional strategies, collaborative networks, observation of students, motivation, self-efficacy, and quality of lesson plans (Watanabe, 2002).

2.4.1.2.3 Partnership

Teachers collaboratively work with scientists and mathematicians to improve learning. They can come together to evaluate curriculum resources. They share their knowledge to contribute teaching. Scientists and mathematicians are mentors and they are mutually benefits of each other. Museums, universities, zoos, science centers or other institutions can be environments for partnership interaction (Loucks-Horsley et al., 2003).

2.4.1.2.4 Professional Network

Around the common purpose, teachers join networks to share their problems or improve their teaching. They focused on specific subject. Networks can be through meetings, or online (e.g., forum). Continuity is important to pursue communication. Teachers participate voluntarily formal or informal way. Members respect and trust each other. There is a strong mechanism to discuss and share knowledge in PD networks (Lieberman & McLaughlin, 1992).

2.4.1.3 Action Research

It is a research practice used by teachers to evaluate a problem in their classroom and try to find out a solution. Teacher collects and analyzes data to solve an issue related to their teaching (Bakula, 2010). It provides the enhancement of inquiry and problem solving skills. Teachers think their own practice and criticize their work as a researcher. Action research can focus directly on issues with students, teachers, curriculum, school, and teaching practices. Teacher conducts a research in their own teaching settings.

2.5 Characteristics/Features of Effective Professional Development Programs

Literature identifies some important characteristics that need to be found in effective PD programs. Most of them indicated the same features or similar things. I reviewed some of them given by researchers and then explained the most common ones in detail.

Birman, Desimone, Porter, and Garet (2000) stated that important structural features of PD are form, duration, and participation. Content based, coherence and active learning are the core features. Content means to improvement of knowledge in the discipline. Active learning engages teachers more in discussion and practice. If teachers actively participate in constructing knowledge, they translate it into the practice. Coherence refers the integration of the PD program to the teacher context. Effective PD links to the curriculum and teachers' knowledge standards. Coherence relates to the duration. Short term PD programs do not connect to the previous experiences to build on new ones.

According to Blank and de la Alas (2009) effective PD should be sustained, apply active learning and focus on content knowledge.

No Child Left Behind Act of 2001 [NCLB] (2002) announced the effective PD criteria; intensive, sustained, content dependent, coherence, focusing on increasing content knowledge, using effective instructional strategies, evaluating teacher practices and student learning.

Shulman and Shulman (2004) defined the elements of personal and professional development. A teacher should be ready to change and volunteer to the development (willing). He/she is capable to be able to do (trust). He/she is a reflective learner (connection to experience) and member of a group (feeling a member of community).

A meta-analysis study conducted by Desimone, Porter, Garet and Birman (2002) presented six features for high quality of PD as: (1) Structural features: These features refer to the (a) form of the activity; including reform or traditional types such as mentoring, networking, lesson study, study group workshops, or seminars, (b) the degree of collective participation. This participating can be from the same or many different schools, (c) duration includes total time in which participants spend in the activity (contact hours) and the span of time over which the activity occurs. (2) Core features: (a) active learning provides teachers opportunity actively engagement on teaching such as analyzing students work or getting feedback for their practices. (b) content-based refers to the specific subject to improve knowledge in the discipline (c) coherence associated with common standards and link previous experiences with teachers' goals and supporting continuous communication.

Darling-Hammond & Richardson (2009) stated that PD should be focus on curriculum content to improve student learning. Teachers involve in actively learning environment, transfer their knowledge to the students, identify students' difficulties, develop their own lessons and plan their teaching with the help of PD programs. PD should relate with goals of school environment. Teachers should strong relationships with their colleagues. Programs should also be sustained, intensive, long-term and link to practice.

Based on literature and researcher views, I pick up some of the most common characteristics and elaborate them in below:

Need-Based Assessment

To consider teachers' needs and respect for teachers' ideas when designing PD program, creates strong base for effective program and gives overall perspectives about specific details to the researchers. Inputs from teachers and students assist to plan effective learning activities. Meeting the needs stimulates teacher participation as a motivational factor. In his study, Bethel (1982) considering 254 elementary teachers' needs designed a PD program and reported significantly test score improvement of teachers' science knowledge. Exposing teachers' needs should be one of the primary steps in the planning process for any PD program (Ricketts & Duncan, 2005).

Content

Research studies have an agreement that content-based PD significantly impact on teacher practices and student learning (Blank & de la Alas, 2009; Owston, Sinclair & Wideman, 2008). Focusing on specific topics and issues (e.g., misconceptions of NOS, understanding of force concept in physics) makes PD program more useful and purpose dependent. Content-based PD increases teacher knowledge, skills, practice and finally student achievement. Teacher subject-matter knowledge should be strong and rich thus he/she can transfer it to their students. PD programs must focus on important concepts and provide conceptual understandings in science disciplines. Study by Simon and Black (2011) found that 59% of teachers indicated only content-specific PD is useful. According to a national survey in the U.S, only about half of PD focuses on specific content areas in the related disciplines (Hochberg & Desimone, 2010).

Active Learning

Active learning can take many forms; working mentally and physically in the learning environment, providing teachers to implement their learning with a presentation, participating in discussions actively, giving feedbacks, planning how delivering curriculum in the classroom, examining students' work, etc. It requires fully participation in learning, and experimenting what they have learned during the PD. It can involve inquiry based practices or interaction among peers. Teachers must actively engage in PD process as both teacher and learner (Desimone, 2009).

Coherence

Coherence is seen another effective characteristic of PD. Program connects with teachers' experiences and goals. It aligns with current curriculum and standards (Darling-Hammond & Richardson, 2009). Teacher learning experiences should be associated with curriculum objectives and should provide opportunities for student learning.

Duration

The total time of PD can be thought as the contact hours in which participants spend time on any practice, and span time refers from the beginning to the end of program (Desimone et al., 2002). Duration is an important variable that affects more on teachers' practices. If experiences last long enough, teachers start changing process. PD programs with between 30 to 100 contact hours and follow up, long enough nearly between 6-12 months span time are the most influence on teacher practices (Darling-Hammond & Richardson, 2009). Sustain PD programs have a significant role for the change. Collaborative types of PD impact sustainability more than traditional PD forms as presented in Table 2.1. Yoon, Duncan, Lee, Scarloss, and Shapley (2007) reviewed nine studies in terms of duration and span time of PD and their effects on student achievement. These studies have characteristics (contact hour-span time) as:

- 83 hours in 4 month period PD (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989)
- 60 hours in 6 month period PD (Saxe, Gearhart, & Nasir, 2001)
- About 100 hours in 10 month period (McCutchen et. al. 2002)
- About 40 hours in a year (Cole, 1992)

All these studies had positive significant effect on student achievement. Other five studies which had less than 14 hours of PD did not show significant effect. Banilower, Boyd, Pasley, and Weiss (2006) have common consensus that at least 50 hours of PD training had positive effects. Another study of Supovitz and Turner (2000) showed teachers implemented less effective teaching practices between 1 and 19 hours of PD.

Table 2.1 Percentage of professional development sustainability

Categories	**Impact**
One day workshops	Less than 5 to 15% use of strategy
Conference or summer institutes	Less than 5 to 10% use of strategy
Practice, feedback, coaching	85-90% continued use of strategy
Action research	85-90% continued use of strategy

Source: Baker, 2014, p. 4

Collaborative Participation

Research has shown that collaboratively working and discussing possible issues related to teaching in PD process positively impact on teacher practices (Loucks-Horsley et al., 2003). Chinese and Japanese teachers spent over 20 hours in every week to collaborate with other teachers working on some subjects (e.g., teaching strategies) to improve classroom practices. This opportunity provides improvement of teachers and student achievement (Darling-Hammond, 2006). It can be with schools meeting or different types on group settings. Interaction and effective discourse lead to deepen understanding. Teachers learn much more from each other. According to Locke (2012), using internet for collaboration can be an effective way in PD designs.

Building Learning Community

Collective participation can be met through the learning communities including teacher's attendance from the same school, institute, grade level or district. Building learning group with teachers commonly called Professional Learning Communities (PLC). Especially for school based PD models, building strong communities and strong culture can affect positively teacher and school improvement. Teachers in PLC work interdependently on common goals, and build strong relationship. Members of community are ready, eager to teach. By participating in a learning community, teachers gain new learning strategies, discuss and reflect their knowledge, examine goals, standards, and have an opportunity for ongoing progress (Putnam & Borko, 2000). Collaborative work and support contribute to create PLC. Graham's study (2007) also supports the idea that PLC improves the teacher effectiveness.

Reflection

Reflection is another feature of PD programs. If teachers reflect their teaching, they can more easily change their practice (Tripp & Rich, 2012). Reflection includes learning from previous experiences and extracting meaning from them. Teachers think and then revise their teachings. It also includes self-assessment and metacognition.

2.6 Professional Development Programs and their Effects on Teacher Practices

Some of PD studies asserted that PD is a way to positively change and improve teachers' classroom practices (Chen, 2010; Borko, 2004; Fullan & Stiegelbauer, 1991; Heller, Daehler, Wong, Shinohara, & Miratrix, 2012; Pohland & Bova, 2000). There is also found a strong correlation between students' achievement gain and observed practices of teachers in the Heneman, Milanowski, Kimball, and Odden's (2006) research.

A single case study presented by Rosebery and Puttick (1998) investigated the effect of a PD project. The most important features of this project was intensive and being long time (nearly two years). She also found opportunities to explore her idea and her daily life issues related to teaching. Teacher Liz, six grade classroom science teacher, was videotaped during the workshops. She also interviewed about her teaching and learning. Data results showed that there is an improvement of her learning of science and classroom practice.

Cohen and Hill (1998) performed a PD study and its effects on teaching practices and student achievement. Time length and content had a strong effect on student learning. However the same effect was not seen in changing teacher practice. It also found that there is a positive relationship between the frequency of use of teacher practices and California Learning Assessment System's mathematics student test scores.

A PD program in Ohio's statewide systemic initiative (SSI) was evaluated in terms of teachers' standards-based teaching practices on middle school science students' achievement. Eight teachers participated in the PD program. Questionnaires and achievement tests were data collection tools. Results stated that effective PD increased teaching practices and student achievement (Kahle, Meece, & Scantlebury, 2000).

Porter et al. (2000)'s study examined teachers' changes in terms of instructional practices as a result of a PD program. This result failed because of insufficient active learning, and under the 25 contact PD hours. They suggested cooperative and active learning strategies within a long term PD program.

Supovitz and Turner (2000) collected survey data to see the relationships between professional development and teaching practice. 3500 K-8 teachers participated in a program supported by the Local Systemic Change initiative of the NSF. Different professional development strategies were used from the related literature, including aligning and implementing curriculum, immersion experiences, and examining teaching and learning (Loucks-Horsley et al., 2003). Data on classroom teaching strategies were gathered in different ways, including classroom observations, interviews with teachers about their teaching, and student surveys of teaching strategies. Classroom teaching improved after the PD program. The inclusion of students in these studies provided a further opportunity to gather data about teaching that was not provided by the teacher.

Garet, Porter, Desimone, Birman, and Yoon (2001) searched different characteristics of PD and their effects on teachers' knowledge/skills and classroom practices based on self-reports of teachers. These features are "structural features" and "core features". Structural features includes PD forms (conference or study group), duration (contact hours, time span of the activity), and collective participation (from the same school or department). Core features are content focus PD, active learning and coherence (link to standards, previous experiences). 1.427 science and mathematics teachers attended to the Eisenhower Professional Development Program. Teacher responses rate was 72%. Researchers examined the linear regression between the six features of PD and self-reported change in teachers' practices and knowledge. Activity type effects on duration according to the results. Reform based activities require longer time ($\beta = 0.10$, $p < 0.01$) and more contact hours ($\beta = 0.21$, $p < 0.001$) than traditional ones. Time span ($\beta = 0.30$, $p < 0.001$) and contact hours ($\beta = 0.31$, $p < 0.001$) effect on active learning ($\beta = 0.26$, $p < 0.001$) and coherence ($\beta = 0.16$, $p < 0.001$). Coherence has positive impact on teaching practice ($\beta = 0.21$, $p < 0.001$).

Lee, Hart, Cuevas, and Enders (2004) sought to effect of four day workshops on elementary teachers' practice and their pedagogical content knowledge. Teacher trained to learn inquiry based lessons on third grade matter and measurement and fourth grade weather and climate topics. Mixed method study analyzed with pre-post questionnaire, interview and observation. PD program focused on content based, and had follow-up workshops. At the end, teachers' self-confidence increased and teachers' fears related to inquiry decreased. PD provided opportunities to study with curriculum materials.

Minuskin (2009) conducted a study to find the effectiveness of a PD program on teacher knowledge and classroom practices. Eight elementary school science teachers in grade 4 participated in this study. The researcher used collaborative models of PD. Teachers were trained with content and pedagogical practices. A content test was administered to measure teacher knowledge. Lesson plans, surveys, observations were used as data collection tools. According to the result, teachers did not significantly change (in terms of knowledge and practice) after the PD program. The researcher stated local factors could affect the outcomes and suggested to well-designed PD program.

Harlow (2014) reported elementary school teachers' practices after the course on Physics and Everyday Thinking (PET) curriculum. Course was thought as a PD program. Course content was magnetism and electricity. Hands-on and computer-based activities used in small group and class discussions. Videos, lesson plans, student works, pre-post exams, attitude survey were used as data collection tools. As a limitation of the PD program, researcher showed 15h contact time which is short for teacher changing. But researcher insisted that some content transfer occurred for some teachers. PD helped transferring content knowledge and instructional activities easily to the students.

In Jacobs, Franke, Carpenter, Levi, and Battey (2007) study investigated the effects of a one year PD program with elementary teachers. Teachers divided two groups, one of them participated in PD program, and the other group was non-participated teachers. Teachers received an algebra test to measure their understanding. There was not any significant difference between two groups of teachers (participating teachers M=2.23, SD=1.19, non-participating teachers M=2.14, SD=1.16). There was a difference in interview results. Based on logistic regression analysis, participation was associated with the number of strategies ($z = 6.62$, $p =<.05$; $R^2 = .27$). Research also pointed out that participating teachers' students ($X^2 = 7.70$, $p = <.05$) performed better than non-participating teachers' students ($X^2= 3.84$, $p =<.05$).

As a scope of the research, I am interested in effective PD models, their characteristics and possible outcomes in terms of teacher practices. I want to give some information about conducted PD research based on the literature review presented in Table 2.2.

Table 2.2 Summary of some PD research studies in terms of structure/characteristic, duration, participants, instruments, and outcomes

Author (s)	Structure and characteristics	Duration	Participants	Instruments	Outcomes
David L. Radford (1998)	Reform-based, active engagement, conceptual change problem-centered learning	3-week intensive summer course	90 middle-grades life science teachers	Classroom observations, surveys, student tests	Changes in teacher behavior and improvements in student attitude and achievement
Jonathan A. Supovitz & Herbert M. Turner (2000)	Inquiry-based	Minimum of 100h	Primary (K- 8) science teachers	Survey	The relationship between teacher background characteristics, teacher PD experiences, school environment characteristics, and teacher practices and classroom culture
Fernando Flores, Angel Lopez, LeticiaGallegos & Jorge Barojas (2000)	Epistemology and history of physics, theories of learning and intuitive models, experimenting and computing, and problem solving and assessment	In-service teacher course working sessions for a year and a half	12 preparatory school physics teachers	Questionnaire	Changes teachers in their epistemological and learning conceptions
Ellen van den Berg (2001)	Constructivist approach	Four three hour meetings	43 elementary teachers	Lesson observations and interviews	The effect of the program on teachers' constructivist approach practice
Tracy John Posnanski (2002)	Three main phases (planning, training, follow-up), and 16 components or strategies	Once a week for three to four hours, 32 weeks during the school year	43 elementary science teachers	Beliefs instrument, evaluation forms	Changes positively in self-efficacy beliefs and teaching behavior

Table 2.2 (continued)

Author (s)	Structure and characteristics	Duration	Participants	Instruments	Outcomes
Judith A. Morrison & Jeffrey C. Estes (2007)	High-quality curriculum, sustained PD, materials administrative and community support, student and program assessment	4-day workshop	47 middle school science teachers	Interviews, surveys, and classroom observations	Positive experience, Improve teachers’ science content and understanding
Ji Shen, Patrick C. Gibbons, John F. Wiegers & Ann P. McMahon (2007)	Conceptual change, use of research based assessment tools	Fall semester electricity and magnetism course	15 K-8 science teachers	Survey	Support using the research-based tests to identify teachers conceptions
Genaro Zavala & Hugo Alarco´ n, Julio Benegas (2007)	Constructivist, active learning, small collaborative groups, read and discuss specific physics education research literature	3-day meeting	25 in-service physics teachers	Multiple-choice test (FCI)	Improve instruction
Dorit Taitelbaum, Rachel Mamlok-Naaman, Miriam Carmeli & Avi Hofstein (2008)	Inquiry approach in the chemistry classroom-laboratory	Meetings, lasting about three hours, in once a month	14 experienced chemistry teachers	Interviews, teachers’ portfolios, documentation of the workshop, videotaped observations	Changes in teachers’ reflections, and teachers’ practice

Table 2.2 (continued)

Author (s)	Structure and characteristics	Duration	Participants	Instruments	Outcomes
Carla C. Johnson & Jamison D. Fargo (2014)	The transformative professional development (TPD)	A 2-year period	21 elementary teachers, 311 students	The state-mandated assessment	The effect of model on student achievement
Norma D. Felton (2014)	Opportunity to collaborate, content specific, practice with material and modeling of RBTS	Two week summer institutes and long term professional development (a year or two)	66 mathematics/ science teachers	Survey, Focus group discussions, individual interviews	Teachers' perceptions of the impact of research based teaching practices
Lindsay B. Wheelera, Randy L. Bellb, Brooke A. Whitworthc, & Jennifer L. Maeng (2015)	Inquiry based	A week-long session totaling 30 contact hours 7 follow-up sessions, totaling 15 contact hours	21secondary science teachers	Classroom observations, pre/post-surveys, interviews	Understanding of inquiry instruction and factors affecting implementation
Okhee Lee, Juliet E. Hart, Peggy Cuevas & Craig Enders (2004)	Inquiry-based	Four full-day workshops on regular school days	53 third- and fourth-grade elementary teachers	Focus group interviews, questionnaire, and classroom observations	The impact of the workshops on teachers' beliefs and practices

Table 2.2 (continued)

Author (s)	**Structure and characteristics**	**Duration**	**Participants**	**Instruments**	**Outcomes**
Claudia Khourey-Bowers & Doris G. Simonis (2004)	Inquiry approach	10 full days of instruction extended over a 10-month time span (paper discussed on years of the 1994, 1995, 1999 2001)	135 middle grades teachers	Out-of-class assignments, beliefs Instrument	Changes in self-efficacy beliefs, chemistry content, PCK
Yehudit J. Dori, & Orit Herscovitz (2005)	Case-based teaching method	One day per week during the 3-year period	51 teachers	Teacher portfolios, reflection, questionnaires, classroom observations, teacher interviews, student feedback questionnaires.	Improve theoretical, content knowledge, and PCK
Soonhye Park, Soo-Young Lee, J. Steve Oliver, & Bonnie Cramond (2006)	Lectures on creativity -centered science	Each day lasted for 8 hours in 2 weeks	35 secondary science teachers	Open-ended questionnaire, interviews	Changes in Korean science teachers' perceptions of creativity and science teaching
Eric R. Banilower, Daniel J. Heck & Iris R. Weiss (2007)	Content based, sustained over time	Longitudinal data from 42 projects over a span of 7 years	18.657 science teachers in grades K–8	Survey	The impact on teacher attitudes, perceptions of preparedness, and classroom practices

Table 2.2 (continued)

Author (s)	Structure and characteristics	Duration	Participants	Instruments	Outcomes
Andrew Lumpe, Charlene Czerniak, Jodi Haney & Svetlana Beltyukova (2012)	Five characteristics of effective professional development listed earlier (content focus, active learning, coherence, duration, and collective participation)	Six, 2-week-long summer program intense (over 100 contact hours annually)	Approximately 450 elementary teachers	Survey	The effect on the teacher belief systems (self-efficacy), teaching practices, and student learning
Kent J. Crippen (2012)	An argue-to-learn intervention	2-week summer science institute	42 high school science teachers	Content test, artifacts , electronic argumentation maps, group interview	Improving content knowledge (gain was statistically significant, but the magnitude of change was not large)
Danielle B. Harlow (2014)	Transformative professional development (TPD) model (engaging participants with experiences, supportive, collaborative, and meaningful discourse)	A semester-long undergraduate course	5 elementary school teachers	Interviews, observation, content exams, attitude surveys, artifacts (lesson plans, student work)	The effect of PD content course based on the Physics and Everyday Thinking (PET) curriculum on teaching practices

Table 2.2 (continued)

Author (s)	**Structure and characteristics**	**Duration**	**Participants**	**Instruments**	**Outcomes**
Melissa Lynn Kiehl (2008)	Inquiry based laboratory science	A three-year PD model	Five participants	Interviews, observations, surveys	Impacts teachers' learning and classroom practice
Tyler Beamer, Meta Van Sickle, Gary Harrison & George Temple (2008)	Constructivist teaching methods	225 hours, in a three-year program	Four teachers	Observations, survey, interviews	Increase the teachers' use of constructivist practices
Tracy J. Posnanski (2010)	Constructivist approach content knowledge, activity practice sessions, discussion, reflection, action	2 year PD project	22 elementary teachers	Surveys, action research plan documentation, classroom observations	Positive effect on developing the teachers' understanding of NOS
Jonathan Singer, Christine Lotter, Robert Feller & Harry Gates (2011)	Grade level specific contents (earth science, life science, physical science, chemistry), Inquiry based	105 contact hours 15 consecutive days, 7 h per day	13 middle school science teachers	Observation	Improve teachers' ability to use inquiry-based pedagogical practices
Diosdado M. San Antonio , Nelson S. Morales & Leo S. Moral (2011)	Module-based professional development (MBPDT) (learning activities, higher order thinking skills, mathematics, teaching approaches)	Five weeks	55 grade six elementary mathematics teachers 18,466 pupils	Surveys Open-ended questionnaire	Effects of teachers' levels of commitment (not significant) and professional content knowledge (significant) Effects of MBPDT on pupils' academic achievement (not significant)

2.7 Professional Development Research in Turkey

In this section, the studies, made on professional development in science and mathematics in Turkey, are given under the name "in-service training". As mentioned in the summary part at the end of this section, there are quite many in-service publications in the literature. Within the scope of this study, the researches made with teachers from science and mathematics group in the last 10 years are considered. For reaching these studies, Turkish Journal Park Academic in which there are more than 2 million Turkish articles was scanned by using the following keywords; Teacher professional development, in-service training, teacher training, teacher practice, teacher education, teacher career development, teacher change and teacher development. Then the following journals and indexes such as SSCI, ERIC, which are common in the field and possibly contain Turkish articles in the related subject, were scanned with the same keywords:

Eurasia Journal of Mathematics, Science & Technology Education
Education and Science Journal
Hacettepe University Journal of Education
Educational Sciences: Theory & Practice
Eurasian Journal of Educational Research

In the following section, there are some studies obtained from the literature review:

Kaya (2006) has performed an in-service training which was developed as university supported in order to provide development of physics teachers in laboratory studies. Four of thirty physics teachers, who participated in the in-service course program applied for two weeks and who worked in the schools in Trabzon province's center on June 2002, participated in the research. The data were collected with observation and interview methods. As result of this observation assessment, it was determined that the participant physics teachers still have not used the laboratory method actively in their lessons yet, however they performed 83% of the expected behaviors in in-service education and training (INSET) program and three fourth of them could use skills and knowledge they gained in INSET program in their lessons.

Akkuş and Kadayıfçı (2007) examined the knowledge level on new education approaches and techniques, point of views on laboratory usage and the cognitive levels of questions prepared for measuring understanding levels of students, of 23 Anatolian Teacher High School chemistry teachers attended in-service training on laboratory usage. Case study method was used for the research. The lessons were performed as three 90-minutes sessions each day in the 10-days laboratory usage course given in Sinop Anatolian Teacher High School's chemistry laboratory. At the beginning of course, needs of teachers, expectations from the in-service course and the content of course were discussed. The content of course was presentations on science education and laboratory usage, demonstrations on the subjects in high school chemistry program and assessment of teachers by making experiments and planning experiments by using new approaches. Five presentations which are planned to be made with new approaches in laboratory use and science education were considered in appropriate sessions during the course. The results of research has revealed that, with the in-service training course, there has been a meaningful change in point of views of the teachers on new education approaches and laboratory usage and the levels of questions prepared by teachers for measuring the understanding levels of students.

Şenel (2008) has prepared an in-service training course program (IST) related to the structured grid and diagnosis branches tests, student portfolio and performance assessment and he examined its efficiency with the alternative measurement and assessment techniques applied on science and technology teachers. In the research, case method was used. The sample of study was consistent of 40 science and technology teachers working in Trabzon and its districts. IST course in the research was prepared in accordance with the System Approach Model. In this process, while preparing IST course program, the stages of analysis, design, development, application and assessment were considered. Six science and technology teachers from the sample voluntarily participated in IST course program. Data were obtained from observation, researcher diary, interview, achievement test, questionnaire, and document. As result of the research, it was determined that IST course, which was prepared on the alternative measurement and assessment techniques, has contributed to development of knowledge and skills of participant teachers ($z=2.20$, $p<.05$). It was determined that

IST course has impacted attitudes of teacher on IST activities but there hasn't been a meaningful change. On monitoring assessment phase of the research, it was determined that two science and technology teachers participating in the course could transfer many of knowledge and skills gained in course to their lessons but they did not use them in the lessons due to the fact that analytical rubric and structured grid preparation stage is hard, inconvenient and time-taking.

Önen, Mertoğlu, Saka, and Gürdal (2009) have made a research on whether there is a difference in knowledge of Anatolian Teacher High School teachers, who participated to the in-service training, on used methods and techniques after and before IST. 104 out of 120 teachers from six different fields participated in the research. Pretest-posttest design was used to evaluate changes. Research was made in July and August 2007 within the 15-days (10 business days=1.5*4 hours/day) project work performed mutually by MoNE, Turkish Education Foundation (TEF) and Vodafone. In the qualitative research conducted with 11 open-ended questions, it was determined that the teachers used question and answer, lecturing and experiments more in their classes before the training; and no differences in terms of their experience and fields was found. However, it was determined that there have been importance increases in the teachers' knowledge on teaching methods, techniques and constructivist approach.

Metin (2010)'s study investigates on the efficiency of IST program made for performance assessment for science and technology teachers. In the research, mixed method approach has been adopted. The sample of study was consistent of 30 science and technology teachers and 245 elementary teachers working in Artvin. Twenty-five science and technology teachers from the sample voluntarily participated in IST course program. In the first stage, the relevant needs of teachers were identified with surveys and interviews. Then the course program was presented to the teachers with a 60-hours application plan. Achievement test and attitude scale were developed within the research and they were applied as preliminary test on the teachers before applying IST program and as final test after applying IST program. Besides, observations were made and the documents prepared by the teachers were examined during the research. In the last stage, observation, interviews and document examinations were made in order to determine how two of the participant teachers apply performance assessment in their classes after the course. As result of the research, it was determined that IST course, which was prepared on performance assessment, has contributed to development of knowledge and skills of participant teachers. It was determined that IST course has impacted attitudes of teacher on performance assessment but there hasn't been a meaningful change.

Aydın and Çepni (2011) have developed a professional support program based on Continuous Professional Development of Teachers (CPDT) model in order to contribute to use of Project-Based Teaching Method (PBTM) in classes by science and technology teacher. This support program is consistent of two stages. On the first stage, an in-service training course on PBTM was given to the teachers and the teachers prepared draft projects in seven groups under consultancy of academicians working in universities. 14 science and technology teachers participated in this stage. On the second stage, five volunteer teachers among the science and technology teachers participating in the first stage made their students prepare projects and the researchers directed them in this progress. Interview was used as data collection tool in the study. The interview, which was applied before the support program, was used for determining needs of teachers about PBTM and the interviews, which were applied after each stage, were used for determining the supply statuses of these needs. NVivo 8.0 was used for qualitative data analysis. Quantitative results were obtained from project scores. According to the results obtained from the study, it was seen that the support program has been effective in meeting the relevant needs of science and technology teachers on PBTM.

Doğan, Çakıroğlu, Çavuş, Bilican, and Arslan (2011) conducted an in-service training program supported by MoNE and TUBITAK for a week with 44 elementary science and technology teachers in the subject of NOS. Summer training program focused on NOS tenets. In determination of teachers' opinions on nature of science, 14 questions of Views on Science, Technology and Society (VOSTS) survey were used as preliminary and final tests. Teacher views were categorized as “naive”, “merit” and “informed”. It was determined that the opinions of teachers on "scientific information is based on evidences obtained from experiments and observations, nature of classification level of scientific information, “Scientific Method” myth and epistemological situation of hypothesis" have developed positively after the training.

These results reveal that the in-service program made effectively to change teachers' NOS understanding.

In the thesis study carried out by Esendemir (2011), the impacts of a PD program, which is prepared through mathematical problem solving and metacognitive thinking skill, on development of the teachers' knowledge levels and the impacts of teacher development on understanding and awareness of students in problem solving were examined. 15 elementary classroom teachers and 15 elementary mathematics teachers working in Gaziantep and 761 first school students before training and 550 first school students after training participated in the research. Participants received a 4-week (a total of 16 hours) of development program. The data on development of teachers were collected with surveys consisting of open-ended questions and video records. The data on student development were collected with a survey consisting of open-ended questions applied after and before the PD program. As result of analysis of data obtained within the study, it was determined that the development program has contributed to development of understanding and awareness of teachers on problem solving and metacognitive thinking skills as well as development of students in problem solving with help of aforementioned developments.

Demir, Böyük and Erol (2012) have developed a training program through the educational needs on laboratory usage of science and technology teachers who work in rural areas and have limited laboratory facilities and they presented the assessment of its pilot application. This program, named Mobilim Education Program, was developed based on the system approach. An important factor separating the program from the other training programs is that the application place was a mobile laboratory. The application was conducted with participation of 46 teachers in the yard of Yozgat Province Erdoğan Akdağ Primary School and it lasted 15 business days and totally 90 hours. Mobilim evaluation questionnaire and Mobilim interview form were used as data collection tools. As result of analysis of data obtained from the study, it was concluded that the applied training has made important contributions to laboratory works of teachers and improvement of teachers' laboratory skills. It was also determined that such applications should cover the students either.

Baş (2013) examined the change of teachers' noticing (i.e. understanding of students' mathematical thinking) on the students' mathematical thinking within a PD program prepared in accordance with the principles of model and modeling perspective. Case study approach was adopted in the research. The study was made in two high schools with four secondary mathematics teachers in 2011-2012 education term. Program duration was seven months divided into one-month terms and three 1-week stages were passed in each term. These stages are respectively an introductory meeting, application of modeling activities prepared within the program and the follow-up meeting. One-to-one interviews were made with teachers after each follow-up meeting. In analysis of data, a previously prepared frame was adopted and used for examining development of recognition skills of teachers on mathematical thinking of the students. As result of the analyses, it was determined that there has been development in three teachers' noticing on mathematical thinking of the students.

Yılmaz (2013) has developed and implemented an in-service training (INSET) through gaining the necessary professional knowledge and skills for the elementary school mathematics teachers to gain reflective thinking skill and to use this skill effectively in lessons. The sample of study was consistent of six elementary mathematics teachers. The study was made with mixed approach and it was completed in four stages. In the first stage of research, IST needs for the elementary school mathematics teachers to gain reflective thinking skills were determined and literature review, survey and interviews were made for this. In the second stage, a course program on INSET needs of teachers was developed. INSET program was created within the research and a system approach model consisting of five stages as need analysis, design, development, application and assessment was adopted. In the third stage, the course program was given to the teachers with a 20-hours application. Interview and reflective thinking trend scale (RTTS) were applied before INSET within the research. This scale was re-applied for examining knowledge-skill change after the training. Besides, the teachers were requested to make theme diaries during the training and the documents they prepared were examined. In the last stage, they were asked to assess INSET. As result of the research, it was determined that INSET, which was prepared for gaining reflective thinking skill, has made contribution on development of qualitative knowledge and skills although there has been no meaningful quantitative change. The documents prepared and the discussions made have supported the necessity to integrate reflective thinking to mathematics education. Besides, it was determined that the teachers generally assess IST positively. Suggestions such as provision of environment to take teachers to IST in certain periods, making IST special to branches and gaining and applying this skill by the teachers were made.

The purpose of Koç (2014) is to examine impact of teacher-centered, Reading-Writing-Application (RWA) and Student Teams-Achievement Division (STAD) methods used in application of cooperative learning model to academic successes of students in science and technology lessons; and to inform science and technology teachers working in Ağrı on cooperative learning model. The sample of study was consistent of 25 science and technology teachers and 331 students studying at 6th, 7th and 8th classes in four elementary schools in this province. Thirty-six hours of workshop on cooperative learning model was given to the science and technology teachers within the study. After the course, four teachers were selected for performing the applications in schools. In the research, pre-workshop and post-workshop scales on cooperative learning model, pre-achievement tests for students, academic achievement tests and attitude scales for students were used. Study was made in three different groups for each class. In the first of these groups, RWA method, in the second, STAD method and in the third, traditional teaching method was used. Descriptive statistics and one way variance analysis (ANOVA) were used. As a result, it was determined that the workshop has made great contribution on both theoretical and practical learning of teachers on the cooperative learning model. Besides, it was determined that RWA and STAD methods have generally similar impacts on academic successes of students but STAD method is more effective on some groups and these students are more successful than the students studying with the traditional method.

In short, it is noticeable that the trainings given as in-service training in Turkey are generally made as short seminars. The subject content is mostly a single field and/or method. It is seen that only the researchers are educators in a big portion of studies.

When the assessment on quality of training is considered, it is seen that it is made by using methods such as survey and interviews either during PD or just after PD. Not much research is made on variables such as in-class applications of participant teachers or the students' success. Almost all of publishing as articles and/or thesis are researches made by academicians in universities. There are scarcely any studies on in-service trainings conducted by MoNE. When the content of publishing are considered, in most of time, there is no detailed information on the components forming IST trainings and the application method of them in the system. This either reduces the common impact of applications made or prevents feedbacks that may be gained in long terms.

Some In-service Training Models Currently Applied in Turkey

School Based Professional Development (SBPD) Model was created by MoNE for school managers and teachers to meet their individual and professional development needs through their general and field-specific qualifications. The SBPD model is a road map for managers and teachers to question their individual and professional qualifications by taking self-assessment and performance assessment results as base, to create development targets and to make necessary applications for reaching these targets (MoNE, 2007). The following issues are targeted with the School Based Professional Development Model:

- School managers and teachers to determine the fields in need of individual and professional development by making self-assessment,
- School managers and teachers to become more conscious on the new approach and information about school development and teaching strategies,
- School managers and teachers to share their experiences with their colleagues and to reflect these to their implementations,
- To increase teaching and learning quality,
- To increase students' participation in all kinds of learning and development progresses,

- To take advantage of expertise and experiences of school managers, teachers and other shareholders due to development of school culture (values, norms, symbols, traditions, etc.),
- To integrate the school with the environment and to use environmental facilities more for solving the problems of the school due to development plans of the school (MoNE, 2007 p.3).

With this model, the teacher will perform his/her development at his/her duty, in the school. He/she works without disrupting his/her education-training progress. Thus, it is much more economical. The teacher creates his/her own development model. The teacher is an active participant in preparation, application, observation, interpretation and assessment of own professional development plan. Thus, he/she plays an active role in the development process.

Another in-service training model currently applied in Turkey is the Innovative Teachers Program performed within Microsoft's PIL Program (Partners in Learning) in 86 countries with support of Microsoft. It was started in Turkey with the protocol signed between the Ministry of National Education and Microsoft in 2007. Emphasizing the teacher as “continuously learning individual” role model is among main targets of the program. It shows teachers how to take advantage of national and international education and development facilities by using technology actively. It makes available the web portals prepared specially for teachers and enables the teachers to present themselves, applications they make and the projects they prepare. At the same time, it is an umbrella program covering global and regional sharing conferences and award programs. In the Innovative Teachers Program performed in volunteering principle, the main target is to grow new “Innovative Teachers” by the "Innovative Teachers", who have taken partner orientation and leadership training, as “Guide Innovative Teachers” in the next stage in cooperation with the managers in their own region especially in their own schools. In this way, it is targeted to make great common impact.

2.8 Summary of the Literature Review

There are many research investigated of PD effects in terms of different outcomes in the literature (e.g., beliefs, self-efficacy, practices, content knowledge, student achievement, etc.). Common core features of PD given by Desimone et.al. (2002) content-based, coherence, duration, active learning and collective participation are confirmed by some studies in the literature (Borko, 2004; Darling-Hammond, 1997; Darling-Hammond&Richardson, 2009; Lieberman 1995; Penuel, Fishman, Yamaguchi & Gallagher, 2007). Literature also discussed the ineffective of PD programs that is not follow-up, traditional style seminars or workshops, without specific content aligned with curriculum, and lack of information of planning and transferring to the classroom setting (Fullan & Stiegelbauer, 1991). Literature has also indicated that the importance of need-based analysis before starting the PD development (Lieberman & Wilkins, 2006; Ricketts & Duncan, 2005).

Although there is a consensus on that PD programs have some characteristics, it is not more clear evidence to how these characteristics were combined together and affected teachers' practices with systematic data collection procedures in long term duration. Most research conducted in short time duration as a seminar or workshops (traditional style) that are not effective to improve the teacher development (Clarke & Hollingsworth, 2002). On the other hand, longitudinal research usually spread over more than one year and financially support with a project. PD programs built on general learning approaches such as constructivism and inquiry based learning. Literature has limited research on content specific PD programs and pedagogical approaches in special discipline. Most PD research was found at elementary level. As a missing part there is a need for more research to examine the changes in real classroom situations after participating in a PD program (Eylon, Berger & Bagno, 2008). Teacher professional development in science is itself inherently complex, consisting of many interrelated components. Therefore, it is necessary for research to focus on the nature of relationships between these components (Hewson, as cited in Lederman, 2007) and explain them in its own context.

In Turkey, there are the same deficiencies similar to international PD literature. Most PD research was made in the format of in-service training carried out in short-time duration. Instead of focusing specific content, they include more general topics. Teacher opinion surveys are generally used to measure the effectiveness of trainings. There is no detailed information about the training components and its long term effects. On the other hand, recently some model based research initiatives such as SBPD created by MoNE and Innovative Teachers Program with support of Microsoft have been performed.

Based on the gaps that are summarized by the literature review above, this study aims to address the following deficiencies:

The effect of PD is measured by considering different variables in the literature. There are few studies on the reflection of these PD programs on teaching practices and the achievement levels of students. In this study, the change in teachers' classroom practices after the PD program was taken as a measure of the success of the program. As I understand from the literature review, there are PD models (designs) using different forms and/or types (e.g., lesson study, workshop) or approaches (e.g., constructivism, inquiry based) in combination with different characteristics (e.g., collaboration, content specific). Based on this, I try to develop an effective PD model framework including teachers who work together on a voluntary basis through face to face (workshops) and non face to face interactions. Considering the adult learning theory, this model incorporates effective PD characteristics in one research design and investigates what happened before and after the PD program in terms of teacher practices.

There is a common consensus on the main characteristics that are supported by different studies in the literature. In addition, the literature specifies some characteristics as ineffective. There is a need for more evidence to show how these effective PD characteristics are integrated in PD programs and to describe the whole PD process in detail. According to the results obtained from all of these studies examined in depth, 12 PD characteristics are put together in this PD model framework.

The literature review has shown that the impact of PD trainings on teachers' practices was generally measured with teachers who teach at elementary level. The study is performed with the participation of physics teachers at the high school level. In this respect, it is believed to contribute to the literature.

CHAPTER 3

METHODOLOGY

This study proposes a professional development (PD) model to improve in-service physics teachers' practices. It includes qualitative methodology using multiple data collection methods. This chapter provides information about the methods and procedures used in this study. The following sections construct the structure of this chapter.

3.1 Research Design and Rationale

This study employed qualitative approaches. Main focus is to improve in-service physics teachers' practices due to the PD program.

3.1.2 Research Methodology

This study is used both action research and qualitative case study research methodology. Action research is a type of inquiry allows investigation of situations to improve practices (Fazio & Melville, 2008). I focused on the process in which what is happening and how it affects to the research group. Teachers involved in action research process. Teachers helped researcher to form the study. According to need analysis results, teachers were unsatisfied with previous PD programs. Based on the pre data analyses, problems are identified about teachers' practices in the learning context. I searched existing conditions and set goals. I assessed teachers' performance with careful observations and students' interviews. Teachers need support and guidance for the implementation of a new curriculum unit. To improve the quality of education, a PD model is proposed and reviewed in the process.

Case study is a systematic process to search events by collecting, and analyzing data to explain of why event happened (Gerring, 2005). The total group of teachers participated in the PD program is a single case of my study. The PD program was investigated to see the teachers' changes. Case study is complemented by action research process in the study to investigate the success of the PD program. Multiple data collection methods (survey, observations, interviews, document collection) were used. Teacher selection, measuring instruments, qualitative data analysis, procedure, design and implementation of the PD program are presented in the following sections.

3.1.2.1 Teacher Selection

Main participants of the study are in-service physics teachers. Firstly, participating teachers in the PD program were chosen based on the following criteria announcing via e-mail, social networks or online websites, and communicating school and their administrations in Ankara. These criteria are:

(1) To work in state public high schools or private schools as a physics teacher
(2) To teach in 9^{th} grade before and will teach then
(3) To have interest in new physics curriculum and its development
(4) To have willingness to participate in the study

As much as possible, I intended to reach in-service physics teachers in Ankara. I created a database of teachers' e-mail. I announced these criteria to them by a Google Docs survey. At the same time this group of teachers (N=64) were asked in which content areas they wish to attend in the PD program. I intended to study in 12^{th} grade NOP unit as well. I asked teachers the possibility of studying on this unit in a survey. I was concerned that it is the last unit of 12^{th} grade physics curriculum. They indicated it is impossible to find students and implement this unit completely. For that reason, I just focused on NOS unit in 9^{th} grade level. An open-ended question was asked teachers expressing their willingness in more than one specific content area related to NOP unit. Results were given as following:

- NOP knowledge and its misconceptions (80%)
- Teaching strategies (methods, techniques) (75%)
- Materials/technologies (68%)
- Assessment techniques (65%)
- Laboratory applications (40%)
- The use of computers (28%)
- Others (classroom management, project development training, etc.) (15%)

Nearly similar results were also found by Öztürk Akar (2007). 338 biology teachers stated that they need professional training more in some specific subject area such as; new effective method/techniques (N=70), effective use of internet, learning technologies (N=59), and measurement/assessment (N=11). Considering incoming results and feasibility conditions, it was decided to design in the first four content areas which were the most desired. Teacher survey on the NOP unit PD program (TSNOP) (Appendix A) was developed. TSNOP was implemented to select teachers to be observed and to determine teachers' needs. In the administration process, survey was given to in-service physics teachers by hand, e-mails or sent to their schools. I provided to return them back by communicating teachers or vice principals of those schools more than once. I also asked teachers who I know to deliver this survey to their colleagues. Survey was commonly distributed and collected by me. I gave this survey between June and July term in 2012. Sixty surveys returned to me (90.9% response rate). I directly asked teachers whether they want to take part in this PD program. According to the results in August, 2012, 20 teachers said "yes" to involve in the program. I obtained teachers' contact details and announced them at the beginning of September. Five of them indicated they will not have 9th grade or they will not allocate time for this type of intensive program. 2012-2013 fall term observations of NOP unit were made with the remaining 15 teachers. While there was a little time for the beginning of Workshop I, four teachers indicated they were not able attend to the program because of private reasons. Then, totally 11 teachers participated to the PD program. Although 11 teachers participated in the PD program, the entire study was carried out by seven teachers. I was not able to observe four teachers in 2013-2014 fall term because of health issues, the task of administrative work in school, school change, and the lack of given 9th grade. Seven teachers named in this study as TA, TB, TC, TD, TE, TF and TG, for research convenience. Table 3.1 shows teachers' demographics and their professional experiences from TSNOP survey.

According to the table, seven teachers (1 male, 6 female) participated in this study. Two teachers are graduates of science faculty and five of faculty of education. Teachers have different degrees from undergraduate to doctoral program. They had 20.7 years of teaching experience on average. The distribution of school types is Anatolian, vocational and sport schools. Work/project related to education and previous PD experiences are given in a detailed manner.

Table 3.1 Teachers’ demographics and their professional experiences

Teachers	**[1]Gender**	**Faculty graduated**	**Degree**	**Years of teaching**	**Type of school**	**Work/project related to education**	**[2]Previous PD experiences**
TA	F	Education	MSc	18	Sport	-	• 4 times, 15 days, related to curriculum knowledge, passive participation • 4 times, 25 days, related to curriculum knowledge, active participation
TB	F	Education	BS	26	Anatolian	Science fair	• 4 times, 4 days, related to curriculum knowledge, assessment, passive participation • 1 times, 15 days, related to basic computer, active participation
TC	M	Education	BS	24	Anatolian	Writing physics books	• 1 times, 20 days, related to basic computer, active participation
TD	F	Education	MSc student	19	Vocational	-	• 2 times, 18 days, related to curriculum knowledge, passive participation • 4 times, 28 days, related to curriculum knowledge, assessment, active participation
TE	F	Science	BS	23	Anatolian	-	• 1 times, 15 days, related to curriculum knowledge, passive participation • 5 times, 39 days, related to curriculum knowledge, material development, active participation
TF	F	Education	PhD	11	Vocational	Research project	• 2 times, 9 days, related to curriculum knowledge, passive participation
TG	F	Science	BS	24	Vocational	-	• 3 times, 129 days, related to curriculum knowledge, basic computer, passive participation

[1]= F: female, M: male
[2]= The total number and duration of trainings so far, PD content, and the role of participant, respectively in the previous PD experiences section.

3.1.2.2 Measuring Instruments

Data collection tools are teacher survey on the NOP unit PD program (TSNOP), observation form (OF), student group interview protocol (SGIP), documents, treatment fidelity expert opinion form (TFEOF), treatment verification opinion form (TVOF), and professional development program evaluation interview protocol (PDEIP). All measurement tools are explained in the following sections.

3.1.2.2.1 Teacher Survey on the Nature of Physics Unit PD Program

Need assessment is used in research area to find out particular problems and points current situations about the topic being studied. It is recommended to provide evidence-based results and be data-driven (Hayes & Robnolt, 2007). The main purpose of this survey is to explore teachers' needs for the PD program. Survey developed by the researcher to:

(a) select teachers and get their demographics information.
(b) explore teachers' previous PD experiences, issues, concerns and their ideas for possible solutions to the problematic areas.
(c) determine content specific needs and get information for planning structure of the PD program.
(d) gather any opinions about the PD organizations.

TSNOP survey was developed in approximately four months (between January to April in 2012) investigating by current PD literature (see for the first version of TSNOP in Appendix B). Need based studies were analyzed and existing surveys were searched during the development process. I and my advisor had regular meetings to develop need based survey. We also prepared expert opinion form presented in Appendix C to validate this survey. TSNOP survey and expert opinion form together were given to 13 experts (8 academicians and 5 teachers). They checked TSNOP according to content, language, format and appropriateness of the development purpose. They also gave feedbacks about the readability and checked whether questions are understandable or not. Percentage agreement was 95% among the experts for all items. In addition, a 45-minute interview was conducted with a physics teacher.

I told her she could think aloud and feel comfortable during the interview. I took some notes when she was completing the survey. By regarding to all feedbacks coming from experts as seen in Appendix D and the interviewed teacher, the survey was modified. Pilot study was applied in an in-service training program held in May, 2012. Twenty-two in-service physics teachers filled in the survey. They were asked to check and make comments if there are problematic parts. The last version was created without any changes. The survey was elaborately prepared consisting of structured and unstructured question formats. Final TSNOP survey provided in Appendix A has 10 pages consisting of 4 parts. The first has demographics information from participants. Second part comprises of some questions about the teacher professional experiences. It is aimed to learn teachers' concerns and issues faced with the previous PD programs. Teachers are also asked to propose some possible solutions for these problems. They answer some more specific questions about how training can be organized (e.g., type, context, roles in PD, time, etc.) in the third part. They express their requests about general features (collaborations among teachers and researcher, evaluation procedures, supports, incentives) of the PD program. If they want, the teachers may indicate general opinions and thoughts in the last part of the survey.

3.1.2.2.2 Observation Form

Observation is a strong mechanism to make detailed explanations and descriptions about the phenomenon being investigated in the natural setting (Yıldırım & Şimşek, 2006). In the qualitative nature, this record is taken to what the researcher sees, hears, experiences, and thinks in the context of the study. In-service physics teachers' real classroom teaching practice may be different from what they intended to plan. That's why observing their lesson enables researchers to find out how their lesson actually works and occurs in the classroom.

One of the aims of my study is to observe in-service physics teachers' classroom practices and investigate implementations on the related curriculum content. I documented how teachers put the PD training into practice and change in their behavior before and after the development program. I developed unit-specific observation form (see Appendix E for the first version of OF) to show how extent objectives of unit are delivered and transferred by the teachers.

For validity purpose, I got expert opinions to improve form and check if there are some problematic and unclear parts. Six academicians as experts gave their feedback (see in Appendix F for the analysis of the expert evaluation of the OF) to improve this form. 2012 fall term form included the NOP unit and its objectives are given in Appendix G. On the other hand, as the new curriculum has been implemented since 2013, the form given in Appendix H was modified preserving the original structure and made available to the ISOP unit content. I just added new objectives of 2013 curriculum into the existing form. I observed all class lessons in 2012 and 2013 term without any break. Sometimes I had a change to observe teachers' another classes. This provided me evidence to see all classes were taught as the same way by each teacher.

Form development process took five months. It was developed based on NOP unit curriculum objectives. It consists of two main parts. Part I evaluates how teachers deliver content/skill teaching strategy, material/technology and assessment in their classrooms during the whole unit implementation. Changes in practices were assessed in terms of variety, increase in number, and quality as a result of the PD program.

Part II covers the general elements (e.g., physical situations of the context) that may be observed related to the course. In addition, form has evaluation column for some tables. It requires the ratings as "3=good", "2=medium", "1=poor", and "0=irrelevant" to evaluate the quality of using teaching strategies, material/technology and assessment. Each curriculum objective was elaborately evaluated.

In the development process, literature was searched to find similar forms. Actually, this form is not a similar classroom observation form types. This is not a checklist style. Observation form was in the same format for each unit objectives and coded with related objectives numbers. After identifying the presented objectives in class, observer can complete the some parts of the form during the teaching. All classes were audio-recorded to get more reliable results. In order to display the overall situation, all forms were completely filled with the help of classroom taking notes and transcripts after the each lesson.

3.1.2.2.3 Student Group Interview Protocol

This group discussion method provides interactions among the different group of members to identify different perspectives given on the particular topic. It is a systematic questioning technique conducted in formal or informal environments (Fontana & Frey, 1994).

I conducted group interviews in participating teachers' observed classes. For that reason, I developed SGIP (see the first version of SGIP in Appendix I). I discussed implementation of the unit with the students in their natural settings. I saw how students interacts each other on the common topics. They responded to the questions showing agreement or disagreement about the unit teaching in their classes. They were also encouraged each other to verify what did during the teaching. SGIP was made for the two purposes in 2012 term, before the PD program. One of them was made a need assessment to see the problems of teachers' implementations and their students' requests. This helped to develop the PD program. Second, it provided support to the observation results of each teacher. SGIP was used again to represent the changing of teachers' practices in 2013 term. I was a moderator during the unit implementation in the classrooms. At first, I explained the process and introduced myself to the students. I asked students their experiences about the lesson and their opinions for their own teachers' practices.

Experts gave feedback for the development of interview questions. The analysis of the expert opinion for the SGIP is presented in Appendix J. Questions in 2013 as seen in Appendix K were in the same parallel with the version in 2012 protocol (see Appendix L for the SGIP-2012 version). Interview protocol has two parts; first part is related to the PD content dimensions and their implementations in the classes of teachers, second part consists of general questions about attitudes toward unit and opinions to improve lesson. Teachers obtained the summary of the first group interview results to see their tudents' opinions about their lesson. It motivated teachers at the beginning of the PD program. Interviews lasted one class hour.

3.1.2.2.4 Classroom Documents

Document is a written material that includes information about the phenomenon being investigated. It can be used as a supplementary material to main data collection methods (Yıldırım & Şimşek, 2006). I collected students' notebooks after the unit implementation in two terms. I obtained two notebooks from different classes taught by the same teachers. Before the Workshop I, teachers received the results as a summary format. For the two implementations of the unit, assessment tools (exams, quizzes) used in the classrooms were taken to see the changes in assessment dimension.

3.1.2.2.5 Treatment Fidelity Expert Opinion Form

It is important to ascribe the changes observed in teachers' practices to the PD treatment. Before the study, treatment fidelity was ensured in some ways. The PD characteristics used in this program were selected by a detailed literature review. For the treatment fidelity, a form (Appendix M) was developed and sent to the experts who are university members and profession in PD and teacher education research. A detailed explanation followed after the each PD characteristic. Two questions with three choices ("yes", "no" and "partially") were asked to the experts. These are: "Could this title given be a characteristic of the PD program?" And "Is given the characteristic and its explanation integrated into the PD program?". If they want to make any comment and or add new characteristics, there is also an explanation part in the form. They approved for each characteristics which can be as PD components. They evaluated all the PD characteristics. They also gave some comments and made corrections of unclear parts before the PD program. In addition, I regularly met with my supervisor to construct and check the PD characteristics. Every step of the PD treatment was reviewed by the supervisor and me.

3.1.2.2.6 Treatment Verification Opinion Form

Treatment fidelity opinion form was modified for treatment verification of the PD implementation (see TVOF in Appendix N). I had explicitly identified my PD characteristics and wrote clear explanations of them in the treatment fidelity form. Based on the treatment verification, the same PD characteristics were verified by seven teachers and me after the PD program. For this purpose, the question "Did you do the things that I wrote in the 'What I did' section in the TVOF form" was asked. Teachers were asked if they have additional opinions to improve this model with this form. There is one question with three options ("yes", "no" and "partially") to approve the characteristics on the form. As a same manner, form has explanations/opinions column for additional information. It took approximately 20 minutes to fill the form.

3.1.2.2.7 Professional Development Program Evaluation Interview Protocol

Interviewing is one of the data collection methods. It is used when "we cannot observe behavior, feelings or how people interpret the world around them" (Merriam, 1998, p. 72). So, this technique can provide to remove the limitations of the observations. Interviewing is explored what is in someone else's mind about the concept.

Teacher reaction is measured by a set of questions at the end of the teacher PD program (see the first version of PDEIP in Appendix O). The feedback about the interview protocol given by six experts was assessed. Teacher educators found the protocol is clear and they just suggested some minor corrections. Based on these opinions, the arrangements made on PDEIP are given in Appendix P. All experts are university members. They are specialist in teacher education.

The final interview protocol (Appendix Q) consists of five open-ended and a rating scale questions. Teachers gave opinion about the overall PD activities and evaluate the strengths and weaknesses of the program. Data were collected from teachers with 40 minutes semi-structured interviews. Interviews were conducted using audio recording by the permission of the participants. In addition, reflective notes were taken to interpret the progress of the interviews.

During the interviews I talked with the teachers as a friendly manner. Although I asked the list of interview questions, sometimes they were free to add additional information and expressed their opinions related to topics. I took some notes on the critical points and then I transcripted the interviews without passing more time so as to remember much more things and make comments in conjunction with raw data.

3.1.2.2.8 Qualitative Data Analysis

In the qualitative analysis method, data were investigated to make sense of and infer from social settings. It includes some general steps as: collecting and organizing the data, reading data to understand overall meanings, arrangements the information by coding, placing the codes under the meaningful themes and categories, choosing the appropriate representation, and interpreting the results for the intended purpose (Yin, 2011). There is no a step by step process instead researchers can make changes and use iterative path. Initially, research process reshaped according to data results. My focus is to utilize thematic coding under the name of four dimensions: (a) content/skill/ misconception, (b) teaching strategy, (c) material/technology and (d) assessment. I carefully read the note takings, and comments that can be relevant to my study. I categorized range of answers of each questions to develop the same categories in TSNOP survey. Frequencies were calculated and tables were created to display data. Questions were included in the related parts, so categories were listed before the developing of the survey. Findings common codes were easy for that reason.

To code observation data more accurately: I developed coding manual observation form (Appendix R). Then this form was clarified and modified with my supervisor to make sure the consistency of data coding. Major criteria lists were created and set of rules were put for each dimension. To increase to the reliability of coding, the scoring criteria for the quality of three dimensions (teaching strategy, material/technology and assessment) was prepared.

As indicated in Table 3.2, totally 60 and 64 hours were observed in NOP and ISOP units, respectively.

Table 3.2 Timetable in observation classes

Teacher	2012 (9 h in the curriculum)	2013 (8 h in the curriculum)	1st observation	2nd observation
TA	10	9	9A	9A
TB	8	10	9A	9D
TC	8	8	9D	9D
TD	10	10	9M	9M
TE	9	9	9D	9B
TF	7	9	9B	9B
TG	8	9	9A	9F
Total (h)	60	64		

There were two hours of physics lessons in 9th grade high schools. Classes were selected randomly. In addition, availability of the researcher schedule was important, because I observed 15 classes in 2012 term. This number decreased to seven classes in 2013. Classes were selected in the same order of last year's lectures for each teacher considering this might be an effect on teachers' practices. For example; Teacher TB gave her first physics course to 9A students in 2012 and to 9D students in 2013. I used the same coding manual observation form in the two terms, because I wanted to compare the common topics in two units. New curriculum objectives and skills were also integrated in 2013 observation form. All lessons were transcripted by me and stored in word documents. The first six hours (nearly 10% of the total observed hours) of teachers' classes which are randomly selected in 2012 term, were also observed by one of a research assistant. Before class observations, he was trained and got necessary information about the coding process. At the same time we were in class and took notes individually. Then I gave him coding manual observation form with lesson transcripts. We coded independently. The consistency of coding rate was found 80% among us. After having long discussions on the disagreements, we arrived at a common consensus with the 92% agreement. After that, I continued coding myself. I needed to do more coding practices to get more reliability results from the observation data. It was iterative process, so if I had a problem on coding, I consulted my advisor with weekly meetings. Separate folders for each participant were created. I analyzed teacher by teacher preparing detailed coding schema in each dimension (see the sample coding schema for content/skill dimension in Appendix S). I wanted to be familiar with all teachers' practices. I filled the form detailed in 2012 and 2013 seperately (detailed coding example of the observation form is given in Appendix T). After coding the observation form in 2012, I selected a sample (randomly one of teachers' whole class data) and examined the same data nearly a month later. I calculated the agreement rate among the two same data and found as 97%. After the detailed investigations, I reached full agreement with my previous coding. Then I compared the two terms results in order to show the changes in practices. According to level of participation rate, observation results were analyzed based on this ranking in each PD content dimension. Teachers categorized as in upper and lower group to show the PD program effects associating with participation level. Group averages were measured and changes were given by showing difference between 2012 and 2013 year. Data were displayed in tables.

Interviews (SGIP and PDEIP) were tape-recorded and then transcribed question by question. I wrote notes and codes on the manuscripts. I re-read data many times to be familiar with contexts. I prepared coding scheme sorting out categories and sub-categories. A thematic approach (Miles & Huberman, 1994) was used to analyze coded transcripts. During the interviews, I preferred using everyday vocabulary instead of terminology. I used prompts (nonverbal noises such as “Ok” “Yes” and probes (e.g., has anyone else had the same thought?) to stimulate and expand discussions. Interviews were passed in everyday language. Data results were represented in tables.

As a document, notebooks were investigated based on unit content. Missing parts and wrongly delivered topics were noted and summarized. Exams and quizzes made for summative purposes were collected from participating teachers’ classrooms to check the content validity of the tests. Table of specification was prepared for each test and results were given in tables to show the quality of assessment for formative purposes.

Study focuses on in-service teachers’ practices and investigates any changes as a consequence of the PD program. Research purpose, questions, research types and measurement tools are summarized in Table 3.3.

Table 3.3 Purpose, research questions, types of research, and data collection tools

Purpose	**Research questions**	**Types of research**	**Data collection tools**
Improvement of teacher practices (due to the PD program)	What is the effect of the PD program on in-service physics teachers' classroom practices? (i) To what extent are the common topics and skill objectives delivered, and content specific misconceptions/cautions emphasized by in-service physics teachers in physics classes before and after the PD program? (ii) What and how frequently and effectively teaching strategies are used by in-service physics teachers in physics classes before and after the PD program? (iii) What and how frequently and effectively instructional materials/ technologies are used by in-service physics teachers in physics classes before and after the PD program? (iv) What, for what purposes, how frequently, and effectively assessment techniques are used by in-service physics teachers in physics classes before and after the PD program?	Qualitative	▪ Observation Form ▪ Student Group Interview Protocol ▪ Professional Development Program Evaluation Interview Protocol ▪ Classroom Documents

3.2 Procedure

The procedures of the study are explained as followings:

(1) After the decision is made to work with teacher PD, an initial literature review conducted to build a logical framework for the research. As the study progress, a detailed literature review continued in all the time. I labelled some key terms of my study. The initial key terms are as follows: teacher professional development,

in-service training, staff development, classroom practices, and in-service teachers. Then, general references were searched for the relevant primary sources such as; Educational Resource Information Center (ERIC), International Dissertation Abstract Database, Science Direct, Social Science Citation Index (SSCI), Ebcohost and Thesis Research of Council of Higher Education. To reach primary sources in international e-journals, library databases were searched such as; Journal of Research in Science Teaching, Teaching and Teacher Education, Journal of Teacher Education, Teacher Development and International Journal of Science Education. To reach primary sources in Turkey the following journals were searched manually: Hacettepe University Journal of Education, Education and Science, Journal of Turkish Science Education, and Gazi University Journal of Gazi Educational Faculty. Then, books were reviewed by using determined key words in internet and library search. Articles were categorized in terms of publication year and put the files giving their journal names. Continuously and periodically new articles were checked and added to these files. After the review of the related literature, obtained resources were read by taking notes. Finally, if there is an additional source in the reference part of primary sources, these sources were obtained and read. At that time, I was abroad as a visiting researcher at Harvard University. I searched all databases using Harvard library portal (Hollis+, http://library.harvard.edu). A review of literature was conducted between February, 2012 and April, 2013.

(2) Based on the literature review, I focused more on PD characteristics. I started to think like a designer and then constitute of my research framework. I wanted to select appropriate physics topics and see teacher PD results on this. I am interested in NOS as a concept and conducted research with this topic before. Although this research area is perceived as an easy concept, I knew there are many misunderstandings of all levels of learners. After discussing my supervisor, I chose related topic to my research interest. NOP was the first unit of the 2007 physics curriculum. It took place in the physics curriculum for the first time. Teachers might not be familiar more and could not have enough pedagogical equipment. Therefore, I decided to study on the NOP unit as PD content. Then I need to focus on improving some specific teacher knowledge bases related to this unit.

I created a Google Docs survey asking teachers to their preferences of components of effective teaching to determine specific PD contents. They preferred PD training in four dimensions that are named as; content/skill/misconception, teaching strategy, material/technology and assessment. I developed need analysis survey based on the NOP unit to find out teacher professional development needs and explore their PD experiences. During the development process of the TSNOP, experts gave opinions for revision of this tool. It also helped me organize of my PD program. I also used this survey to select the participants of my study.

(3) I developed some instruments for the purpose of the study. All of them were checked many times by experts for validity and reliability purposes. The main data tool of my study was observation form. It was implemented two times in 2012 during the NOP unit and in 2013 during the ISOP unit. OF gave detailed results for the comparison of teachers' practices in two terms. I observed only one class of each teachers and audio-typed all lessons. I did note taking to get more information in each lesson. I listened to all audio recordings, transcribed and then coded on observation form. I used well designed coding book to get more accurate consistent result. One of my friends also coded some of lessons to ensure coding reliability. A content specific achievement test was developed for the NOP unit. In the scope of this study, it was not used as a PD outcome to see the effects of PD program on students' achievement. Pre-post test results of achievement test (in percentages) were given teachers before the PD program. They were aware of their students' situations and motivated more to the trainings. At the end of the units, participating teachers' classes were interviewed by me. I allocated one class lesson asking students to evaluate the classroom teaching during the units. I did it again after the PD program. First term interviews provided for need analysis through the eyes of students. I used some results for the PD design. Results were given to the teachers as the same purpose of student achievement test results before the PD program. I compared two semester interview data to collect more evidence of changing of each teacher's practices. As documents, students' notebooks were evaluated in two terms. Two different notebooks from different classes were collected after teaching and assessed in two semesters. Class exams

and quizzes were collected to the analysis of teacher assessment. Treatment fidelity and verification opinion forms were developed to check the PD implementation. These were the same format with different purposes. Treatment fidelity form was assessed by experts before the PD program, while treatment verification was evaluated by participating teachers and me after the PD program. Experts investigated PD characteristics and approved that they are adequately integrated in the PD process as planned. In order to test the PD implementation, treatment verification form was used. The observers (teachers and me) evaluated the PD characteristics, whether they were used in the PD program. At the end of the training, the teachers evaluated themselves, strengths and weaknesses of the PD program. These were all data collection tools used for the study.

(4) The PD program had face to face and non face to face interactions. Teacher development was explained under the five phases. These are:

Phase 1: Before Workshop I
Phase 2: During Workshop I
Phase 3: Between Workshop I and Workshop II
Phase 4: During Workshop II
Phase 5: After Workshop II

In summary, Phase 1 includes all preparations for the PD program. Need based assessment, first term classroom observations, student group interviews, literature review to select appropriate PD characteristics, and treatment fidelity were used to build my PD framework in this phase. I formed a PD model with 12 characteristics explained in the next parts. In Phase 2, Workshop I was held in June, 2012. It had theoretical and practical features. Teachers attended the 20 hours face to face training. It consists of four hours in each five session (regularly every other day in the afternoon) spreading two weeks. Phase 3 involved in non face to face interaction between the two workshops. Teachers prepared their teaching presentations during the summer time. Teachers interacted with colleagues and me (researcher) via social environment networks and phone calls. Shortly before the opening of schools, teachers were given the opportunity to teaching practices in Workshop II. They had voluntarily selected common topics at the end of Workshop I, and then prepared teaching during the summer time. They lectured in Workshop II as if they were in actual class in Phase 4. They prepared themselves to their classes after receiving feedbacks from Workshop II in Phase 5. They communicated with each other and me through non face to face interaction before the start of classes.

(5) I observed again each teacher classes in 2013 fall term. As a remarkable point, the PD program was designed based on the content of the ISOP unit. Because, physics curriculum has changed at the middle of the study. Then, I decided to compare the common topics of two units pointing out positive changes of teachers' practices. As similar in 2012 term, I interviewed with students, and collected class documents in 2013. I implemented treatment verification opinion form to the teachers. In addition, I conducted an interview with teachers to evaluate their own changes and the PD implementation as a whole at the end of the teachers' classroom teaching.

(6) Qualitative data analysis techniques were used for this study. I depicted the data by using frequency and percentage tables. Mostly, I discussed all teachers' result together calculating the average scores. Microsoft Office Excel and Word helped me to organize data. I transcripted audio recordings and then coded themes considering research questions.

(7) Duration of this thesis approximately took place four years. All PD characteristics were integrated to the model from June, 2012 to September, 2013 (including need based assessment). Within this time, PD treatment (face to face + non face to face interactions) was held from June 2013 to September, 2013. Totally contact time is 42 hours, consisting of 32 hours for face to face and 10 hours for non face to face interactions. A schedule given in Table 3.4 indicating the order of the events was the timeline of the study.

Table 3.4 Timeline for the study

Date	Events
January / April, 2012	Literature review Development of the TSNOP
May, 2012	Pilot study of the TSNOP
June, 2012	Implementation and recollection of the TSNOP
July, 2012	Analysis of the TSNOP
April/August, 2012	Development of the OF
September 17, 2012	First day of the classes (the beginning of the NOP unit)
September/December, 2012	Implementation of pre-post student achievement test Classroom observations Student group interviews Collection of classroom documents/exams
January/May, 2013	Analysis of pre-post student achievement test Classroom observations Student group interviews Documents/exams Literature review to form the PD model and its organization Development of treatment fidelity opinion form and getting experts opinion Analysis of treatment fidelity opinion form and constitution of the PD model
June 15, 2013	Last day of the classes
June 11-13-17-19-21, 2013	Workshop I (face to face interaction)
July/August, 2013	Non face to face interaction (summer time)
September 9-10-11, 2013	Workshop II (face to face interaction)
September 16, 2013	First day of the classes (the beginning of the ISOP unit)
September/December, 2013	Classroom observations Student group interviews Collection of classroom documents/exams Development of treatment verification opinion form Development of PD program evaluation interview protocol
January, 2014	Implementation of treatment verification opinion form Implementation of PD program evaluation interview protocol
February, 2014/June, 2015	Analysis of classroom observations Student group interviews Documents/exams Treatment verification opinion form PD program evaluation interview protocol
July/October, 2015	Writing thesis

3.3. Design and Implementation of the Professional Development Program

In this part, I described the PD design process into the five phases. Basically the PD model components; analysis, planning, implementation and evaluation are elaborately explained into these phases. I also explained to how effective PD characteristics were integrated in the PD program.

The role of the researcher

I was the PD provider to the teacher so I am a natural part of the research process. I organized all processes and made arrangements. In addition, I had a role as a mentor. Teachers consulted me in any time. I also had a role of instructor. Sometimes I explained some contents to the teachers. In the data collection process, especially implementation parts, I was totally as a researcher. I participated to the classes as an observer. I sat back to the class and took notes. I did not involve in any class discussion between teacher and students. As stated Cresswell (2003), if researchers are "observer as participant", there is a minimum level of engagement in observation.

Design and implementation of the PD program includes five phases as given in Figure 3.1. Detailed descriptions of these phases are clarified, respectively.

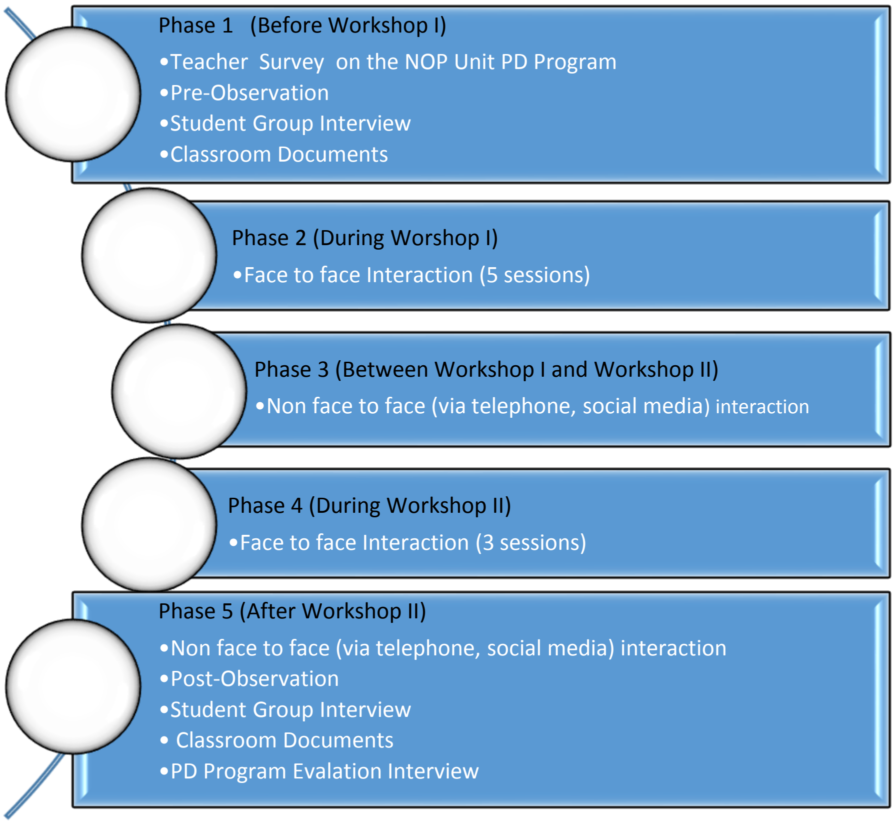

Figure 3.1 Design process of the PD program

3.3.1 Phase 1: Before Workshop I

This part describes the preparatory phase of the PD program. Required permissions were taken from METU Human Subjects Ethics Committee (HSEC) for this study. Then, Ankara Provincial Directorate for National Education approved my study before the starting of data collection from participated teachers' schools (see permission from MoNE in Appendix U). Permission process took about two and half months. I also applied this activity as in-service training workshop to the MoNE (see permission of in-service training workshop from MoNE in Appendix V). After two workshops, they said they will provide certificates to the participating teachers for two times separately. I had used TSNOP survey to do need based teacher assessment and to identify critical needs of the participants. After the selection of the teachers, communications between me and the teachers launched to warm up and motivate for the PD program. I made conversations with them one by one explaining the purpose of the PD program and expectations from them. At the same time, I also searched literature review of existing PD models and characteristics to help me create mine. I and my supervisor evaluated and revised the whole process during the weekly meetings to prepare the Workshop I. To decide the content of the PD program sessions, determine the problematic topics in the unit and see the teaching practices of teachers, observations were made in 2012 fall term in the NOP unit. It has nine hours separated weekly in two hours sessions. This unit has 15 objectives (see Appendix W for the NOP unit objectives). I visited 15 teachers' classes as an observer. Schools gave permission to conduct the study and provide every facility. I used audio records in the lessons. I have monitored one of teachers' classes from beginning to end of the unit. I took some additional notes to depict the classroom situations. These field notes helped me to grasp some points that are not noticeable in the recordings. After the first physics exams in all teacher classes, I conducted group interview with students in the observed classes. During the one class hour, the students were asked their needs, and wishes about the unit of teaching. They gave useful information to evaluate unit implementation. Unit specific achievement test (Nature of Physics Achievement Test) was given students before and after the teaching of NOP unit. Classroom documents (notebooks, exams) were collected when the unit was finished. Based on the evidence-based results and my availability, I arranged the structures and scopes of the Workshop I and Workshop II. Table 3.5 and

3.6 categorize some issues that teachers experienced in their previous in-service trainings. The teachers proposed some possible solutions on these issues.

Table 3.5 Some uncontrollable issues related with in-service training and possible solutions offered by teachers

Category	Issue	Possible solution
Content	Giving general unrelated topics to the physics	Physics curriculum based physics content knowledge
	Passive learning	Active learning
	Lack of new physics curriculum contents	-
	Lack of knowledge of trainers	Lecturing from experts in their disciplines
Personal/ general needs	Over-crowded environment	Working with small groups
	Lack of social activities	Taking part in social activities
	Technical incompetencies, lack of internet connection	-
	Accomondation problems, lack of food	-
Program	Unplanned organization Unknown the program content in advance	Giving program syllabus
Duration	Short- time duration	Long-time duration
Participation	Compulsory participation	Volunter participation
Follow-up	Lack of follow-up after the training	Observing classes after the training
Other	Perceived as a holiday	Made within the province
	The level of knowledge differences among participating teachers	-

When considering past experiences of the teachers, they criticize mostly in in-service trainings that contents in the training are general. The teachers want to obtain new information and experiences that directly provide benefit in physics education. This demand was considered in preparation of the PD program. A unit in the curriculum was directly selected as content, and the PD program was prepared. Another issue that was mentioned frequently from previous in-service training experiences is lack of knowledge levels of incoming instructors. Thus, academicians who are expert in their fields were called in the PD workshops.

The teachers played an active role in trainings rather than their passive positions that they criticized in previous in-service trainings. Points that I consider in the PD program on personal and general needs are as follows; Ventilation, adjustment of physical environment as seating order, providing internet connection and offering of coffee, tea and snacks in training breaks. The PD program was introduced to the teachers with syllabuses. Another subject criticized from previous experiences is that trainings are short-term and participation is compulsory. Mostly, no communication is provided after trainings. These criticisms were considered in the planned the PD program, and participation was arranged as optional and long-term. Besides, communication with the teachers was continued after the PD program and their evaluation was made.

When considering problems arising from the teachers as given in Table 3.6 below, unwillingness heads.

Table 3.6 Some issues arising from the teachers, themselves, and possible solutions offered by them

Category	Issue	Possible solution
Participation	Unwillingness	Providing motivation, making products
Communication	Lack of sharing knowledge between teacher to teacher	-
Perception	Not to believe in benefit of training	Showing evidences to change
Other	Lack of knowledge	Active learning during the training

Certificates approved by the Ministry of Education were given by obtaining necessary permissions to motive participation in the PD workshops. Demands of teachers to increase communication among them were tried to be provided continuously before, during and after the PD program. One of the most important components of the planned PD program is evidences providing that teachers believe importance of the trainings. Observations of the teachers before the PD, interviews made with their students and successes of their students in the unit were used to convince them for change. Activities were made to provide active participation of the teachers during trainings, and it was provided that they studied together. In terms of the PD organization, Table 3.7 shows the results of the TSNOP.

Sixty in-service physics teachers were asked about their opinions about how the PD program should be designed. The following results were guided the planning of the PD program.

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Table 3.7 The results of the TSNOP in terms of the PD organization

PD content dimension	Training type	Application of training	Sources you demand to be used in training	The place	By whom training should be given	Your role in training	Products	Application time	Period of training (hour)	Frequency of training
9th grade NOP unit objectives	Workshop (47.7%) Seminar (27.7%)	Theoretical and practical (61.4%) Theoretical (13.6%) Practical (4.5%)	Technological devices (61.4%) Laboratory equipment (38.6%) Internet (36.4%) Book (34.1%) Article (27.3%) Magazine (29.5%)	School (50%) Outside of my school in province or district (20.5%) Outside of the province (20.5%) Distance learning (6.8%)	Academician (68.2%) Teacher trainer (36.4%)	Listener (38.6%) Develop material (22.7%) Give sample lectures (20.5%)	Worksheets (47.7%) PowerPoint (45.5%) Tests (43.2%) Handouts (38.6%)	At the beginning (45.5%) during (20.5%) end of the school (15.9%) In need (9.1%) Summer (6.8%) Weekends (2.3%) Evening (2.3%)	4 hours (31.3) 2 hours (12.2)	2 hours per week (18.8%)

Table 3.7 (continued)

PD content dimension	Training type	Application of training	Sources you demand to be used in training	The place	By whom training should be given	Your role in training	Products	Application time	Period of training (hour)	Frequency of training
Technology in teaching NOP	Seminar (29.5%) Workshop (20%)	Theoretical and practical (43.2%) Theoretical (11.4%) Practical (9.1%)	Technological devices (59.1%) Laboratory equipment (38.6%) Internet (31.8%) Book (29.5%) Magazine (20.5%) Article (18.2%)	School (38.6%) Outside of my school in province or district (18.2%) Outside of the province (15.9%) Distance learning (6.8%)	Academician (50%) Teacher trainer (27.3%)	Listener (38.6%) Develop material (20.5%) Give sample lectures (9.1%)	Worksheets (38.6%) PowerPoint (38.6%) Tests (34.1%) Handouts (31.8%)	At the beginning (34.1%) At the end (15.9%) During the school (13.6%) In need (6.8%) Summer (4.5%) Weekends (2.3%) Evening (2.3%)	2 hours (23.5%) 4 hours (17.7%)	2 hours per week (16.7%)

Table 3.7 (continued)

PD content dimension	Training type	Application of training	Sources you demand to be used in training	The place	By whom training should be given	Your role in training	Products	Application time	Period of training (hour)	Frequency of training
Assessment in teaching NOP	Workshop (45.5%) Seminar (20.5%)	Theoretical and practical (52.3%) Theoretical (9.1%) Practical (4.5%)	Technological devices (50%) Laboratory equipment (40.9%) Book (31.8%) Internet (27.3%) Article (20.5%) Magazine (20.5%)	School (45.5%) Outside of my school in province or district (18.2%) Outside of the province (15.9%) Distance learning (9.1%)	Academician (54.5%) Teacher trainer (29.5%)	Listener (34.1%) Develop material (22.7%) Give sample lectures (18.2%)	PowerPoint (43.2%) Worksheets (40.9%) Tests (38.6%) Handouts (29.5%)	At the beginning (38.6%) during (13.6%) end of the school (13.6%) Summer (6.8%) In need (6.8%) Weekends (2.3%) Evening (2.3%)	2 hours (35.7%) 4 hours (21.4%)	2 hours per week (16.7%) 2 hours per month (16.7%)

Table 3.7 (continued)

PD content dimension	Training type	Application of training	Sources you demand to be used in training	The place	By whom training should be given	Your role in training	Products	Application time	Period of training (hour)	Frequency of training
Material in teaching NOP	Workshop (34.1%) Seminar (25%)	Theoretical and practical (40.9%) Theoretical (9.1%) Practical (6.8%)	Technological devices (38.6%) Laboratory equipment (34.1%) Internet (31.8%) Book (29.5%) Article (25%) Magazine (25%)	School (34.1%) Outside of my school in province or district (18.2%) Outside of the province (15.9%) Distance learning (9.1%)	Academician (50%) Teacher trainer (25%)	Listener (29.5%) Develop material (25%) Give sample lectures (9.1%)	Worksheets (43.2%) PowerPoint (36.4%) Tests (34.1%) Handouts (29.5%)	At the beginning (36.4%) At the end (15.9%) during the school (11.4%) In need (6.8%) Summer (4.5%) Weekends (2.3%) Evening (2.3%)	4 hours (33.3%) 2 hours (16.6%)	2 hours per week (20%)

Table 3.7 (continued)

PD content dimension	Training type	Application of training	Sources you demand to be used in training	The place	By whom training should be given	Your role in training	Products	Application time	Period of training (hour)	Frequency of training
Teaching strategy in teaching NOP	Workshop (34.1%) Seminar (20.5%) Conference (15.9%)	Theoretical and practical (47.7%) Theoretical (11.4%) Practical (4.5%)	Technological devices (40.9%) Laboratory equipment (36.4%) Internet (29.5%) Book (29.5%) Magazine (27.3%) Article (18.2%)	School (38.6%) Outside of my school in province or district (18.2%) Outside of the province (15.9%) Distance learning (6.8%)	Academician (52.3%) Teacher trainer (29.5%)	Listener (34.1%) Develop material (18.2%) Give sample lectures (9.1%)	Worksheets (40.9%) PowerPoint (40.9%) Tests (34.1%) Handouts (27.3%)	At the beginning (34.1%) At the end (15.9%) During the school (13.6%) In need (9.1%) Summer (2.3%) Weekends (2.3%) Evening (2.3%)	2 hours (18.8%) 4 hours (18.8%)	2 hours per week (20%)

Training type:

The most preferred training types: workshop, and seminar.

Workshop was demanded in four content dimensions (content/skill/misconception, assessment, material, and teaching strategy), and seminar was demanded in one dimension (technology).

The reasons:

Given subjects may be practically learned better in workshop.

The subject may be understood better by listening from expert in a seminar.

- Accordingly, it was planned to make training on type of workshop that includes both theoretical and practical applications in the PD program.

Application of training:

Both theoretical and practical are the most demanded types on the PD content dimensions as given in the TSNOP.

The reasons:

Efficient learning is realized.

The subjects are understood more clearly when they are given theoretically and practically.

It is more attractive.

Firstly, theoretical basics of event should be known. Teaching is important in application because it is a practical profession. Only theory remains incapable. Sample applications will be guiding for learning.

- The PD program included both theoretical and practical applications.

Sources you demand to be used in training:

Using technological devices are the most preferred in all content dimensions. Laboratory equipment, internet, book, article, magazine were demanded approximately at the same rates on each dimension.

The reasons:

Variety of sources enriches content of training.

Opinion of each source is valuable in itself and usage of various sources increase efficiency.

- These sources mentioned above were used in training that was made.

The place:

Training on school environment was mostly demanded in five content dimensions.

The reasons:

Transport is easy.

However some teachers said that:

"There is no proper environment in each school, and transport does not create problem provided that the school is located in the same province or district."

"I prefer that training is made apart from environment in which people work but within the same province. Change of place may be useful, but the fact that this place is distant may cause problem on transport"

Teachers stated that they will prefer a physical place apart from their own school provided that this place is located in the same province or district. Even some teachers said that physical place in which training is made is not important.

- However, PD trainings were made at university instead of school. Easy transport is important for easy access to internet for the participant. It was thought that these expectations can be met at university.

By whom training should be given:

Academician was selected on all PD content dimensions.

The reason:

The training will be more efficient because academicians are expert on their fields.

- Academician support was provided on particular subjects in workshop trainings.

Your role in training:

Teachers stated that they want to participate into training as listener, develop material in training and to give sample lectures.

The reasons for being a role as listener:

Listening is sufficient.

Learning by listening to contents of the subjects is important.

The reasons for being a role as developing material:

It is important to develop activities that will teach nature of physics after training given theoretically.

Learning by doing is permanent.

The reason for being a role as giving sample lectures:

It is important to apply known things and obtain feedback.

- Teachers played active role in two workshops as they stated above.

Products:

Teachers wanted to see worksheets, power point presentations, tests for different assessment purposes and handouts as PD products.

The reasons for worksheet as PD products:

Work sheet facilitates expression.

It increases student participation.

The reasons for power point presentations as PD products:

They make content of subject visual.

They are more attractive.

The reasons for tests as PD products:

Using tests for different assessment purposes enriches the student learning and assessment.

Prepared tests with different purposes provide time efficiency in the semester.

The reason for handout as PD products:

Student receives summary of the contents thanks to the handouts.

- Teachers were given opportunity to create products mentioned above in the training.

Application time:

It is mostly-preferred time frame at the beginning and end of school.

The reasons for application time at the beginning of school:

It provides an opportunity for preparation before starting to apply subjects at school.

Time-wise participation is more proper.

The reasons for application time at the end of school:

It provides an opportunity for evaluating lessons within the period and correcting them while the topic is hot.

Time-wise participation is more proper.

- Workshop I which is face to face application was made when the school was closed within June, and Workshop II was made before starting school in period of September.

Period of training:

Time was demanded at interval of 2-4 hours for each dimension. When considering that there are five content dimensions in the TSNOP survey, it can be said that a training of 20 hours in total is demanded.

The reason:

No comment

- Workshop I took 20 hours, whereas Workshop II was completed in 12 hours.

Frequency of training:

Mostly-preferred frequency is trainings of two hours per week. Teachers demanded a rare and short-term training spreading on a long term period. When considering implementation conditions of research that was made, this preference is out of being applicable.

The reason:

No comment

- All of the teachers are obliged to participate into trainings without hindering their lessons and as a whole group for a long period. Thus, training spreading on a period of three months condensed at the end of beginning of school was planned.

Communication in PD program

The teachers emphasized that communication should be available among them and with instructors before, during and after the PD program. Teachers expressed their requests related to the communication during the PD program in Table 3.8.

Table 3.8 Communication in the PD program

Before the PD Program	
Between teacher to teacher	Determination of the content of the training (topic distribution, etc.)
	Questioning, discussion (e.g., on learning difficulties)
	Introduction
Between teacher to instructor	Setting goals before the PD program
	Determination of the content of the training (topic distribution, etc.)
	Questioning, discussion (e.g., on learning difficulties)
Durıng the PD Program	
Between teacher to teacher	Sharing knowledge
	Giving feedback
Between teacher to instructor	Mentoring
	Questioning, discussion
After the PD Program	
Between teacher to teacher	Sharing knowledge
	Sharing products
Between teacher to instructor	Sharing outcomes
	Questioning, discussion

They wanted to determine content of the PD program among them and with the instructors before the PD program. Besides, they stated that they want to discuss subject content, and to share learning difficulties encountered by students with their colleagues and the instructors. However, when considering these expectations for the planned PD, no teacher to teacher communication was established before the PD program. Information sharing among the teachers and opportunity of giving feedback for each other during the PD program were provided. This communication was continued after the PD program. Besides, obtained products and resources used in the PD program were shared.

Supports to increase participation

The most important demand by the teachers from MoNE is financial support. They claimed that expenses that they will make in case they attend the PD trainings are covered and that additional course payments are continued to be made. Teachers' demands for supports to increase participation are presented in Table 3.9.

Table 3.9 Supports to increase participation

To whom	Supports
From MoNE	Expenditure (remuneration)
	Tuition fee payments during the trainings
	Permission
	Certificate
From PD provider	Material/technology support
	Lecturing from academicians/experts
	Planned organization
	Mentor

They demanded that schools give permission during the participation. Another attractive demand is having certificate. Communication was made with MoNE before the PD program for these expected supports. It was provided that the teachers who will attend the PD program after negotiations were assigned with daily wage-travel pay. Besides, participation certificates approved by MoNE were given to the teachers after two workshops.

It attracts attention that supports expected from the PD providers are rather academic. The most important is material/technology support. The teachers demand that trainings are given by people who are expert on their fields. A planned PD organization is expected from the PD program providers. All necessary materials and technology supports were provided during the PD program within the frame of these incoming demands. Two academic members who are experts on their fields gave training on needed contents. Syllabus was given to the teachers in the first day of workshops to show that trainings that were made for them are planned organization, and necessary explanations were made in the first session. Mainly the TSNOP, SGIP, literature review and 2012 fall term observations provide meaningful data to construct the structure and content of the PD program. According to results, I developed my PD characteristics. Table 3.10 shows these characteristics and where they were obtained from.

Table 3.10 PD characteristics and where they were obtained from

PD characteristics	Purpose	PD survey (teachers)	Observation (2012)	Student focus group interview (2012)	Student achievement test (pre/2012)
NEEDS, DEMANS	Consider to the needs of the teachers, students	PD content dimensions Organization (transportation, environmental characteristics, etc.) Requests and suggestions (set goals, etc.) Previous PD experiences	Strengths and weakness of the teachers in four dimensions (content/skill/ misconception, teaching strategy, material/technology, assessment)	Problematic objectives in the NOP unit Requests (teaching strategies, material/technology, assessment)	Problematic objectives in the NOP unit
AWARENESS	Convince teacher to change Collect evidence to show current situations Enable teachers to recognize their weaknesses and strengths	-----	Strengths and weakness of the teachers in four dimensions (content/skill /misconception, teaching strategy, material/technology, assessment)	Problematic objectives in the NOP unit Requests (teaching strategies, material/technology, assessment)	Assessment of their student data
SUPPORT	Increase participation/ motivation	Support from MoNE (certificate, permission) Support from academicians/teachers (lecturing, providing sources, easily access to them)	-----	------	-----
FEEDBACK	Evaluate teachers' work and products	-----	-----	-----	------
OPPORTUNITY	Provide opportunity to practice	Opportunity to develop material in training and give sample lectures	-----	-----	-----

Table 3.10 (continued)

PD characteristics	**Purpose**	**PD survey (teachers)**	**Observation (2012)**	**Student focus group interview (2012)**	**Student achievement test (pre/2012)**
PLANNED AND FLEXIBLE PROGRAM	Design uniform, specific as well as flexible structure, encourage teachers to prepare their own implementation strategies	Set goals (preparing syllabus, time arrangements) Previous PD experiences	-----	-----	-----
DURATION	Having an ongoing and sustained structure to improve effectiveness	Previous PD experiences Giving workshop nearly to the class implementation Period of training Frequency of training	-----	-----	-----
CONTENT SPECIFIC	Getting to the core of the ISOP unit Aligning with the curriculum	PD content dimensions	-----	-----	-----
ACTIVE LEARNING	Improve learning	Training type	-----	-----	-----
COLLABORATION/ INTERACTION	Provided opportunity to work collaboratively to develop products	Collaboration in training (teacher to teacher, teacher to researcher interactions before, during and after the PD program)	-----	-----	-----
MOTIVATION/ INCENTIVES	Giving certificate to increase participation	As an incentive from MoNE	-----	-----	-----
EFFECTIVE COMMUNICATION/ BUILDING LEARNING COMMUNITY	Collaborate work to increase interactions	Teacher to teacher and teacher to researcher communications before, during and after the PD program	-----	-----	-----

Treatment fidelity

Table 3.11 Treatment fidelity expert opinion form results

Title	Under the title given is a PD characteristic					PD characteristic (detailed explanations)	PD characteristic is integrated in the program				
	E1	E2	E3	E4	E5		E1	E2	E3	E4	E5
Needs, demands	Y	Y	Y	Y	Y	Consider to the needs of teachers	Y	Y	Y	Y	Y
						Consider to the needs of students	Y	Y	Y	Y	Y
Awareness	Y	Y	Y	Y	Y	Convince teacher to change	P	P	Y	Y	P
Support	Y	Y	Y	Y	Y	Support from MoNE	Y	Y	Y	Y	Y
Support from academicians/ teachers	Y	Y	Y	Y	Y	Workshops	Y	Y	Y	Y	Y
						Providing materials/sources	Y	P	P	P	P
						Easy access	Y	Y	Y	Y	Y
Support from schools	Y	Y	Y	Y	Y	Easy attendance	Y	Y	Y	Y	Y
						Easy application	Y	Y	Y	Y	Y
Feedback	Y	Y	Y	Y	Y	Feedback from researcher	P	P	Y	P	P
						Feedback from teachers	P	P	P	P	P
						Self feedback	Y	Y	Y	Y	Y
Opportunity	Y	Y	Y	Y	Y	The opportunity to practice	Y	Y	Y	Y	Y
Planned and flexible program	Y	Y	Y	Y	Y	Planned and flexible program	P	Y	Y	Y	P
						Planned and flexible teacher application	Y	Y	Y	Y	Y
Duration	Y	Y	Y	Y	Y	Long term PD	Y	Y	Y	Y	Y
						Having an ongoing structure					
						Giving workshop nearly to the class implementation	Y	Y	Y	Y	Y
Content specific PD	Y	Y	Y	Y	Y	Getting to the core of ISOP unit	Y	Y	Y	Y	Y
						Aligning with the curriculum	Y	Y	Y	Y	Y
Active learning	Y	Y	Y	Y	Y	Effective/productive working	P	P	P	Y	P
						Reflective thinking/discussion	Y	Y	Y	P	Y
						Mostly pursued by teacher	Y	Y	Y	Y	Y
Collaboration/ Interaction	Y	Y	Y	Y	Y	Collaborate	P	P	P	P	P
Motivation/incentive	Y	Y	Y	Y	Y	Providing motivation/incentive	P	Y	Y	Y	Y
						Giving certificate	Y	Y	Y	Y	Y
Effective communication/ Building learning community	Y	Y	Y	Y	Y	**Before Workshop 1**					
						Teacher to teacher communication	P	P	P	P	P
						Teacher to instructor communication	P	P	P	P	P
						During Workshop I					
						Teacher to teacher communication	Y	Y	Y	Y	Y
						Teacher to instructor communication	Y	Y	Y	Y	Y
						Between Workshop I and Workshop II					
						Teacher to teacher communication	Y	Y	Y	Y	Y
						Teacher to instructor communication	Y	Y	Y	Y	Y
						During Workshop II					
						Teacher to teacher communication	Y	Y	Y	Y	Y
						Teacher to instructor communication	Y	Y	Y	Y	Y
						After Workshop II					
						Teacher to teacher communication	Y	Y	Y	Y	Y
						Teacher to instructor communication	Y	Y	Y	Y	Y

In Table 3.11, E1, E2… shows each expert who gave opinions for TFEOF form. "Y represents yes," "P represents partially" and "N represents no" According to results, all experts had common views that under the title given can be an effective PD characteristic based on their PD research experiences. They indicated I covered many PD characteristics and they did not add any extra features. However, when they were asked their opinions to what extent the PD program includes these characteristics, they stated explanations are not enough. Sometimes they put P letter. They recommended giving more specific details (e.g., how often teachers will receive feedback, how active participations will be provided, etc.). There were not any negative opinions given by the experts.

3.3.1.1 Characteristics of my Professional Development Model

I explained some of the PD characteristics given below in Chapter 2. In this part, I mainly focused on what I did and how I integrated characteristics into the whole PD process. I suggest a model of PD having the following characteristics as general headings given below. Then, I depicted my PD model components.

1) Needs, Demands

I considered the needs of teachers and students. I explored the content-related specific needs. I analyzed each teacher observation data and searched where the missing parts were in terms of misconceptions, as well as good examples and strengths of teachers' implementations which could be shared with others in the PD program. I asked them some questions related to the organizations such as where the meetings occur, who attend to program as experts, the time and appropriate days for all, transportations, etc. Some needs such as supports, regular feedbacks, evaluations, products and previous PD experiences appeared in the TSNOP tool. The SGIP questioned the general needs and wishes of the students.

2) Awareness

I tried to convince the teachers to change. I prepared some notes for evidence from their observation data. I gave them in the first day of Workshop I. The teachers took their observation results, students' success in each objective of the unit, group interview results, and students' notebook evaluation as reports. I analyzed these results for them. They saw directly their own classroom situations. In the first session of Workshop I, they discussed on these results together and evaluate their practices and their students' outcomes. They assessed their students' success on curriculum objectives. They had a chance to see themselves from their students' eyes. They were aware of their current states and it was aimed to motivate more them to the PD program.

3) Support

I applied to the MoNE for permission that the participating teachers can easily attend to the workshops. They supported my PD program and provided certificate for the teachers. I organized two workshops. Two experts (one prof. and one assoc. prof.) participated in one workshop session and gave lectures. One expert attended to the misconception section of the PD program and made aware teachers related to the some concepts including the meaning of physics, scientific method, law, theory, hypothesis and their relationships, and modelling. He demonstrated an activity based on basic tenets of the NOS in the context of physics. The other gave a lecture with different assessment purposes. He supplied materials to be examples of placement, diagnostics, and formative tests. I also prepared an example of summative tests by collecting all teachers' previous exams and combined appropriate questions aligned with the current curriculum objectives. I collected materials, useful sources and shared them with teachers. Teachers could easily access experts and ask questions to me by calling or sending e-mail. With the permission from MoNE, their schools supported them participating to the workshops. They arranged at least one 9th grade class for the teachers to conduct this study. I easily collected data from their schools and made observations and communicated with students. Apart from me and the experts, the teachers shared their materials, sources, books, journals, videos, simulations, presentations, worksheets, and their exam papers with each other.

4) Feedback

The PD program gave feedback to the teachers. I provided feedbacks prepared materials in written and oral formats. After presentations in Workshop II, every teacher filled in self evaluation form to criticize themselves and other teachers. They expressed personal opinions and contributed to improve practices. Results were sent teachers as a report to their e-mail. They discussed their presentations and preparations in the sessions and gave fruitful feedbacks. They reevaluated themselves before the actual classroom implementations. We used social communication tools for sharing materials and sources. They made comments and discussed on prepared materials and improved them.

5) Opportunity

PD had a long term so there was enough time to revise and adapt the program. The PD program provided opportunity for teachers to design, implement and share their works. Every teacher had a responsible to prepare an hour lecturing. They selected a part of the unit content or assessment type and lectured in Workshop II as if they were in real classroom. They worked individual or with group. They developed worksheets, puzzle or improved some activities (simple pendulum, etc.). They transferred what they had learned during the PD activities. After the PD program, they implemented their teaching in their classrooms.

6) Planned and Flexible Program

The content and the length of the program were designed together with the teachers. The teachers arranged time and days of workshops. At the same time, purpose of the program and content of sessions were previously planned by me. I was a moderator. I informed teachers about the program and its possible changes. Apart from the workshops, teachers' preparation processes were both planned (facebook and e-mail communications were organized by me) or flexible (teachers requested help or feedback on their presentations) I asked them to prepare lecturing at least one time. They chose common topic, teaching strategy, and material/technology according to their wishes. Therefore, the teachers not only developed their own model of teaching but also with the PD program they had a role as active learners.

7) Duration

It was not a one-shot style of PD program. It was an ongoing process spanning long periods of time intervals. Workshop I took 16 hours (conducting in every other day), Workshop II was 12 hours on three successive days. After the Workshop I, non face to face interaction was intensive during the summer time. Teachers spent time to be ready for Workshop II. After all workshops, teachers found opportunity to implement lesson in their classes and were evaluated in the scope of the study. Intention is to be aware of them PD is a lifelong learning process. Classroom results were shared with all teachers, and they were asked their opinions after the PD program. Second workshop was very close (there was one week to the opening of school) to the actual class implementation. They practiced as if they taught to their students in Workshop II. This was intensive and not fragmented and directly associated with teachers' practices. Follow-up feature of the PD program entailed assistance to the teachers in the application of knowledge.

8) Content-specific

I selected 9^{th} grade NOP (2011 revised physics curriculum)/ISOP unit (2013 physics curriculum) as a specific content. 9^{th} grade curriculum starts with this unit. Student attitudes to lessons and courses can be a critical factor in their lives and might affect their future. All students must take major courses like physics, chemistry in the 9^{th} grade. Most students also find physics boring and difficult. As a beginning unit, this unit might affect students' attitudes and motivation to the physics in future. It is a starting point to meet physics at first, so understandings basic concepts of NOS makes physics important for developing scientifically literate person. The PD program is aligned with curriculum objectives. I investigated the NOP content and the ISOP content in detail to find out the similar and different topics in these units. My PD program completely designed based on the ISOP unit to assist the implementation of the new curriculum. We (teachers and me) criticized and discussed unclear parts of the curriculum. We made common decisions on how to teach this unit. We prepared new materials and modified existing ones to meet the requirements of the new curriculum. They first interacted with this unit in the program. The PD program aimed at improving teachers' pedagogical content knowledge. I intended to improve teacher practices in four dimensions: content/skills/misconception, the use of teaching strategy, material/technology and assessment with different purposes. It is known that content knowledge, using materials, learning methods, and assessment are the core elements of any curriculum (Saylor, Alexander, & Lewis, 1981). These were listed in Google.Docs survey and asked teachers to select their content preferences for the PD program at first. Together we criticized current material and technological sources and adapted some of them for the ISOP unit. Teachers began to be more familiar with formative, placement and diagnostic assessment strategies like summative assessment.

9) Active Learning

During the PD program teachers made effective productive working. They used materials, and developed activities. They studied individually but sometimes they were actively working in groups instead of being passive listener. They used multiple representations to create activities. For example, simple pendulum activities did by simulations as well as by using hands-on materials. Each teacher selected different common topics and prepared a lecture individually by integrating related misconceptions/cautions, using appropriate teaching strategies and materials/ technologies. Three teachers wanted to prepare assessment tools considering assessment purposes. I tried to follow teachers with non face to face communications (facebook, phone calls) and they were encouraged to work. They analyzed classroom materials. They gave suggestions and feedbacks to each other. They were involved in all process with active participation. The PD program was mostly pursued by the teachers. They learned together. There were not any hierarchical differences between teachers.

10) Collaboration/Interaction

Some materials were shared by the teachers. I identified existing materials and sources from the teacher observations before the PD program. During the workshops, I asked to share them with others. Face to face and none face to face participant interactions includes collaborative works to transfer the unit. Collaboration provided through technological online sources such as facebook, and gmail. Sometimes, they did group work activities. These collaborative works increased teacher interactions and their productivity.

11) Motivation/Incentives

As incentives, MoNE gave certificates for participating teachers after the two workshops. I encouraged them to see this work as a serious attempt. At the beginning of the Workshop I, they saw and compared their students' success in their own and different schools. They also got their observation and students' interview results to show their practices in the class.

12) Effective Communıcatıon/Building Learning Community

The PD program provided effective communications among the participants. Before the Workshop I, teacher to instructor communication happened more instead of teacher to teacher communication. I communicated them more and explained purposes and expectations broadly. I tried to give a sense as we had a common goal that is to improve implementation of the ISOP unit. Physics teachers with different backgrounds, from different school types, and student characteristics participated to the program. There were two communication ways: teacher to teacher and teacher to instructor provided in Workshop I. I and participating teachers shared information, gave feedbacks and supports. The teachers asked questions to their peers and me. They worked together on the new unit. The teachers mostly worked individually between the two workshops. Teacher to instructor communication was more than teacher to teacher at that time. I tried to keep teacher to teacher communication via online by sharing some questions and materials. Teacher to teacher and teacher to instructor communications were nearly the same at Workshop II. Teachers gave feedback from their colleagues and instructor provided feedback for presentations. They shared materials and information. The teachers asked questions to instructors and others. After the Workshop II, teacher to instructor communication was more than between teacher to teacher. Second workshop was done a short period of time left for opening schools. After the comments, the teachers corrected and improved their presentations and opened materials accessible online. They shared them and the teachers asked any questions to the instructor and other teachers about the unit teaching until the beginning of the actual implementations. The teachers built networks and practiced together in small group of learning.

3.3.2 Phase 2: During Workshop I

Workshops setting

Two workshops were conducted in METU/SSME department in mathematics laboratory class. When compared to other classes, it is designed with different style. It is located apart from the other classes so there were no external distractions during the workshops. Settings were appropriate for teachers' needs and expectations such as heating and lightening (see Figure 3.2 for classroom settings). Before the workshops, I rearranged the seating to work collaborately and see ourselves easily. I put all equipment that teachers could facilitate during the workshops (e.g., books, laptops, etc.) I provided food for the break time and beverage (water, tea, coffee) at any time.

Figure 3.2 Workshops' setting

Workshop 1

Workshop I had five sessions including theoretical and practical applications. It was made in the month of June with four hours afternoon sessions. Sessions were done at one day intervals to provide teachers' preparations before. Contents of each session were determined by me as seen in Table 3.12. Teachers arranged the days and hours of the training. Schools gave permission to the teachers and they attended Workshop I. It started with giving the purposes and general information about the training (see Appendix X for general information about Workshop I). At first, the teachers were introduced themselves. This helped to increase their communications with each other. They mentioned about their school contexts and students' backgrounds. They were attending to the program from different schools.

Table 3.12 Contents of each session in Workshop I

SESSION 1	SESSION 2	SESSION 3	SESSION 4	SESSION 5
Openning / purposes	Overview of the pre observations and students' group interviews in terms of teaching strategies (teacher presentations) Discussion	Activity 4: Science and society	Investigation of common topics (misconceptions/cautions)	Investigation of how common topics should be measured (the use of assessment for different purposes)
Introduction			Activity 7: KWL chart (Know, Want to Know, Learned)	Discussion on assessment
Giving workshop bags/materials descriptions of the items in the bag	Investigation of how common topics should be given (the use of teaching strategies)	Overview of the pre observations and students' group interviews in terms of materials/technologies Discussion	Lecturing Homework discussion (reading book)	Activity 9: Multiple intelligent test/evaluation (placement purpose)
Overview of the pre observations and students' group interviews in terms of common topics Discussion	Session break	Activity 5: Puzzle	Session break	Activity 10: Diagnostic test example
	Article discussion: Modelling	Session break	Activity 8a: Meissner Effect Activity 8b: KWL chart (Know, Want to Know, Learned)	Activity 11: Branched tree technique (formative assessment)
		Activity 6: Creating material/technology list/Watching video		Activity 12: Summative/formative test example
Session break	Activity 3: Simple pendulum	Session evaluation	Session evaluation	Session break
Investigation of common topics, skills	Session evaluation			Lecturing
Activity 1: SI unit system, basic quantities Activity 2: Scalar and vector quantities				Session evaluation
Session evaluation				

Totally 11 teachers (3 male, 8 female) were in Session 1. Except from the main participants (7 teachers) of the study, 4 teachers (3 male, 1 female) voluntarily attended the workshops. Each teacher received workshop bag in which there were a notebook, pen, flash memory, and workshop materials. All written materials were given in the flash memory. These were pre-readings, science journals related to the ISOP subjects, e- books, and content related materials. Syllabus handed out to the teachers. I distributed summary results of teachers' classroom observations (see Appendix Y), students' group interviews (see Appendix Z), and students' achievement test (see Appendix AA). They investigated their classroom practices and made comments on the results. It helped to become aware of the teachers. The main topic of this section was to investigate common topics. I gave a summary paper about some points that should be considered when delivering objectives as given in Appendix AB. I prepared general notes regarding some issues in pre observations and students' group interviews. They discussed on this paper together and evaluate themselves. After a 20 minutes break, we started to analyze the NOP and the ISOP unit together. The aim is to see differences and similarities between the two units. To make it clear, I prepared a one page paper in which comparison was made between the 2011 NOP and the 2013 ISOP units. I integrated the 2011 NOP unit content into the 2013 ISOP content in order to see the changes between two years. Skill objectives, misconceptions and cautions are not clear in the new curriculum. I also put them skills in parenthesis next to the new curriculum objectives as used in the 2011 revised physics curriculum (see Appendix AC for the modified version of the ISOP unit curriculum objectives considering the NOP unit). Although the PD program was included overall the ISOP units content (see the 2013 9th grade ISOP unit objectives in Appendix AD), my scope is the only common topics in both curriculum (see Appendix AE for the common topics in the 2011 NOP and the 2013 ISOP units). These common topics are coded as given below in Table 3.13. I labelled them with the letter of "O" to indicate the common parts between the two units.

Table 3.13 General and common topics

General topics	Common topics (specific topics)
Science of physics and its purpose	O1: What is physics? O2: The aim of science of physics (why I need to know physics?)
Application fields of physics and its relation with other disciplines	O3: Physics practice areas, sub-areas O4: Physics' relation with other disciplines (chemistry, biology, etc.)
The relationship between physics and technology	O5: The relationship between physics and technology
Role of observation in emergence and development of scientific knowledge	O6: Role of observation in emergence and development of scientific knowledge O7:Qualitative-quantitative observation relationship
The emergence and development of knowledge and scientific methods	O8: The emergence and development of knowledge and scientific methods (law, theory, imagination and creativity)
Role of experiment in emergence and development of scientific knowledge	O9: Role of experiment in emergence and development of scientific knowledge (differences between hypothesis, theory, law)
Role of mathematics in emergence and development of scientific knowledge	O10: Role of mathematics in emergence and development of scientific knowledge
The use of mathematics and modeling in physics	O11: The use of mathematics and modeling in physics
Measurement of some basic quantities in physics and use of error and unit system in measurement	O12:Measurement of some basic quantities in physics and unit system O13: Error in measurement and its sources
Describing units of some basic quantities in physics in SI unit system	O14: Describing units of some basic quantities in physics in SI unit system
Scalar and vector classification of some basic quantities in physics	O15:Scalar and vector classification of some basic quantities in physics

We investigated these common parts and then revised them together. All teachers were agreed on this new curriculum format which is more clear and understandable for teachers. We were also focused on problematic concepts and missing parts that are taught incorrectly. Then activity 1 and 2 were distributed to the teachers. First activity was about the SI unit system, basic quantities; the second one is related to the scalar and vector quantities (see Appendix AF for activity 1 and 2 worksheets). Teacher individually worked on these two activities. Then every sheet was filled out by other teachers passing from hand to hand. They evaluated their colleagues' works by using different color pens. I was the last person to receive the sheets. After the activities, we discussed and completed the sheets. Teacher took handout about the two activities. At the end of Session 1, participating teachers did self evaluation about the session of the day without writing their names (see Appendix AG for self evaluation form about the sessions of Workshop I). I gave them a pre-reading for the next session before leaving. I informed the next session topics as teaching strategies. I wanted some teachers to give a five minutes lecture about teaching strategies that they had implemented when teaching the NOP unit in the last term. They accepted this idea and were excited to present their good examples. This provided to motive them for the next session.

Eight teachers were attended in Session 2. We overviewed last semester observation results in terms of teaching strategies. Good examples related to teaching methods were displayed by some teachers (e.g., modelling activity, argumentation: technology or physics, a scientific method from Galileo, measurement of mass and length). The teachers discussed these activities and thought how they can be modified in their classes. They tried to improve some of the activities. As seen in Appendix AH, I prepared general notes about the some points of teaching strategies coming from pre observations and students' group interviews. They studied on this paper together and did brainstorming on the use of different teaching strategies. After the session break, we talked about an article on modelling in science education. Simple pendulum activity, modified from 9^{th} grade 2011 revised physics curriculum program (Talim ve Terbiye Kurulu Başkanlığı, 2011), was used to grasp the role of observation and experiment to produce scientific knowledge, understand science process skills (observation, making hypothesis, inferring, modelling, measurement data collection and recording, evaluation). We consider some common topics labelled as O6, O8, O9, O10, and O11 with this activity. Teacher did experiment in groups (see simple pendulum activity worksheet in Appendix AI). Activity consisted of four parts. Two teachers paired and worked on different parts of the activity. First, we discussed how to design this inquiry activity in their physics laboratory. They preferred to conduct this experiment with a simulation (available at http://phet.colorado.edu/tr/simulation/pendulum-lab) in order to use time effectively. Teachers received worksheets and laptops for this activity. It was said to provide facilities for using activities by this simulation in their own classrooms. Session was assessed by teachers at the end.

There were eight teachers in Session 3. We started with an activity to this session. Science and Society is an activity that generally used to the introduction of NOS (Cavallo, 2008). I modified this activity a little bit and provided worksheets to both two groups of members (see Appendix AJ for science and society activity worksheet). Three volunteer teachers had the role of scientists, while the others were society members. The teacher experienced what it feels like to think like a scientist. How a scientist works and uses scientific process were tested by the teachers in the activity. They tried out this activity as they were students and took some notes about how they can implement in their classroom. We then discussed the importance of using scientific methods in physics. Session continued with general notes regarding the use of material/technology as presented in Appendix AK. I reported the common problems of using material/technology in the previous lesson based on classroom observations. We then discussed on these results and teachers mentioned their plans about how they will enrich their practices in terms of using instructional tools for the next semester. Teachers made a puzzle in group work (see puzzle activity in Appendix AL). Groups were randomly formed by two teachers pulling a card of the same color. They produced a material to use in their lessons. Session break continued with the comprising of material/technology list. I put material list online. Together we added extra resources to the list and then watched videos one by one at the rest of the time. We analyzed all materials. Teachers reflected their opinions and criticized materials whether they can be used or not in the teaching of the ISOP unit. Session finalized with the assessment of the day. There was a reminding at the end of the session. Teachers were expected to do next session readings.

Misconceptions/cautions was the main topic of the Session 4. All teachers were in this session. Based on the need analysis and data results, teachers need to support on some subjects. An academician who is expert in the field of the NOS attended to this session and provided knowledge and material support. He conducted KWL (know, want to know, learned) activity about the scientific theories with the teachers. He tried to explain the confused concepts and tenets on the NOS in the content of physics. They evaluated his book chapter given to the teachers as homework before. After a short break, he lectured superconductivity and demonstrated the Meissner Effect. He integrated scientific law and theory concepts into the activity. The teachers again filled in KWL chart to explore their ideas on the scientific law. The teachers indicated their opinions on session evaluation form.

The last session was devoted to the assessment dimension. Ten teachers participated in Session 5. For this section, an academician was invited to the training. As a same manner, firstly we discussed the deficiencies in the previous classroom observations about the assessment based on data results given as general notes 4 in Appendix AM. We mainly focused on purposes of assessment. It is the most clearly seen that teachers generally know and use summative assessment as physics examination at the end of the unit. The expert wanted to draw attention to other assessment techniques used for different purposes. He focused on placement, formative and diagnostic assessments. I and the expert had decided to give test examples for different assessment purposes before. We had prepared some sample tests for the teachers. In the first activity, the expert implemented multiple intelligence test (Özden, 2003) to the teachers for placement purpose. The teachers did the test and evaluated themselves. Training was not just lecture format. It also included practical parts. The teachers asked questions to the expert. Together they evaluated the results and discussed how this test can be used at the beginning of the ISOP unit. The teacher received another placement assessment example (anxiety/motivation survey) modified from Abak's (2003) study as seen in Appendix AN. Two questions were selected from VNOS-C survey (Lederman, Abd-El-Khalick, & Scwartz, 2002) and adapted to the diagnostic test format to identify misconceptions (see Appendix AO example for diagnostic test format). Teachers were not familiar with this type of format. It seemed a bit difficult to the teachers to understand question format and its evaluation. Formative assessment was explained by the expert. Teachers indicated they knew this assessment but they were not able to use in classes because of time constrain. My data also revealed that teachers confused formative assessment with the summative purpose. The expert informed on this issue. He first explained what formative assessment is and how it can be used during the teaching. The branched tree technique was preferred as an example of formative purpose. I and expert had prepared a branched tree of the ISOP unit concept from 9th grade MoNE book (see Appendix AP for branched tree example). 2012 fall term physics exam had collected from the teachers. I choice some questions appropriate to the content of unit. I prepared table of test specification to consider the importance of content validity of the test. As given in Appendix AQ, an example test for formative and assessment purposes was distributed to the teachers. We investigated together and teachers were explained they can use this for both formative and summative purposes.

Table of specification had some missing questions of some new ISOP unit content. A teacher volunteered to prepare questions of the new ISOP objectives for Workshop II.

After the evalution of session break, we determined the distribution of the tasks. The teachers selected their duties voluntarily. The common parts of both units were shared by eight teachers. They were responsible for the content teaching, the use of teaching strategy and material/technology. The remaining three teachers wanted to prepare tests for formative, diagnostic, placement and summative purposes. Distribution of the tasks is seen in Table 3.14. Teachers were expected to do preparations on particiular contents in Workshop II.

Table 3.14 Distribution of the tasks for Workshop II

Teachers	**Selected contents**
TD	O1, O2
TA	O3, O4
T1	O5
TF	O6, O7, O9
TG	O8, O10
TE	O11
TB	O12, O13
T2	O14, O15
TC	Formative test
T3	Diagnostic test
T4	Placement test, summative test (considering missing parts)

Note: T1,T2,T3,T4 refer teachers participating in the PD program but not participating in the data analysis

At the end of the each session, participating teachers received six statements in a five-likert type format to evaluate the sessions. (see Appendix AG for self evaluation form about the sessions of Workshop I). Figure 3.3 shows evaluations that teachers attended the training made for each session in Workshop I.

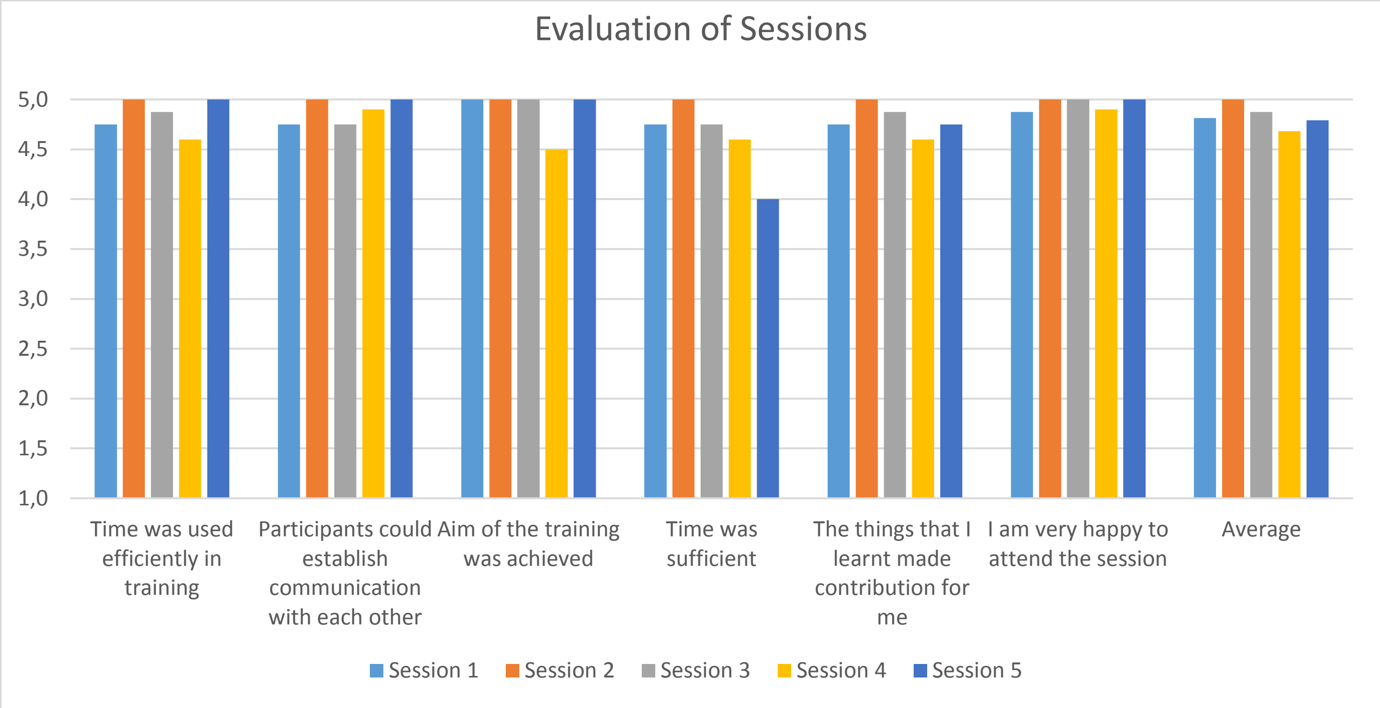

Figure 3.3 Evaluation of sessions

It is observed that the teachers were generally satisfied with the sessions (Item 6). The teachers stated that training in Session 4, in which misconception content is weighted, achieved its goal less than others. (item 3, average 4.5). According to teachers, purpose was achieved wholly in all other sessions. Level of being able to establish communication with participants with each other was evaluated in the range of 4.8-5 (item 2). As it is observed, value of level of being able to establish minimum communication is 95%. The lowest value given for relevant question on efficient time usage in the training is 4.6 on average (item 1 and 4), and session confronts us as 4. Session 2 and Session 5 are the sessions in which time was used most efficiently. Session 5, was the session in which time was minimum. This is followed by Session 4 in which misconception is the content. Method session, Session 2, includes teaching strategies, was considered entirely sufficient in terms of time. Lastly, Session 4 was the session in which teachers thought that the things that learnt made least contribution for them (item 5, average: 4.6). When the sessions are generally evaluated according to average point, they are arranged respectively as Session 2, Session 3, Session 1, Session 5 and Session 4.

3.3.3 Phase 3: Between Workshop I and Workshop II

Workshop I and Workshop II sessions had been videotaped using a camera by the permission of the teachers. I checked the attendance of the teachers. I skimmed video records that everything did in the desired manner after the each session. During the data analysis, sometimes I returned them to remember or see what had happened on particular topics or sessions. I put all sessions in DVD. Each teacher got five DVD and a flash disc after the first workshop training. I gave release time for the teachers to prepare their presentations between Workshop I and Workshop II. Duration was approximately two months and non face to face interaction had an ongoing structure. This summer time included non face to face interactions consisted of some activities. These are:

- Individual feedbacks

Teachers requested feedbacks individually about their preparations to the Workshop II. Some teachers sent ppt presentations and activity sheets. I and the teachers discussed on them in detail.

- Communications via telephone

Teachers easily accessed to me to ask anything about the unit and got feedbacks for individual preparations which will be in Workshop II.

- Communications through social media

I opened facebook group named as Introduction to Science of Physics PD program. Teachers easily reached anytime to me and colleagues on facebook by sharing classroom materials and discussing questions. I put activities on facebook. Based on teachers' needs, I uploaded questions and videos related to the ISOP unit content. The teachers were involved in reflective discussions.

- E-mails

I created a group e-mail account to increase teacher to teacher and teacher to instructor communications. Some teachers shared their ideas of class preparations for the next semester. Teachers helped the others providing materials to support. I also gave support anytime when they needed.

In addition, face to face interaction among teacher to teacher happened during this time. Some teachers came together to give one another constructive feedbacks for their presentations in Workshop II.

3.3.4 Phase 4: During Workshop II

Workshop II had three sessions including practical applications. It was held in September 2013 before opening the schools. Each session lasted four hours. It was spread out three consecutive days with afternoon meetings. Before coming to the meetings, I sent teachers program schedule as a syllabus. Participating in-service physics teachers designed one hour lesson for the next semester. Each presentation took approximately 40 minutes. They prepared available materials integrated with suitable teaching strategies and shared their teaching practices with their colleagues. Teacher explained their current practices and discussed together how the other teachers would fit them in their classroom. They presented their lectures with ppt slides. Some teachers enriched their teaching with handouts and worksheets. The teachers not only develop their own model of teaching but also with the Workshop II training they have a role being active learners. They had opportunity to practice as if they were in real classroom. The most important benefit of the Workshop II is to be recently held to the class implementation. Therefore, the teachers had opportunity to practice and were ready to the actual classroom implementation. All three sessions were recorded by video camera getting teachers' permissions. Feedback provided more during the training. Three feedback mechanisms were used for teacher assessment: feedback from colleagues, feedback from expert and self-evaluation. A form developed by me was used to get feedback (feedback from colleagues and self evaluation forms in Appendix AR). According to results: Course lecturings were evaluated in common topics, teaching strategy and material/technology usage with 5-rating scale by the teachers, other colleagues and me (expert). Results of this evaluation are given in Table 3.15. No name was written by the teachers during evaluation. Thus, the teachers were coded as T1, T2… in the evaluated column.

Table 3.15 Results of evaluation of course lecturing of the teachers

Evaluated teacher	Evaluator	Dimensions		
		Common topic	Teaching strategy	Material/technology
TB	T1	5	5	5
	T2	5	5	5
	T3	4	4	4
	T4	5	4	4
	T5	5	4	4
	T6	5	5	5
	T7	4	5	4
	T8	5	5	5
	Average	4.8	4.6	4.5
	Himself/herself	5	5	5
	Expert	5	5	5
TD	T1	5	4	5
	T2	4	3	5
	T3	4	4	5
	T4	5	4	4
	T5	5	5	4
	Average	4.7	4.2	4.5
	Himself/herself	5	4	5
	Expert	5	4	4
TF	T1	5	5	5
	T2	5	4	4
	T3	4	4	4
	T4	5	4	4
	T5	4	4	5
	T6	4	4	4
	Average	4.5	4.2	4.3
	Himself/herself	5	4	5
	Expert	4	4	4
TG	T1	4	5	5
	T2	5	4	4
	T3	4	5	4
	T4	4	4	3
	T5	5	4	4
	T6	4	4	4
	T7	3	4	4
	Average	4.1	4.3	4.0
	Himself/herself	5	5	4
	Expert	4	4	4
TA	T1	4	4	4
	T2	5	3	4
	T3	4	4	4
	T4	5	4	4
	T5	5	4	5
	T6	5	4	3
	Average	4.7	3.8	4.0
	Himself/herself	5	4	4
	Expert	5	4	4
TE	T1	4	2	3
	T2	3	4	4
	T3	5	5	5
	T4	5	5	4
	T5	5	4	2
	T6	5	5	3
	T7	5	5	5
	T8	4	4	4
	Average	4.5	4.3	3.8
	Himself/herself	5	5	4
	Expert	5	4	4

3.3.5 Phase 5: After Workshop II

Feedback results were distributed to the teachers individually. Video records were also given. They were asked to modify and finalized the last version of their products. They uploaded their presentations on facebook and shared with the others until the beginning of classes. They communicated each other during the implementation. Non face to face interaction lasted at that time. 2013 curriculum 9th grade textbook approved by MoNE has been published. We discussed and criticized before using this textbook. This helps us to realize common issues before the implementation. This non-scheduled networking continued until the beginning of the classes. As a same manner, I made post classroom observations during the ISOP unit. Seven teachers' practices were noted to see the effect of the PD program on the teachers' practices. Students were interviewed in the observed classes. It took one class hour. The research sequence was the same as in 2012. First observations were made. After the first unit physics exam, students' group interviews were conducted. At the end of the unit of teaching, interviews were done with the teachers lasted about one hour. The teachers filled in treatment verification form to ensure the PD treatment. I conducted semi-structured interviews with the teachers on what teachers took from the PD program and how they used this in the teaching of ISOP unit. In addition, they evaluated the PD program as a whole and indicated their opinions about to what worked well or what didn't.

Figure 3.4 presents the PD model framework which shows the pathway of the program. As can be seen in this figure, PD program has four main components; analysis, planning, implementation and evaluation. Table 3.16 displays how these components are integrated in the PD program and summarizes the overall design.

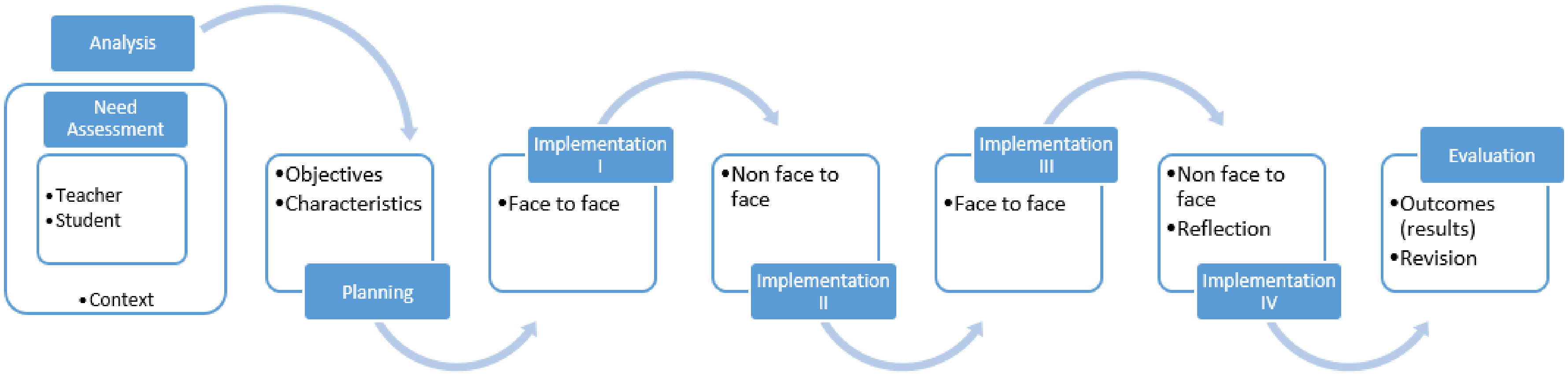

Figure 3.4 Professional development model framework

Table 3.16 PD model components and their integrations into the PD program

Components	Treatment
Analysis	**Need assessment** Examine students' and teachers' needs concerns, problems and wants (TSNOP, SGIP, documents) Obtain necessary information (experiences, talents)
	Context (OF)
Planning	The purpose and value of design to participants (common topics, skill objectives, instructional environment, stategies) Characteristics of the design (12 characteristics, my framework TFEOP
Implementation Theoretical and Practical Components and Interactions	**Implementation I** Face to face (Workshop I)
	Implementation II Non-face to face (networks)
	Implementation III Face to face (Workshop II)
	Implementation IV Non-face to face (networks) Reflection
Evaluation	Outcomes (teacher practices; OF, SGIP, documents) Revision (TVOF, PDEIP)

CHAPTER 4

RESULTS

At the beginning of this chapter, the professional development (PD) program is verified by giving the results of treatment verification. Following section presents results related to teacher practices. Results are discussed in conjunction with the level of teacher participation rate in the PD program. It elaborately gives the effect of the PD program and teachers' changes in four dimensions; content/skill/misconception, teaching strategy, material/technology, and assessment. Then, results of students group interviews and classroom documents are given. Finally, teachers' opinions about the strengths and weaknesses of the PD program are presented. Next, summary part evaluates the overall results.

4.1 Treatment Verification

Evidence for the implementation of the PD program was assessed with two ways in this study. Initially, the result of treatment verification opinion form is assessed by seven teachers and me to see what extent characteristics of the PD program are applied and whether they are applied or not (see Appendix N for the TVOF). This result is given in 4.1.1. In addition to this, item 3 in the self-evaluation form (see Appendix AG for self evaluation form about the sessions of Workshop I) given to the teachers after the each Workshop I was used as verification of the PD treatment. According to item 3 "Aim of the session was achieved" was assessed with an average of 4.9 out of 5. The teachers found that Workshop I sessions were made in accordance with the aims.

4.1.1 Results of Treatment Verification Opinion Form

"Was the PD program performed as planned in the beginning?" The answer to this question supports the results of the study and gives clear evidence that the implementation of the PD program was made as intended. Opinions of teachers, and of researchers to the components of PD training, gain importance as observers. For this purpose, a detailed form (Appendix N) about to what extent planned PD characteristics were considered was developed. This form interrogates whether each PD characteristic is in practice or not. This form was evaluated by me and participating teachers. Common opinion of the seven teachers who participated in the study is that all characteristics were reflected exactly into the PD program with face to face and non face to face interactions. That is, 37 points (100%) were obtained from the form as a result of seven teachers' opinions. My treatment verification evaluation result (Appendix AS) is given in detail. In the form "+ symbol means that the related characteristic is integrated into the program", "- symbol means that related characteristic is not integrated into the program". Each + symbol corresponds to 1 point, while – symbol corresponds to 0 point. Characteristics 5 and 27 in Appendix AS were graded by considering each contribution of the three academicians participating in the PD program. According to my evaluation, characteristic 24 ("communication between teacher-teacher before Workshop I") was not performed in both face to face and non face to face interactions. I had planned the followings according to this characteristic while forming the PD model framework: The teachers are gathered approximately one month before and they met each other. PD program is introduced in this acquaintance meeting, and a sufficient period is provided so that teachers get prepared beforehand for the subjects within the PD program. Besides, materials to be used in the PD are given to them. Thus, teachers are acquainted with the program content and materials before the PD program implementation and consult with each other on these subjects. However, the teachers probably evaluated negotiations not in the expected scope before Workshop I as a communication, and may have answered this part positively and thought it was performed during the PD program. According to my opinion, except from characteristic 24, the other PD characteristics were performed similar to the teachers' opinions. Figure 4.1 visually illustrates the treatment verification result of my evaluation in detail. Given characteristics, it was obtained 34 out of 37 point (92%) in face to face interaction part, whereas 29 (78%) point was attained for non face to face interaction. When these percentages are proportioned to each other, the ratio is found as 1.2 (92/78). Common score (i.e. given score for common PD characteristics observed in both face to face and non face to face interactions) was 27 (73%).

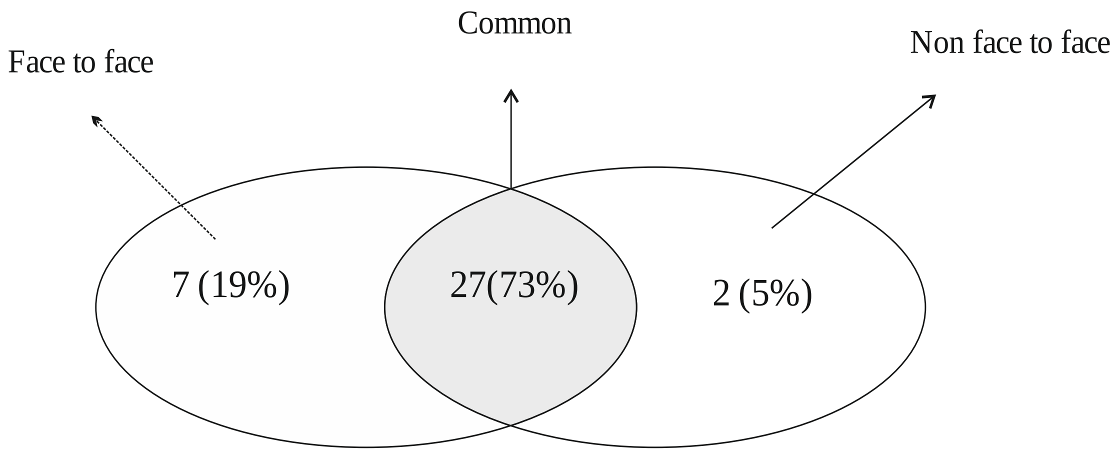

Figure 4.1 Treatment verification result of my evaluation

Consequently, The PD program included 32 out of 33 characteristics (except characteristics 24). As a result of 97 percent agreement between teachers and me, I can say that applied PD is a PD that was planned before the PD program.

4.1.2 Level of Teachers' Participation in the Professional Development Program

The extent to which the participating teachers to part in the PD program was calculated and explained below. The impact of the program on teachers' practices is presented on the basis of participation rate. Then, the findings are discussed according to this participation classification.

As it can be seen in Table 4.1, face to face interaction was made with two workshops performed in different times in the PD program. Workshop I includes totally 20 hours consisting of 5 sessions of 4 hours, and Workshop II includes totally 12 hours of training consisting of 3 sessions of 4 hours. Distribution of 32 hours of face to face training to content/skill/misconception, teaching strategy, material/technology and assessment dimensions is given in Table 4.1. First digit in each dimension in the table shows the time spent in Workshop I and the second digit shows the time spent in Workshop II. For example, Session 1 is just for content/skill/misconception dimension including 4 hours in Workshop I. Session 1 in Workshop II has two hours for content/skill/misconception dimension and one hour for teaching strategy dimension.

Table 4.1 Allocated time for each session in terms of four dimensions in face to face interaction

Session	Content/skill/ misconception (h)*	Teaching strategy (h)*	Material/ technology (h)*	Assessment (h)*
Session 1	4 + 2	0 + 1	0 + 0	0 + 0
Session 2	1 + 1	3 + 1	0 + 1	0 + 1
Session 3	0 + 0	1 + 1	3 + 2	0 + 2
Session 4	3 + 0	0 + 0	1 + 0	0 + 0
Session 5	0 + 0	0 + 0	0 +0	4 + 0
Total (h):	11	7	7	7

*Workshop I + Workshop II

The teachers participated in trainings in different dimensions in face to face workshops. Total participation time for each participant was given in Table 4.2. 32 hours of total workshop time (Workshop I + Workshop II) were divided into four dimensions: 11 hours for content/skill/misconception, 7 hours for teaching strategy, 7 hours for material/technology and 7 hours for assessment. Based on this, teacher TA participated in 9 hours out of 11 (82%). Average participation rates to the face to face trainings in each dimension vary between 77% and 80%.

Table 4.2 Participation time of teachers in session trainings with different dimensions in face to face interaction and percentages according to the total training time of these dimensions

Teacher	**Content/skill/ misconception time (%)**	**Teaching strategy time (%)**	**Material/ technology time (%)**	**Assessment time (%)**
TA	9 (82)	4 (57)	5 (71)	5 (71)
TB	11 (100)	7 (100)	7 (100)	7 (100)
TC	8 (73)	4 (57)	4 (57)	4 (57)
TD	10 (91)	6 (86)	6 (86)	6 (86)
TE	8 (73)	6 (86)	5 (71)	5 (71)
TF	8 (73)	5 (71)	6 (86)	6 (86)
TG	7 (64)	6 (86)	6 (86)	5 (71)
Total (h)	61	38	39	38
Average (h)	8.7 (79)	5.4 (77)	5.6 (80)	5.4 (77)

Non face to face interaction time spent for each dimension is given in Table 4.3. Total non face to face interaction (e.g., phone calls) time was calculated for each teacher. As given an example, the total non face to face interaction time spent on content/skill/misconception dimension is 157 minutes for Teacher TA. Non face to face interaction takes attention as being 35 minutes in assessment dimension as minimum for seven teachers in average and 160 minutes in content/skill/ misconception dimension as maximum level.

Table 4.3 Participation time of teachers in different dimensions in non face to face interaction

Teacher	**Content/skill/ misconception (min.)**	**Teaching strategy (min.)**	**Material/ technology (min.)**	**Assessment (min.)**
TA	157	168	116	63
TB	148	142	87	22
TC	89	80	78	47
TD	182	173	94	46
TE	209	125	64	52
TF	200	168	56	7
TG	132	96	28	8
Average (minute)	160	136	75	35

In Table 4.4 percentage rates of trainings in each dimension as face to face and non face to face interactions are given. In session trainings, it is seen that face to face interaction is performed at teaching strategy as at least twice more than non face to face interaction and nine times more in the assessment dimension.

Table 4.4 Distribution rates of face to face and non face to face interaction in the PD program

	Face to face interaction* (%)	**Non face to face interaction** (%)**	**Rate**
Content/skill/misconception	77	23	3
Teaching strategy	71	29	2
Material/technology	82	18	4
Assessment	90	10	9

*= [av. time for face to face / (av. time for face to face + av. time for non face to face)] *100

**= [av. time for non face to face / (av. time for face to face + av. time for non face to face)] *100

(For instance; Average time passed in face to face interaction for content/skill/misconception dimension is 8.7x60=522 minutes. This time is 160 minutes for non face to face interaction. Therefore, when calculating the percent of face to face interaction = [522/(522 + 160)]*100 formula was used and 77% was found)

According to treatment verification results of my evaluation (Figure 4.1), the ratio of face to face and non face to face interactions was 1.2. This rate was taken into account to calculate weighted participation rate as presented in Table 4.5. To understand the change of teacher practice in each dimension based on the participation time of teacher in the PD program, weighted participation rate was calculated.

Table 4.5 Teachers' weighted participation rate in each dimension

Content Dimension	Teacher	Face to face interaction (minute)	Face to face % (1)	Non face to face interaction (minute)	Non face to face % (2)	Total weighted participation rate
Content/skill/ misconception	TB	660	100	148	71	94
	TD	600	91	182	87	90
	TA	540	82	157	75	80
	TE	480	73	209	100	79
	TF	480	73	200	96	78
	TC	480	73	89	43	66
	TG	420	64	132	63	64
Teaching strategy	TB	420	100	142	82	95
	TD	360	86	173	100	90
	TE	360	86	125	72	82
	TF	300	71	168	97	79
	TG	360	86	96	55	77
	TA	240	57	168	97	69
	TC	240	57	80	46	54
Material/ technology	TB	420	100	87	75	96
	TD	360	86	94	81	85
	TF	360	86	56	48	79
	TA	300	71	116	100	76
	TG	360	86	28	24	75
	TE	300	71	64	55	69
	TC	240	57	78	67	59
Assessment	TB	420	100	22	35	94
	TD	360	86	46	73	85
	TF	360	86	7	11	79
	TA	300	71	63	100	74
	TE	300	71	52	83	72
	TG	300	71	8	13	66
	TC	240	57	47	75	59

(1) = (face to face interaction (min.) *100)/ interaction time (min.) in each dimension
(2) = (non face to face interaction (min.) *100)/ max interaction (min.) in each dimension
Total weighted interaction rate formulas:
Content/skill/misconception = (((1) *3.6+(2) *1))/(3.6+1)
Teaching strategy= (((1) *2.4+(2) *1))/(2.4+1)
Material/technology= (((1) *4.8+(2) *1))/(4.8+1)
Assessment= (((1) *10.8+(2) *1))/(10.8+1)

For example, teacher's TB weighted participation rate in content/skill/misconception dimension is calculated as follows: teacher TB participated 100% in 660 minutes of face to face interaction lessons in Workshop I and Workshop II. As there is no upper limit in non face to face interaction, minute of teacher reaching to the highest limit was accepted as maximum. According to this, percentage participation rate of teacher TB gained approximately 71% ([148*100]/209) interaction on maximum 209 minutes in this dimension in comparison with teacher TE. When calculating total weighted participation rate, the formulas given on the bottom of Table 4.5 were used for each dimension.

When we use the formula applied for content/skill/misconception dimension for teacher TB:

Content/skill/misconception = $((^{(1)} *3.6+^{(2)} *1))/(3.6+1)$

(for (1), and (2) = see the explanations given on the bottom of Table 4.5)

Content/skill/misconception = $((100 *3.6+71*1))/(3.6+1) = 94$ is obtained.

3.6 coefficient in this formula is equal to multiplication of face to face interaction in each dimension to non face to face interaction rate (see at Table 4.4) and face to face interaction to non face to face interaction rate. This coefficient is calculated as 3 x 1.2 = 3.6 for content/skill/misconception dimension.

Besides, when face to face and non face to face rates of characteristics considered while creating the PD model, we can see that this rate is 1.2 as indicated above.

For instance, if weighting was not made to the teacher TB, this rate would be 85.5% [(100+71)/2]. However, in that case, weighted impact of face to face and non face to face interaction to the PD program was not the same.

4.2 Results in Teacher Practices

As seen in Table 4.2 average participation rates to the face to face trainings in each dimension vary between 77% and 80%. In case that the participating teachers join approximately 80% (cut off point) in weighted participation rates of the PD program, it was accepted that the program would have impacted on them. In this acceptance, weighted participation rate for each teacher group was classified as upper group for 80 and more and lower group for less than 80. Results of teachers meeting this condition (see the teachers marked in grey in Table 4.5) are considered firstly and then all teachers' results are given in each dimension when interpreting the effect of the PD implementation on teachers’ practices.

4.2.1 Findings of SubQ1

Content dimension: To what extent are the common topics delivered?

Table 4.6 shows the effect of the PD program on participating teachers’ practices for content dimension. TB, TD, TA, TE, TF are in upper, whereas TC and TG are in lower group based on weighted participation rates of each teacher in the program. 15 common topics were analyzed. When evaluating the results in each table below, changes have been taken into consideration in upper, lower teacher groups first, and then for all teachers. The change in number of common topics before and after the PD program points out the difference between 2012 and 2013 teachers’ practices. As example, teacher TB completely delivered 7 common topics in 2012, and 15 common topics in 2013.

Table 4.6 Common topics delivered for each teacher classified according to weighted participation

Common topics	Completely delivered		Partially delivered		Wrongly delivered		More delivered than aimed at the curriculum		None delivered		The common topics were stated		The common topics were associated with daily life	
Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB	7	15	5	0	3	0	3	0	0	0	4	14	5	7
TD	5	15	9	0	2	0	2	0	1	0	6	12	6	8
TA	6	12	9	2	2	1	3	0	0	0	7	13	5	9
TE	5	10	9	5	3	0	3	0	0	0	3	10	7	9
TF	3	10	8	4	5	2	2	0	2	0	0	13	3	7
Average	5.2	12.4	8.0	2.2	3.0	0.6	2.6	0.0	0.6	0.0	4.0	12.4	5.2	8.0
Difference	7.2		-5.6		-2.4		-2.6		-0.6		8.4		2.8	
TC	3	5	8	8	2	3	3	1	2	0	1	7	2	5
TG	2	5	7	10	3	0	2	0	3	0	0	9	4	5
Average	2.5	5.0	7.5	9.0	2.5	1.5	2.5	0.5	2.5	0.0	0.5	8.0	3.0	5.0
Difference	2.5		2.5		-1.0		-2.0		-2.5		7.5		2.0	
Total average	**4.4**	**10.3**	**7.9**	**4.1**	**2.9**	**0.9**	**2.6**	**0.1**	**1.1**	**0.0**	**3.0**	**11.1**	**4.6**	**6.1**
Difference	**5.9**		**-3.8**		**-2.0**		**-2.5**		**-1.1**		**8.1**		**1.5**	

When considered for all teachers participating in the PD program, it is seen that the number of common topics given for totally 15, the teachers increased to 10.3 from 4.4 in average (Table 4.6). This increase is to 12.4 from 5.2 for the upper group of teachers whom we considered as approximately 80% and above participation rate in the PD program. As can be seen from the table, the number of common topics reached is quite close to 15. Some teachers (TB, TD) even reached to complete common topic number after the PD program. Consistently, with the increase in completely delivered number of common topics given, there is decrease in partially and wrongly delivered number of common topics in the upper group teachers after the program. There is not any none delivered common topic in both upper and lower group of the teachers after the PD program. “The common topics were stated” and “The common topics were associated with daily life” categories had the expected increase. “The common topics were stated” category had nearly same high level of increase in upper and lower group of teachers.

Skills dimension: To what extent are the skill objectives delivered?

2011 physics curriculum clearly indicates skill objectives under the four titles: Physics-Technology-Society-Environment (PTSE), Information and Communication Skills (ICS), Problem Solving Skills (PSS) and Attitudes and Values (AV). Curriculum aims to develop not only content but also skills knowledge. In summary, the PTSE considers the relationships among physics, technology, society and environment. The ICS includes information, communication and computer skills. The PSS takes consideration to solve a problem by using creative and critical thinking, scientific process and higher order thinking skills. The AV involves in scientific attitudes and values, self-development skills. Although 2013 curriculum emphasized using the skills into the physics lessons, there is not clearly skill objectives matched with content objectives. For this matter, I and participating teachers coded basic PTSE, ICS and PSS skills with appropriate content objectives in the current curriculum together. The AV skills were not included in this study. The results of the PTSE, ICS and PSS skill objectives are elaborately given following.

In Table 4.7 the effect of the PD program is seen on participating teachers in terms of delivering the PTSE skill objectives. For this dimension, TB, TD, TA, TE, TF are in upper group; TC, and TG are in lower group of teachers. Ten PTSE skill objectives were examined. For instance, the number of completely delivered PTSE skill objectives is 4 for in 2012 and 10 is in 2013 year for Teacher TB.

Table 4.7 PTSE skill objectives delivered for each teacher classified according to weighted participation

	Completely delivered		**Partially delivered**		**Wrongly delivered**		**More delivered than aimed at the curriculum**		**None delivered**		**The objective statements were stated**		**The objectives were associated with daily life**	
PTSE Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB	4	10	1	0	0	0	0	0	5	0	0	0	0	1
TD	5	8	0	0	0	0	0	0	5	2	0	0	1	1
TA	2	8	2	0	0	0	0	0	6	2	0	0	0	0
TE	1	9	1	0	0	0	0	0	8	1	0	0	2	3
TF	5	8	9	0	0	0	0	0	5	2	0	1	0	1
Average	3.4	8.6	0.8	0.0	0.0	0.0	0.0	0.0	5.8	1.4	0.0	0.2	0.6	1.2
Difference	5.2		-0.8		0.0		0.0		-4.4		0.2		0.6	
TC	1	5	1	1	0	0	0	0	8	4	0	0	0	0
TG	1	5	1	2	0	0	0	0	8	3	0	0	2	1
Average	1.0	5.0	1.0	1.5	0.0	0.0	0.0	0.0	8.0	3.5	0.0	0.0	1.0	0.5
Difference	4.0		0.5		0.0		0.0		-4.5		0.0		-0.5	
Total average	**2.7**	**7.6**	**0.9**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**6.4**	**2.0**	**0.0**	**0.1**	**0.7**	**1.0**
Difference	**4.9**		**-0.5**		**0.0**		**0.0**		**-4.4**		**0.1**		**0.3**	

When Table 4.7 is examined generally, there is a noticeable increase in complete giving rated of the PTSE skill objectives both in upper and lower level group teachers. However, when the number of PTSE skill which must be given completely as 10 is considered, half of the complete number was reached in lower group teachers. 27% of the PTSE skill objectives were completely delivered prior to the PD program, while 76% of them have been given after the PD program. “The objective statements were stated” and “The objectives were associated with daily life” categories had not a meaningful increase for the PTSE skill objectives.

Table 4.8 presents the effects of the PD program on delivering the ICS skill objectives. For this dimension upper group teachers were TB, TD, TA, TE, TF, while lower group teachers were TC, and TG. Five ICS skill objectives were examined. For example teacher TB did not use any ICS skill objectives in 2012; on the other hand, she used all of them in her classroom teaching after the PD program.

Table 4.8 displays the change in ICS skill reached to 3.2 of totally 5 skills in teachers group having high participation. The point is that the ICS skills were not completely delivered before the PD program. This picture has changed after participating to the PD program. 64% of the ICS skills were fully given as a result of the PD program. In upper group teachers, the average of none delivered ICS skill objectives number decreases from 5.0 to 1.6 after the program. There is no a noticeable increase in other categories.

Table 4.8 ICS skill objectives delivered for each teacher classified according to weighted participation

	Completely delivered		**Partially delivered**		**Wrongly delivered**		**More delivered than aimed at the curriculum**		**None delivered**		**The objective statements were stated**		**The objectives were associated with daily life**	
ICS Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB	0	5	0	0	0	0	0	0	5	0	0	0	0	0
TD	0	4	0	0	0	0	0	0	5	1	0	0	0	0
TA	0	4	0	0	0	0	0	0	5	1	0	0	0	0
TE	0	2	0	0	0	0	0	0	5	3	0	0	0	0
TF	0	1	0	1	0	0	0	0	5	3	0	0	0	0
Average	0.0	3.2	0.0	0.2	0.0	0.0	0.0	0.0	5.0	1.6	0.0	0.0	0.0	0.0
Difference	3.2		0.2		0.0		0.0		-3.4		0.0		0.0	
TC	0	0	0	0	0	0	0	0	5	5	0	0	0	0
TG	0	0	0	0	0	0	0	0	5	5	0	0	0	0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	0.0	0.0	0.0	0.0
Difference	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Total average	**0.0**	**2.3**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**5.5**	**2.6**	**0.0**	**0.0**	**0.0**	**0.0**
Difference	**2.3**		**0.1**		**0.0**		**0.0**		**-2.9**		**0.0**		**0.0**	

The PSS skill objectives delivered for each teacher are presented in Table 4.9. There are eight PSS skill objectives considering before and after the PD program. Only 4.6 of 8 PSS skills were given by the upper group of teachers as shown in Table 4.9. The number of PSS skill objectives in upper group of teachers decreased to 2.8 in average while this average decreased to 1 in lower group of teachers in none delivered category. There is not any noticeable change in other categories.

Table 4.9 PSS skill objectives delivered for each teacher classified according to weighted participation

	Completely delivered		Partially delivered		Wrongly delivered		More delivered than aimed at the curriculum		None delivered		The objective statements were stated		The objectives were associated with daily life	
PSS Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB	4	8	0	0	0	0	0	0	4	0	0	0	0	0
TD	3	3	3	3	0	0	0	0	2	2	0	0	0	0
TA	0	4	0	0	0	0	0	0	8	4	0	0	0	0
TE	0	6	2	0	0	0	0	0	6	2	0	0	0	0
TF	0	2	2	2	0	0	0	0	6	4	0	0	0	0
Average	1.4	4.6	1.4	1.0	0.0	0.0	0.0	0.0	5.2	2.4	0.0	0.0	0.0	0.0
Difference	3.2		-0.4		0.0		0.0		-2.8		0.0		0.0	
TC	0	2	1	0	0	0	0	0	7	7	0	0	0	0
TG	0	0	0	1	0	0	0	0	8	6	0	0	0	0
Average	0.0	1.0	0.5	0.5	0.0	0.0	0.0	0.0	7.5	6.5	0.0	0.0	0.0	0.0
Difference	1.0		0.0		0.0		0.0		-1.0		0.0		0.0	
Total average	**1.0**	**3.6**	**1.1**	**0.9**	**0.0**	**0.0**	**0.0**	**0.0**	**5.9**	**3.6**	**0.0**	**0.0**	**0.0**	**0.0**
Difference	**2.6**		**-0.2**		**0.0**		**0.0**		**-2.3**		**0.0**		**0.0**	

When assessed generally, it can be said that the effect of the PD program is more in group of teachers who have weighted participation rate in the PD program is approximately 80% or above. The highest increase was obtained when common topics were presented completely. It takes attention to the decreases in number of giving wrong and/or none delivered common topics in this category. In addition to these, daily life emphasis and statement of common topics increased as expected. The change trend in common topics is more than skill objectives, however, some positive changes in the desired direction are observed in terms of skill objectives.

Change in both common topics and skill objectives until this part was expressed numerically. However, another important issue is to see what kind of changes occurred on the basis of common topics. In this context, the changes occuring in each common topic are given for each teacher in Table 4.10.

Table 4.10 Assessment of changes in each common topic based on teachers

Completely delivered	**O1**		**O2**		**O3**		**O4**		**O5**		**O6**		**O7**		**O8**		**O9**		**O10**		**O11**		**O12**	
Teacher	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
TB	+	+	+	+	+	+	+	+		+		+	+	+		+		+	+	+		+		+
TD	+	+		+		+		+		+		+	+	+		+		+	+	+				+
TA	+	+		+	+	+		+	+	+	+	+	+	+						+				+
TE	+	+		+	+	+						+		+					+	+	+	+		
TF	+	+		+	+	+		+		+		+		+		+								
TC	+	+		+	+	+																		
TG	+	+				+		+		+														
Total	7	7	1	6	5	7	1	5	1	5	1	5	3	5	0	3	0	2	3	4	1	2	0	3
Difference	0		5		2		4		4		4		2		**3**		**2**		**1**		**1**		**3**	

Completely delivered	**O13**		**O14**		**O15**	
Teacher	2012	2013	2012	2013	2012	2013
TB		+	+	+		+
TD	+	+		+	+	+
TA		+		+	+	+
TE		+		+	+	+
TF		+			+	+
TC				+	+	+
TG		+			+	+
Total	1	6	1	5	6	7
Difference	5		4		1	

Note: Completely delivered common topic is marked with + symbol

Empty boxes show common topic which are not given

Grey colored boxes show remarkable parts

When the table is generally assessed, O1, O3 and O15 common topics were completely delivered by most of the teachers in 2012. Same objectives were given by all teachers completely in 2013. O8, O9 and O12 common topics were not given by any teachers in 2012 and they were given a little more in 2013. As O8 and O9 common topics contained misconceptions and the issues to be considered, these parts increased but no more changes were seen in the expected level. O12 common topic includes measurement of some basic quantities and unit system in physics. Some students also stated O12 as difficult topic in the group interviews in both terms.

Figure 4.2 presents the changes in total number of 15 common topics which are completely delivered by each teacher before and after the PD program. According to the figure, all teachers show positive changes after the PD program.

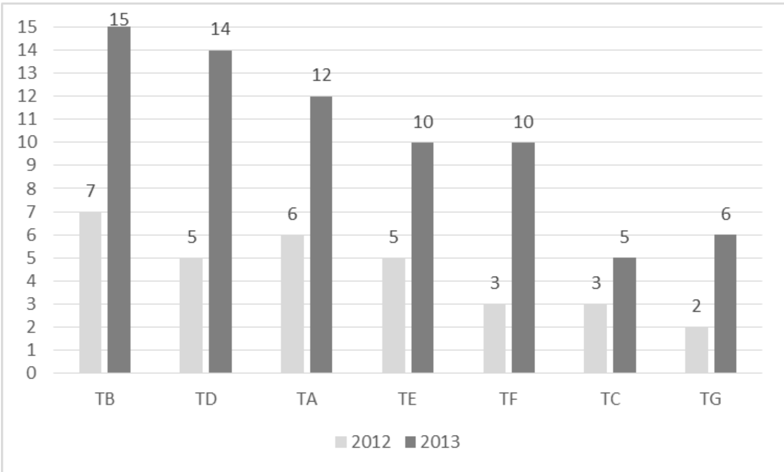

Figure 4.2 Increase in the 15 common topics according to each teacher

The common topics other than O8, O9, O11 and O12 and partially O10 (grey colored boxes in Table 4.10) were delivered completely by a quite few teachers in 2012 and this number slightly increased in 2013. When we make a more detailed analysis for the common topics delivered completely by a few number of the teachers, it is seen that the aforementioned common topics are coded as partially delivered section in observation forms for the other teachers. It can be said there is a little development on these common topics after the PD program. As illustrated in Table 4.11, total number of teachers who partially delivered objectives of O8, O9, O11, O12 decreased by years, and remained the same as O10 (Table 4.11).

Table 4.11 Partially delivered common topics for each teacher

Partially delivered	**O8**		**O9**		**O10**		**O11**		**O12**	
Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB							+			
TD	+		+				+	+	+	
TA	+	+	+		+		+	+	+	
TE	+	+	+	+					+	+
TF	+		+	+		+	+	+		+
TC		+			+	+	+	+	+	
TG	+	+	+	+	+	+	+	+		+
Total	5	4	5	3	3	3	6	5	4	3

When we consider the numbers of partially delivered common topics with completely delivered common topics, it is seen that there is positive change in delivery of aforementioned common topics after the PD program. However, in all cases the scientific methods, hypothesis, theory, law and modelling concepts causes still trouble for the teachers.

When we consider the wrongly delivered common topics in the same way as can be seen in Table 4.12, the first common parts taking our attention are O8 and O9. Error in O8 decreased by 2013 and the same teacher (TC) continued to deliver O9 wrongly. Common topics of O4 and O14, which were given more incorrectly by the teachers before the PD program, have been delivered almost completely after the PD program.

In inter-class observations of the teachers, O2 and O13 common topics were given just by one teacher in 2012 however; it is a noticeable event that it has begun to be given by six teachers in 2013.

Table 4.12 Wrongly delivered common topics for each teacher

Wrongly delivered	**O4**		**O6**		**O7**		**O8**		**O9**		**O10**		**O11**		**O12**		**O14**	
Teacher	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
TB							-		-						-			
TD	-																-	
TA							-		-	-								
TE	-						-										-	
TF	-						-		-	-					-		-	-
TC				-				-	-	-							-	
TG					-						-		-					
Total	3			1	1		4	1	4	3	1		1		2		4	1

(1:2012 term; 2:2013term)

Misconceptions and cautions dimension: To what extent are the misconceptions and cautions emphasized?

Misconceptions and cautions in the unit are summarized in Table 4.13.

Table 4.13 Misconceptions and cautions in the unit

No	**Misconceptions /cautions**
O5	4.1? Physics and technology are the same thing.
O7	2.2! It is emphasized that qualitative and quantitative observations are not the opposite of each other, which can be used both at the same time.
O8 a.	2.7? A single scientific method is used in all scientific investigations
b.	? When theories are validated, it becomes law.
c.	! When physics principles, laws and theories are discovered, the influence of people's imagination and creativity should not be overlooked.
d.	! It is emphasized the theory can't become law or vice versa
O9	! It is emphasized differences between hypothesis, theory and law.
O11	3.1? Models exactly represent reality.

Note: ?: misconception, !: caution

How participating teachers paid attention to these misconceptions and cautions in their lessons are assessed in four categories: completely emphasized, partially emphasized, wrongly emphasized, and not emphasized.

Notation	Misconceptions/cautions
+	Completely emphasized
⊥	Partially emphasized
x	Wrongly emphasized
-	Not emphasized

In Table 4.14, participating teachers' consideration of each misconception/caution after and before the PD program is given. When considered generally, it is seen that misconception and caution were cared more in 2013. In observations made before the PD program, only one teacher (TG) considered O8a misconception whereas after the PD program, all teachers met this expectation. The change of this misconception, which is known to be strong and commonly faced in the literature, is noticeable. In the same way, O8c “When physics principles, laws and theories are discovered, the influence of people's imagination and creativity should not be overlooked” caution had quite big changes. Misconception “Physics and technology are the same thing” in O5 had the least change.

Table 4.14 Teachers' consideration of each misconception/caution before and after the PD program

Teacher	**TA**		**TB**		**TC**		**TD**		**TE**		**TF**		**TG**	
	2012	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
O5	-	-	-	+	-	-	-	-	-	-	-	-	-	-
O7	⊥	+	+	+	-	-	+	+	-	+	+	+	+	+
O8 a.	x	+	-	+	-	+	⊥	+	-	+	-	+	+	+
b.	x	+	+	+	x	x	+	+	-	+	+	+	⊥	⊥
c.	-	⊥	-	+	-	+	-	+	-	+	-	+	-	+
d.	x	⊥	x	+	x	x	⊥	+	-	⊥	⊥	+	⊥	⊥
O9	x	x	x	+	x	x	x	+	-	x	x	⊥	-	-
O11	⊥	+	-	+	-	-	-	+	-	-	-	-	-	-

Table 4.14 (continued)

Teacher	**2012**				**2013**			
	+	**⊥**	**X**	**-**	**+**	**⊥**	**X**	**-**
O5	0	0	0	7	1	0	0	6
O7	4	1	0	2	6	0	0	1
O8 a.	1	1	1	4	7	0	0	0
b.	3	1	2	1	5	1	1	0
c.	0	0	0	7	6	1	0	0
d.	0	3	3	1	3	3	1	0
O9	0	0	5	2	2	1	3	1
O11	0	1	0	6	3	0	0	4

Table 4.15 Teachers' consideration of each misconception/caution based on four categories

Teacher	TA		TB		TC		TD		TE		TF		TG	
Misconceptions/cautions	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
Completely emphasized	0	4	2	8	0	2	2	7	0	4	2	5	2	3
Partially emphasized	2	2	0	0	0	0	2	0	0	1	1	1	2	2
Wrongly emphasized	4	1	2	0	3	3	1	0	0	1	1	0	0	0
Not emphasized	2	1	4	0	5	3	3	1	8	2	4	2	4	3

Teacher	Total average		Difference
Misconceptions/cautions	**2012**	**2013**	
Completely emphasized	1.0	4.1	3.1
Partially emphasized	0.9	0.8	-0.1
Wrongly emphasized	1.4	0.6	-0.8
Not emphasized	3.8	1.5	-1.8

The situation which takes attention the most in Table 4.15 is that almost half of (4.1 in average) totally eight misconceptions/cautions were completely emphasized by the teachers after the PD program. Although this change is about four times more than the situation at the beginning, it is a small amount after the PD program.

Change in average of teachers participating to the PD program approximately 80% and more was to 5.6 from 1.2 and this change was to 2.5 from 1 for three teachers in the lower group (Table 4.16). Teachers participating to the PD program effectively considered 6 of 8 misconceptions/cautions after the PD program.

Table 4.16 Teachers' (classified according to participation rate to the PD program) consideration of each misconception/caution and their changes

Teacher	TB		TD		TA		TE		TF		Average			TC		TG		Average		
Misconceptions/cautions	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**Difference**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**Difference**
Completely emphasized	2	8	2	7	0	4	0	4	2	5	1.2	5.6	4.4	0	2	2	3	1.0	2.5	1.5
Partially emphasized	0	0	2	0	2	2	0	1	1	1	1.0	0.8	-0.2	0	0	2	2	1.0	1.0	0
Wrongly emphasized	2	0	1	0	4	1	0	1	1	0	1.6	0.4	-1.2	3	3	0	0	1.5	1.5	0
Not emphasized	4	0	3	1	2	1	8	2	4	2	4.2	1.2	-3.0	5	3	4	3	4.5	3.0	-1.5

	Total average		
Misconceptions/cautions	**2012**	**2013**	**Difference**
Completely emphasized	1.1	4.7	3.6
Partially emphasized	1	0.9	-0.1
Wrongly emphasized	1.6	0.7	-0.9
Not emphasized	4.3	1.7	2.6

4.2.2 Findings of SubQ2

When Table 4.5 in the level of teachers' participation section is considered, it is seen that the teachers other than TA and TC are above the weighted participation limit in this dimension. The effect of the PD program on teachers' practices in terms of the use of teaching strategy is given the following.

Teaching strategy dimension: How are the common topics delivered?

Table 4.17 shows teaching strategy usage in terms of frequency and quality before and after the PD program. The use of teaching strategies is evaluated as R and NR in different columns according to teachers' status on participating students to lessons (R-requiring student participation; NR-not requiring student participation).

When Table 4.17 is evaluated generally, it is seen that there is obvious increase in the use of teaching strategy in both groups after the PD program. This increase is observed when teachers use requiring student participation strategies. The quality in the use of teaching strategy also increases with the increase in teaching strategy use. In teaching strategies which do not require student's participation to the lesson (NR), the number of uses remained almost stable in upper group teachers or decreased slightly in lower group teachers. Before the PD program, the quality of requiring student participation strategies is 77.0 points for upper group and 54.0 points for lower group teachers in average. These points increase in 92.5 for upper group and 87.2 for lower group of teachers after the PD program. The increases in the qualities of the use of requiring student participation strategies are 15.5 points in upper group, while 33.2 points in lower group teachers between the two years.

Table 4.17 The frequency of the use of teaching strategies and their qualities according to years

	Number of times used				Quality			
Teacher	**2012 R**	**2013 R**	**2012 NR**	**2013 NR**	**2012 R**	**2013 R**	**2012 NR**	**2013 NR**
TB	15	49	10	11	79.9	96.9	87.5	97.2
TD	20	43	14	16	92.2	97.5	81.4	89.0
TE	15	34	10	13	70.2	90.8	64.6	83.9
TF	7	33	11	10	82.4	89.6	66.0	76.9
TG	7	30	11	9	60.1	87.6	50.0	75.7
Average:	**12.8**	**37.8**	**11.2**	**11.8**	**77.0**	**92.5**	**69.9**	**84.5**
Difference:	**25.0**		**0.6**		**15.5**		**14.6**	
TA	13	24	18	13	82.9	96.5	78.4	82.5
TC	2	10	14	11	25.0	77.8	46.9	57.9
Average:	**7.5**	**17**	**16**	**12**	**54.0**	**87.2**	**62.7**	**70.2**
Difference:	**9.5**		**-4.0**		**33.2**		**7.6**	
Total average:	**11.3**	**31.9**	**12.6**	**11.9**	**70.4**	**91.0**	**67.8**	**80.4**
Difference:	**20.6**		**-0.7**		**20.6**		**12.6**	

R-requiring student participation
NR-not requiring student participation

However, even in these teaching strategies, quality usage increased after the PD program. As a consequence of the PD program, the number of requiring student participation strategies increases to 31.9 from 11.3 in total. Their qualities are up to 91.0 from 70.4. The usage of not requiring student participation strategies decreases from 12.6 to 11.9 after the PD program. On the other hand, their qualities increase 80.4 in 2013 from 67.8 in 2012 for the seven teachers.

When the average numbers in Table 4.18 are determined, the number of use of aforementioned teaching strategy by teachers is shown in the first part. In the second part, it is shown in how many different common parts it was used in average. Thus, the numbers in these two parts are different for some teaching strategies. The cells with no change in number are colored in grey. The following teaching strategies were used more than one in a common topic:

Questioning: number of questions

By using history of science: number of examples

Repeating the content: number of repeats

Repeating by solving question: number of question solving with purpose of repeat

Investigation+reading: number of assignment and reading

Storytelling: number of stories

By letting students do presentation with poster or PowerPoint: number of presentation or poster

Group working: number of activities made with group

Demonstration (from MoNE): number of demonstration

Table 4.18 The average numbers of teaching strategies, their qualities, and their distribution according to 15 common topics

	Number of times used (How many times was this teaching strategy used in 15 common topics) - Average number of use				In how many different common topics was it used (in how many of 15 common topics was this teaching strategy used (max 15)			
How are the common parts delivered	2012R	2013R	2012NR	2013NR	2012R	2013R	2012NR	2013NR
Questioning	4.9	13.6	2.6	0.0	4.4	9.7	2.6	0.0
Lecturing	0.0	0.0	5.9	3.4	0.0	0.0	5.9	3.4
From known to unknown	0.1	1.3	0.4	0.0	0.1	1.3	0.4	0.0
By using history of science	0.0	0.3	0.6	4.0	0.0	0.3	0.6	2.7
Analogy/metaphor	0.0	0.0	0.3	1.0	0.0	0.0	0.3	1.0
Repeating the content	0.3	2.0	2.0	2.4	0.3	1.9	1.9	2.3
Repeating by solving question	1.9	1.4	0.0	0.0	1.9	1.3	0.0	0.0
Investigation+reading	1.1	2.1	0.0	0.0	1.0	1.6	0.0	0.0
Storytelling	0.4	0.0	0.6	0.4	0.4	0.0	0.4	0.4
By letting students do presentation with poster or powerpoint	0.0	1.5	0.0	0.0	0.1	1.3	0.0	0.0
By using worksheet	0.3	1.0	0.0	0.3	0.3	1.0	0.0	0.3
Group working	0.6	2.9	0.0	0.0	0.6	2.6	0.0	0.0
Demonstration (from MoNE)	0.4	0.3	0.3	0.3	0.4	0.1	0.3	0.3
By solving puzzle	0.0	0.7	0.0	0.0	0.0	0.7	0.0	0.0
Role playing	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Game	0.0	0.4	0.0	0.0	0.0	0.4	0.0	0.0
By doing project	0.0	0.3	0.0	0.0	0.0	0.3	0.0	0.0
By letting students reading text	0.0	0.4	0.0	0.0	0.0	0.4	0.0	0.0

Table 4.18 (continued)

	Quality			
How are the common parts delivered	2012R	2013R	2012NR	2012NR
Questioning	83.1	92.9	63.6	-
Lecturing	-	-	61.0	75.6
From known to unknown	91.7	93.5	76.4	-
By using history of science	-	95.8	87.5	83.5
Analogy/metaphor	-	-	43.8	69.0
Repeating the content	90.6	94.2	81.5	86.8
Repeating by solving question	76.0	78.2	-	-
Investigation+reading	63.3	87.2	-	-
Storytelling	80.5	-	70.8	82.3
By letting students do presentation with poster or powerpoint	-	90.2	-	-
By using worksheet	100.0	100.0	-	85.6
Group working	92.7	98.6	-	-
Demonstration (from MoNE)	56.3	100.0	89.6	91.7
By solving puzzle	-	100.0	-	-
Role playing	-	75.0	-	-
Game	-	94.4	-	-
By doing project	-	100.0	-	-
By letting students reading text	-	100.0	-	-

4.2.3 Findings of SubQ3

When level of teachers' participation in the PD program in Table 4.5 is considered, it is seen that teachers named TB, TD and TF are above the participation criteria in this dimension. The effect of the PD program on teachers' practices in terms of the use of material/technology is presented as the following.

Material/technology dimension: What and how frequently and effectively instructional materials/technologies are used?

Each teacher group both under and above the weighted participation rate have increased in the number of material usage approximately three times after the PD program. The quality of use has also increased with this increase. In total average, 7.9 number of times material/technology was used with the quality of 63.7 by the teachers before the PD program. The change is 24.1 in number with quality of 86.4 after the PD program (Table 4.19).

Table 4.19 The number of material use of each teacher and their qualities

	Number of times used		**Quality**	
Teacher	**2012**	**2013**	**2012**	**2013**
TB	14	55	87.8	99.3
TD	10	31	68.6	85.1
TF	10	21	70.1	84.6
Average:	**11.3**	**35.7**	**75.5**	**89.7**
Difference:	**24.4**		**14.2**	
TA	9	18	81.9	94
TG	5	21	52.7	86.3
TE	3	14	51.4	81.7
TC	4	9	33.3	74
Average:	**5.3**	**15.5**	**54.8**	**84.0**
Difference:	**10.2**		**29.2**	
Total average:	**7.9**	**24.1**	**63.7**	**86.4**
Difference	**16.2**		**22.7**	

Before the PD program, the quality of material use is 75.5 points for upper group and 54.8 points for lower group teachers in average. These points increase in 89.7 for upper group and 84.0 for lower group of teachers after the PD program. The increases in the qualities of the use of material/technology are 14.2 points in upper group, while 29.2 points in lower group teachers between the two years.

Average number of materials used after and before the PD program by the teachers participated to the study is summarized in Table 4.20. It can be said that the most used materials after the PD program are video (used in the PD program), board and lab equipment. These materials have been used in different common topics in a more qualified way.

Table 4.20 The average numbers of materials/technologies, their qualities, and their distribution according to 15 common topics

	Number of times used		**Number of different common topics**		**Quality**	
Material/ technology	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
Video (used in PD training)	0.7	2.6	0.7	2.4	87.5	90.2
Simulation	0.0	0.4	0.0	0.4	-	100.0
Book	1.1	2.4	0.9	2.4	61.3	83.6
Board	1.1	3.7	1.1	3.7	70.8	90.2
Worksheet	0.3	1.0	0.3	1.0	91.7	94.4
Lab Equipment	1.1	3.4	1.1	2.7	74.1	93.6
Poster	0.3	2.1	0.3	1.6	81.3	90.9
PowerPoint slide	0.0	1.3	0.0	1.1	-	95.4

When the average numbers in Table 4.20 are calculated, the number of use of aforementioned material by the teachers is shown in the first part. In the second part, it is shown in how many common topics it was used in average. Thus, the numbers in these two parts are different for some materials/technologies (colored cells with grey).

Both MoNE lesson book and the other source books have begun to be used in a more qualified way and in more common topics both in and out of the class (see Table 4.21).

Table 4.21 The number of use of books, their quality usage, and their distribution according to 15 common topics

	Number of times used		Number of different common topics		Quality	
Book	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
Sourcebook (inclass)	1.4	1.7	1.4	1.7	60.0	91.3
Sourcebook (outclass)	0.0	1.1	0.0	1.1	-	74.0
Book (MoNE-inclass)	2.7	5.0	2.1	4.9	57.1	93.6
Book (MoNE-outclass)	0.1	1.7	0.1	1.7	66.7	75.5

4.2.4 Findings of SubQ4

When Table 4.5 is considered, it is seen that teachers named TB, TD and TF are above the participation criteria. In this part, the observations in assessment dimension were evaluated separately in common topics and skill objectives. In addition, assessments were also grouped whether they were made in written exam or not.

Assessment dimension: What, for what purposes, how frequently, and effectively assessment techniques are used?

a) Common topics

i) Formative, summative, diagnostic and placement assessment in lessons (except written exam)

Number of formative assessment use especially by teachers who participated in upper level and the serious increase in quality of use of them are noticeable. According to observation data, when the tools were used for the purpose of formative assessment by the seven teachers, mostly solving question was observed. As shown in Table 4.22, formative assessment use was 2.1 in average, in 2012 and this number increased to 5.3 in 2013. The quality was increased to 78.9 from 58.0.

Table 4.22 The number of formative assessment used by the teachers in common topics and their quality usage

	Number of times used		Quality	
Formative assessment / **Teacher**	**2012**	**2013**	**2012**	**2013**
TB	3	11	66.7	93.4
TD	4	10	57.6	86.1
TF	0	3	-	93.9
Average:	**2.3**	**8.0**	**62.1**	**91.1**
Difference:	**5.7**		**29**	
TA	2	2	87.0	65.0
TE	2	2	24.2	93.9
TG	0	4	-	65.2
TC	4	5	54.5	54.5
Average:	**2.0**	**3.3**	**55.3**	**69.7**
Difference:	**1.3**		**14.4**	
Total average:	**2.1**	**5.3**	**58.0**	**78.9**
Difference	**3.2**		**20.9**	

When Table 4.23 is considered generally, it can be said that the use of summative assessment has increased after the PD program. However, there is no change in summative assessment use except for some teachers. It was seen that summative assessment was used by the teachers mostly when giving assignment (investigation).

Table 4.23 The number of summative assessment used by the teachers and their quality usage

	Number of times used		Number of different common topics		Quality	
Summative assessment	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
Teacher						
TB	0	1	0	1	-	75.8
TD	0	0	0	0	-	-
TF	0	4	0	4	-	96.3
Average:	**0.0**	**1.7**	**0.0**	**1.7**	**-**	**86.0**
Difference:	**1.7**		**1.7**		**86.0**	
TA	1	1	1	1	75.8	80.0
TE	6	7	4	3	42.2	66.7
TG	1	6	1	6	30.0	80.6
TC	0	0	0	0	-	-
Average:	**2.0**	**3.5**	**1.5**	**2.5**	**49.3**	**75.7**
Difference:	**1.5**		**1**		**26.4**	
Total average:	**1.1**	**2.7**	**0.9**	**2.1**	**-**	**79.9**
Difference	**1.6**		**1.2**		**79.9**	

According to observation results, diagnostic assessment was not used by any teachers in assessment in the year 2012, while it was used by only one teacher (TB) in the year 2013. The quality of implementation is quite successful (100 quality scores). This teacher is the teacher who participated in the PD program most.

In Table 4.24, it is seen that any placement test was not used by the teachers before the PD program; however it has begun to be used successfully by especially upper group teachers after the PD program.

Table 4.24 The number of placement tests used by the teachers and their quality usage

	2012		2013	
Placement assessment / **Teacher**	**Type**	**Quality**	**Type**	**Quality**
TB	-	-	Multiple Intelligence	100
TD	-	-	Learning Style	33.3
TF		-	Learning Style	100
Average:				**77.8**
TA	-	-	-	-
TE	-	-	Multiple Intelligence	33.3
TG		-	Learning Style	33.3
TC	-	-	-	-
Average:				**33.3**
Total average:				**60.0**

ii) Common topics in written exam

As well as the inter-class applications, written exams applied at the end of lessons or units with summative purpose were analyzed by collecting in both terms. In exams made in 2012, summative exams covering averagely 7.7 common parts was prepared as seen in Table 4.25. However, in 2013 this number was increased to 8.9. The main reason of this may be that the teachers had to prepare common exam in their schools with other physics teachers in 2013. Because, even decreases were observed in teachers prepared common exam compared to the year 2012 (TF, TA, TG). However, serious increases were observed in TB, TD, TE, and TC who prepared the exams alone in common exams. Therefore, the special situations mentioned above must be considered when interpreting Table 4.25.

Table 4.25 The number of common topics considered by the teachers when preparing written exam (summative) and their quality usage

	2012		2013	
Written exam (summative) Teacher	**Number of common topics covered in the exam (#15)**	**Quality (100 points)**	**Number of common topics covered in the exam (#15)**	**Quality (100 points)**
TB	10	55.6	14	100.0
TD	7	77.8	10	72.2
TF	15	80.6	7	77.8
Average:	**10.7**	**71.3**	**10.3**	**83.3**
TA	12	97.2	7	80.6
TE	2	55.6	7	75.0
TG	6	77.8	5	55.6
TC	2	55.6	12	97.2
Average:	**5.5**	**71.5**	**7.8**	**77.1**
Total average:	**7.7**	**71.4**	**8.9**	**80.2**

b) Skill objectives

In this part, the result of analysis made for determining how the skills are considered in assessment tools used in lessons and exams is given.

i) Formative and summative assessment in lessons (except written exam)

The most noticeable change in formative assessments is seen in the PTSE skill objective (Table 4.26). Especially in upper participation group of teachers, there is a noticeable increase in the PTSE skill numbers by using formative assessment and the quality of use of these.

No change to be averaged was determined in the ICS skill objectives. For this, assessment on the basis of person will be the most appropriate way. In this context, teachers TB and TF did not consider this ICS skill objectives in formative assessment in 2012, however, in 2013 TB used it 5 times more often with quality of 87.9 and TF used it once with quality of 93.3.

Table 4.26 The number of formative assessment used by the teachers in the PTSE skill objectives and their quality usage

	Number of times used		Number of different objectives		Quality	
Formative assessment			**PTSE**			
Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB	0	10	0	6	-	87.9
TD	4	7	3	3	57.6	73.6
TF	0	4	0	2	-	87.9
Average:	**1.3**	**7.0**	**1.0**	**3.7**	**57.6**	**83.1**
Difference:	**5.7**		**2.7**		**25.5**	
					-	**-**
TA	0	1	0	1	-	70.0
TE	0	1	0	1	-	87.9
TG	0	2	0	2	-	66.7
TC	1	4	1	2	54.5	54.5
Average:	**0.3**	**2.0**	**0.3**	**1.5**	**54.5**	**69.8**
Difference:	**1.7**		**1.2**		**15.3**	
Total average:	**0.7**	**4.1**	**0.6**	**2.4**	**56.0**	**75.5**
Difference	**3.4**		**1.8**		**19.5**	

When we consider average results of these seven teachers, it is seen that they preferred formative assessment in the PTSE objectives and mostly in solving question. This method was used 0.7 times in average in 2012 and this number increased to 4 in 2013 while the quality was increased to 74.1 from 56.0.

In the PSS skill objective, the change in upper group of teachers is noticeable (Table 4.27).

Table 4.27 The number of formative assessment used by the teachers in the PSS skill objectives and their quality usage

	Number of times used		Number of different objectives		Quality	
Formative assessment	**PSS**					
Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB	2	7	1	4	66.7	90.9
TD	0	4	0	3	-	74.2
TF	0	2	0	1	-	87.9
Average:	**0.7**	**4.3**	**0.3**	**2.7**	**66.7**	**84.3**
Difference:	**3.6**		**2.4**		**17.6**	
TA	0	0	0	0	-	-
TE	0	0	0	0	-	-
TG	0	0	0	0	-	-
TC	0	1	0	1	-	54,5
Average:	**0**	**0.3**	**0.0**	**0.3**	**-**	**54.5**
Difference:	**0.3**		**0.3**		**54.5**	
Total average:	**0.3**	**2.0**	**0.1**	**1.3**	**66.7**	**76.9**
Difference	**1.7**		**1.2**		**10.2**	

When generally considered, it can be said that the participants individually considered the PTSE skills in summative assessments (Table 4.28). Teachers TF, TA, TE and TG have begun using it by 2013 school year. The PTSE skills were measured by giving performance (80 quality score) and investigation (95 quality score) assignments.

Table 4.28 The number of summative assessment used for the PTSE skill objectives by the teachers and their quality usage

Summative assessment	Number of times used		Number of different objectives		Quality	
	PTSE					
Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB	0	0	1	0	-	-
TD	0	0	0	0	-	-
TF	0	4	0	2	-	95.0
Average:	**0.0**	**1.3**	**0.3**	**0.7**	**-**	**95.0**
Difference:	**1.3**		**0.4**		**95.0**	
TA	0	1	0	1	-	80.0
TE	0	3	0	1	-	80.0
TG	0	2	0	2	-	90.0
TC	0	0	0	0	-	-
Average:	**0**	**1.5**	**0**	**1**	**-**	**83.3**
Difference:	**1.5**		**1.0**		**83.3**	
Total average:	**0.0**	**1.4**	**0.1**	**0.9**	**-**	**86.3**
Difference	**1.4**		**0.8**		**86.3**	

Based on observation data, it was determined that the teachers did not consider the ICS skill objectives in summative assessment tools both before and after the PD program.

In the PSS skill objective, teacher TE used this skill objective in summative assessment once in assignment (investigation) with 33.3 quality score in 2012 and she used it twice in performance assignment with 80.0 quality score in 2013. The PSS was used in solving question as formative assessment in 2013.

ii) Skill objectives in written exam

In Table 4.29, it can be said that only PTSE skill objective considering levels of especially upper participation group of teachers increased in written exams. There is no generally noticeable increase in average numbers except some individual changes in consideration of other skill objectives in written exams. Only TB used 2 of 8 skills of the PSS in written exam and this number increased to 4 after the PD program.

Table 4.29 The number of skill objectives considered by the teachers when preparing written exam (summative) before and after the PD program

Written exam	**PTSE/10**		**ICS/5**		**PSS/8**	
Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
TB	0	7	0	1	2	4
TD	1	4	0	0	0	0
TF	2	1	0	0	0	0
Average:	**1**	**4**	**0**	**0.3**	**0.7**	**1.3**
Difference:	**3**		**0.3**		**-0.6**	
TA	0	7	0	0	0	0
TE	1	1	1	0	0	0
TG	1	0	0	0	0	0
TC	0	1	0	0	0	1
Average:	**0.5**	**2.3**	**0.3**	**0.0**	**0.0**	**0.3**
Difference:	**1.8**		**-0.3**		**0.3**	
Total average:	**0.7**	**3**	**0.1**	**0.1**	**0.3**	**0.7**
Difference	**2.3**		**0**		**0.4**	

4.3 Results of Student Group Interviews

While the studies made within this thesis continue, the physics curriculum was updated in 2013 just before the PD program. Therefore, some of the objectives have changed their locations, some of them have been removed or new objectives have been added. The skill objectives were cross-coded to the objectives in 2007 program while in 2013, the necessity to use skill objectives frequently was emphasized and the application was left to teacher without encoding to the objectives clearly. However, the common objectives in both curriculum units were determined for identifying the efficiency of the PD program and totally 15 common topics were determined.

The comparisons to be made after and before the PD program will be made based on these common topics. The PD program was developed according to the new curriculum subjects for provision of actuality and increasing familiarity of teachers to the new curriculum.

The student interview form including semi-structured questions is consistent of two sections. The first section consists of four dimensions. These dimensions are the PD program content dimensions which were created as result of the conclusions obtained from the TSNOP survey made to the teachers and requested to be within the content of program to be made. They are as follows:

1. the content/skill/misconception in 9^{th} class NOP unit
2. Teaching strategy
3. Material/technology
4. Assessment

In the second section, there are general questions out of four dimensions mentioned above and thought to make contribution to the determination of the PD program to be made. With the questions to be asked, it is targeted to make students determine what is made and how often, what is needed, the problems and possible solutions for these problems by making observation on teachers. The interviews were made in one lesson hour collectively with one class of the teacher as a group interview. In Table 4.30 shows the percentage of students who thought they were unable to learn based on common topics in the group interviews.

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Table 4.30 Percentage of students who thought they were unable to learn based on common topics in the group interviews

		O1		02		O3		O4		O5		O6		O7		O8		O9		O10	
	Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
UPPER GROUP	**TB**	59	16	11	17	37	0	26	0	0	12	0	0	0	0	33	0	15	23	0	0
	TD	0	0	x	32	91	0	52	17	0	0	0	0	0	0	52	0	0	0	30	0
	TA	61	0	83	0	83	15	56	12	44	13	0	0	0	0	61	0	37	28	0	16
	TE	35	0	x	0	17	0	26	0	0	12	0	0	0	0	13	16	0	0	0	0
	TF	17	0	0	16	33	13	42	0	46	0	0	0	29	0	50	19	25	30	52	13
LOWER GROUP	**TC**	0	0	0	0	0	0	0	15	0	0	0	0	0	0	39	0	54	31	0	0
	TG	12	0	x	14	59	14	x	0	x	14	0	0	0	0	63	0	45	30	0	17

Note: x refers “common topics told to be not delivered in the lesson”

Table 4.30 (continued)

		O11		O12		O13		O14		O15	
	Teacher	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
UPPER GROUP	**TB**	0	0	22	16	0	0	22	16	11	16
	TD	x	12	30	17	0	17	17	14	13	0
	TA	50	12	72	19	0	16	72	29	14	15
	TE	0	13	39	16	0	0	39	16	57	11
	TF	46	12	48	0	0	0	48	0	11	11
LOWER GROUP	**TC**	0	0	0	26	0	0	0	16	19	19
	TG	x	14	45	31	18	0	15	11	12	0

Note: x refers “common topics told to be not delivered in the lesson”

Light grey values on table show 50% or more change in the opinions of students in observed classes of each teacher. This change is obviously in a positive direction as of 2013. In other words, the percentage of students who thought common topics were not delivered in 2013 is less than the percentage in 2012. Dark grey values are the subjects in which no serious changes happened in consideration of the number of students as percentage. As it can be seen, the decrease in common topics thought to be not delivered by the students for the teachers who are in upper groups is remarkable. However, O9 is the common topic which is mentioned to be problematic in terms of learning in both years by the students of teachers in both lower and upper group.

Table 4.31 gives some students' reasons to explain why they are not able to learn some subjects in the unit. As a common problem, fast and superficial introduction of scalar and vector quantities is mentioned by the students of some teachers in both years.

Table 4.31 Some reasons mentioned by the students who are thought they were unable to learn subjects

Teacher	2012	2013
TB	Confusing scalar and vector quantities	Confusing scalar and vector quantities
TD	Failure to make sufficient questions and samples supporting the subject	
TA	Fast introduction and lack of samples in description of physics, sub fields and its relation with the other science fields	Fast introduction and lack of samples about scalar and vector quantities
TE	Fast and superficial introduction of scalar and vector quantities Failure to make sufficient questions and samples supporting the subject	Fast and superficial introduction of scalar and vector quantities
TF	Using only question and answer method Writing much	
TC	Fast introduction	Fast introduction
	Problematic and incorrect source book	Problematic and incorrect source book
TG	Too much noise in class	Too much noise in class
	Writing much Less teaching	

When Table 4.32 is examined, it can be said that the students of teachers in upper groups in terms of use of teaching strategies see the lessons methodically richer (various) in the year 2013. The teachers have begun to use strategy more in their lessons after the PD program. Another notable development is that the teachers gave feedback to the assignments in 2013.

Table 4.32 Student opinions in terms of the teaching strategy used in lesson

	Teacher	**2012**	**2013**
Upper	TB	Active participation in the lesson	Active participation in the lesson Group work Experiments Presentation preparation Receiving feedback for given assignment
	TD	Active participation in the lesson Failure to receive feedback for given assignment	Active participation in the lesson Group work Project-making Experiments Receiving feedback for given assignment
	TE	Active participation in the lesson Failure to receive feedback for given assignment	Active participation in the lesson Group work Experiments Receiving feedback for given assignment
	TF	Active participation in the lesson	Active participation in the lesson Group work Presentation preparation Puzzle solving
	TG	Active participation in the lesson Failure to receive feedback for given assignment	Active participation in the lesson (nearly 50%) Group work Experiments Receiving feedback for given assignment
Lower	TA	Active participation in the lesson (44%) Failure of active participation in the lesson	Active participation in the lesson Group work Experiments Receiving feedback for given assignment
	TC	Failure of active participation in the lesson Failure to receive feedback for given assignment	Failure of active participation in the lesson Receiving feedback for given assignment

As can be seen from Table 4.33, in 2013, the students mentioned that they use material/technology in the lessons. Material/technology usage has increased notably in upper groups teachers in 2013 (Table 4.33).

Table 4.33 Student opinions in terms of material/technology used in lesson

Teacher	2012	2013
TB	-	Poster, handouts, source book, ppt
TD	-	Poster, video
TF	-	Puzzle, poster, video
TA	-	Smart board
TG	-	Video, poster
TE	-	-
TC	-	Source books (in two terms),

Table 4.34 displayed students' opinions about assessment techniques used with different purposes. According to students, teachers in upper groups used more rich assessment techniques and for more different purposes. Teachers in lower groups in terms of participation level used nearly the same assessment techniques in 2013 as usual in 2012.

Table 4.34 Assessment purposes used in lesson based on students' opinions

Assessment purpose	Placement	Diagnostics	Formative	Summative	Placement	Diagnostics	Formative	Summative
Teacher		**2012**				**2013**		
TB	-	-	-	+	+	+	+	+
TD	-	-	-	+	-	-	+	+
TF	-	-	-	+	+	-	+	+
TA	-	-	-	+	-	-	+	+
TE	-	-	-	+	-	-	+	+
TG	-	-	-	+	-	-	-	+
TC	-	-	-	+	-	-	-	+

"+": Assessment was used in the class
"-": Assessment was not used in the class

4.4 Results of Classroom Documents

At the end of unit, notebooks used by the students in lessons were examined and the results were summarized in Table 4.35. The noticeable issue in all students in both years is that the things written on the board in the lessons were exactly noted. However, in the notebooks of 2012, it is seen that there are missing issues in terms of subject. In particular; subjects such as hypothesis, theory, law, modelling are missing. This lack continues partially in 2013. In addition, subjects not in objectives, such as absolute error, relative error, were noted in some notebooks. By the year 2013, it is noteworthy that the skill objectives are also seen in the notebooks. Besides, the subjects were noted more regularly by supporting with visual tools such as graphics and/or tables. Another important point is that in 2013, notebook control was made by putting signatures. In general, by the year 2013, notebooks of the students have become more regular and comprehensive in terms of subjects and in a manner in which the students can make repetition by themselves. Another documents, class exams and quizzes were evaluated inside the assessment dimension and discussed in findings of subQ4.

Table 4.35 Results of notebooks used by the students in lessons

Teacher	**2012 ☺**	**2012 ☹**
TB	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Given studying papers were affixed to the notebooks.	----
TD	Subjects written on notebooks and the things written on board in the lesson were exactly noted.	Subject content not in objective was written (e.g., units of volume; gallons, inches). All content was not written on the notebook (e.g., physics-mathematics, physics-technology relationship).
TF	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Although notes were not taken on the notebook, some important parts in MoNE book were underlined.	There are some missing parts although most of the contents were written on the notebook (e.g., description of physics, modeling).

☺: Positive findings in students’ notebooks, ☹: Negative findings in students’ notebooks

Table 4.35 (continued)

Teacher	2013 ☺	2013 ☹
TB	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Given studying papers were affixed to the notebooks. Notebooks are regular, assignments were made on the notebook. Some subjects were delivered by being summarized into tables (e.g., the scientific method steps, activity tables, observation types, sizes, measurement, and volume systems). Information about skill objectives in the unit and the information to be marked were written on the notebook by making importance warning. Although notes were not taken on the notebook, some important parts in MoNE book were underlined. Notebook control was made by putting signature.	----
TD	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Subjects were noted shortly and concisely as titles. Some subjects were delivered by being summarized into tables (e.g., quantities). Everything including activities was noted regularly. Information about skill objectives in the unit and the information to be marked were written on the notebook. (e.g., characteristics of physics knowledge, no absolute true in physics).	----
TF	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Subjects were noted shortly and concisely as titles. Although notes were not taken on the notebook, some important parts in MoNE book were underlined. Some subjects were delivered by being summarized into tables (e.g., SI quantities)	There are some missing parts although most of the contents were written on the notebook (e.g., modelling)

☺: Positive findings in students’ notebooks, ☹: Negative findings in students’ notebooks

Table 4.35 (continued)

Teacher	2012 ☺	2012 ☹
TA	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Subjects were noted shortly and concisely as titles.	There are some missing parts although most of the contents were written on the notebook (e.g., hypothesis, theory, law concepts).
TG	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Subjects were noted shortly and concisely as titles. Notebook control was made by putting signature.	There are some missing parts although most of the contents were written on the notebook (e.g., physics relation to other fields, modelling).
TE	Subjects written on notebooks and the things written on board in the lesson were exactly noted.	Subject content not in objective was written (e.g., absolute, relative error and sample questions related to this subject). All content was not written on the notebook (e.g., physics relation to other fields, modelling).
TC	Subjects written on notebooks and the things written on board in the lesson were exactly noted.	There are some missing parts in the content (e.g., physics relation to other disciplines, scalar and vector quantities, hypothesis, theory, law concepts, and scientific methods). There are concepts unrelated to objectives on the notebook (e.g., formulas about scales).

☺: Positive findings in students' notebooks, ☹: Negative findings in students' notebooks

Table 4.35 (continued)

Teacher	2013 ☺	2013 ☹
TA	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Subjects were noted shortly and concisely as titles. Some subjects were delivered by being summarized into tables (e.g., scientific methods, observation types, basic quantities). Information about skill objectives in the unit and the information to be marked were written on the notebook (e.g., characteristics of physics knowledge) Assignments given by the teachers were made on the notebook.	----
TG	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Subjects were noted shortly and concisely as titles. Information about skill objectives in the unit and the information to be marked were written on the notebook (e.g., characteristics of scientific knowledge) Some subjects were delivered by being summarized into tables (e.g., measurement, unit and unit systems and quantities). Notebook control was made by putting signature.	There are some missing parts although most of the contents were written on the notebook (e.g., physics relation to other disciplines, modelling).
TE	Subjects written on notebooks and the things written on board in the lesson were exactly noted. Subjects were noted shortly and concisely as titles. Some subjects were delivered by being summarized into tables (e.g., observation types, basic quantities). Model and modeling related misconceptions were noted.	There are some missing parts in the content (e.g., physics relation to other disciplines, hypothesis, theory, law).
TC	Subjects written on notebooks and the things written on board in the lesson were exactly noted. There are concepts unrelated to objectives on the notebook Notebook control was made by putting signature.	There are some missing parts in the content (e.g., hypothesis, theory, law).

☺: Positive findings in students' notebooks, ☹: Negative findings in students' notebooks

4.5 Results of Teachers' Opinions about Strengths and Weaknesses of the Professional Development Program

In this section, questions measuring the impact of the PD program to delivery of the unit and whether the training is efficient and effective were asked by the PD program evaluation interview protocol (PDEIP). Results of the teacher interviews including five semi-structured and a 12 item 5-likert-type questions were given in detail below.

1. In this term, did you deliver the ISOP unit by student-centered or teacher-centered method? Please explain.

Four of totally seven teachers participating in the study mentioned that they deliver the unit by participating their students to the lesson more, in other words, they deliver the lesson with student-centered method in which require more student participation to the lesson. The teachers stated that they use student-centered lesson delivery method in the following ways (Table 4.36).

Table 4.36 The number of teachers and their student-centered lesson delivery methods

Student-centered lesson delivery methods	Number of teachers
By participating the student to learning process, lesson (question-answer, asking for ideas)	5
By using visual materials	3
Made students projects and experiments	3
By motivating students, taking their attention to the lesson	2
By giving research topics before and after the lesson (or assignment)	2

The teacher has made student-centered lesson delivery method by asking the students for their ideas and involved them in the process more actively. Besides, the materials used, performed project and experiments have contributed to this process together with the given assignments. The teachers have stated their views in this subject as follows:

> I gave them projects and they prepared slides and I wanted them to get prepared for the lesson. The students shared what they did in the lesson and we discussed together in the classroom. I used visual materials more and this took their attention and effected their participation in the lessons positively. When I make comparison with the last year, at least I knew what to do and what to focus on this year (Teacher TF).

> I have tried to use more student-centered method after this PD program. I have tried to join the students in the process and lesson by taking their ideas. I have tried to make more different teaching strategies and activities in the lesson after the PD program. In addition, sometimes I use just lecturing according to the situation. If we leave it to the trends of children, then the time and management of class is lost and two physics lessons are spent for making an activity. In summary, it has been a different point of view than the last year, I am satisfied (Teacher TD).

Two teachers said that they use teacher-centered lesson delivery method more by showing the students' skills and behaviors coming from the past. For example, Teacher TE said "the purpose was to engage students in the activities more by taking them to the center but when we consider their skills and behaviors coming from the past years, it happened teacher-centered automatically. Unlucky for you, the class did not have the requested performance this year, the other classes were better in the lesson." and she emphasized both the behaviors and skills coming from the past and the impact of class' level on application of new things learnt from the PD.

2. Please explain positive and negative changes occurred in your inter-class applications after taking the PD program considering the following issues;

a) In terms of content of the unit (common topics and skill objectives). Did your students have any difficulties in this dimension? Please explain.

The teachers stated that "they care more about the objectives" after the PD program (4 teachers). For example, Teacher TG stated the following as: "We knew the subjects, but we didn't pay too much attention on the objectives. I tried to determine which objectives to focus, which objectives to give in which level. I thought whether I prepared the exam questions according to the objectives and whether I could measure the students and I got awareness on how to look at the curriculum. I cared more attention on which question the students could not answer in the exam. I adopted objective-focused lesson delivery more. They still have problems on units and they couldn't understand the modelling". Teacher TB said that she started to give skill objectives after the PD program. "I thought of the objectives and I determined how to deliver the lesson and how to prepare for the lesson. I delivered the objectives on evidence-inference, modelling, and the necessity to use units well. Theory, law and hypothesis connection were the hardest topic for the students. I will make the students watch Einstein's great idea film and works of scientists using scientific method next lesson. I have watched it at home and I liked it". Besides, historical development, dependent-independent variable, evidence-inference as new subjects have begun to be given in lessons. The hardest subjects for the students at this level are listed as follows:

- Using units
- Making a hypothesis
- Law, theory-related misconceptions
- Making mathematical modeling

Teacher TE stated that the students still have problem in making relation in daily life even after the PD program because they are used to bookish expressions focused on memorizing: "Although I tried to make it actual, they couldn't make a connection with daily life and they couldn't reflect it in their daily lives because they are used to bookish expressions which are based on memorizing. They see it as something else, we make experiments but they think that we are playing games and they cannot establish the cause-effect relation and I think this is a habit coming from past. They have difficulties in establishing modeling and hypothesis."

Teacher TC, who has a successful student profile, stated the following:

> I had to face with the students because the books in market were not written in accordance with the objectives. For example, I didn't deliver unit transformation

to the students as it was not in the new curriculum but they told me that they saw it in many books and they questioned why they didn't learn.

b) In terms of teaching strategy (tasks/activities). Did your students have any difficulties in this dimension? Please explain.

All teachers said that they delivered "richer" lessons in terms of teaching strategies after the PD program. They provided this environment by making group works (three teachers), and doing different experiments (two teachers). Two teachers stated that they did simple pendulum activity used in Workshop I. But, the most encountered problem especially in group works and activities is the noise. The teachers thought that the situation is due to the fact that students are not used to this kind of works and their past experiences are not very positive in this way. Similarly, they had difficulties in connecting them with daily life.

Teacher TD:

> This year, I tried the activity made with simple pendulum with my students and they liked it. We solved the puzzle we developed in the PD program together and we had varieties in the use of method compared to the last year.

c) In terms of technology/material you use. Did your students have any difficulties in this dimension? Please explain.

Most of the teachers mentioned that they started using more materials in their lessons after the PD program (five teachers). They began to use smart board more and they delivered their lessons with visual materials such as video and simulations. Thus, the students paid more attention to the lessons and they had more enjoyable lessons (two teachers). Besides, the students prepared materials such as posters (two teachers), history line (one teacher) and board (two teachers). In this subject, Teacher TB said "I made them watch videos, which I didn't do before. They used the technology, they prepared posters and made boards. For example, they prepared a history line about historical development of atom. I wanted to make them prepare different materials and use some things. I think that the students liked it and I will use it as performance assignment. I collected the materials prepared by students to use as examples in the next year". As in the previous teaching strategy part, the most encountered problem faced by the teachers is noise (view of four teachers) that affects the use of material/technology in their classes. In addition, lack of material in school was mentioned by two teachers.

Teacher TD:

> We made board study for sharing the presentations made by children with the whole school. They liked it and they want to use it in the other units too. We transferred the thing we used in the PD program to the other units. We will also use this part as performance assessment (connection to the assessment dimension). I even created an assessment form based on different assessment tools used in the training. In this form, we made scoring with the students by creating sub-dimensions such as validity and reliability of presentations, contents and sources.

d) In terms of assessment approach you use (assessment for measuring prior knowledge, revealing the difficult subjects, measuring what is known/not known in the process, and giving grade). Did your students have any difficulties in this dimension? Please explain.

Six teachers mentioned that they started to prepare questions more carefully after the PD program. For example, they started to consider the objectives more in question preparation and they understood that they should ask questions for measuring their skills. With the PD program, three teachers started making exams for placement purpose for the first time. Some teachers prepared exams measuring the pre-knowledge of students while some of them prepared rubrics for making performance assessment (three teachers). However, two teachers mentioned that such activities take time and they are not used to this kind of activities. Teacher TC said “common exam has been mandatory this year. I included all kinds of questions in my exams 22 years ago” and he stated that the new common exam application prevents them from revealing their creativities.

Teacher TB summarized her assessment process in the lessons with these views:

I used assessment for placement. I made them solve the example questions we used in the PD program in the lesson. In the process, I prepared worksheet papers and gave them to the students; this showed its benefit with the high grades that took in the first physics exam.

3. Are there anything you couldn't do this year but plan to do in the next term for four dimensions mentioned in the PD program (content/skills/misconceptions, teaching strategies, technologies/materials and assessment approaches)? If any, please explain shortly by mentioning the reason why you couldn't do them this year.

Table 4.37 are summarized the things which are planned to be made in the lessons of next year although couldn't be made in the first applications after the PD program and the reasons why they couldn't be made this year.

Table 4.37 Planned activities in future and reasons why they couldn’t be made this year

Activity planned to be made in future	**Why it couldn't be made**
Misconceptions tests	Lack of time
Worksheets	Lack of time
Preparation of visuals	Lack of time
Giving project and following up strictly	Lack of time
Increasing number of experiments	Lack of experience
Asking for written student’s opinions	Lack of time
Application of things learnt in the unit to other units	Lack of experience
Presentations by students	Lack of time

Teacher TF summarized the activities planned to be made by the teachers in the next term as follows: "I gave the students some projects but I want to give them as performance assignment and follow-up more strictly. I think of increasing the experiments more. I want answer for a question such as what wouldn't be in our daily life if physics didn't exist. When I ask verbally, I don't get an answer but I want to get their opinions in some subjects in written. I think of more making activities. Maybe this year was an intensive term, I was unprepared for applying the new program this year but it was my fault".

The reason mentioned the most for not making some activities this year was time problem. Apart from this, the teachers mentioned they are lack of experience. Another remarkable result is that the teachers think that the practices performed during the PD program will be internalized in themselves in time. Teacher TG said the following in this subject:

> Why exactly I couldn't do it? You cannot perform it if you don't internalize it. We liked it but we may have not performed it completely this year. We got a number of things and we even applied some of them but we couldn't reach to the requested level. Maybe the development of consciousness was nice but it will develop in time. It was a start for me, I learned to look at the objectives in some subjects and this has been a turning point for me.

4. How much of your expectations were met by this PD program?

All of the teachers participating in the study mentioned that their expectations were mostly met. They mentioned that they were pleased of creation of discussion environment in the PD sessions and they shared their opinions and experiences (five teachers). They declared that they saw themselves as shareholders in the education process by determination of needs before the PD program and focus of training on practice as well as by giving opportunities for delivering lessons and this has made great contribution for motivation. Views of three teachers are given as examples below:

> In the previous trainings, content of units were only told and you might take notes and the trainings were over like this, you didn't know how to practice and you didn't have a guide for applying what you learnt. Here, we discussed, corrected the mistakes and asked questions and you (researcher) supported us, which have been contributions during the program. In this way, I mean, if there is someone like you in the trainings, we would ask our questions and know what we are doing. This PD program met my expectations. Maybe we didn't have much time for internalization. Your training was really nice and it contributed to me (teacher TG).

> If we compare this course with the course of the Ministry of Education, we would say we only used to go to the course and listen to it and come back. We made practices in your course. We discussed the unit, we took words, we made presentations and critiques, I mean, we didn't just come and sit, these were the best things. It was very different than the course of Ministry of Education. We saw our errors and corrected them together (teacher TA).

> The reports you gave us in written were great, it made me think that we were there for a purpose, we discussed on the unit, worked together, and I believed that we can achieve something on any topic in a community with our colleagues in future (teacher TE).

The suggestions on development of the PD program can be listed as follows by teachers:

- Worksheets and handouts could be prepared more
- Workshop II could have been longer
- It could have been connected with the other units
- MoNE could support more (e.g., upgrade in position and salary)
- Other feedback mechanism could be in order to control performance regularly on the job after the PD program (e.g., school community meetings, via online platforms, etc.)

5. Just after the interviews made with teachers, they were asked to assess the PD program on a 5-likert-type measurement consisting of 12 questions.

The participant teachers assessed the items between 4.6 and 5 points in average. The lowest score was given for expression "I used the program materials in my lessons". Teacher TG, who assessed the item with 3 points, said "The student profile was not sufficient. I saw that I couldn't get sufficient feedback from them although I tried to use it, which made me take a step backwards in the system; I wanted to deliver the lesson in this way but nobody took notes, there were some students making it good and trying make something, I mean, very few number of students made assignment (history of atom models), there are some difficulties in the students' works, some of them copied subjects from internet, it is not a problem too, but I think the more we reach, the better it would be, thus I couldn't create the requested student profile". In which she mentioned the impact of student profile in application of materials. Then the items:

"Materials used in the PD program helped my learning"
"The content of the PD program was sufficient for me"
"Duration of the program was sufficient"

were scored on 4.9.

The other eight items took full scores. The PD has been found quite successful by the teachers. Even, longer PD programs with increased contents were requested by participating teachers. The overall scores for each item are given in Figure 4.3.

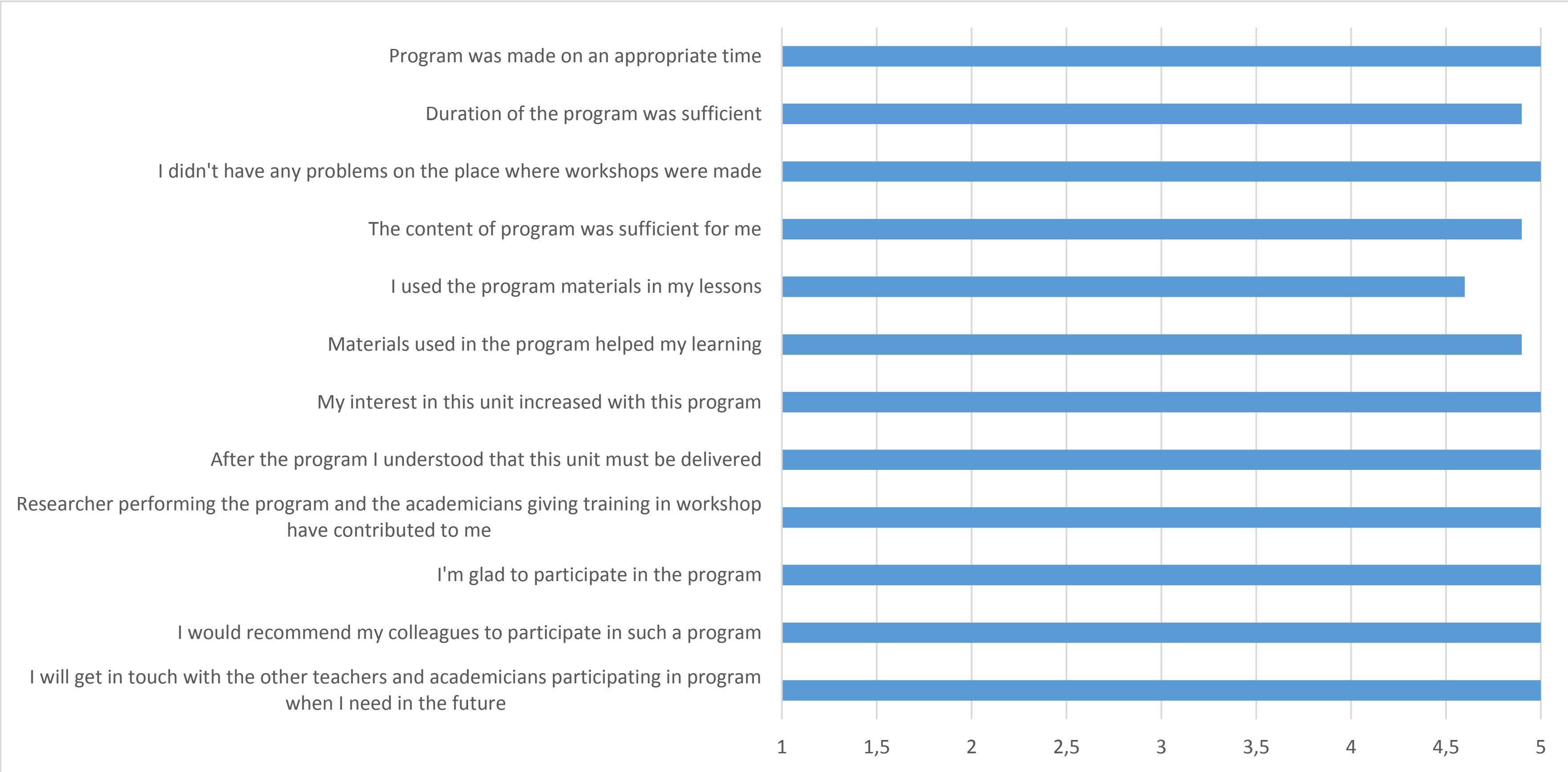

Figure 4.3 Assessment of the PD program on a 5-likert-type measurement

6. Do you have any extra idea or general comments on the PD program? Please explain in short.

As it was the first application this year, the teachers have increased their awareness by clearly determining which which unit content and skill objectives will be delivered for how long time. Some teachers couldn't deliver their lessons in the requested way as they also mentioned, and this can be due to the fact that the change cannot be succeeded immediately and practice after internalization stage is a progress which takes time.

A teacher (TB) with good student success profile mentioned that the general attitudes of students to the physics was impacted her practice.

> I didn't know how to deliver the lesson at first, as they were used to solve numeric questions. However, I am implementing this type of unit preparation that we took in the PD program and the consideration of objectives in the unit of "substance and its features" which I deliver nowadays and I will continue to apply them in all units.

Teacher TD indicated that:

> It is really helpful experience when you talk to other teachers. We are mutually communicated each other. All of us share ideas and I see how other colleagues do practice in their own school and they recommended their practices and gave fruitful feedbacks to improve our practices. I then come to my school, try and examine how it works for my students. I criticize my practice and add or delete some parts to improve my teaching.

The teachers mentioned that they are used to make assessment for giving scores but they have never thought of the availability of assessment types made for different purposes they have seen in the workshop training. They have seen the availability of this kind of assessments and they said that they have concrete examples in their hands now. This helps them to prepare similar assessment tools in their classrooms. All teachers indicated that observations of their lessons by me were very useful. At first they said they were a bit nervous and felt uncomfortable but then they used to be observed by someone. Teacher TB stated that: “I have a chance to see both my strengths and weaknesses during the teaching. You gave me feedback and it makes me more concern and alert to the lesson and my students”.

4.6 Summary of the Results

Treatment verification, level of teachers’ participation rate, observations, student group interviews, classroom documents and PD program evaluation interview results are summarized. Each part is named with a title. Written in italics under the titles shows what the results are mainly related with. Decimals in tables were rounded to the nearest whole numbers and then results were elaborately summarized in this part.

Treatment verification

Treatment verification results are provided with two ways. First is the determination of to what extent selected characteristics appeared in the PD program. As observers, teachers had fully agreement (100%), whereas researcher found 95% agreement that PD characteristics were immersed in the PD program with face to face and non face to face interactions. Second is the assessment of item 3 in self-evaluation form (Appendix AG) given to the teachers after the each Workshop I sessions. Teachers evaluated this item with average of 4.9 for all five sessions indicating all of them made in associated with their purposes.

Level of Teachers’ Participation rate

The effect of the PD program in each dimension is associated with *the level of teacher participation rate* in the PD program. Data results are given according to this participation classification. This rate was calculated considering the total time of face to face and non face to face interactions for each teacher. Total weighted participation rate formulas given on the last column in Table 4.5 were used for the calculation in four dimensions. If teachers participate nearly 80% or over weighted participation rates of the PD program, it is assumed that they were affected by the program. Based on this acceptance, teachers nearly 80% cut off point or above participation rate classified as upper group, while 80% or below participation rate classified as lower group (see the conditions in Table 4.5). Findings were assessed into four dimensions: content/skill/misconception, teaching strategy, material/technology and assessment.

Then, results of students group interviews and classroom documents were presented. Finally, the teachers' opinions about the PD program were discussed.

Observation result

- Observation results about delivering *common topics* and skill objectives and misconceptions/cautions in the unit were evaluated in the content dimension. Participating teachers gave about 6 common topics more completely after the PD program (an increase to 10 from 4 on average). This increment is 7 common topics for the upper group of teachers and 3 common topics for the lower group of teachers. Two teachers (TB and TD) completely delivered 15 common topics as result of the program. The number of partially and wrongly delivered common topics decreased in the upper group teachers, whereas partially delivered common topics a little bit increased and wrongly delivered common topics decreased in the lower group teachers. The number of more delivered common topics than aimed at curriculum before the PD program diminished after the PD program. There is not any common topic in none delivered status in both groups after the PD program. More common topics were stated and more common topics were associated with daily life in 2013 when compared to 2012.

- Changes were observed delivering the *PTSE, ICS and PSS skill objectives*. Noticeable improvement occurs in transferring the PTSE and ICS skills. 34% of PTSE skill objectives were completely delivered before and 86% of them delivered after the PD program by upper group teachers. This change is from 10% to 50% in the lower group. 8 out of 10 and 3 out of 10 PTSE skill objectives were given by all teachers before and after the PD program, respectively. Teachers did not use the ICS skills in 2012. After the PD program, 64% of the ICS skills were fully given by the upper group teachers. There is 40% increase of completely delivered objectives after the PD program (Table 4.9).

- *Changes in each common topic* were addressed based on the teachers. At first, O2 (the aim of science of physics) and O13 (error in measurement and its sources) common topics were fully given by just 1 teacher in 2012, then 6 teachers implemented these objectives in 2013. There was not more increase in number of teachers who delivered O8 (the emergence and development of knowledge and scientific methods) and O9 (role of experiment in emergence and development of scientific knowledge), O10 (the role of mathematics in emergence and development of scientific knowledge, O11 (the use of mathematics and modeling in physics and O12 (measurement of some basic quantities in physics and unit system) common topics in consequence of the PD program. However number of teachers who partially delivered common topics of O8, O9, O11, O12 decreased by years, and remained the same as O10 (Table 4.11). Observation results indicated that the myths related to hypothesis, theory, law and modelling concepts were still difficult for the teachers. Wrongly delivered common topics (O4 and O14) before the PD have been delivered almost completely (without any error) after the program.

- Teachers were expected to emphasize *eight misconceptions/cautions* in the unit. Teachers considered more of them after the PD program. Prior to the PD program, only teacher TG completely emphasized "a single scientific method is used in all scientific investigations", thereafter all teachers considered it. Although none of the teachers gave "when physics principles, laws and theories are discovered, the influence of people's imagination and creativity should not be overlooked", six teachers fully gave as the result of the PD program. O5 (physics and technology are the same thing) and O9 (it is emphasized differences between hypothesis, theory and law) common topics includes misconceptions known in the NOS literature, had the least change. Four misconceptions/cautions out of 8 were completely emphasized in average. This change can be considered as quite low level, yet trends were in the desired direction. In average, six common topics were completely emphasized by the teachers participating to the PD program approximately 80% and more, three common topics completely emphasized by the lower group teachers. Before the PD program, these numbers were one in the upper group and one for the lower group.

- How are the common topics delivered was investigated in *teaching strategy* dimension. According to student participation/non participation to the lessons, the use of teaching strategies was classified as R (requiring student participation) and NR (not requiring student participation). First, frequency use of teacher strategies and their qualities based on each teacher were given in average before and after the PD program (Table 4.17). On the basis of new teachers' participation classification, the use of teaching strategies increased in both teacher groups. Qualities of them also increased in parallel. Upper group of teachers used 13R (77 quality score) teaching strategies in 2012 and 38R (93 quality score) teaching strategies in 2013. This rate is same as 11NR for the lower group, but the increase is to 85 from 70 in terms of quality score. For lower group of teachers, there are 2 teachers using 8R (54 quality score) in 2012 and 17R (88 quality score) in 2013. NR teaching strategies decreased to 12 from 16 but quality score increased to 63 from 70 in average. Positive results were seen in all teachers' classes after the PD program (2012=11R, 70 quality score, 13NR, 68 quality score; 2013=32R, 91 quality score, 12NR, 80 quality score). Second, variety of teaching strategies was examined in detail. Based on the results given in Table 4.18, the first part shows the number of use of aforementioned teaching strategy by the teachers. Second part shows in how many different common topics this teaching strategy was used in average. Qualities are also given in last column. According to this the mostly used teaching strategies was questioning labelled as R. 7 teachers used 5 times (83 quality score) in 2012 and 14 times (93 quality score) in 2013 in average. Questioning strategies where students were not required to participate in lessons were dropped after the PD program. Teachers used questioning as R in more different common topics after the program (10 different common topics) when compared to 2012 (5 different common topics). Lecturing, known teacher centered strategy, were lessen from 6 to 3 in number. On the other hand, the quality score in average increased to 76 from 61. Teachers used more repeating the content strategies with high quality scores in their lessons. Investigation + reading (from 63 to 87 quality score), by using worksheet (with 100 quality score), and group working strategies (from 93 to 99 quality score) were more utilized by requiring student participation to the lesson after the PD program.

Teachers increased the use of group learning strategies to 3 from 1 in average. Some teachers varied their teaching strategies with a high quality as well as involving students to the lessons (solving puzzle, role playing, game, doing project, letting students reading text) after participating the PD program.

- In the *material/technology* dimension there were 3 teachers (TB, TD, and TF) above and 4 teachers (TA, TG, TE, and TC) below the weighted participation rate. Each group has increased frequent use of material/technology, in addition to its quality. Upper group teachers used 11 materials/technologies in 2012, 36 materials/technologies in 2013. The quality scores were 76 before, then 90 in average after the PD program. Lower group teachers increased the number of use of material/technology from 5 (64 quality score) to 16 (87 quality score). Seven teachers used a further 16 materials/technologies on average after the program (Table 4.19) with an increase in their qualities. The most used materials after the PD program are video (used in PD program), board and lab equipment. These materials have also been used in different common topics with high quality. All books were used more and effectively in class teaching. Especially the use of book from MoNE increased to 5 (94 quality score) from 3 (58 quality score) in-class.

- Teachers TB, TD and TF were in above cut off point (80%), while teachers TA, TE, TG and TC were the below of this point in the *assessment* dimension. Common topics and skill objectives were separately assessed. Types of assessment were also classified whether they were made in written exam or not. Upper group teachers in terms of participation rate used more formative assessment with high quality in their lessons. Teachers preferred using 2 (62 quality score) formative assessments in 2012 and 8 (91 quality score) formative assessments in 2013. The quality difference score was 29 in average. Although there was not more change in the number of use of formative assessment for 7 teachers (from 2 to 5), quality score was up to 79 from 58 after the PD program. The use of summative assessment except in written exam has little more increased in the lower group than the upper group teachers. No teachers in the upper group used summative assessment except from written exam in 2012.

When teachers used formative assessment in their lessons, both groups received high quality scores after the PD program (86 quality score in upper group, 76 quality score in lower group). The most preferred formative assessment type was giving investigation in the lessons. Diagnostic assessment was used just by one teacher (TB) who participated in the PD program most in 2013 (100 quality score). Placement test was not seen in 2012 in any class, but it was mostly observed in 2013 by the upper group teachers (78 quality score). Summative purpose assessment was applied in written exam at the end of the unit implementation. Upper group teachers used 10 common topics covered in the exam in 2012 and as the same number in 2013. The quality score was increased to 83 from 71. Lower group teachers used 6 common topics covered in the physics exam in 2012 and, 8 objectives in 2013. The quality was up to 80 from 71. Seven teachers considered to use 8 (71 quality score) out of 15 common topics in the exam prior to the PD program, then 9 (80 quality score) out of 15 after the PD program. Although the PD program emphasized many times that exam questions should cover all common topics, the teachers could not achieve this, because they had to prepare common exam questions with colleagues in 2013 to provide balance among in all classes.

- *The PTSE skill objectives were assessed by formative assessment* and changes were mostly seen in the upper group teachers. This increase was from 1 (58 quality score) to 7 (83 quality score) objectives given by formative assessment in lessons. Totally 4 out of 10 PTSE were given using formative assessment after the PD program with 76 quality score in average (Table 4.26). Solving question evaluated as formative assessment in the PTSE objectives was mostly used by seven teachers (2012=1 time with 56 quality score; 2013= 4 times with 74 quality score). Nevertheless, there was no big change in the ICS skill objectives for all teachers, TB (5 times with 88 quality score) and TF (1 times with 93 quality score) used the ICS objectives in formative assessment only after the PD program. These teachers include in upper level participation group. Change in the PSS skills delivered by upper group teachers was from 1 (67 quality score) to 4 (84 quality score) in average.

- *The PTSE skill objectives were also evaluated as summative assessment* in lessons (Table 4.28). Teachers TF, TA, TE and TG have used this assessment in the PTSE objectives after the PD program. Among these teachers TA, TE, and TG were in the lower participant level with the use of 83 quality score in average. TF was located in the upper level group using it with 95 quality score. The ICS skill objectives were not assessed for summative purpose in lessons. The PSS skill objectives were also evaluated as giving assignment (performance assessment) by only one teacher (TE) who is in the lower group after the PD program. Teacher TF from the upper group gave 4 assignments (investigation) and they were evaluated with 95 quality score in average. Teacher TA from lower group used also assignment in her class with 90 high quality score in 2013.

- Both groups used more the PTSE skills objectives in written exam. There was not change to be observed in written exam in terms of the ICS skills and there was a little change in the PSS skills before and after the PD program.

Student group interviews result

- When compared to both years in terms of students thought, there were meaningful changes based on *students' opinions about the common topics* in the lessons. 50% or more change was labelled as light grey in Table 4.30. Teacher TD's students indicated 91% of them were unable to learn O3 and 52% indicated they did not learn O8 in 2012, but all said they learned them in 2013. 61% students of TA said they did not learn O1 and O8, 83% of them had problem with O2 as well as O3, 72% of them did not understand O12 and O14 before the PD program. All students of TA stated they learned O1, O2, and O8, but %15, %19 and %29 of the students still said they did not learn O3, O12, and O14, respectively. These examples were from the upper group teachers' classrooms. 63% percentage rate of TG's students' understandings in 2012 disappeared in 2013 term. The change for teachers' students in two terms was mostly positive after the PD program. Students' problems with O9 (the role of experiment in the emergence and development of scientific knowledge) still appeared remaining nearly the same rate as prior and after the program.

Reasons mentioned by the students who thought they were unable to learn subjects were decreased by 2013. Fast and superficial introduction on some subjects in general and special on the subject of scalar and vector quantities, problematic and incorrect source books, and too much noise in class were also stated as common problems by the students for two implementation years.

- Students of the upper group teachers found more variety in *the use of method* in 2013. Unlike in 2012, the students stated that feedback was given to the assignments by the teachers in 2013. The students in both terms indicated they did not participate actively to the lessons in the class of TC who is in the lower group (Table 4.32).

- Students in 2012 said their teachers did not *use any material/technology* in the observed class. Conversely, the material/technology was used in 6 teachers' classes (except teacher TE's class appeared in upper group) according to the students in 2013.

- Student group interviews in 2012 related *to assessment* dimension displayed that none of teachers used any assessment technique besides summative purposes. This situation has changed in 2013. Students of TB and TF (upper group teachers) stated that their teachers applied a test at the beginning of the unit and then they were grouped in some activities during the unit implementation (placement). Only TB's students said teacher asked different types of questions in which she assessed their knowledge about some confused and difficult concepts in the unit (diagnostic). Students in observed classes (except TG and TC teachers' classes) said they regularly got feedback whether they had learned or not during the unit. Some of them received worksheets at the end of each topic (formative). They pointed out that they were evaluated at the end of each unit and graded to see their achievement level.

Classroom document result

Based on the *notebooks* of the students from different classes in each teacher; they were more regular in 2013, compatible with each other, included more subject associated with the curriculum, cautions, and important parts related to the content when compared to 2012. In both terms all things written on the board were presented in the notebooks. Teachers took more attention to notebook control in 2013. Some subjects not in the unit objectives (e.g., absolute, relative error, formulas about scales etc.) appeared in 2012 but they were not seen in 2013. However, there were still missing parts (e.g., modelling, hypothesis, theory, law, etc.) in some students' notebooks in 2013 (students of teacher TF, TG, TE, TC). As documents, *class exams and quizzes* were evaluated inside the assessment dimension.

PD program evaluation interview result

- At the end, delivery of the unit was assessed by the *PD program evaluation interview* protocol. Five teachers asserted that they used more student-centered methods in which require student participation to the lesson. They indicated they taught the unit with active student participation by using different teaching strategies, visual materials, and assessment types, giving assignments, and projects after the PD program. Four teachers stated they considered common topics and skill objectives during the teaching. Mostly, teachers indicated using units, making a hypothesis, mathematical modelling, and law, theory-related misconceptions are still seen as difficult subjects from students' perspectives.

- All teachers believed they used more diverse (e.g., by making group works, doing different experiments) and more quality teaching strategies based on their views. The students were not used to this kind of activities, therefore some problems such as too much noise have occurred in group works. Five teachers mentioned they used more different materials (e.g., video, simulations, posters, history line, and board) after the PD program. As a same manner, they reported noise issue during the use of material/technology in the class.

- In terms of assessment dimension, six teachers addressed to consider objectives when preparing questions. They indicated they are more familiar with summative assessment other than placement, diagnostic and formative. They were satisfied to see these types of assessments with concrete examples. Two teachers explained the difficulty of making diagnostic and formative assessments because of time. None of the teachers were familiar with placement assessment. After the PD program, three teachers started using placement purpose for the first time.

- Some teachers indicated they could not use some activities because of time constrains. Apart from this, the teachers thought they have not more experience with this type of trainings. Teacher TG, the lower group of teachers, in terms of content, material/technology and assessment dimensions emphasized that she learnt most of the things during the PD program, but she failed to apply them in the desired level. She thinks the change is not easy and requires time to practice more. All teachers expressed that they were satisfied with this development program. They liked most in the PD program were discussions in the sessions, sharing their thoughts and opinions, opportunity for practice, actively being a member of the PD program, guidance and feedback, showing data as evidence about their teachings. Some recommendations were made by the teachers for future programs. The teachers also assessed the PD program on a 5-likert-type items. The range of the scores was 4.6-5 points in average. The lowest score was given to the item: “I used the products in training in my lessons". As a reason for this, teacher (TG) remarked she has very low level students. All teachers assessed the PD program that was quite successful for them.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

Chapter begins with the validity and reliability issues of the study. Then, ethical considerations are given. Follow the ethical considerations, summary of major findings and discussion are presented under the two headings: Discussion of related results in four dimensions creating content of the professional development (PD) program and discussion of the features of the PD program model. Implications from the results are discussed. Next, a proposal for the implementation of this model in Turkish context is introduced. At the end of the chapter, assumptions and limitations are provided.

5.1 Validity and Reliability Issues of the Study

Patton (2002) states that validity and reliability are two important indicators for any qualitative researcher should be concerned while designing a study, and analyzing the results. Conventionally validity requires inferences to be usefulness, and meaningfulness. Reliability is related to the consistency or repeatability of inferences over time (Fraenkel, Wallen, & Hyun, 2012). These two terms are used in different names in qualitative studies. Basically in qualitative studies, credibility, dependability, confirmability and transferability need to be considered to enhance quality of research (Miles & Huberman, 1994). As a major term trustworthiness is ensured by using some naturalistic techniques in qualitative research as seen in Table 5.1. These are under four categories: credibility, transferability, dependability and confirmability.

Table 5.1 Techniques for ensuring trustworthiness for qualitative research design

Concepts	**Techniques**
Credibility/Authenticity (Internal validity)	Prolonged engagement
	Triangulation
	Peer debriefing
	Peer scrutiny
	Persistent observation
	Member checking
	Ensure honesty of informants
	Quasi statistics
Transferability/Fittingness (External validity)	Thick description
Dependability (Reliability)	Dependability audit
Confirmability(Objectivity/External reliability)	Confirmability audit

Adapted from Erlandson, Harris, Skipper, and Allen (1993); Lincoln & Guba, 1985

These concepts were explained briefly and then how these techniques were established in this study was stated in the following part.

Credibility is a key concept in the validity of a study. It is accurate representation of reality through the research results (Yıldırım & Şimşek, 2006). There are some techniques as indicated in Table 5.1 to ensure credibility.

Prolonged engagement was achieved by being present in the research site for an extended period of time. Most of the time was spent with in-service physics teachers to make rapports. It was a longitudinal study. I was able to develop rapport and trust with the participants. We were together with face to face and none face to face interactions. Teachers felt as if they were a member of community and had a common goal to improve their practices and enriched the teaching of the ISOP unit. I communicated them from June, 2012 to January, 2014. I observed them in their classes, conducted interviews and mostly we spent more time during the implementation of the PD program in actual data settings. This makes me develop the sense about the data and participants. The frequent contacts increased the likelihood of obtaining trust and reliable results.

Triangulation means the use of different sources of data (Lincoln & Guba, 1985). I studied seven teachers and applied multiple data collection tools to them and their students. Each research question investigated more than one data collection tools. Especially in the development process of the PD program, needs-based analysis was supported by the TSNOP survey, observation, student group interview, student achievement data results and also literature review before the PD program. Observation results, teacher interviews, student group interviews, classroom documents were used as evidence of changing teachers' practices.

Peer debriefing involves locating a person who analyzes and asks questions about qualitative study (Marshall & Rossman, 2006). I consulted my advisor while developing tools, collecting, coding, analyzing and interpreting the data. We discussed the study from beginning to the end. He is knowledgeable about my research. We did regular meetings to check all data collection tools, data analysis, and as well as the content of the PD program. The iterations of data analysis were debated until the final decisions. We prepared a coding book for getting reliable observation results. Expert opinions gave their feedbacks during the development of measuring tools. Based on their suggestions, adjustments and corrections have been made. They also controlled the PD program content and its characteristics by checking treatment fidelity form. Committee members of this study gave regular feedbacks on the research design and implementation nearly in every six months. I also asked opinions of participating teachers and their students about the PD program.

Additionally, ***peer scrutiny*** was provided by presenting the thesis research proposal as presentations (e.g., Mazur Group meetings at Harvard University, I. National Physics Education Congress at Hacettepe University). I had opportunities to get feedback about my study.

I conducted ***persistent observations*** in 2012 and 2013 fall term from beginning to the end of the NOP, and ISOP units teaching. I took detailed notes and filled in observation form.

Member checking is another credibility technique to get the approval of the participants about the results and interpretations. Before the Workshop I, I sent student achievement data and observation results to the teachers to see their classroom situations. It was asked whether they agreed the results or not. I saw teachers as an observer of the whole PD implementation like me. I conducted two interviews with them for treatment verification and asking their opinions about the strengths and weaknesses of the PD implementation. They completed treatment verification form for approving the PD treatment. In the interviews, sometimes I gained approvals during their explanations to get more clear answers by asking "I think you said", "I understand." I got confirmations from teachers as much as possible during the interviews.

I made clear explanations of the purpose at the beginning of the study for ***ensuring honesty of informants***, and I also wrote necessary information and instructions at the beginning of all measurement tools. The process of the PD program was explained and the role of the researcher was given in detail. We have known each other for a long time so they felt comfortable to express their opinions and ideas.

Quasi statistics refers to present data by using quantitative results (Maxwell, 2005). Mostly I used frequency tables, and percentages to display observation results. I preferred some graphs and figures for student group interviews and teacher interview results about the PD program.

According to Patton (2002) the credibility of the researcher and beliefs are important in qualitative research. These are mainly associated by reseacher's experience. I took a qualitative course and conducted qualitative research studies related to teacher education and PD of teachers, so my training experiences enhanced my credibility.

Transferability is related to whether the results of a study are transferable to other contexts (Miles & Huberman, 1994). As a technique, ***Thick description*** means providing a description in a detail way and permitting the reader to determine how well this study transfers to other similar settings (Yıldırım & Şimşek, 2006). Researcher explained the PD model and its differences from existing models by comparing it with the examples in the literature. The whole process (design and implementation of the PD program, participants and their characteristics, data collection tools, data analysis processes, etc.) was described in detail. I gave selected narratives from the data in quotations to reflect actual teachers' responses.

Dependability shows the process is consistent or stable over time and among researchers (Miles & Huberman, 1994). I had large amount of observation data. I controlled all teachers' transcripts multiple times to find necessary information and marked with red pen. I prepared well designed coding manual form. I coded all information on the observation form. I tried to ensure the dependability calculating inter-rater (agreement among different researchers) by using the formula (Miles & Huberman, 1994);

Reliability =[Number of agreements /
Total number of agreements + disagreements] X 100

For inter-rater reliability, a teacher assistant who is familiar with qualitative data coding attended randomly six different class hours with me and took notes. Before attendance lessons, we examined the coding manual book together and discussed the coding process. He conducted qualitative research many times, so he is knowledgeable in this research area. After the all transcriptions of six class hours, I and he coded observation form independently. Our agreement was 80% at first. We met and talked disagreements to ensure consistency, so second time we reached 92% agreement. After completing all transcripts in 2012, I repeated coding administrations twice in order to do more practice. Among the two codings, I reached 97% agreement. I examined the disagreements and fixed the problematic parts. Student and teacher interview transcripts were checked at least two times with the same teacher assistant to get meaningful information. Inter-rater reliability scores were 94%, and 95% respectively. These scores exceed 70% above, so the results are considered as reliable (Miles &Huberman, 1994).

To increase the reliability of the results, observations and interviews were utilized as confirmation strategy to find out what teachers actually did in their classrooms. In addition, I compared the teachers' data. I coded for each teacher separated question by question to explore the common parts. Objectivity and consistency were provided with these procedures.

Confirmability is a critical issue about the researcher bias. It can be a problem if researcher focuses on his/her own anticipated results rather than the actual observed outcomes. I described my data collection process and data analysis in Chapter 3. Data triangulated (student focus group and teacher interviews) provided more evidence of observation results. It also provides evidence for replicability of research in similar contexts. In this study, I clearly defined my role. I was participant observer, PD provider, interviewer, and researcher during the research process. I used convenient sampling and I clearly described the participant selection and their demographics characteristics. I explained the PD program design and its characteristics in detail.

5.2 Ethical Considerations

Ethical standards were taken into account from the beginning of the study. Required permissions were taken from Graduate School of Natural and Applied Science, the Ethical Committee, MoNE, and school boards. Participants were fully aware of the purpose of the study, measuring tools, and the PD program requirements. Therefore, there is not any deception in this study. Before the achievement test implementations and group interviews, the students were informed about the related tools by verbally and in written format in the instruction sections of the instruments. During the classroom observations, each teacher introduced me to the students and explained the study purpose. Teachers participated voluntarily in the study. The study did not include any physical and psychological harm. I sat back at the classes and used audio record to follow the all content. I got permissions from the teachers for the sound recording. I did not involve in any communication during the teaching and there was not any uncomfortable situations have occurred by me. I recognized that teachers and students forgot that I was in class. The teachers were relaxed when they taught the lesson. Also their names (both teachers and students) did not use without their permissions. The names of the schools and the teachers were not used in publications. I preferred to code teacher names as the letters of the alphabet (*anonymity).* Data were not shared with third parties. I gave guarantee to the teachers that I will not use raw data for any other purposes *(confidentially).* The teachers had opportunity to withdraw from this study at any time.

5.3 Major Findings and Discussion

This thesis work was created a PD model framework and then examined its effectiveness in terms of teacher classroom practices. I would say that the findings of this research give evidence to improve teacher practices as a result of involving in the PD program. Whether my observations or students' and teachers' thoughts support the positive changes of teachers' practices. Impacts of the PD program which has been implemented as much as planned, associated with the level of participation rate. Then the teacher changes in four dimensions: content/skill/misconception, teaching strategy, material/technology and assessment are investigated considering teachers' participation rate in the PD program. The study results intended to show effective teachers' practices after participating a well-designed PD program. In the literature, there have been studies to examine changing of teacher classroom practices. They have different type of designs given with the strengths and weaknesses in Chapter 2. Present study is associated with literature findings in terms of positive effects of the PD program on teacher practices (Desimone et al., 2002; Fullan & Stiegelbauer, 1991; Heller, et al., 2012; Ingvarson et al., 2005; Pop, Dixon, & Grove, 2010). Because of the complexity of conducting PD research, it is recommended to evaluate any PD research results in their own contexts and with their own characteristics. As a same manner this model needs to be thought with their overall design components. With the study, direct PD effects on teachers' classroom practices are provided with detailed evidence-based results.

I explained this program in five phases with qualitative data collected before, during and after the PD program. The process of changes in teachers' practices was investigated by case study and action research approaches. Case study approach helps to describe the PD program in detail. During the action research process both researcher and teachers worked collaboratively and systematically. They practiced new things in their learning environments.

5.3.1 Discussion of Related Results in Four Dimensions Creating Content of the Professional Development Program

The more participation to the PD program (face to face and non face to face interactions) in each dimension (content/skill/misconception, teaching strategy, material/technology and assessment), the more positive change was in lesson applications of the teachers in that dimension. This study shows the importance of obtaining more intended results due to interaction time and paying attention on subjects to increase participation and continuation to PDs to be made. Participating teachers of the study were divided into lower and upper groups according to participation rate of approximately 80% (participation value having sharp changes) and then results were discussed. Again, for seeing the change according to participation rates or for incentives and awards (e.g., certification) to increase participation, assessment can be made based on the cut off points to be determined uniquely for the study.

According to the results of observation, all teachers positively changed due to delivery of the common topics after the PD program. In addition, there is more increase in the number of completely delivered common topics for teachers having more participation rate to the PD program. Besides, common topics presented partially delivered, wrongly delivered, and more delivered than aimed at the curriculum have decreased. None delivered common topics were not observed in upper and lower level of teacher groups. More daily life emphasis was made after the PD program. Not delivering the common topics, which was seen in the first observations, has been a subject emphasized in the PD program and it was determined that it was given more clearly by the teachers in the second observations. In subjects, which are mentioned to be not learnt according to the observations in student group interviews, it is seen that there is improvement after the PD program.

When the observation results are considered in terms of the PTSE, ICS and PSS skill objectives, again a positive development is seen and this development is more in teachers in upper groups in terms of participation rate. The PTSE and ICS skill objectives in class have been presented more. In addition, content of the teaching program was discussed with participating teachers in detail. In this context, the subject on how to present common topics and skill objectives in an integrated way expected from the teachers was shown with examples. The teachers state that they pay more attention on skill objectives after the PD program. When the PTSE objectives in 2007 physics program are examined, it is seen that these skill objectives are quite close to the content objectives as structure and content. For example PTSE1a skill objective: "Defines physics and understands that it is one of the main disciplines to realize the events in universe" is similar with content objective: "It seeks to answer the question of what physics is". Thus, it can be said that presentation of the PTSE skills more by the teachers is related to this similarity. The ICS skill objectives which were never used before the PD program have begun to be used after then. The PSS involves science process, creative thinking, analytical and spatial thinking, data and numerical processing skills and higher order skills (TTKB, 2011) which are different from the PTSE, ICS and AV skill objectives. Therefore, when it is considered that the PSS are consistent of higher level skills, increase was not as much as the other skills.

O8, O9, O11 common topics in which there are misconceptions and cautions have begun to be given more and correctly after the PD program, however, increase was not as much as the others. In these common topics, as dealing with misconceptions is hard due to their resistant and solid structure (Hammer, 1996) increase was not in the expected level. Misconceptions can be very difficult to change (Singer, Nielsen, & Schweingruber, 2012) and it requires more time using alternative techniques to remediate them (Tuan & Chin, 1999). According to the results of this study, it can be said that PD programs, which will have the basic purpose of eliminating misconceptions, need to allocate more time.

There was not much increase in misconceptions and cautions which are related to the structure and characteristics of scientific knowledge (O8b, O8d, and O9). On the other hand, there was a change in misconceptions and cautions which are related to the ways of accessing scientific knowledge (O8a, O8c through the PD program. Results are compatible with previous NOS research findings that NOS understandings are inconsistent and fragmented. For example, many teachers, who have the idea that the science has a tentative structure that can change, now have the idea that scientific theories can be turned into law over time (Schwartz, Lederman, & Crawford 2004).

There were students who mentioned that they did not learn the hypotheses, theories on O9 and relations and differences between them after the PD program. Misconceptions on O11 and O5 and changes in O7 common topics are quite few. There are missing parts after the PD program on some NOS concepts (modelling, hypothesis, law, and theory) in which there were problems as a situation emerging in students' notebooks examined as documents. According to the PD program evaluation interview result, the teachers indicated using units, making a hypothesis, mathematical modelling, law, and theory-related misconceptions are still seen as difficult concepts from students' perspectives.

When the observation results are examined in terms of teaching strategies, it is seen that number, variety and quality of strategies have increased after the PD program. One of the purposes in this dimension was to apply more student-centered methods. Teaching methods requiring students' participation have been used by all teachers in the upper and lower groups.

In the interviews made with student groups after the PD program, it was mentioned that the students talked about different and various methods used in their classes and they participated in lessons actively (except the students of teacher TC who participated in the program least). No decrease or significant change was seen in the number of teaching strategies (included teacher–centered) which required less participation of students. When they are used, it has been observed to increase in their qualities. The results taken from the PD program evaluation interviews support the idea that teachers used more various and richer teaching strategies which make the students participate in lesson.

When the observation results are examined in terms of material/technology, it is seen that there is increase in number, variety and quality after the program. This increase is also supported by student group interviews. The students in the interviews before the PD program said that they didn't use any material/technology in the lessons, while the students in interviews after the PD program said that they used material/technology in different variety and numbers. As targeted by the PD program, the emphasis on appropriate and effective use of books in and out of class was considered by the teachers. For enforcing this dimension, they were given the materials which can be used directly in this unit and they discussed the material selection together. It is seen that this method is useful. When the teachers were directly given concrete materials and they were shown how to use them in the lessons, they preferred to use these materials more in their own lessons. The results taken from the PD program evaluation interviews support the idea that the teachers used more various and richer strategies which make the students participate in lesson.

When the common topics were assessed by the teachers, it was seen that summative-purpose assessment as written exam was traditionally common in all teachers in upper and lower group before the PD program. The teachers stated that they know summative assessment more than the other assessment types in the interviews. However, when these exams made by the teachers are examined in terms of common topics distribution, it was determined that content validity is in low levels. In the PD context, it was emphasized that content validity must be paid attention in written exams made for summative purposes. However, it was seen that this problem continued after the PD program. However, as common exam application was started after 2013 curriculum program, some teachers could not prepare exams including all common topics in end-of-unit exams after the PD program. When the unit exams made after the PD program were assessed in terms of their qualifications, increase was seen in their quality scores. Placement and diagnostic assessments which are less known were not observed before the PD program. It is again seen that Teacher TB showing maximum participation in the program used these two assessment methods in the most effective way after the PD program. In general, this program has increased awareness of the teachers on these assessment types used for different purposes. Formative assessment increased in number and it has begun to be used in a more qualified way. In interviews made with the students before the PD program, grading based unit exams were stated more, while the teachers talked about different assessment types used in lessons for different purposes after the PD program. In interviews, the students stated that their teachers gave them more feedback and they examined whether they had learned or not.

Although importance given for each dimension was nearly the same in face to face interactions, when four dimensions are thought together, the teachers did not pay attention to the assessment dimension as much as others in non face to face interactions. Seven teachers gave 35 minutes in average for assessment dimension in non face to face communication. This time was 160 minutes for content/skill/misconception dimension, 136 for teaching strategy dimension and 75 for material/technology dimension. In order to motivate them, some documents and questions related to the assessment dimension were uploaded to the social media group and although discussion environments tried to be created, the teachers were less interested in this area. Teachers have been in communication more for teaching strategy and material use in non face to face interactions. Content, using teaching strategy and material may have appeared to be more related to each other by the teacher and these may have been thought as a whole. Assessment dimension may have been seen as a separate part and required more attention to be given.

The PTSE skill objectives were assessed for formative and summative purposes. Assessment of the PSS skills has increased in the teachers in upper group. The ICS skills were assessed by one teacher for formative purpose, but it was not assessed by any teacher for summative purpose. Assessment of the skill objectives is not as common as assessment of common topics. In addition to the emphasis on use of the skills, information on how to assess them should be considered by teacher educators.

5.3.2 Discussion of Characteristics of the Professional Development Program Model

As indicated in both international and national literature review, crowded traditional PD forms such as meetings, seminars, or workshops which are far away actual teachers' expectations and needs are found inadequate. (Büyüköztürk, Akbaba, Altun & Yıldırım, 2010; Walker 2013). Teachers are in a passive role without collaborating (Burbank & Kauchak, 2003). Need analysis is neglected in most PD initiatives; therefore, they do not meet many expectations of participants. Longer PD programs are found more effective and provide notable changes in teacher practices (Akerson & Donnelly, 2008; Hunzicker 2011; Supovitz & Turner, 2000; Thomson & Kaufmann, 2013).

In consequence of the shortcomings mentioned in the literature, the results from the needs analysis, 12 characteristics were intended to integrate in the PD model framework. This development model which consists of 12 characteristics had a positive effect on class teaching in four selected dimensions for teachers. When the characteristics taken on basis of the PD model are considered, it is important to:

- *Consider the needs of participants*

  The first property of this program is that it is oriented on the needs of teachers. The PD program has not only focused on missing issues as the points that must be considered but also it has determined the richness which are useful for teachers as result of preliminary assessments (e.g., observations, student group interviews) and they were transferred into each other through workshops. In addition to implementation of need determination to the persons in need, the students' needs of the teachers which are indirectly affected from the PD program were considered. The students expressed ideas to contribute on determination of their teachers' needs and data in compliance with the observations were obtained. In the light of these, in addition to the need analysis survey made on the teachers, this study was contributed more by using student group interviews as need analysis.

- *Raise participants' awareness related to current situation*

  Some mechanisms were developed for convincing the teachers to change and create awareness for their current situation. Observation and student interview summary results were given before starting the PD program as written reports without negatively impacting participating teachers. Missing or incorrect parts were expressed with symbols (smile, sad face) instead of being assessed as good or bad. In this way, PD programs to be given can be supported with awareness in similar way.

- *Provide support in different ways*

  MoNE gave permission to the teachers for participating in the PD program. Schools also supported the PD program. I easily collected data from the schools. Academicians gave lectures in the Workshop I. Anytime, teachers received materials and useful sources during the PD program. Giving and receiving support in different ways during the program implementation contributed to the development of teachers.

Consider motivation elements to participate in trainings

Certificates as the support received from MoNE motivated the teachers. As indicated in Guskey's (1986) study one of the reason for failure of PD programs is not to consider motivation elements to participate in trainings. These certificates were given to the teachers as award for participating in the PD program. By considering the needs of teachers, expert persons were invited as university members and they were open for communication with teachers as friendly manner. Participating teachers firstly hesitated on working with university members but they started working with them due to the selected persons' soothing behaviors and movements.

- *Apply some feedback strategies*

  The teachers were given feedback for sample lectures in Workshop II from three different sources. As result of self-assessment, which is identified as an important role in learning of teachers (Ross & Bruce, 2007), and the feedbacks given by me and their colleagues (Fullan, 2006), missing parts in Workshop II presentations were completed and lectures to be made in their schools were enforced more.

- *Provide opportunity to practice*

  As supported in PD literature (van Driel, Beijaard, & Verloop, 2001) the teachers stated that the opportunity to apply the knowledge they learned theoretically in the PD program was an important feature of developing professionally. Besides, performance of the Workshop II at a time near to the real class implementations helped teachers remember what they had learned by giving them opportunity to apply them directly.

- *Develop planned and at the same time flexible PD programs including effective communications*

  The teachers used the time effectively and efficiently due to the fact that program was planned with workshops and it was in a flexible structure which is supported by non face to face interaction. In the PD program, which was spread to a long time without being boring and monotonous, motivation was on the top level. They mentioned that they want to know what they will learn about the program content. They had the opportunity to make preparation for the sessions in workshops. Before the Workshop I, teacher to teacher communication part was marked as "-" in treatment verification form by me. For a better preparation stage, it should have been more efficient if teacher-educator and especially teacher-teacher interaction was made by sharing the whole content (e.g., one month before the PD program).

- *Consider long-term duration and ongoing structure in PD programs*

  When it is considered that learning of teacher is a dynamical progress (Sparks & Loucks-Horsley, 1990) the fact that PD is a long term and ongoing progress has provided adaptation and application of the program. Supovitz and Turner (2000) findings indicated quality of teacher implementation is associated with total PD hours. According to the suggestions of Desimone (2009), at least 20 hours of professional development program is required for change of teacher. Totally contact time was 42 hours, consisting of 32 hours for face to face and 10 hours for non face to face interactions in the PD program.

- *Develop content specific PD programs aligning with the curriculum*

  By considering the fact that teachers who want to participate in content specific PD programs and appropriate grade levels for their school contexts as supported in the literature (Chval, Abell, Pareja, Musikul, & Ritzka, 2008), this program was effective and efficient for teachers because it was prepared in accordance with the teachers' content specific needs. For this purpose a curriculum unit was selected as content of the PD program. There were questions prepared based on contents in the need analysis surveys. Missing issues and expectations were determined with general questions on a specific subjects to be focused by the program. This unit which was included in the 2011 revised physics curriculum program named as Nature of Physics (NOP) and appears as Introduction to Science of Physics (ISOP) unit in 2013 physics curriculum. The PD program helped the teachers to know more about common topics in both physics curricula and aimed to increase the content development with the use of teaching strategy, material/technology and assessment for different purpose. It must be known that applications which take attention on how to teach the content are better than being only focused on subject matter knowledge (Cohen & Hill, 2000; Hunzicker, 2011). With the aspect, the PD program has been useful for the new curriculum unit application.

- *Provide an active learning environment (effective/productive working, reflective thinking, and discussion)*

  The fact that teachers worked together actively in a small group without hierarchical structure has increased the efficiency of the PD program. This feature enriched the quality of the PD program. Works made on product development by taking active role instead of passive role have gained production habit for the teachers. As suggested by Van Driel and Berry (2012), the teachers had the opportunity to discuss good and bad practices in the PD program, the articles were given in Workshop I and activities were made in small groups. Environments in which results of applications are discussed together were recommended in the literature (Borko, 2004). This program which was made in accordance with their needs and participating voluntarily made the teachers develop professionally. Participating teachers were previously educated on the use of materials and their experiences helped them implement these more comfortable in the class.

- *Include interactions and collaborately working*

  As result of face to face and non face to face interactions, a collaborative learning environment was created. Unlike traditional trainings, face to face interactions were consistent of workshops in which there are practical applications rather than giving theoretical information. Social media is used as an environment in which almost everyone spent of his/her time with non face to face interactions. This media was actively used for learning with discussions during the PD program. In this way, using two environments together as hybrid have enriched the PD context as well. In informal speeches made after the study, determination of collaborative work in environments out of school (e.g., science festivals) has shown that the interaction created due to program continued itself.

- *Provide building learning community*

  Group study was made by developing team soul with creation of learning group. As suggested in PD literature (Luft, & Hewson, 2014), network is a fairly important factor in learning, all teachers of the study participated in the PD program from different schools and they made collaborative activities. Networks between teacher to teacher and teacher to educator during the training have tried to be continued after the PD program. Networks in social media opened for the unit continued for the other units after this. Networks were provided during and after the PD program as planned. Previously mentioned, teacher-teacher network could not be used in the requested level as it was intended to use more before the program. This part is suggested to be tried and tested for the PD programs.

5.4 Implications and Suggestions

The study indicates some implications for teachers and PD program developers/ teacher educators. In addition, some suggestions for further research are given in the following sections.

Implication for teachers

It was found that the teachers have the highest level of efficiency when they participate in the program voluntarily by requesting to learn more. It should be noted that each teacher is responsible for his/her own professional development (Shapiro & Last, 2002). To be a change in the practices of the teachers, one of the necessary conditions is “teachers must be willing to change” (Kirkpatrick ve Kirkpatrick, 2006 p:23). Teachers also should do their part. Any successful result can get, if all stakeholders share their responsibilities.

Implications for PD program developers or teacher educators

According to the findings of this study, participation rate to the professional development program created positive effect on in-class applications of the teachers. Therefore, it is suggested to consider participation rate in PD programs and to take measures for increasing participating hours to the programs.

In the study, transfer of common topics and skill objectives, the use of teaching strategy and material/technology were seem to reflect the applications by the teachers who participated in the program. Although, some misconceptions and cautions were emphasized correctly after the PD program, the positive change was not as much as seen in the common topics. To see more changes in misconceptions/cautions, PD programs should have more time. It was observed that the teachers have deficiencies in assessment due to past experiences and assessment of skill objectives is not as common as assessment of common topics. Based on these findings, it is thought that the needs on knowledge and practice can be more on class assessment in pre-service and in-service trainings.

Versatile research will be useful when determining needs of teachers. For this purpose, in addition to taking thoughts and learning about experiences of one teacher, uncovering the real needs will be a more realistic approach. Observations, student interviews can be used for this. Studies in which observation is not useful, getting of students’ thoughts can be fruitful approach for determination of needs and current teaching situation. Adult learning approach was also considered when designing this PD program. In the same manner, consideration of learning theories can also be useful in professional development stage. In addition, it is suggested to ask questions on contents of programs as well as the general questions in need assessment surveys.

The model developed was created by integration of 12 professional development characteristics to the program in certain levels. As suggested by Luft and Hewson (2014), and considering the research results, studies in which these components are integrated and examined in terms of their effects are needed instead of studies in which the effect of only one PD characteristic is measured.

In PD programs, models in which teachers are directly on the forefront should be applied rather than lecturing only by persons who are deemed to be experts. Still, educators to be invited for support should be determined according to teacher needs. PD programs given by experts should include mutual communication rather than single-way lecturing.

Suggestions for Further Research

In this study, practices of teachers were deeply examined and a PD model was presented. For testing the same model, other variables from the PD literature; teachers' pedagogical content knowledge (Frey & Fisher, 2009), teachers' self-efficacy (Bümen, 2009), beliefs (Haney, Czerniak, & Lumpe, 1996), students' success (Luft, & Hewson, 2014) can be examined as learning outputs. This study explains the development process in five phases. In the literature, details of these development processes are not given much importance (Stolk, M. J., de Jong, O., Bulte A.M.W., & Pilot A. 2011). The same study can be tested with a bigger and difference sampling group and by repeating in difference disciplines.

Positive impact of the PD model framework for a unit newly presented in the physics curriculum was seen with the help of study results. By considering this issue, development of teachers should be provided with new subjects and concepts as suggested in the literature (Ayvaci, Bakırcı, & Yıldız, 2015). Primarily, the needs of teachers should be determined and the different subject areas in which they have problems or which they have known less should be considered in PD programs.

The PD program was unable to provide teacher-teacher communication environment before starting the training. This communication can be realized by spreading to a longer term before the programs. Preliminary preparation can be useful for teachers to be more familiar with the PD programs. This part is suggested to be tried and tested for future PD programs.

In this study, it was seen that presence of the necessary materials and tools for active performance of face to face interactions in the study environment motivates the teachers according to my experiences. Programs, in which the teachers are active participants, and involved in practical applications should be created. With face to face and non face to face interactions (computer networks, phone calling), PD of the teachers were tried to be increased. In this way, hybrid learning environments can be suggested to be used for PD programs as a supportive system for learning of teachers (Elster, 2010).

5.4.1 A Suggestion on Dissemination of Developed Professional Development Model (Turkey context)

This long-term PD model was executed, designed, applied and evaluated by me (researcher). In order to make this model effective (reducing work load, cost effective, saving time, dissemination etc.), it is suggested to follow-up and audit this program by an organization/unit which can work instead of the researcher. Ministry of National Education (MoNE) is selected as a responsible organization. How this PD program can be implemented by Ministry of National Education (MoNE) associated with its model framework is explained as following:

Basically, the execution authorization belongs to the MoNE and this PD model can be modified if necessary and used in different disciplines. First of all, the training approach which is generally consistent of ineffective features (for example, short term, including general subjects far from needs and expectations) and known as in-service training need to be avoided, and it is suggested to prefer using teacher professional development term by adopting individual development and the thought that it is a long term and comprehensive subject which continues along the profession. In the current system used in Turkey, teacher professional development programs are organized by the Directorate General for Teacher Training and Improvement (Öğretmen Yetiştirme ve Geliştirme Genel Müdürlüğü) (ÖYGM) and locally by governorates (Provincial Directorates of National Education) (İl Milli Eğitim Müdürlükleri) (MoNE, 2011). In this model, participants can come together by creating small groups (target group, about 10-15 people) on demand. These groups can be consistent of the teachers in same branches (community group), as well as the teachers working in the schools in same district. Created groups apply to MoNE with the training content they request, or MoNE groups the participants by opening individual application platforms online. These are individuals who need development on a particular subject. MoNE Private Bureau Unit, (MEB Özel Büro Birimi) announces these programs with annual education plans. A program coordinator (PC), responsible for designated groups, is assigned. PC has the duty of following up all kinds of correspondences, communications, regulations and programs. PC makes interviews with the target groups and he/she determines the university member who is able to help in the requested subjects (he/she can work jointly with Department for Teacher Training and Relations with Foundation Higher Education Institutions (Öğretmen Yetiştirme ve Yükseköğretim Kurumları ile İlişkiler Daire Başkanlığı)

This program manager (PM), selected objectively, is a university member having scientific ability in related areas. In addition, supervision expert(s) (SE) will be assigned by a unit within ÖYGM (e.g., Department for Support and Monitoring of Professional Development (Mesleki Gelişimi Destekleme ve İzleme Daire Başkanlığı) for making all kinds of supervision-assessment activities scientifically. Alternatively, a ministry unit can be appointed for this part (e.g., Directorate General for Measurement, Assessment and Examination Services (Ölçme, Değerlendirme ve Sınav Hizmetleri Genel Müdürlüğü). PM and SE will work together to select the necessary measurement tools and develop the PD contents. PM can also work with an assistant (another university member or MoNE can collaborate with experts in some institutes such as TÜBİTAK, TODAIE or a “teacher educator” (formatör) suggested by MoNE (HEDB, 2008).

With collaboration of PM, SE and participant teachers, ***analysis*** of the target group is made as the first step. This is a multi-dimensional need analysis covering the stages in which necessary information are collected before for determining how to execute the program and its contents. When determining the needs, technics and tools to be used (surveys, document reviews, teacher/student interviews, teacher/student achievement tests, lesson observations etc.) are selected according to the program's purpose and present conditions. Data results are reported by SE and shared with PM. PM works on the results and creates awareness of teachers by sharing the information obtained from different sources. PM reviews all data with details and creates a program ***plan*** by benefiting from his/her scientific expertise experience in this subject. At this stage, teachers take active roles and make contributions (planned and flexible schedule is created). Implementation which consists of four parts is started by PM. PM, who takes duty on organization of these stages, is responsible for determining program structure with PC and target group individuals (location, physical conditions, environment, time, necessary equipment, food, transportation etc.). This kind of support is given by MoNE. PC encourages teachers and supports for using present applications (e.g., Board of Education Teacher Portal) (Talim ve Terbiye Kurulu Başkanlığı Öğretmenler Portalı) contributing to professional development. With this portal, teachers can access useful sources related to their teaching via internet. PC can select schools, university environments, in-service training institutes or teacher houses as place. In the implementation, all phases followed in this thesis will be applied (face to face, non-face to face interactions). In this long progress, target group's members can participate in activities sometimes as group and sometimes individually. In this component, the most active part is the target group's teachers. Teachers participate in the progress with in-depth discussions and active/productive works. Effective communication and team spirit are created and development of common objectives is targeted. Information exchange continues with both face to face and non face to face interactions. PM mostly takes part in process monitoring, support providing, guidance and feedback. According to the results of need analysis, if there are concrete deficiencies, PM may invite his/her expert colleagues for different dimensions in the content (e.g.; misconceptions, measuring and assessment for different purposes etc.).

Similarly, school directors of the target group teachers give the necessary support for increasing quality of the PD (encouraging teachers, announcing programs, giving official permission, etc.). These feedbacks and supports are maintained until class teaching. The teachers have the chance to lecture as if they are in class environment. PM and, if necessary, SE jointly assess these commentaries and teachers are given feedback. Interactions continue until the class application. In the thesis work, teachers had the chance to lecture only once, by teaching what they had learned. In the interviews made after the PD program, numbers of these lectures can be increased in organization of MoNE as participating teachers mentioned that they need more practice. In the PD evaluation part, some variables are determined in parallel with the first assessment as in the analysis part under coordination of SE. Reports are assessed by PM and positive and negative things of the PD are discussed with the individual interviews conducted with the teachers. Interests of teachers can be collected with ways such as sharing the results with public for dissemination of program, announcement via; newspapers, magazines, electronic newsletters, presentation in academic environments such as congresses, conferences and publishing essays. Participation of the other teachers to this program may be encouraged with methods such as using highly motivated and volunteer teachers as a guide for sharing their experiences. MoNE may provide some mechanisms for awarding and encouraging teacher participation (wages, promotion, salary increase, school selection, certification, etc.). PM (researcher in the thesis) who actively takes part in the suggested model develops himself/herself in this program. A two-sided learning environment is created. In this way, credits can be given to program managers and they can be used for their academic development (Asunta, 2006b) or in calculation of points for academic incentive allowance.

5.5 Assumptions

The main assumptions of the present study are given below:

- The study did not change the implementation of routine course contents in all schools.
- I compared the differences of teachers' practices in two consecutive years. I assumed that teachers' students are about the same knowledge level and do not change more from year to year.

5.6 Limitations

Limitations in this research are listed as:

1. The result of the study was limited to the sample of participating teachers working in Ankara.
2. Physics curriculum has changed in the middle of the study, so I had to present the study results based on the common topics in two units.

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APPENDIX A

TEACHER SURVEY ON THE NATURE OF PHYSICS UNIT PD PROGRAM

HAZIRLANACAK OLAN "FİZİĞİN DOĞASI" KONULU EĞİTİME YÖNELİK ÖĞRETMEN GÖRÜŞ ANKETİ

Değerli Öğretmenlerimiz;
Bildiğiniz gibi, mevcut fizik öğretim programının 9. ve 12. sınıflarında "Fiziğin doğası" üniteleri yer almaktadır. Bu ünitelerin gerek öğrenilmesi gerekse öğretilmesini daha etkin kılmak için bir eğitim programı hazırlamaktayız. Bu programın oluşturulması aşamasında sizlerden gelecek öneriler, verilecek eğitimin organizasyonunun ve içeriğinin şekillenmesi açısından bizlere yol gösterici olacaktır. Bu bağlamda aşağıdaki sorulara samimi ve içtenlikle yanıt vermenizi beklemekteyiz. Doktora çalışması kapsamında yapacağımız bu araştırmadaki bütün kişisel bilgileriniz ve görüşleriniz gizli tutulacak ve başka herhangi bir amaç için kullanılmayacaktır. Çalışma ile ilgili sorularınız için, aşağıda verilen e-posta adresinden bize ulaşabilirsiniz. Çalışmamıza katkılarınızdan dolayı şimdiden teşekkür ederiz.

İletişim
Doç. Dr. Ali Eryılmaz, Araş. Gör. Özlem Oktay
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A) KİŞİSEL BİLGİLER

Aşağıdaki sorular, hazırlanacak eğitim programı hakkındaki görüşlerinizin kişisel bilgilerinizle ilişkisini tespit etmek amacıyla sorulmuştur.

A1. *Cinsiyetiniz* : ☐ Bay ☐ Bayan

A2. *Mezun olduğunuz fakülte* : ☐ Eğitim Fakültesi ☐ Fen-Edebiyat Fakültesi
☐ Diğer (Lütfen yazınız): ……………………………………......

A3. *Şu anki eğitim durumunuz* :

☐ Lisans mezunu ☐ Tezsiz yüksek lisans mezunu

☐ Tezli yüksek lisans öğrencisi ☐ Tezli yüksek lisans mezunu

☐ Doktora öğrencisi ☐ Doktora mezunu

A4. *Fizik öğretmeni olarak çalıştığınız toplam süre (yıl olarak)*: ....

A5. *Çalıştığınız okul türü* :

☐ Anadolu Lisesi ☐ Genel Lise

☐ Anadolu Öğretmen Lisesi ☐ Meslek Liseleri

☐ Fen Lisesi ☐ Diğer (Lütfen yazınız): …………………….

A6. *Okulunuzda şu anda öğretmenlik dışında yaptığınız görev(ler):*

☐ Müdür ☐ Müdür Yrd. ☐ Zümre Başkanlığı

☐ Formatörlük ☐ Diğer (Lütfen yazınız): …………………………………………

B) ÖĞRETMENLERİN MESLEKİ TECRÜBELERİNİ ORTAYA ÇIKARMAYI AMAÇLAYAN SORULAR

B1. Eğitimle ilgili herhangi bir çalışma/proje yapmış veya yapıyor iseniz, hangi konularda çalıştığınızı ve kimin tarafından desteklendiğinizi kısaca yazınız.

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B2. Daha önce herhangi bir hizmet-içi eğitime katıldıysanız aşağıdaki tabloyu doldurunuz.

Tablo 1

Yılı	**Eğitimin süresi** (gün)	**Eğitimin türü** (çalıştay, seminer, konferans, vb.)	**Eğitimin uygulaması***	**Eğitimin konusu** (aynı eğitimde birden fazla ise hepsini yazınız.)	**Eğitimin düzenleyicisi** (M.E.B, TÜBİTAK, vb.)	**Eğitimin düzenlendiği yer** (okul, hizmet-içi enstitüleri, üniversite, vb.)	**Eğitimdeki rolünüz** (sunum yapmak, materyal geliştirmek, sadece dinleyici olmak, vb.)	**Eğitimin verimliliği****
								(5) (4) (3) (2) (1) (0)
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								(5) (4) (3) (2) (1) (0)

* Katıldığınız eğitimin türüne bağlı olarak size en uygun seçeneğin harfini tabloya yazınız. a) teori ağırlıklı b) uygulama ağırlıklı c) hem teori hem de uygulama ağırlıklı

** Katıldığınız eğitimlerin verimliliğini; 5 (çok verimli), 4 (verimli), 3 (orta verimli), 2 (az verimli), 1 (verimsiz), 0 (kararsızım) olacak şekilde dereceelendiriniz.

B3. Bundan önce katıldığınız hizmet-içi eğitimler öncesinde, esnasında ve sonrasında yaşadığınız tecrübelerinizi göz önünde bulundurduğunuzda ne tür sorunlarla karşılaştınız? Size göre bu sorunlara yönelik çözüm önerileri neler olabilirdi?

B3.1) Sizin kontrolünüz dışında gelişen sorunlar ve çözüm önerileri:
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B3.2) Sizden kaynaklanan sorunlar ve çözüm önerileri:
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B4. Mevcut fizik öğretim programında fiziğin doğası 9. sınıfın ilk ve 12. sınıfın ise son ünitesidir. Bu ünitelerin öğretiminde karşılaşılması muhtemel bazı sorunlar aşağıda sıralanmıştır. Siz de bu sorun/sorunlarla karşılaşıyorsanız, hangi sınıf ve/veya sınıflar için söz konusu olduğunu ilgili kutucuğu işaretleyerek, yanlarında verilen boşluklara ne tür çözüm önerileri sunabileceğinizi yazınız. Bunların dışında, karşılaştığınız başka sorun(lar) varsa "Diğer" bölümüne yine çözüm önerileriyle birlikte belirtiniz.

☐ Ünite için gerekli kaynakların azlığı: (☐9. sınıf, ☐12. sınıf) …………………………......
……………………………………………………………………………….................

☐ Ünitenin öğretim programındaki yeri (sırası): (☐9. sınıf, ☐12. sınıf) ..……………………
……………………………………………………………………………….................

☐ Diğer ünitelerle karşılaştırıldığında yeni öğretiliyor olması: (☐9. sınıf, ☐12. sınıf) ……..
……………………………………………………………………………….................

☐ Bu konudaki bilginizi yetersiz/eksik görmeniz: (☐9. sınıf, ☐12. sınıf) ..…………...........
……………………………………………………………………………….................

☐ Gereksiz bir konu olarak görmeniz: (☐9. sınıf, ☐12. sınıf) ……………………………….
……………………………………………………………………………….................

☐ Zaman yetersizliği: (☐9. sınıf, ☐12. sınıf) ..…………………………………………….
……………………………………………………………………………….................

☐ Çevresel tutumlar (üniversite giriş sınavlarında henüz bu konunun yer almamasından dolayı öğrencilerin ve ailelerin bu konuyu önemsiz görmesi, vb.): (☐9. sınıf, ☐12. sınıf) ……
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☐ Diğer: (☐9. sınıf, ☐12. sınıf) ………………………..
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B5. Mesleki gelişiminizde okulunuzdaki zümre çalışmalarını etkili kullanabildiğinizi düşünüyor musunuz? Zümre çalışmalarının daha etkili kullanılması konusunda neler yapılmalıdır? Kısaca yazınız.

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C) HAZIRLANACAK OLAN "FİZİĞİN DOĞASI" KONULU EĞİTİME YÖNELİK SORULAR

C1. Yapılacak eğitimin organizasyonu

Tablo 2'de, hazırlanacak olan eğitime katılmanız durumunda bu eğitimin nasıl olmasını istediğiniz ile ilgili görüşleriniz sorulmaktadır. Tablonun altındaki **Açıklamalar** kısmı size yardımcı olacağından bu bölümü okumadan tabloyu doldurmayınız.

Tabloda verilen konular dışında, 9. ve 12. sınıf fiziğin doğası üniteleri ile ilgili olarak bu eğitimde verilmesini istediğiniz konu/konular var ise, "Diğer" kısmına yazıp yine açıklamalar kısmındaki bilgiler yardımıyla ilgili alanları doldurunuz.

Tablo 2

Konular	Eğitimin türü [(1)]	Eğitimin uygulaması [(2)]	Eğitimde kullanılmasını istediğiniz kaynaklar [(3)]	Verilecek ortam [(4)]	Kim tarafından verilmeli [(5)]	Eğitimdeki rolünüz [(6)]	Ürünler [(7)]	Uygulama Zamanı [(8)]	Eğitimin Süresi (saat)	Eğitimin yapılma sıklığı [(9)]
9. sınıf fiziğin doğası ünitesindeki konular										
12. sınıf fiziğin doğası ünitesindeki konular										
Fiziğin doğası öğretilirken kullanılan ölçme-değerlendirme										
Fiziğin doğası öğretilirken kullanılan teknoloji										
Fiziğin doğası öğretilirken kullanılan materyal geliştirme-uygulama										
Fiziğin doğası öğretilirken kullanılan öğretim yöntemleri										
Diğer:										

Açıklamalar:

1-8. sütunlar için verilen seçeneklerden size uyan bir veya birden fazlasını seçip, yalnızca harfini ilgili alana yazınız.

(1) a) Seminer b) Çalıştay c) Konferans d) Diğer (İlgili boşluğa ne olduğunu açıkça yazınız)
(2) a) Teori ağırlıklı b) Uygulama ağırlıklı c) Hem teori hem de uygulama ağırlıklı
(3) a) Kitap b) Makale c) Dergi d) İnternet e) Laboratuvar malzemeleri f) Teknolojik araç ve gereçler (video, animasyon, vb.) g) Diğer (İlgili boşluğa ne olduğunu açıkça yazınız)
(4) a) Okulumda b) Okulumun dışında ilimde veya ilçemde c) İl dışında d) Uzaktan eğitimle e) Diğer (İlgili boşluğa ne olduğunu açıkça yazınız)
(5) a) Akademisyen b) Formatör öğretmen c) Diğer (İlgili boşluğa ne olduğunu açıkça yazınız)
(6) a) Örnek ders anlatmak b) Materyal geliştirmek c) Sadece dinleyici olarak katılmak d) Diğer (İlgili boşluğa ne olduğunu açıkça yazınız)
(7) Eğitim sonunda, somut anlamda ortaya çıkmasını beklediğiniz ürünler: a) Özet sayfaları b) Çalışma yaprakları c) Powerpoint sunuları d) Değerlendirme amaçlı kullanabileceğiniz testler e) Diğer (İlgili boşluğa ne olduğunu açıkça yazınız)
(8) a) Okulda eğitim-öğretim yılının başında b) Okul devam ederken c) Okulda eğitim-öğretim yılının sonunda d) Yaz tatilinde e) Hafta sonlarında f) Gündüz g) Akşam h) İhtiyaç duyulduğunda i) Diğer (İlgili boşluğa ne olduğunu açıkça yazınız)
(9) Örneğin: Her hafta 2 saat veya her ay 5 saat gibi yazınız.

C2. Tablo 2' de her bir sütun için önerilerinizi yazarken neleri dikkate aldığınızı kısaca açıklayınız.

"Eğitimin türü"

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"Eğitimin uygulaması"

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"Eğitimde kullanılmasını istediğiniz kaynaklar"

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"Verilecek ortam"

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"Kim tarafından verilmeli"

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"Eğitimdeki rolünüz"

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"Ürünler"

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"Uygulama zamanı"

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"Eğitimin süresi (saat)"

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"Eğitimin yapılma sıklığı"

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C3. Yapılacak eğitimde dayanışma

Fiziğin doğası ünitesi için hazırlanacak olan eğitimin daha verimli ve faydalı olması için bu eğitim öncesinde, esnasında ve sonrasında sizin hem kendi aranızda (öğretmen-öğretmen) hem de eğitimi veren kişilerle aranızda (öğretmen-eğitmen) nasıl bir iletişim olmasını isterdiniz? Aşağıdaki tabloda ilgili yerlere yazınız.

Tablo 3

Eğitim					
Öncesinde		**Esnasında**		**Sonrasında**	
öğretmen-öğretmen	öğretmen-eğitmen	öğretmen-öğretmen	öğretmen-eğitmen	öğretmen-öğretmen	öğretmen-eğitmen

C4. Yapılacak Eğitimin Değerlendirilmesi

"Fiziğin doğası" konulu hazırlanacak olan eğitimin verim ve etkinliğini görmek adına hem sizde (**Tablo 4**), hem de öğrencilerinizde (**Tablo 5**) meydana gelen gelişmeyi tespit etmek için hangi ölçüm araç ve/veya araçlarının kullanılmasını istersiniz? İlgili alanı (X) ile işaretleyerek nedenini açıklayınız. Kullanılmasını düşündüğünüz farklı ölçüm araçları var ise, "**Diğer**" kısmına yazınız.

Sizlerin değerlendirilmesi

Tablo 4

Ölçüm araçları	Eğitim öncesinde	Eğitim esnasında	Eğitim sonunda	Bu ölçüm araçlarını seçme nedeniniz
Anketler				
Mülakatlar				
Başarı testleri				
Performansa dayalı ölçüm araçları (portfolyo, gözlem formları, vb.)				
Diğer:				

C4.1) Katılacağınız eğitim öncesinde, esnasında ve sonunda kim tarafından değerlendirilmek istersiniz? Nedenini yazınız.

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Öğrencilerinizin değerlendirilmesi

Tablo 5.

Ölçüm araçları	**Eğitim öncesinde**	**Eğitim esnasında**	**Eğitim sonunda**	**Bu ölçüm araçlarını seçme nedeniniz**
Anketler				
Mülakatlar				
Başarı testleri				
Performansa dayalı ölçüm araçları (portfolyo, gözlem formları, vb.)				
Diğer:				

C4.2) Katılacağınız eğitim öncesinde, esnasında ve sonunda öğrencilerinizin kim tarafından değerlendirilmesini istersiniz? Nedenini yazınız.

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C5. Yapılacak eğitime katılımı artıracak destekler

Hazırlayacağımız "Fiziğin doğası" konulu eğitime katılımı artırmak için Milli Eğitim Bakanlığı'ndan ve bizden ne tür destek veya destekler beklerdiniz? Katkı sağlayabilir dediğiniz başka kurum/kuruluşlar var ise, diğer kısmına beklediğiniz katkıyı da yazarak belirtiniz.

C5.1) Milli Eğitim Bakanlığı'ndan; ..…………………………………………………………..
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C5.2) Bizden; ……………………………………………………………………………...
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C5.3) Diğer; …………………………………………………………………………………
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D) ÖNERİLER

D1. Hazırlanacak eğitim programının etkinliğini değerlendirmede bir ölçütte, program bittikten sonra derslerinizdeki öğrencilerin başarılarındaki değişimdir. Bu nedenle derslerinizde öğrenci gözlemleri yapılacak ve öğrencilerinizin başarılarında bir değişim olup olmadığı değerlendirilecektir. Fizik öğretim programına bakıldığında fiziğin doğası ünitesi 9. sınıflarda ilk, 12. sınıflarda ise son ünite olarak karşımıza çıkmaktadır. Gerek en son ünite olması gerekse 12. sınıftaki öğrencilerin özellikle üniversite sınavları gibi nedenlerden dolayı son dönem okula devamsızlıkları göz önüne alındığında, 12. sınıflarda bu çalışmanın gerçekleştirilme imkanı hakkında neler düşünmektesiniz?

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D1.1) Sizin bu konudaki çözüm önerileriniz nelerdir?
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D2. Şu ana kadar 12. sınıflarda fiziğin doğası ünitesini kaç kez anlattınız?

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D2.1) Eğer anlattıysanız, bu ünite için ne kadar süre ayırdınız?

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D2.2) 12. sınıfın son ünite olması, derslerinizdeki öğrenci katılımını ne düzeyde etkiledi?

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D2.3) 12. sınıflarda derslerin gözlemlenmesi ve öğrenci başarılarının değerlendirilmesi söz konusu olduğunda, fiziğin doğası ünitesi 12. sınıflarda birinci dönem anlatılabilir mi?

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D3. Fiziğin doğası ünitesinin öğretim programındaki yeri ile 9. ve 12. sınıf öğrencilerinin genel olarak durumları düşünüldüğünde, hangi sınıflarla çalışmak hem sizler için hem de bizim açımızdan daha elverişlidir?

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D4. M.E.B.'dan gerekli izinler alındıktan sonra, 2012-2013 bahar döneminde uygulanması planlanan "Fiziğin doğası" konulu eğitim programına katılmak ister misiniz?

☐ Evet ☐ Hayır

D5. Hazırlayacağımız eğitimle ilgili olarak yukarıda bahsi geçmeyen ancak sizin eklemek istediğiniz hususlar var ise aşağıda belirtiniz.

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APPENDIX B

THE FIRST VERSION OF TEACHER SURVEY ON THE NATURE OF PHYSICS UNIT PD PROGRAM

FİZİĞİN DOĞASI İÇERİKLİ HAZIRLANACAK SEMİNER İÇİN ÖĞRETMEN GÖRÜŞ ANKETİ

Değerli Öğretmenlerimiz;
Fiziğin doğası içerikli hazırlayacağımız bir seminer programı için sizlerin düşüncelerini aşağıdaki sorularla tespit etmeye çalışacağız. Bu bağlamda sorulara samimi ve içtenlikle yanıt vermenizi beklemekteyiz. Verdiğiniz her bilgi gizli tutulacak ve başka herhangi bir amaç için kullanılmayacaktır. Çalışma ile ilgili sorularınız için, aşağıdaki iletişim bilgilerinde bulunan e-posta adresinden bize ulaşabilirsiniz. Çalışmamıza katıldığınız için şimdiden teşekkür ederiz.

İletişim
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ODTÜ, OFMAE Bölümü
E-posta: ozoktay@metu.edu.tr

A) DEMOGRAFİK BİLGİLER

Aşağıdaki bilgiler, hazırlanacak seminer programı hakkındaki görüşlerinizin demografik özelliklerinizle ilişkisini tespit etmek amacıyla istenmektedir.

A1. *Cinsiyetiniz* : ☐Bay ☐Bayan

A2. *Doğum yılınız* : ....

A3. *Mezun olduğunuz fakülte* : ☐Eğitim Fakültesi ☐Fen-Edebiyat Fakültesi
☐Diğer (Lütfen yazınız):……………………………………..

A4. *Şu anki eğitim durumunuz* :

☐Lisans mezunu ☐Tezsiz yüksek lisans mezunu

☐Tezli yüksek lisans öğrencisi ☐Tezli yüksek lisans mezunu

☐Doktora öğrencisi ☐Doktora mezunu

A5. *Fizik öğretmeni olarak çalıştığınız süre (yıl olarak)*: ....

A6. *Çalıştığınız okul türü* :

☐Genel lise ☐Fen lisesi

☐Anadolu Lisesi ☐Anadolu öğretmen lisesi

☐Meslek liseleri ☐Diğer (Lütfen yazınız):…………………….

A7. *Okulunuzda şu anda var ise yaptığınız görevler:*

☐Müdürlük ☐Müdür Yrd. ☐Zümre başkanlığı

☐Formatörlük ☐Diğer (Lütfen yazınız):……………………………………

B) ÖĞRETMENLERİN TECRÜBELERİNİ ORTAYA ÇIKARMAYI AMAÇLAYAN SORULAR

B1. Okul dışında eğitimle ilgili herhangi bir çalışma/proje yapmış veya yapıyor iseniz, hangi konularda çalıştığınızı ve kimin tarafından desteklendiğinizi yazınız.
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B2. Daha önce katıldığınız hizmet-içi eğitimlerini düşünerek aşağıdaki tabloyu doldurunuz. Tabloyu doldurmanızda yardımcı olabilecek bilgiler için tablonun altındaki Notlar kısmını inceleyiniz.

Tablo 1

Yıl	Süre (1)	Etkinlik türü (2)	Etkinliğin uygulaması (3)	Etkinlik konusu (4)	Kim tarafından organize edildiği (5)	Verildiği ortam (6)	Etkinlikteki rolünüz (7)

Notlar

(1) Aldığınız her bir eğitim için toplam süre (ay, gün, saat olarak yazabilirsiniz).
(2) Bu sütuna yazılabilecek etkinlik türleri: workshop, seminer, konferans, kurs, vb. olabilir. Katıldığınız hizmet-içi eğitim birden fazla tür içeriyorsa, bu kutucuğa hepsini yazabilirsiniz.
(3) Aldığınız etkinlik türüne bağlı olarak aşağıda size uyan seçeneğin harfini tabloya yazınız.
a) teori ağırlıklı b) uygulama ağırlıklı c) hem teori hem de uygulama ağırlıklı
(4) Aynı etkinlikte birden fazla konuda eğitim almış iseniz her konuyu yazınız.
(5) Örneğin: M.E.B, Tübitak, vb.
(6) Örneğin: Okul, üniversite, otel, kamp, vb.
(7) Örneğin: Sunum yapmak, örnek ders anlatmak, materyal geliştirmek, sadece dinleyici olarak katılmak, vb.

B3. Bundan önce katıldığınız hizmet-içi eğitimlerinin öncesinde, sırasında ve sonrasında yaşadığınız tecrübelerinizi göz önünde bulundurduğunuzda hangi sorunlarla karşılaştınız? Size göre bunlara yönelik çözüm önerileri neler olabilirdi?

B3.1) Sizden kaynaklanan sorunlar ve çözüm önerileri; ....
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B3.2) Sizin dışınızdaki sorunlar ve çözüm önerileri; ……………………………………………...
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B4. Fiziğin doğası konusu şu anda 9. ve 12. sınıf fizik öğretim programında yer almaktadır. Bu konuların öğretiminde karşılaşılan muhtemel bazı sorunlar aşağıda sıralanmıştır. Siz de bu sorun ve/veya sorunları yaşamakta iseniz ilgili olanları işaretleyerek bu sorunlara ne tür çözüm önerileri sunabileceğinizi ayrıntılı bir şekilde bir sonraki sayfadaki boşluğa yazınız. Bunun dışında, sizin karşılaştığınız başka sorunlar varsa, yine çözüm önerileri ile ''Diğer sorunlar ve çözüm önerileri''kısmına yazınız.

☐Kullanılan kaynakların azlığı

☐Konunun öğretim programındaki yeri (sırası)

☐Diğer konularla karşılaştırıldığında yeni öğretiliyor olması

☐Bu konudaki bilginizi yetersiz / eksik görmeniz

☐Gereksiz bir konu olarak görmeniz

☐Zaman yetersizliği

☐Çevresel tutumlar (üniversite giriş sınavlarında henüz bu konunun yer almamasından dolayı öğrencilerin ve ailelerin bu konuyu önemsiz görmesi, vb.)

☐Diğer sorunlar ve çözüm önerileri; ……………………………………………………...

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C) FİZİĞİN DOĞASI KONUSUNDA HAZIRLANACAK OLAN SEMİNERE YÖNELİK SORULAR

C1. Seminerin organizasyonu

Bu bölümde; fiziğin doğası içerikli bir seminere katılmanız durumunda söz konusu seminerin, **Tablo 2**'de verilen belli özellikler dahilinde nasıl olmasını istediğiniz ile ilgili görüşleriniz sorulmaktadır. Tabloda verilen her bir konu için istediğiniz seminer türünü, süresini (saat), zamanını, seminerdeki buluşma sıklığını, seminerin kim tarafından verilmesini istediğinizi, ortamını, seminerdeki katılımcıların rolünü ve seminerde kullanılmasını istediğiniz kaynakları belirtiniz. Tabloyu doldururken diğer sayfadaki **Ek bilgiler** kısmındaki açıklamaları dikkatlice okumanız gerekmektedir. Ek bilgiler kısmını okumadan Tablo 2' yi doldurmayınız. Tabloda verilen konular dışında fiziğin doğası içeriği kapsamında bu seminerde "…………… konu ile ilgili de bir eğitim verilseydi iyi olurdu" dediğiniz konu/ konular var ise "Diğer" kısmının altındaki boş sütunlara yazıp yine verilen yönerge yardımıyla ilgili alanları doldurunuz.

Uyarı: Tabloyu ve arkasından gelecek ek bilgiler kısmını rahat doldurmanız açısından 6. ve 7. sayfanın baskıda yerleri değiştirilmiştir. Bu tabloyu 6. sayfadaki ek bilgileri göz önüne alarak doldurduktan hemen sonra, tablonun arkasına basılmış 7. sayfayı cevaplayınız!

Tablo 2

Konu[1]	Etkinlik türü[2]	Etkinliğin uygulaması[3]	Süresi (saat)[4]	Uygulama zamanı[5]	Buluşma sıklığı[6]	Kim tarafından verilmeli[7]	Verildiği ortam[8]	Etkinlikteki rolünüz[9]	Seminerde kullanılmasını istediğiniz kaynaklar[10]
9. ve 12. sınıf fiziğin doğası üniteleri[a]									
Ölçme-değerlendirme[b]									
Fiziğin doğası öğretilirken kullanılan ölçme-değerlendirme[c]									
Fiziğin doğasının öğretim programındaki içeriği[d]									
Genel teknoloji[e]									
Fiziğin doğası öğretilirken kullanılan teknoloji[f]									
Materyal geliştirme-uygulama[g]									
Fiziğin doğası öğretilirken kullanılan materyal geliştirme-uygulama[h]									
Öğretim yöntemleri[i]									
Fiziğin doğası öğretilirken kullanılan öğretim yöntemleri[j]									
Diğer:									

Aşağıdaki sorular Tablo 2' deki sorularla ilgilidir. Bundan dolayı tabloyu cevaplamadan aşağıdaki sorulara geçmeyiniz.

C1.1) Seminerin "Süresi (saat olarak)", "Zamanı" ve "Buluşma sıkılığı" başlığı altındaki sütunlara yazdığınız cevapları neleri düşünerek belirlediniz? Her bir sütuna verdiğiniz cevap için ayrı ayrı açıklama yapınız.

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C1.2) "Kim tarafından verilmeli" sütunu için verdiğiniz cevapları göz önünde bulundurarak neden bu cevabı verdiğinizi açıklayınız. Ek olarak bu veren kişi / kişileri düşündüğünüzde niteliklerinin nasıl olmasını istersiniz? Açıklayınız (Örneğin, tecrübeli, materyal geliştirmiş olan, vb.).

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C1.3) "Verildiği ortam" sütunu için, verdiğiniz cevapları göz önünde bulundurarak neden bu cevabı verdiğinizi açıklayınız.

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C1.4) Mesleki gelişiminizin daha etkili olabilmesi için okulunuzdaki zümreyi nasıl kullanıyorsunuz? Kendinizi geliştirmek için sizce nasıl kullanılmalı? Kısaca yazınız.

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Ek bilgiler

[1]Bu başlık altında, fiziğin doğası içerikli seminerde yer alması düşünülen konular yer almaktadır.
[2]Verilen seçeneklerden size uyan bir veya birden fazlasını seçip, yalnızca harfini ilgili alana yazınız. a) seminer b) workshop c) okulda öğretmenlerle birlikte çalışma d) bireysel çalışma e) proje f) online g) soru-cevap h) üniversitede master / doktora derslerine katılma i) gözlem yapma (meslektaşlarını) j) zümre ile birlikte çalışma k) okul dışında öğretmenlerle birlikte çalışma l) Diğer ise (açıkça ilgili alana yazınız)
[3]a) teori ağırlıklı b) uygulama ağırlıklı c) hem teori hem de uygulama ağırlıklı seçeneklerinden birini seçip, sadece harfini ilgili alana yazınız.
[4]Verilen her bir konu için gerekli olan seminer süresini (saat olarak) belirtiniz.
[5]Verilen seçeneklerden size uyan bir veya birden fazlasını seçip, yalnızca harfini ilgili alana yazınız a) okulda eğitim-öğretim yılının başında b) okul devam ederken c) okulda eğitim-öğretim yılının sonunda d) yaz tatilinde e) hafta sonlarında f) gündüz g) akşam h) her ihtiyaç duyulduğunda i) Diğer ise (açıkça ilgili alana yazınız)
[6]Her hafta 2 saat veya her ay 5 saat vb. gibi yazınız.
[7]Verilen seçeneklerden size uyan bir veya birden fazlasını seçip, yalnızca harfini ilgili alana yazınız. a) aynı okuldan öğretmen b) farklı okuldan öğretmen c) akademisyen d) Diğer ise (açıkça ilgili alana yazınız)
[8]Verilen seçeneklerden size uyan bir veya birden fazlasını seçip, yalnızca harfini ilgili alana yazınız a) okulumda b) okulumun dışında ilimde veya ilçemde c) il dışında d) online e) Diğer ise (açıkça ilgili alana yazınız)
[9]Verilen seçeneklerden size uyan bir veya birden fazlasını seçip, yalnızca harfini ilgili alana yazınız a) sunum yapmak b) örnek ders anlatmak c) araştırmacı d) materyal geliştirme e) sadece dinleyici f) Diğer ise (açıkça ilgili alana yazınız
[10]Verilen seçeneklerden size uyan bir veya birden fazlasını seçip, yalnızca harfini ilgili alana yazınız. a) kitap b) makale c) dergi d) online-forum (materyal paylaşımı, vb.) e) laboratuvar malzemeleri f) teknoloji araç ve gereçleri (video, animasyon, vb) g) Diğer ise (açıkça ilgili alana yazınız)

[a]9. ve 12. sınıf fiziğin doğası konusundaki tüm içeriği ve kazanımları düşününüz. Örneğin: "Fizikte modelleme ve matematiğin yeri" veya "Bilimin olgu ve olayları incelerken ana hatlarını bozmadan basitleştirerek açıkladığı durumlara örnekler verir", vb.
[b]Örneğin: Alternatif ölçme ve değerlendirme teknikleri, vb. konularda genel bir bilgi almak
[c]Fiziğin doğası öğretilirken kullanılabilecek her türlü ölçme ve değerlendirme bilgisini kapsamaktadır. Örneğin: Fiziğin doğası konularını öğretirken alternatif ölçme tekniklerini kullanma, vb.
[d]Fiziğin doğası içeriğinin öğretim programı dikkate alınarak neleri kapsadığı ve nasıl anlatılacağı bilgisi, vb.
[e]Eğitimde teknoloji nasıl kullanılır?, vb.
[f]Fiziğin doğası öğretilirken teknoloji nasıl kullanılır?, vb.
[g]Genel olarak materyal geliştirme ve uygulama bilgisi almak.
[h] Fiziğin doğası öğretilirken bu konuya özgü materyal geliştirme ve uygulama bilgisi.
[i]Örneğin: Problem çözme yöntemi, akran öğretimi yöntemi, vb. konularda bilgi almak
[j]Problem çözme yönteminin fiziğin doğası öğretilirken kullanılması, açık-düşündürücü yaklaşımın bilimin doğası öğretilirken kullanılması, vb.

C2. Seminerde Dayanışma

Fiziğin doğası konusunda hazırlanacak olan seminerin daha verimli ve faydalı olması için bu eğitimin öncesinde, sırasında ve sonrasında sizin hem kendi aranızda (öğretmen-öğretmen) hem de semineri veren kişilerle aranızda (öğretmen-eğitmen) nasıl bir iletişim olmasını isterdiniz? Aşağıdaki tabloda ilgili yerlere yazınız.

Tablo 3.

Mesleki Gelişim					
Öncesinde		**Sırasında**		**Sonrasında**	
Öğretmen-öğretmen	Öğretmen-Eğitmen	Öğretmen-öğretmen	Öğretmen-Eğitmen	Öğretmen-öğretmen	Öğretmen-Eğitmen

C2.1) Eklemek istedikleriniz var ise;
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C3. Seminerin Değerlendirilmesi

Fiziğin doğası konusunda hazırlanacak olan seminerin daha verimli ve etkili olabilmesi için bu eğitimin öncesinde, süreç içerisinde ve sonunda hem sizin (**Tablo 4**), hem de öğrencilerinizin (**Tablo 5**) değerlendirilmesinde hangi ölçüm araç ve/veya araçlarının kullanılmasını istersiniz? İlgili alanı (X) ile işaretleyerek nedenini kısaca yazınız. Her iki tabloyu doldururken size yardımcı olabilecek aşağıda verilen açıklamaları okuyunuz. Kullanılmasını düşündüğünüz farklı ölçüm araçları var ise, diğer kısmında verilen yere ekleyiniz.

Öğretmenin değerlendirilmesi

Tablo 4

Ölçüm araçları	**Önce**	**Süreçte**	**Sonda**	**Bu ölçüm araçlarını seçme nedeniniz**
Yazılı görüş anketleri[1]				
Yazılı başarı testleri[2]				
Performansa dayalı ölçüm araçları[3]				
Diğer:				

Açıklamalar

[1]İhtiyaçları ortaya çıkarmayı sağlayan, görüşlerin alındığı değerlendirme yaklaşımları (Örneğin: Fizikte matematik ve modelleme konusunda kendinizi ne kadar yeterli görmektesiniz?).
[2]Bir konu hakkında bilgiyi doğrudan ölçen yöntemler (Örneğin: Hangisi ya da hangileri fizikte kullanılan modellemelere örnek olabilir? I. Evren modelleri II. Atom modelleri III. Işık modelleri
A) Yalnız I B) I ve II C) I ve III D) II ve III E) Hepsi).
[3]Portfolyo, gözlem formları, proje ürünleri, vb.

C3.1) Katılacağınız seminerin öncesinde, süreçte ve sonrasında siz değerlendirilirken rolünüzün ne olmasını istersiniz? Nedenini yazınız.

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C3.2) Katılacağınız seminerin öncesinde, süreçte ve sonrasında siz kim tarafından değerlendirilmek istersiniz? Nedenini yazınız.

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Öğrencinin değerlendirilmesi

Tablo 5.

Ölçüm araçları	Önce	Süreçte	Sonda	Bu ölçüm araçlarını seçme nedeniniz
Yazılı görüş anketleri[1]				
Yazılı başarı testleri[2]				
Performansa dayalı ölçüm araçları[3]				
Diğer:				

Uyarı: Tablo 4'ün altındaki açıklamalar Tablo 5 için de geçerlidir.

C3.3) Katılacağınız seminerin öncesinde, süreçte ve sonrasında siz değerlendirilirken rolünüzün ne olmasını istersiniz? Nedenini yazınız.

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C3.4) Katılacağınız seminerin öncesinde, süreçte ve sonrasında siz kim tarafından değerlendirilmek istersiniz? Nedenini yazınız.

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C4. Seminere Katılımı Artıracak Destekler

Hazırlamayı düşündüğümüz fiziğin doğası içerikli seminerimize katılımınızı artırmak için Milli Eğitim Bakanlığı'ndan ve bizden ne tür bir destek / destekler beklerdiniz? Katkı sağlayabilir dediğiniz başka kurum/ kuruluşlar var ise diğer kısmına beklediğiniz katkıyı da yazarak belirtiniz.

C4.1) Milli Eğitim Bakanlığı'ndan;……………………………………………………………..
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C4.2) Bizden; ………………………………………………………………………………..
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C4.3) Diğer; ……………………………………………………………………………………
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C5. Seminerin Sonunda Elde Edilebilecek Ürünler

Yapılacak seminer sonunda, somut anlamda ne tür ürünler ortaya çıkmasını beklersiniz? (Örneğin: Dersinizin içinde kullanabileceğiniz çalışma yaprakları, powerpoint sunuları, videolar, materyaller, konu ile ilgili her türlü biliyi bulabileceğiniz bir web sayfası, değerlendirme amaçlı kullanabileceğiniz testler, öğretmen kılavuz kitapçıkları, vb.)

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D. Fiziğin doğası ile ilgili geliştireceğimiz, uygulayacağımız mesleki gelişim etkinlikleri ile ilgili olarak yukarıda bahsi geçmeyen ancak sizin eklemek istediğiniz hususlar var ise aşağıda belirtiniz.

APPENDIX C

TEACHER SURVEY ON THE NATURE OF PHYSICS UNIT PD PROGRAM EXPERT OPINION FORM

UZMAN GÖRÜŞ FORMU

Fizik öğretmenlerine yönelik fiziğin doğası içerikli hazırlanacak olan seminer için katılımcılardan gelen dönütler, gerek içeriğin belirlenmesinde gerekse seminerin organizasyonunda yol gösterici olacaktır. Bu amaçla katılımcı öğretmenlerin görüşlerini ortaya çıkarmayı hedefleyen bir anket hazırlanmıştır. Söz konusu anketin geliştirilmesinde önce ilgili kaynaklar taranmış ve bir mesleki gelişim programını oluşturan ortak özellikler ortaya çıkarılmıştır. Bu özelliklerden alt boyutlar oluşturularak daha sonra soru formatına dönüştürülmüştür. Anketin katılımcılara uygulanmadan önce daha geçerli ve anlaşılır hale gelmesi için siz uzmanların değerli görüşleri bizim için oldukça önemlidir. Dönütleriniz için şimdiden teşekkür ederiz.

İletişim
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GİRİŞ BÖLÜMÜ

I. Bu görüş formunda size sorulan tüm soruları, anketimizi dikkatli bir şekilde inceleyerek yanıtlayınız. İlk olarak anketin giriş bölümü ile ilgili aşağıdaki sorulara cevabınız EVET ise "E", HAYIR ise "H" harfini ilgili kutucuğa yazınız. Yanıtınız "H" ise, ilgili bölüme kısaca açıklama yapınız.

Giriş Bölümü	Görüşünüz (E/H)	"Hayır" ise önerileriniz
1. Anketin amacı giriş kısmında açıkça verilmiş mi?		
2. Cümleler kısa ve anlaşılması kolay mı?		
3. Giriş kısmı yeterli mi?		

II. Eklemek istedikleriniz: (İstediğiniz takdirde bu formla birlikte size verilen anketin üzerine gereken düzeltmeleri yapabilirsiniz).

A) DEMOGRAFİK BİLGİLER

Bu bölümdeki soruların amacı; *katılımcılar hakkında tanıtıcı bilgiler almak ve öğretmenlerden alınacak görüşlerin, onların demografik özellikleriyle ilişkilerini incelemektir.*

I. Bu bölüm için aşağıdaki soruları yanda kodları verilen anketteki her bir soru için yanıtlayınız. Cevabınız EVET ise "E", HAYIR ise "H" harfini ilgili kutucuğa yazınız. Sonuç aşamasında ise; her bir soruyu ankette kalsın ya da düzenleme yapılsın diye değerlendiriniz.

	A1	A2	A3	A4	A5	A6	A7
1. Kolay cevaplanabilir türde mi?							
2. Anlaşılır mı?							
3. Soru türü uygun mu? 4. "Diğer" seçeneği var ise uygun yerde kullanılmış mı?							
Sonuç olarak:							
Soru ankette kalsın mı?							

II. Eğer yukarıdaki tabloda herhangi bir bölümü "H" olarak işaretlediyseniz, lütfen nedeni ile birlikte açıklama yapınız. Gerekli bilgiyi anket üzerinde veya aşağıdaki boş yere anketteki soru numarası ile birlikte yazınız.

III. Demografik özellik olarak sorulabilecek sizce başka bir soru var mıdır? Var ise nedeniyle birlikte yazınız.

B) ÖĞRETMENLERİN TECRÜBELERİNİ ORTAYA ÇIKARMAYI AMAÇLAYAN SORULAR

Bu bölümdeki soruların amacı; *olgusal sorularla öğretmenlerin yaşadığı tecrübeler ya da davranışları ortaya çıkarmak, öğretmenlerin katıldığı mesleki gelişim programlarını inceleyip, seminerin hazırlanmasında faydalı olabilecek bilgileri edinmek, katılan öğretmenlerin bilimsel faaliyetlere iştirak etmede ne kadar aktif olduğunu araştırmak ve fiziğin doğası konusunu öğretirken yaşadıkları sorunları irdelemek ve eksikliklerini ortaya çıkarmaktır.*

I. Bu bölüm için aşağıdaki soruları yanda kodları verilen anketteki her bir soru için yanıtlayınız. Cevabınız EVET ise "E", HAYIR ise "H" harfini ilgili kutucuğa yazınız. Sonuç aşamasında ise; her bir soruyu ankette kalsın ya da düzenleme yapılsın diye değerlendiriniz.

	B1	**B2**	**B3**	**B4**
1. Yukarıda belirtilen amaçlara uygun mu?				
2. Anlaşılır mı?				
3.Verilen boşluklar cevaplama için yeterli mi?				
4. "Diğer" seçeneği var ise uygun yerde kullanılmış mı?				
Sonuç olarak:				
4. Soru ankette kalsın mı?				

II. Eğer yukarıdaki tabloda herhangi bir bölümü "H" olarak işaretlediyseniz, lütfen nedeni ile birlikte açıklama yapınız. Gerekli bilgiyi anket üzerinde veya aşağıdaki boş yere anketteki soru numarası ile birlikte yazınız.

III. Anketteki B1, B2, B3 ve B4 soruları dışında bu bölümün amacına uygun olarak sorulabilecek başka soru var ise yazınız.

IV. Tablo 1'e eklemek ve/veya çıkarmak istedikleriniz varsa lütfen yazınız.

V. *B4 kodlu soru ile ilgili:*

Listelenen sorunları göz önünde bulundurarak, eklemek ya da çıkartmak istedikleriniz varsa lütfen belirtiniz (İstediğiniz takdirde bu formla birlikte size verilen anketin üzerine düzeltmeleri yapabilirsiniz).

C) FİZİĞİN DOĞASI KONUSUNDA HAZIRLANACAK OLAN SEMİNERE YÖNELİK SORULAR

Bu bölümdeki soruların amacı; *geliştirilecek seminer programını daha etkili ve verimli hale getirmek için yapabileceklerimiz dahilinde (bunlar her bir bölümün başlığında verilenler) ve öğretmenlerin istekleri doğrultusunda şekillendirmek, seminerin, organizasyonunu (seminer türünü, süresini (saat), zamanını, seminerdeki buluşma sıklığını, seminerin kim tarafından verilebileceğini, ortamını, seminerdeki katılımcıların rolünü ve seminerde kullanılabilecek kaynakları) öğretmenlerin istekleri doğrultusunda belirlemeye çalışmak, semineri aktif hale getirecek katılımcı-eğitmen iletişimini sağlamak, seminerlerin değerlendirilmesinin kimler tarafından ve nasıl yapılması konusunda öğretmenlerin görüşünü almak ve seminere katılımı arttırıcı destekleri ve seminer sonunda ortaya çıkabilecek somut ürünleri belirlemektir.*

I. Bu bölüm için aşağıdaki soruları yanda kodları verilen anketteki her bir soru için yanıtlayınız. Cevabınız EVET ise "E", HAYIR ise "H" harfini ilgili kutucuğa yazınız. Sonuç aşamasında ise; her bir soruyu ankette kalsın ya da düzenleme yapılsın diye değerlendiriniz.

	C1	**C1.1**	**C1.2**	**C1.3**	**C1.4**	**C2**	**C3**	**C3.1**	**C3.2**	**C3.3**	**C3.4**	**C4**	**C4.1**	**C4.2**	**C4.3**	**C5**
1. Belirtilen amaçlara uygun mu?																
2. Anlaşılır mı?																
3.Verilen boşluklar cevaplama için yeterli mi?																
4. "Diğer" seçeneği var ise uygun yerde kullanılmış mı?																
Sonuç olarak:																
Soru ankette kalsın mı?																

II. Eğer yukarıdaki tabloda herhangi bir bölümü “H” olarak işaretlediyseniz, lütfen nedeni ile birlikte açıklama yapınız. Gerekli bilgiyi anket üzerinde veya aşağıdaki boş yere anketteki soru numarası ile birlikte yazınız.

III. Anketin C kısmında sorulan tüm sorular dışında bu bölümün amacına uygun olarak sorulabilecek başka soru var ise yazınız.

IV. Tablo 2’ye eklemek ve/veya çıkarmak istedikleriniz varsa lütfen yazınız.

V. Tablo 3’e eklemek ve/veya çıkarmak istedikleriniz varsa lütfen yazınız.

VI. Tablo 4’e eklemek ve/veya çıkarmak istedikleriniz varsa lütfen yazınız.

VII. Tablo 5’e eklemek ve/veya çıkarmak istedikleriniz varsa lütfen yazınız.

ÖĞRETMEN GÖRÜŞ ANKETİNİN GENEL OLARAK DEĞERLENDİRİLMESİ

I. Anketin geneli ile ilgili aşağıdaki sorulara cevabınız EVET ise "E", HAYIR ise "H" harfini ilgili kutucuğa yazınız.

Genel sorular	**Görüşünüz (E/H)**
1. Akıcı mı?	
2. Soruların yeri ve sırası uygun mu?	
3. Sayfa düzeni uygun mu?	
4. Anlaşılır mı?	
5. Sorular dilbilgisi ve yazım kurallarına uyuyor mu?	

II. Eğer yukarıdaki tabloda herhangi bir bölümü "H" olarak işaretlediyseniz, lütfen nedeni ile birlikte açıklama yapınız. Gerekli bilgiyi anket üzerinde veya aşağıdaki boş yere anketteki soru numarası ile birlikte yazınız

III. Ankette sorulmayan ancak katılımcılarla karşılıklı görüşmelerde sorulmasını düşündüğünüz sorular var ise lütfen yazınız.

APPENDIX D

THE EVALUATION OF THE EXPERT OPINION FORM OF TEACHER SURVEY ON THE NATURE OF PHYSICS UNIT PD PROGRAM

HAZIRLANACAK OLAN FİZİĞİN DOĞASI KONULU EĞİTİME YÖNELİK ÖĞRETMEN GÖRÜŞ ANKETİ UZMAN GÖRÜŞ FORMU DEĞERLENDİRMESİ

BAŞLIK: Kelimelerin yeri değiştirilmiş ve seminer yerine "Eğitim" ifadesi kullanılmıştır.

GİRİŞ BÖLÜMÜ

- Bazı cümleler parçalanmış ve uzmanlardan gelen dönütler doğrultusunda ekleme ve çıkarmalar yapılmıştır.
- Bilimin doğasının öğretim programındaki yeri belirtilmiştir.
- Seminerin amacı eklenmiştir.

A) KİŞİSEL BİLGİLER

"Demografik Bilgiler" ifadesi "Kişisel Bilgiler" olarak değiştirilmiştir. "Doğum yılınız" sorusu çıkartılmıştır.

B) ÖĞRETMENLERİN MESLEKİ TECRÜBELERİNİ ORTAYA ÇIKARMAYI AMAÇLAYAN SORULAR

B1. "Okul dışında eğitim" ifadesi "Eğitim" olarak değiştirilmiştir.

B2. Tablo 2'ye "Eğitimin Verimliliği" sütunu eklenmiş ve tablo ile ilgili açıklamalar bölümü kısaltılıp bazı ifadeler tablonun içine aktarılmıştır.

B4. Her bir soru 9. ve 12. Sınıflar için ayrı ayrı ifade edilmiştir.

B5. Zümre çalışmaları ile ilgili bir soru eklenmiştir.

C) HAZIRLANACAK OLAN "FİZİĞİN DOĞASI" KONULU EĞİTİME YÖNELİK SORULAR

C1. Tablo 2'ye yönelik açıklamalar değiştirilmiş ve kısaltılmıştır. Tablo 2 içerisindeki ifadelerin bazıları değiştirilmiştir.

C2. Daha önceki sürümde C1,2,3 ve C4 soruları bu bölümde bir araya getirilmiştir.

C3. Tablo 3'de "Mesleki Gelişim" ifadesi "Eğitim" olarak değiştirilmiştir.

C4. Tablo 4 ve 5'de "Ölçüm araçları" sütununa "Mülakatlar" eklenmiştir.

Bir önceki sürümde yer alan "Seminer sonunda elde edilecek ürünler" bölümü tümüyle çıkartılmıştır.

D) ÖNERİLER

Araştırmada Fiziğin doğası ünitesinin 12. sınıflarda uygulanıp uygulanamayacağına yönelik sorular eklenmiştir. Öğretmenlerin Fiziğin doğası ünitesini daha önce kaç kez anlattıkları, bunun için ne kadar süre ayırdıkları ve öğrencilerin bu derslere ne derecede katıldıklarını tespit etmeye yönelik sorular ilave edilmiştir. Ayrıca, Fiziğin doğası ünitesinin öğretimine yönelik bir hizmet içi eğitim hazırlandığında bu eğitime katılıp katılmak istedikleri sorulmuştur.

APPENDIX E

THE FIRST VERSION OF OBSERVATION FORM

GÖZLEM FORMU

Bu formun amacı, 9. sınıf "Fiziğin doğası" ünitesini anlatan öğretmenlerin bu ünite boyunca sınıf içi uygulamalarını gözlemlemektir. Gözlem formunun temelini öğretim programındaki ilgili ünitedeki kazanımların ne ölçüde verildiği ve öğretmen tarafından sınıf ortamına nasıl aktarıldığı oluşturmaktadır. İki bölümden meydana gelen gözlem formunda, Bölüm I'de genel anlamda kazanımların nasıl verildiği ve daha önce hazırlanmış olan ihtiyaç analizine dayalı olarak geliştirilen öğretmen görüş anketindeki öğretim yöntemleri, teknoloji - materyal ve ölçme - değerlendirme boyutları yer almaktadır. Bölüm II ise ders ile ilgili gözlemlenebilecek genel unsurları kapsamaktadır.

BÖLÜM I

Gözlem tablosundaki kazanım ile ilgili sütunları doldururken, kazanımın sınıf içinde nasıl yapıldığını veren ifadeyi seçerek ilgili kutucuğa (X) işareti koyunuz. Kazanımlar ile ilgili numaralanmış bazı sütunları doldurduktan sonra tablonun altında bulunan "Açıklamalar" bölümüne gerekli gördüğünüz kısımları yazınız. Diğer sütunlarda verilen yöntem- etkinlikler, materyal / teknoloji, ölçme / değerlendirme tekniği ve ölçme / değerlendirmenin amacı kısımlarını açıkça yazarak doldurunuz. Bu sütunlardaki değerlendirme bölümlerine ise 4: Çok iyi, 3: İyi, 2: Orta, 1: Kötü, 0: Kullanmadı şeklinde verilen derecelendirmelerden uygun olanı seçerek rakamını yazınız. Değerlendirmenizi yaparken;

✓ **Öğretim yönteminin etkin bir şekilde kullanılıp kullanılmadığı;**

Yöntemin bütün aşamalarının yerine getirilip getirilmediğine,
Yöntemin kazanıma uygun olup olmadığına,
Öğrencinin aktif bir şekilde derse katılımını sağlayıp, sağlamamasına bakarak ortalama bir puan veriniz.

✓ **Teknoloji / materyalin etkin bir şekilde kullanılıp kullanılmadığı;**

Teknoloji / materyalin niteliğine (içerik, görsellik, vb.),
Teknoloji / materyalin kazanıma uygun olup olmadığına,
Öğrencinin aktif bir şekilde derse katılımını sağlayıp sağlamamasına bakarak ortalama bir puan veriniz.

✓ **Ölçme ve değerlendirmenin etkin bir şekilde yapılıp yapılmadığı;**

a) Kazanımı ölçüp ölçmediğine,
b) Sorduğu sorunun teknik olarak uygun olup olmadığına,
c) Dönüt verip vermediğine (sorduğu sorular, ödevler vb. için) bakarak ortalama bir puan veriniz.

✓ **Ölçme ve değerlendirmenin amacı sütununa ise, aşağıda verilen ifadelerden uygun olanı veya olanları seçip, ifadenin önünde bulunan harfi yazınız.**

a) Öğrencilerin ön bilgi ve becerilerini ortaya çıkarma (diagnostik amaç)
b) Öğrencilerin verilen kazanımlara ulaşma aşamasında sürecin takip edilmesi (formatif amaç)
c) Öğretim sonunda öğrencinin ulaştığı en son düzeyi belirleme (summatif amaç)

Öğretmenin adı, soyadı: …………………………… **Okulu:** …………………………….. **Sınıfı:** …….. **Öğrenci sayısı:** ………

Tarih: ………….. **Saat:** ……….. **Gözlemcinin adı, soyadı:** ……………………………….

1. Fiziğin uğraş alanı ile ilgili olarak öğrenciler;

1.1 'Fizik nedir?' sorusuna cevap arar (FTTÇ-1.a,b,c,d; BİB-1.a-d).

FTTÇ-1. Fizik ve teknolojinin doğasını anlar.
a. Fiziği tanımlar ve evrendeki olayları anlamaya yardımcı temel bilimlerden biri olduğunu kavrar.
b. Fizik biliminin sınanabilir, sorgulanabilir, doğrulanabilir, yanlışlanabilir ve delillere dayandırılabilir bir yapısı olduğunu anlar.
c. Fizik bilimindeki bilgilerin ivmeli bir şekilde arttığını fark eder.
d. Fizik bilimindeki bilimsel bir bilginin her zaman mutlak doğru olmadığının, belli şartlar ve sınırlılıklar içinde *geçerli* olduğunun farkına varır.

BİB-1. Bilgiyi arar, bulur ve uygun olanı seçer.
a. Farklı bilgi kaynaklarını kullanır.
b. Bilgi kaynaklarının güvenilir ve geçerli olup olmadığını kontrol eder.
c. Çoklu arama kriterleri kullanır.
d. Amacına uygun bilgiyi arar, bulur ve seçer.

Gözlem tablosu

Kazanımlar Bilgi/ Beceri	Kazanımı								Kullanılan öğretim yöntemleri etkinlikler		Kullanılan teknoloji / materyal		Kullanılan ölçme ve değerlendirme		
	Tam verdi	Eksik verdi [1]	Hatalı verdi [2]	Sınırlarından fazla anlattı [3]	Hiç vermedi	Verdi ise; Açıkça ifade etti	Günlük hayatla ilişkilendirdi [4]	Verirken kavram yanılgılarını vurguladı [5]	Yöntem, etkinlikler	Değerlendirme	Materyal / Teknoloji	Değerlendirme	Ölçme/Değerlendirme tekniği	Ölçme/Değerlendirmenin amacı	Değerlendirme
Kazanım 1.1															
FTTÇ-1.a.															
FTTÇ-1.b.															
FTTÇ-1.c.															
FTTÇ-1.d.															
BİB-1.a.															
BİB-1.b.															
BİB-1.c.															
BİB-1.d.															

Açıklamalar:

1) Kazanımı eksik verdi ise: ……………………………………………………………………………………………………..
………
………
………
………

2) Kazanımı hatalı verdi ise: ……………………………………………………………………………………………………..
………
………
………
………

3) Kazanımı sınırlarından fazla anlattı ise: ……………………………………………………………………………………
………
………
………
………

4) Kazanımı günlük hayatla ilişkilendirdi ise: ………………………………………………………………………………..
………
………
………
………

5) Kazanımı verirken kavram yanılgılarını vurguladı ise: ………………………………………………………………………..
………
………
………
………

BÖLÜM II

Aşağıda verilen her bir soruya cevabınızı "Evet", "Hayır" ya da "Kısmen" olarak verip, nedenini de açıklama kısmına kısaca yazınız.

1) Derse öğrencinin dikkatini çekebildi mi? Evet ☐ Hayır ☐ Kısmen ☐

Açıklama: ………

……

2) Derse ilgiyi sürekli sağlayabildi mi? Evet ☐ Hayır ☐ Kısmen ☐

Açıklama: ………

……

3) Dersi öğrenci seviyesine uygun mu anlattı? Evet ☐ Hayır ☐ Kısmen ☐

Açıklama: ………

……

4) Dersi iyi planladı mı? Evet ☐ Hayır ☐ Kısmen ☐

Açıklama: ………

……

5) Öğrenciler derse karşı istekli miydi? Evet ☐ Hayır ☐ Kısmen ☐

Açıklama: ………

……

6) Sınıftaki koşullar (sıcaklık, aydınlanma, öğrenci sayısı, sıra sayısı, vb.) dersin işlenmesi için uygun muydu? Evet ☐ Hayır ☐ Kısmen ☐

Açıklama: ………

……

APPENDIX F

THE ANALYSIS OF THE EXPERT EVALUATION OF THE OBSERVATION FORM

GÖZLEM FORMU UZMAN DEĞERLENDİRMELERİ ANALİZİ

Mevcut programın ilgili bölümleri ile uyuşan eski programdaki kazanımlar italik yazı tipi kullanılarak yeni gözlem formuna eklenmiştir.

I. Bölümde yapılan değişikler;

Gözlem formu başındaki açıklamalar "Yönerge" başlığı adı altında yeniden ele alınmıştır.

Değerlendirme ölçütleri 4'lü skaladan 3' indirilmiş ve isimlendirmeleri değiştirilmiştir.

Her bir boyut için yapılmış olan özel açıklamalara gereksinim duyulmamıştır.

Kazanımlar tablo halinde verilmiştir.

Gözlemlerin rapor edildiği tabloların düzeni tümüyle değiştirilmiştir.

Her bir boyut için, Kazanım/bilgi/beceri, Öğretim strateji, yöntem-teknikler; Materyal-teknoloji; Ölçme-değerlendirme ayrı ayrı form tablo şeklinde hazırlanmıştır.

Kazanımlar için, "verdi" veya "anlattı" yerine; "sunuldu", "verildi" ifadeleri kullanılmıştır.

Tablolardaki, "Verdi ise; Açıkça ifade etti" ifadesi, "Kazanım ifadeleri verildi" olarak değiştirilmiştir.

Her boyut için gözlemcinin ihtiyaç duyabileceği "Açıklamalar" tablo içerisine aktarılmıştır.

Ölçme-değerlendirme boyutundaki değerlendirmelere, kullanılan ölçme-değerlendirmenin hangi amaçla yapıldığını sorgulayan bir soru eklenmiştir.

II. Bölümde yapılan değişikler;

II. Bölümdeki sorular düzen olarak tablo haline getirilmiştir.

"Dersi öğrenci seviyesine uygun anlattı" sorusu çıkarılmıştır.

APPENDIX G

OBSERVATION FORM (2012 FALL TERM NOP UNIT)

GÖZLEM FORMU

Bu form, 9. sınıf "Fiziğin doğası" ünitesini anlatan öğretmenlerin bu ünite boyunca sınıf içi uygulamalarını gözlemlemek için hazırlanmıştır. Gözlem formunun temelini öğretim programındaki ilgili ünitedeki kazanımların ne ölçüde sunulduğu ve öğretmen tarafından sınıf ortamına nasıl aktarıldığı oluşturmaktadır. İki bölümden meydana gelen gözlem formunda, I. Bölüm'de derste kazanımların nasıl sunulduğu, kullanılan öğretim strateji,yöntem-teknikleri, materyal-teknolojiler ile ölçme-değerlendirme boyutları yer almaktadır. II Bölüm ise ders ile ilgili gözlemlenebilecek genel unsurları kapsamaktadır.

YÖNERGE

- Ünitedeki her bir kazanım için ayrı ayrı gözlem formları hazırlanmıştır. Derste sunulan kazanımı tespit ettikten sonra ilgili forma gözlemlerinizi yazınız.
- Her bir formda, kazanımlar ve kodları gözlem tablolarını doldurmadan önce verilmiştir. Gözlem tablolarında ise kazanımların kodları kullanılmıştır. İlgili yerde işaretlediğiniz kod veya kodlara göre, söz konusu kazanım/kazanımlar için değerlendirme yaptığınız anlaşılacaktır.
- Bazı tablolarda verilen "Değerlendirme" sütununa ise;

3= İyi: Tam uygulandı
2= Orta: Eksik uygulandı
1= Zayıf: Çok eksik uygulandı
0= İlgisiz

şeklinde verilen derecelendirmelerden uygun olanı seçip ilgili rakamı yazınız.

Öğretmenin adı, soyadı:		**Tarih:**	**......... / .... / ....**
Okul:		**Saat:**	**Başlama: .... Bitiş: ....**
Sınıf:		**Ders zamanında başladı mı?:**	☐ **Evet** ☐ **Hayır**
Öğrenci sayısı:		**Gözlemcinin adı, soyadı:**	

Kodlar	Kazanımlar
K 1.1	'Fizik nedir?' sorusuna cevap arar (FTTÇ-1.a,b,c,d; BİB-1.a-d).
FTTÇ-1.	**Fizik ve teknolojinin doğasını anlar**
FTTÇ-1.a.	Fiziği tanımlar ve evrendeki olayları anlamaya yardımcı temel bilimlerden biri olduğunu kavrar.
FTTÇ-1.b.	Fizik biliminin sınanabilir, sorgulanabilir, doğrulanabilir, yanlışlanabilir ve delillere dayandırılabilir bir yapısı olduğunu anlar.
FTTÇ-1.c.	Fizik bilimindeki bilgilerin ivmeli bir şekilde arttığını fark eder.
FTTÇ-1.d.	Fizik bilimindeki bilimsel bir bilginin her zaman mutlak doğru olmadığının, belli şartlar ve sınırlılıklar içinde geçerli olduğunun farkına varır.
BİB-1.	**Bilgiyi arar, bulur ve uygun olanı seçer.**
BİB-1.a.	Farklı bilgi kaynaklarını kullanır.
BİB-1.b.	Bilgi kaynaklarının güvenilir ve geçerli olup olmadığını kontrol eder.
BİB-1.c.	Çoklu arama kriterleri kullanır.
BİB-1.d.	Amacına uygun bilgiyi arar, bulur ve seçer.

Gözlem Tablosu 1 (Kazanımlar, bilgi/beceri) **I. BÖLÜM**

Kazanımın sunuluş şekilleri	Kazanımlar									AÇIKLAMALAR (Sunuluş şekilleri ile eşleştirdiğiniz kazanımları dikkate alarak, neden böyle bir seçim yaptığınızı kazanım numaralarını da belirterek aşağıda verilen boş alanlara yazınız. Her bir sunuluş şekli için birden fazla kazanım seçebilirsiniz.)
Tam sunuldu	**K**	**FTTÇ-1**				**BİB-1**				
	1.1	a	b	c	d	a	b	c	d	
Eksik sunuldu	**K**	**FTTÇ-1**				**BİB-1**				
	1.1	a	b	c	d	a	b	c	d	
Hatalı sunuldu	**K**	**FTTÇ-1**				**BİB-1**				
	1.1	a	b	c	d	a	b	c	d	
Sınırlarından fazla sunuldu	**K**	**FTTÇ-1**				**BİB-1**				
	1.1	a	b	c	d	a	b	c	d	
Hiç sunulmadı	**K**	**FTTÇ-1**				**BİB-1**				
	1.1	a	b	c	d	a	b	c	d	
Kazanım ifadeleri verildi	**K**	**FTTÇ-1**				**BİB-1**				
	1.1	a	b	c	d	a	b	c	d	
Günlük hayatla ilişkilendirildi	**K**	**FTTÇ-1**				**BİB-1**				
	1.1	a	b	c	d	a	b	c	d	
Kavram yanılgıları var ise vurgulandı	**K**	**FTTÇ-1**				**BİB-1**				
	1.1	a	b	c	d	a	b	c	d	

Gözlem Tablosu 2 (Öğretim strateji, yöntem-teknikler)

Kullanılan strateji, yöntem-teknikler	Kazanımlar					Değerlendirme				AÇIKLAMALAR (Kullanılan strateji, yöntem-teknikleri için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir strateji, yöntem-teknik için birden fazla kazanım seçebilirsiniz.)
1.	K	1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
2.	K	1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
3.	K	1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
4.	K	1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					

Gözlem Tablosu 3 (Materyal-teknoloji)

Kullanılan materyal-teknoloji	Kazanımlar					Değerlendirme				AÇIKLAMALAR (Kullanılan materyal–teknoloji için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir materyal-teknoloji için birden fazla kazanım seçebilirsiniz.)
1.	**K**	1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
2.	**K**	1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
3.	**K**	1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
4.	**K**	1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					

Gözlem Tablosu 4 (Ölçme–Değerlendirme)

Kullanılan ölçme–değerlendirme	Kazanımlar		Değerlendirme	Amacı a) Gruplama b) Diagnostik c) Formatif d) Summatif	**AÇIKLAMALAR** (Kullanılan ölçme-değerlendirme tekniği için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir ölçme-değerlendirme tekniği için birden fazla kazanım seçebilirsiniz. "Amacı" sütununu doldururken de uygun ifadenin önünde bulunan harfi kodlayınız. Birden fazla harf kodlayabilirsiniz.)
1.	K	1.1			
	FTTÇ-1	a b c d			
	BİB-1	a b c d			
2.	K	1.1			
	FTTÇ-1	a b c d			
	BİB-1	a b c d			
3.	K	1.1			
	FTTÇ-1	a b c d			
	BİB-1	a b c d			
4.	K	1.1			
	FTTÇ-1	a b c d			
	BİB-1	a b c d			

II. BÖLÜM

		Evet	Hayır	Kısmen	**AÇIKLAMALAR** **(Verilen her bir soru için cevabınızı "Evet", "Hayır" ya da "Kısmen" olarak işaretleyiniz. Cevabınızı neye göre verdiğinizi aşağıdaki ilgili alana açıkça yazınız.**
1.	Derse öğrencinin dikkati çekildi mi?	□	□	□	
2.	Derse ilgi sürekli sağlanabildi mi?	□	□	□	
3.	Ders iyi planlandı mı?	□	□	□	
4.	Öğrenciler derse karşı istekli miydi?	□	□	□	
5.	Sınıftaki koşullar (sıcaklık, aydınlanma, öğrenci sayısı, sıra sayısı, vb.) dersin işlenmesi için uygun muydu?	□	□	□	

APPENDIX H

OBSERVATION FORM (2013 FALL TERM ISOP UNIT)

GÖZLEM FORMU

Bu form, 9. sınıf "Fizik Bilimine Giriş" ünitesini anlatan öğretmenlerin bu ünite boyunca sınıf içi uygulamalarını gözlemlemek için hazırlanmıştır. Gözlem formunun temelini öğretim programındaki kazanımların ne ölçüde sunulduğu ve öğretmen tarafından sınıf ortamına nasıl aktarıldığı oluşturmaktadır. İki bölümden meydana gelen gözlem formunda, I. Bölüm'de derste kazanımların nasıl sunulduğu, kullanılan öğretim strateji,yöntem-teknikleri, materyal-teknolojiler ile ölçme-değerlendirme boyutları yer almaktadır. II Bölüm ise ders ile ilgili gözlemlenebilecek genel unsurları kapsamaktadır.

YÖNERGE

- Mevcut program olan "Fizik Bilimine Giriş" ünitesindeki kazanımların uygun yerlerine bir önceki programdaki "Fiziğin Doğası" ünitesi kazanımları yedirilmiştir.
- Mevcut programdaki ana kazanım birden fazla kazanım ifadesi içeriyorsa geçen seneki program ile kolay karşılaştırma imkanı olması açısından belli bölümlere ayrılarak her bir kazanım ifadesi için ayrı ayrı gözlem formları hazırlanmıştır. Mevcut programın ilgili bölümleri ile uyuşan eski programdaki kazanımlar *italik* yazı tipi kullanılarak forma eklenmiştir. Bölümlere ayrılan kazanımlarda hangi kısım için gözlem yapılıyorsa ilgili kısım * sembolü ile belirtilmiştir. Derste sunulan kazanımı tespit ettikten sonra ilgili forma gözlemlerinizi yazınız.
- Her bir formda, kazanımlar ve kodları gözlem tablolarını doldurmadan önce verilmiştir. Gözlem tablolarında ise kazanımların kodları kullanılmıştır. İlgili yerde işaretlediğiniz kod veya kodlara göre, söz konusu kazanım/kazanımlar için değerlendirme yaptığınız anlaşılacaktır.
- Bazı tablolarda verilen "Değerlendirme" sütununa ise;

  3= İyi: Tam uygulandı
  2= Orta: Eksik uygulandı
  1= Zayıf: Çok eksik uygulandı
  0= İlgisiz

  şeklinde verilen derecelendirmelerden uygun olanı seçip ilgili rakamı yazınız.

Öğretmenin adı, soyadı:		**Tarih:**	**………. / ………. / ……….**
Okul:		**Saat:**	**Başlama: ……………. Bitiş: ……………….**
Sınıf:		**Ders zamanında başladı mı?:**	**□ Evet □ Hayır**
Öğrenci sayısı:		**Gözlemcinin adı, soyadı:**	

Kodlar	**Kazanımlar**
9.1.1.1.	Fizik biliminin amacının farkında olur * *(1.1)* ve fiziği diğer disiplinlerle ve teknoloji ile ilişkilendirir.
a. **K 1.1**	Öğrencilerin "Fizik nedir?", "Neden ve niçin fizik öğrenmeliyim?' sorularına cevap aramaları sağlanır. *(1.1) (FTTÇ-1a,b,c,d) (BİB-1a,b,c,d) (4.2) (FTTÇ-1.p)* *'Fizik nedir?' sorusuna cevap arar (FTTÇ-1.a,b,c,d; BİB-1.a-d).*
FTTÇ-1.a.	*Fiziği tanımlar ve evrendeki olayları anlamaya yardımcı temel bilimlerden biri olduğunu kavrar.*
FTTÇ-1.b.	*Fizik biliminin sınanabilir, sorgulanabilir, doğrulanabilir, yanlışlanabilir ve delillere dayandırılabilir bir yapısı olduğunu anlar.*
FTTÇ-1.c.	*Fizik bilimindeki bilgilerin ivmeli bir şekilde arttığını fark eder.*
FTTÇ-1.d.	*Fizik bilimindeki bilimsel bir bilginin her zaman mutlak doğru olmadığının, belli şartlar ve sınırlılıklar içinde geçerli olduğunun farkına varır.*
BİB-1.a.	*Farklı bilgi kaynaklarını kullanır.*
BİB-1.b.	*Bilgi kaynaklarının güvenilir ve geçerli olup olmadığını kontrol eder.*
BİB-1.c.	*Çoklu arama kriterleri kullanır.*
BİB-1.d.	*Amacına uygun bilgiyi arar, bulur ve seçer.*
K 4.2	*Vücudumuzun çalışmasında, yakın çevremizde ve yaşantımızda önemli yer tutan fizik ilke ve yasalarını örneklerle fark eder (FTTÇ-1.p; TD-2.c).* *4.2 9. Sınıf, Enerji Ünitesi (Açıklama-ders içi ilişkilendirme)*
FTTÇ-1.p.	*Bilimsel ve teknolojik uygulamalar açısından fiziğin diğer bilim dallarıyla bağlantısını kurar.*

***:** Fizik biliminin amacının farkında olur * *(1.1)*

I. BÖLÜM

Gözlem Tablosu 1 (Kazanımlar, bilgi/beceri)

Kazanımın sunuluş şekilleri	**Kazanımlar**									**AÇIKLAMALAR** (Sunuluş şekilleri ile eşleştirdiğiniz kazanımları dikkate alarak, neden böyle bir seçim yaptığınızı kazanım numaralarını da belirterek aşağıda verilen boş alanlara yazınız. Her bir sunuluş şekli için birden fazla kazanım seçebilirsiniz.)
Tam sunuldu	**K**	**FTTÇ-1**				**BİB-1**				
	a. 1.1	a	b	c	d	a	b	c	d	
Eksik sunuldu	**K**	**FTTÇ-1**				**BİB-1**				
	a. 1.1	a	b	c	d	a	b	c	d	
Hatalı sunuldu	**K**	**FTTÇ-1**				**BİB-1**				
	a. 1.1	a	b	c	d	a	b	c	d	
Sınırlarından fazla sunuldu	**K**	**FTTÇ-1**				**BİB-1**				
	a. 1.1	a	b	c	d	a	b	c	d	
Hiç sunulmadı	**K**	**FTTÇ-1**				**BİB-1**				
	a. 1.1	a	b	c	d	a	b	c	d	
Kazanım ifadeleri verildi	**K**	**FTTÇ-1**				**BİB-1**				
	a. 1.1	a	b	c	d	a	b	c	d	
Günlük hayatla ilişkilendirildi	**K**	**FTTÇ-1**				**BİB-1**				
	a. 1.1	a	b	c	d	a	b	c	d	
Kavram yanılgıları var ise vurgulandı	**K**	**FTTÇ-1**				**BİB-1**				
	a. 1.1	a	b	c	d	a	b	c	d	

Gözlem Tablosu 1 (Kazanımlar, bilgi/beceri)

Kazanımın sunuluş şekilleri	Kazanımlar		AÇIKLAMALAR (Sunuluş şekilleri ile eşleştirdiğiniz kazanımları dikkate alarak, neden böyle bir seçim yaptığınızı kazanım numaralarını da belirterek aşağıda verilen boş alanlara yazınız. Her bir sunuluş şekli için birden fazla kazanım seçebilirsiniz.)
Tam sunuldu	K	FTTÇ-1	
	4.2	p	
Eksik sunuldu	K	FTTÇ-1	
	4.2	p	
Hatalı sunuldu	K	FTTÇ-1	
	4.2	p	
Sınırlarından fazla sunuldu	K	FTTÇ-1	
	4.2	p	
Hiç sunulmadı	K	FTTÇ-1	
	4.2	p	
Kazanım ifadeleri verildi	K	FTTÇ-1	
	4.2	p	
Günlük hayatla ilişkilendirildi	K	FTTÇ-1	
	4.2	p	
Kavram yanılgıları var ise vurgulandı	K	FTTÇ-1	
	4.2	p	

Gözlem Tablosu 2 (Öğretim strateji, yöntem-teknikler)

Kullanılan strateji, yöntem-teknikler	Kazanımlar					Değerlendirme				AÇIKLAMALAR (Kullanılan strateji, yöntem-teknikleri için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir strateji, yöntem-teknik için birden fazla kazanım seçebilirsiniz.)
1.	K	a. 1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
2.	K	a. 1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
3.	K	a. 1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
4.	K	a. 1.1								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					

Gözlem Tablosu 2 (Öğretim strateji, yöntem-teknikler)

Kullanılan strateji, yöntem ve teknikler	Kazanımlar		Değerlendirme	AÇIKLAMALAR (Kullanılan strateji, yöntem-teknikleri için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir strateji, yöntem-teknik için birden fazla kazanım seçebilirsiniz.)
1.	K	4.2		
	FTTÇ-1	p		
2.	K	4.2		
	FTTÇ-1	p		
3.	K	4.2		
	FTTÇ-1	p		
4.	K	4.2		
	FTTÇ-1	p		

Gözlem Tablosu 3 (Materyal-teknoloji)

Kullanılan materyal-teknoloji	Kazanımlar					Değerlendirme				AÇIKLAMALAR (Kullanılan materyal–teknoloji için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir materyal-teknoloji için birden fazla kazanım seçebilirsiniz.)
1.	K	a. [.]								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
2.	K	a. [.]								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
3.	K	a. [.]								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					
4.	K	a. [.]								
	FTTÇ-1	a	b	c	d					
	BİB-1	a	b	c	d					

Gözlem Tablosu 3 (Materyal-teknoloji)

Kullanılan materyal-teknoloji	Kazanımlar		Değerlendirme	AÇIKLAMALAR (Kullanılan materyal–teknoloji için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir materyal-teknoloji için birden fazla kazanım seçebilirsiniz.)
1.	K	4.2		
	FTTÇ-1	p		
2.	K	4.2		
	FTTÇ-1	p		
3.	K	4.2		
	FTTÇ-1	p		
4.	K	4.2		
	FTTÇ-1	p		

Gözlem Tablosu 4 (Ölçme–Değerlendirme)

Kullanılan ölçme–değerlendirme	Kazanımlar					Değerlendirme				Amacı a) Gruplama b) Diagnostik c) Formatif d) Summatif				AÇIKLAMALAR (Kullanılan ölçme-değerlendirme tekniği için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir ölçme-değerlendirme tekniği için birden fazla kazanım seçebilirsiniz. "Amacı" sütununu doldururken de uygun ifadenin önünde bulunan harfi kodlayınız. Birden fazla harf kodlayabilirsiniz.)
1.	K	a. 1.1												
	FTTÇ-1	a	b	c	d									
	BİB-1	a	b	c	d									
2.	K	a. 1.1												
	FTTÇ-1	a	b	c	d									
	BİB-1	a	b	c	d									
3.	K	a. 1.1												
	FTTÇ-1	a	b	c	d									
	BİB-1	a	b	c	d									
4.	K	a. 1.1												
	FTTÇ-1	a	b	c	d									
	BİB-1	a	b	c	d									

Gözlem Tablosu 4 (Ölçme-Değerlendirme)

Kullanılan ölçme-değerlendirme	Kazanımlar		Değerlendirme	Amacı a) Gruplama b) Diagnostik c) Formatif d) Summatif	AÇIKLAMALAR (Kullanılan ölçme-değerlendirme tekniği için değerlendirme bölümüne verdiğiniz puanı neden verdiğinizi aşağıdaki ilgili alanlara yazınız. Her bir ölçme-değerlendirme tekniği için birden fazla kazanım seçebilirsiniz. "Amacı" sütununu doldururken de uygun ifadenin önünde bulunan harfi kodlayınız. Birden fazla harf kodlayabilirsiniz.)
1.	K	4.2			
	FTTÇ-1	p			
2.	K	4.2			
	FTTÇ-1	p			
3.	K	4.2			
	FTTÇ-1	p			
4.	K	4.2			
	FTTÇ-1	p			

II. BÖLÜM

		Evet	Hayır	Kısmen	**AÇIKLAMALAR** **(Verilen her bir soru için cevabınızı "Evet", "Hayır" ya da "Kısmen" olarak işaretleyiniz. Cevabınızı neye göre verdiğinizi aşağıdaki ilgili alana açıkça yazınız.**
1.	Derse öğrencinin dikkati çekildi mi?	□	□	□	
2.	Derse ilgi sürekli sağlanabildi mi?	□	□	□	
3.	Ders iyi planlandı mı?	□	□	□	
4.	Öğrenciler derse karşı istekli miydi?	□	□	□	
5.	Sınıftaki koşullar (sıcaklık, aydınlanma, öğrenci sayısı, sıra sayısı, vb.) dersin işlenmesi için uygun muydu?	□	□	□	

APPENDIX I

THE FIRST VERSION OF STUDENT GROUP INTERVIEW PROTOCOL

Ders Değerlendirme Öğrenci Görüşme Formu

Sınıf: .... Öğretmen: ....

Tarih: .... Başlangıç ve bitiş zamanı: ....

Öğrencilerle yapılacak olan görüşmelerin iki temel amacı vardır. Bunlardan birincisi, öğretmenlerin sınıf içi uygulamalarının kendi öğrencileri tarafından değerlendirilmesini tespit etmektir. Buradan elde edilen bulgular, öğretmenin fiziğin doğası ünitesi boyunca gözlemlenmesinde ortaya çıkan sonuçlara katkı sağlayacaktır. İkinci amaç ise, öğretmenlere verilecek hizmet-içi eğitimi için yapılan ihtiyaç analizine öğrenci boyutundan destek sağlamaktır.

Görüşmeler, odak grup görüşmesi olarak öğretmenin bir sınıfı ile toplu halde yürütülecektir. Yarı yapılandırılmış sorulardan oluşan öğrenci görüşme formu iki bölümden meydana gelmektedir. İlk bölüm öğretmenlere uygulanan görüş anketinden gelen öneriler doğrultusunda eğitimde verilmesi istenilen 9. sınıf fiziğin doğası ünitesindeki konular ile bu konular öğretilirken; kullanılan öğretim strateji, yöntem ve teknikleri, materyaller ve teknolojik araç-gereçler ile öğretmen tarafından bu ünitede kapsamında kullanılan ölçme-değerlendirme yaklaşımları ile ilgili soruları içermektedir. İkinci bölümde ise yapılacak hizmet içi eğitimin içeriğinin belirlenmesine katkı sağlayacağı düşünülen genel sorular bulunmaktadır.

1. BÖLÜM

- **<u>Fiziğin doğası ünitesindeki konular</u>**

Öğretmeniniz bu ünitede her dersin başında ne öğreneceğiniz hakkında sizi bilgilendirdi mi? (frekans al)

Genel olarak bu ünitedeki konuları öğrendiğinizi düşünüyor musunuz? (frekans al)

Öğrenemediğiniz konular olduysa bunlar nelerdi? (her konu için ayrı ayrı frekans al)

(Sonda:
Fiziğin tanımı
Fiziğin alt alanları
Fiziğin diğer bilim dallarıyla ilişkisi
Gözlem (nitel-nicel) ve deney yapmanın önemi
Fizikteki temel büyüklükler ve birimleri
Birimlerin dönüştürülmesi
Ölçmede hata ve kaynakları
Skaler ve vektörel büyüklükler
Bilimsel yöntem ve basamakları

Hipotezin tanımı
Teorinin tanımı
Yasanın tanımı
Modelleme
Fizikte matematiğin kullanımı
Fizik ve teknoloji arasındaki ilişki
Fizik ilke ve yasalarının vücudumuzun çalışmasında ve çevremizdeki önemi (tahtaya yaz)

Bu konuları (tahtaya yazılan) öğrenememenizin başlıca nedenleri nelerdi?

- **<u>Öğretim strateji, yöntem ve teknikleri</u>**

Dersler işlenirken sizler sadece dinlediniz mi, yoksa derse aktif olarak katıldınız mı? (frekans al)

(Alternatif: Karşılıklı iletişim içinde mi dersleriniz yapıldı?)

Katıldıysanız öğretmeniniz sizi derse katmak için neler yaptı? (tahtaya yazdır)

(Sonda: Soru sorma, grup çalışması yapma, proje, poster hazırlama, deney yapma, etkinlikler yapma, oyun oynama, bilim insanlarından örnekler verme vb.) (frekans al)

Bu sayılanlar dışında sizin eklemek istediğiniz şeyler var mı?

Derste yaptığınızı söylediğiniz bu aktivitelerden memnun kaldınız mı? (frekans al)

(Alternatif: Hoşunuza gitti mi? İlgi çekici geldi mi?)

Bu yaptığınızı söylediğiniz aktiviteleri ünitedeki hangi konu veya konuları öğrenirken yaptınız? (tahtaya yazılanların yanına söylenilen konuları yaz)

Yapılan bu aktivitelerin konuları anlamanıza yardımı olduğunu düşünüyor musunuz? (frekans al)

Fiziğin doğası ünitesinin bu şekilde aktiviteler kullanılarak işlenmesini ister misiniz? (frekans al)

Fiziğin doğası ünitesindeki hangi konularda başka ne tür aktiviteler yapılmasını istersiniz?

- **<u>Materyaller, Teknolojik araç-gereçler</u>**

Bu ünite anlatılırken herhangi bir araç-gereç (materyal) kullanıldı mı? (frekans al) Neler kullanıldı?

(Sonda: Modeller, çalışma kağıtları, kaynak kitaplar vb.)

Bu sayılanlar dışında kullanılan araç-gereçler (materyaller) var mı?

Bu söylediğiniz araç-gereçler (materyaller) bu ünitedeki hangi konu veya konuları öğrenirken kullanıldı? (tahtaya yazılanların yanına söylenilen konuları yaz)

Derste kullanılan bu araç-gereçlerden (materyallerden) memnun kaldınız mı? (frekans al)

(Alternatif: Hoşunuza gitti mi? İlgi çekici geldi mi?)

Bu araç-gereçlerin (materyallerin) kullanılmasının konuları anlamanıza yardımı olduğunu düşünüyor musunuz? (frekans al)

Fiziğin doğası ünitesinin bu şekilde işlenmesini ister misiniz? (frekans al)

Fiziğin doğası ünitesindeki hangi konularda başka ne tür araç-gereçler kullanılmasını istersiniz?

Bu ünite anlatılırken herhangi bir teknolojik araç-gereç kullanıldı mı? (frekans al) Neler kullanıldı?

(Sonda: akıllı tahta, video, power point sunuları, simülasyon, vb.)

Bu sayılanlar dışında kullanılan başka teknolojik araç-gereçler var mı?

Bu söylediğiniz teknolojik araç-gereçler bu ünitedeki hangi konu veya konuları öğrenirken kullanıldı? (tahtaya yazılanların yanına söylenilen konuları yaz)

Derste kullanılan bu teknolojik araç-gereçlerden memnun kaldınız mı? (frekans al)

(Alternatif: Hoşunuza gitti mi? İlgi çekici geldi mi?)

Bu teknolojik araç-gereçlerin kullanılmasının konuları anlamanıza yardımı olduğunu düşünüyor musunuz? (frekans al)

Fiziğin doğası ünitesinin bu şekilde işlenmesini ister misiniz? (frekans al)

Fiziğin doğası ünitesindeki hangi konularda başka ne tür teknolojik araç-gereçler kullanılmasını istersiniz?

- **Ölçme-değerlendirme**

Öğretmeniniz sizin bilgi ve beceri düzeyinizi belirlemek için bu ünite başlamadan önce herhangi bir değerlendirme yaptı mı? Bu değerlendirme sonucuna göre sizi sınıflandırdı veya sıraladı mı? (frekans al) Ne yaptı? (placement)

(Sonda: Yetenek testi, seviye tespit sınavı, temel matematik işlem becerisi, ölçme becerisi, gözlem, vb.)

Öğretmeniniz derste ünite ile ilgili sizin zorlandığınız konuları ortaya çıkarmaya ve sizi tanımaya yönelik bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (diagnostic)

(Sonda: Kavram yanılgısı testi, yazılı, sözlü, gözlem, vb.)

Öğretmeniniz ünite süresince sizi izleyerek, öğrenme eksiklikleriniz ve zorluklarınız doğrultusunda sizi değerlendirip öneriler verdi mi? (frekans al) Ne yaptı? (formative)

(Sonda: quizler, deneme testleri, ödev, soru-cevap, kısa / uzun cevaplı yazılı, sözlü, vb.)

Öğretmeniniz sizi değerlendirdikten sonra ünitedeki bazı konulara tekrar geri döndü mü? (frekans al)

Öğretmeniniz ünite sonunda sizin başarınızı belirleyip not verme amaçlı olarak değerlendirme yaptı mı? (frekans al) Ne yaptı? (summative)

(Sonda: başarı testi, yazılı sınav, performans, ürün seçki dosyası-(portfolyo), kavram haritaları, yapılandırılmış grid, tanılayıcı dallanmış ağaç, proje, drama, poster, grup değerlendirmesi, bireysel değerlendirme, sözlü, vb.)

Öğretmeninizin sizi değerlendirmede kullandığı soru türleri nelerdi?

(Sonda: çoktan seçmeli, doğru-yanlış, eşleştirme, boşluk doldurma, açık uçlu sorular, vb.)

Bahsedilenler dışında ölçme ve değerlendirme ile ilgili olarak eklemek istediğiniz bir şey var mı?

Fiziğin doğası ünitesinde kullanılan bu ölçme ve değerlendirme yöntemlerinden memnun kaldınız mı? (frekans al)

(Alternatif: Hoşunuza gitti mi?)

Fiziğin doğası ünitesinde nasıl değerlendirilmek isterdiniz?

2. BÖLÜM

- **<u>Genel değerlendirme</u>**

Fiziğin doğası ünitesini öğrenmek sizce önemli midir? (frekans al) Neden?

Bu üniteyi bilmenizin size ne tür katkılar sağlayacağını düşünüyorsunuz?

Dersin sizin öğrenmenizi ciddi olarak etkileyen olumlu ve olumsuz yönleri nelerdi? Neden?

(Olumlu yönler, olumsuz yönler)(tahtaya yazdır)

Fiziğin doğası ünitesinin daha iyi öğretilmesi için önerileriniz neler olabilir?

APPENDIX J

THE ANALYSIS OF THE EXPERT OPINION FOR STUDENT GROUP INTERVIEW PROTOCOL

DERS DEĞERLENDİRME ÖĞRENCİ GÖRÜŞME FORMU UZMAN GÖRÜŞLERİ ANALİZİ

- Giriş bölümünde formada yer alan 4 farklı boyutun nereden geldiği açıklanmıştır.
- Cümlelerde bazı düzenleme ve düzeltmeler yapılmıştır.
- Materyal ve teknolojik araç-gereçler hakkındaki sorular birleştirilerek, tek bir bölümde, "materyal, teknolojik araç-gereçler" olarak sorulmuştur.

APPENDIX K

STUDENT GROUP INTERVIEW PROTOCOL

(2013 VERSION)

Ders Değerlendirme Odak Grup Öğrenci Görüşme Formu

Sınıf: .... Öğretmen: ....
Tarih: .... Başlangıç ve bitiş zamanı: ....

Yarı yapılandırılmış sorulardan oluşan öğrenci görüşme formu iki bölümden meydana gelmektedir. İlk bölüm 4 boyuttan oluşmaktadır. Bu boyutlar daha önce öğretmenlere uygulanan görüş anketinden elde edilen sonuçlar neticesinde ortaya çıkan ve yapılacak olan eğitimin içeriğinde olması istenilen eğitimin konularıdır. Bunlar:

1. 9. sınıf fizik bilimine giriş ünitesindeki konular (kazanımlar, bilgi/beceri)
2. Öğretim yöntem/teknikleri (etkinlik, aktiviteler)
3. Teknoloji/materyal
4. Ölçme/değerlendirme yaklaşımlarıdır.

İkinci bölümde ise, yapılacak hizmet içi eğitimin içeriğinin belirlenmesine katkı sağlayacağı düşünülen yukarıdaki 4 boyutun dışında genel sorular bulunmaktadır.
Sorulacak sorularla; öğretmenlerin gözlemlenmesi neticesinde sınıflarında nelerin nasıl ve ne sıklıkta yapıldığı, nelere ihtiyacın olduğu, ortaya çıkan sorunlar ve bu sorunlara olası çözümlerin öğrencileri tarafından belirlenmesi hedeflenmiştir. Görüşmeler, odak grup görüşmesi olarak öğretmenin bir sınıfı ile toplu halde yürütülecektir.

1. BÖLÜM

- **Fizik bilimine giriş ünitesindeki konular**

Öğretmeniniz bu ünitede her dersin başında ne öğreneceğiniz hakkında sizi bilgilendirdi mi? (frekans al)

Genel olarak bu ünitedeki konuları öğrendiğinizi düşünüyor musunuz? (frekans al)

Öğrenemediğiniz konular olduysa bunlar nelerdi? (frekans al)

(Sonda: (tahtaya yaz)

Fiziğin neden ve niçin öğrenildiği
Fiziğin tanımı
Fizik ilke ve yasalarının vücudumuzun çalışmasında ve çevremizdeki önemi
Fiziğin diğer disiplinlerle (bilim dallarıyla) ilişkisi
Fiziğin alt alanları
Fizik biliminin tarih boyunca gelişimi ile ilgili örnekler
Fizikte meydana gelen gelişmelere öncülük eden kişi ve olaylar

Fizik ve teknoloji arasındaki ilişki
Tarih boyunca teknoloji ve fizik biliminde meydana gelen gelişmelere öncülük eden kişi ve olaylar
Farklı meslek dallarında fizik biliminin rolü
Bilimsel bilginin ortaya çıkışında ve gelişiminde:
Gözlemin (nitel-nicel)
Deney
Matematik
Rasyonel düşüncenin rolü
Bilimsel yöntem ve basamakları
Hipotezin tanımı
Teorinin tanımı
Yasanın tanımı
Delil ve çıkarım arasındaki ilişki
Fizikte modelleme kullanımı
Fizikte matematiğin kullanımı
Ölçüm yapmanın gerekliliği
Birim sistemi kullanılma gerekliliği (temel birimleri ortaya çıkaran ihtiyaç)
Fizikteki temel büyüklükler, bunların ölçülmesi ve birimleri
Birimlerin dönüştürülmesi
Ölçmede hata ve kaynakları
Skaler ve vektörel büyüklükler

Bu konuları (tahtaya yazılan) öğrenememenizin başlıca nedenleri neler olabilir?

- **Öğretim strateji, yöntem ve teknikleri**

Dersler işlenirken sizler sadece dinlediniz mi, yoksa derse aktif olarak katıldınız mı? (frekans al)

(Alternatif: Karşılıklı iletişim içinde mi dersleriniz yapıldı?)

Derse aktif olarak katıldıysanız öğretmeniniz bu katılımı sağlamak için ne tür uygulamalar yaptı?) (tahtaya yazdır)

(Sonda: Soru sorma, grup çalışması yapma, proje, poster hazırlama, deney yapma, etkinlikler yapma, oyun oynama, bilim insanlarından örnekler verme vb.) (frekans al)

Bu sayılanlar dışında sizin eklemek istediğiniz şeyler var mı?

Derste yaptığınızı söylediğiniz bu aktivitelerden memnun kaldınız mı? (frekans al)

(Alternatif: Hoşunuza gitti mi? İlgi çekici geldi mi?)

Bu yaptığınızı söylediğiniz aktiviteleri ünitedeki hangi konu veya konuları öğrenirken yaptınız? (tahtaya yazılanların yanına söylenilen konuları yaz)

Yapılan bu aktivitelerin konuları anlamanıza yardımı olduğunu düşünüyor musunuz? (frekans al)

Fizik bilimine giriş ünitesinin bu şekilde aktiviteler kullanılarak işlenmesini ister misiniz? (frekans al)

Fizik bilimine giriş ünitesindeki hangi konularda başka ne tür aktiviteler yapılmasını istersiniz?

- **Materyaller, Teknolojik araç-gereçler**

Bu ünite anlatılırken herhangi bir materyal, teknolojik araç-gereç kullanıldı mı? (frekans al) Neler kullanıldı?

(Sonda: Modeller, çalışma kağıtları, kaynak kitaplar, akıllı tahta, video, power point sunuları, simülasyon, vb.)

Bu sayılanlar dışında kullanılan materyal, teknolojik araç-gereç var mı?

Bu söylediğiniz materyal, teknolojik araç-gereçler bu ünitedeki hangi konu veya konuları öğrenirken kullanıldı? (tahtaya yazılanların yanına söylenilen konuları yaz)

Derste kullanılan bu materyal, teknolojik araç-gereçlerden memnun kaldınız mı? (frekans al)

(Alternatif: Bu araç-gereçlerin kullanılmasının konuları anlamanıza yardımı olduğunu düşünüyor musunuz?) (frekans al)

Fizik bilimine giriş ünitesinin bu şekilde işlenmesini ister misiniz? (frekans al)

Fizik bilimine giriş ünitesindeki hangi konularda başka ne tür materyal, teknolojik araç-gereçler kullanılmasını istersiniz?

- **Ölçme-değerlendirme**

Öğretmeniniz sizin ön bilgilerinizi ölçmek için herhangi bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (placement)

(Sonda: Yetenek testi, seviye tespit sınavı, temel matematik işlem becerisi, ölçme becerisi, vb.)

Öğretmeniniz bu üniteyi işlerken sizin zorlandığınız konuları ortaya çıkarmaya yönelik bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (diagnostic)

(Sonda: Kavram yanılgısı testi, sözlü, vb.)

Öğretmeniniz ünite süresince neyi öğrendiğinizi ve/veya öğrenemediğinizi ölçmeye yönelik bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (formative)

(Sonda: quizler, deneme testleri, ödev, soru-cevap, kısa / uzun cevaplı yazılı, sözlü, vb.)

Öğretmeniniz sizi değerlendirdikten sonra ünitedeki belli konuları anlamadığınızı görüp bu konulara tekrar geri döndü mü? (frekans al)

Öğretmeniniz fizik bilimine giriş ünitesi ile ilgili soruların sorulduğu not verme amaçlı bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (summative)

(Sonda: başarı testi, yazılı sınav, performans, ürün seçki dosyası-(portfolyo), kavram haritaları, yapılandırılmış grid, tanılayıcı dallanmış ağaç, proje, drama, poster, grup değerlendirmesi, bireysel değerlendirme, sözlü, vb.)

Sizi değerlendirmede kullandığı soru türleri nelerdi?

(Sonda: çoktan seçmeli, doğru-yanlış, eşleştirme, boşluk doldurma, açık uçlu sorular, vb.)

Öğretmeniniz sizi daha önce alışık olmadığınız bir şekilde değerlendirdi mi? (frekans al) Nasıl?

Öğretmeniniz bu ünitede verdiği ödevleri sadece yapıp yapmadığınıza bakıp değerlendirmenin dışında bunları nasıl yaptığınıza da bakarak sizi değerlendirdi mi?

Bahsedilenler dışında ölçme ve değerlendirme ile ilgili olarak eklemek istediğiniz bir şey var mı?

Fizik bilimine giriş ünitesinde kullanılan bu ölçme ve değerlendirme yöntemlerinden memnun kaldınız mı? (frekans al)

(Alternatif: Hoşunuza gitti mi?)

Fizik bilimine giriş ünitesinde nasıl değerlendirilmek isterdiniz?

2. BÖLÜM

- **Genel değerlendirme**

Fizik bilimine giriş ünitesini öğrenmek sizce önemli midir? (frekans al) Neden?

Bu üniteyi öğrenmenizin size ne tür katkılar sağlayacağını düşünüyorsunuz?

Fizik bilimine giriş ünitesi anlatılırken öğrenmenizi ciddi olarak etkileyen olumlu ve olumsuz yönler nelerdi? Neden?

(Olumlu yönler, olumsuz yönler)

Fizik bilimine giriş ünitesinin daha iyi öğretilmesi için önerileriniz neler olabilir?

APPENDIX L

STUDENT GROUP INTERVIEW PROTOCOL

(2012 VERSION)

Ders Değerlendirme Öğrenci Görüşme Formu

Sınıf: ....   Öğretmen: ....

Tarih: ....   Başlangıç ve bitiş zamanı: ....

Yarı yapılandırılmış sorulardan oluşan öğrenci görüşme formu iki bölümden meydana gelmektedir. İlk bölüm 4 boyuttan oluşmaktadır. Bu boyutlar daha önce öğretmenlere uygulanan görüş anketinden elde edilen sonuçlar neticesinde ortaya çıkan ve yapılacak olan eğitimin içeriğinde olması istenilen eğitimin konularıdır. Bunlar:

1. 9. sınıf fiziğin doğası ünitesindeki konular
2. Öğretim strateji, yöntem ve teknikleri
3. Materyaller-teknolojik araç ve gereçler ile
4. Ölçme-değerlendirme yaklaşımlarıdır.

İkinci bölümde ise, yapılacak hizmet içi eğitimin içeriğinin belirlenmesine katkı sağlayacağı düşünülen yukarıdaki 4 boyutun dışında genel sorular bulunmaktadır.

Sorulacak sorularla; öğretmenlerin gözlemlenmesi neticesinde sınıflarında nelerin nasıl ve ne sıklıkta yapıldığı, nelere ihtiyacın olduğu, ortaya çıkan sorunlar ve bu sorunlara olası çözümlerin öğrencileri tarafından belirlenmesi hedeflenmiştir. Görüşmeler, odak grup görüşmesi olarak öğretmenin bir sınıfı ile toplu halde yürütülecektir.

1. BÖLÜM

- **<u>Fiziğin doğası ünitesindeki konular</u>**

Öğretmeniniz bu ünitede her dersin başında ne öğreneceğiniz hakkında sizi bilgilendirdi mi? (frekans al)

Genel olarak bu ünitedeki konuları öğrendiğinizi düşünüyor musunuz? (frekans al)

Öğrenemediğiniz konular olduysa bunlar nelerdi? (frekans al)

(Sonda:
Fiziğin tanımı
Fiziğin alt alanları
Fiziğin diğer bilim dallarıyla ilişkisi
Gözlem (nitel-nicel) ve deney yapmanın önemi
Fizikteki temel büyüklükler, bunların ölçülmesi ve birimleri
Birimlerin dönüştürülmesi
Ölçmede hata ve kaynakları
Skaler ve vektörel büyüklükler

Bilimsel yöntem ve basamakları
Hipotezin tanımı
Teorinin tanımı
Yasanın tanımı
Modelleme
Fizikte matematiğin kullanımı
Fizik ve teknoloji arasındaki ilişki
Fizik ilke ve yasalarının vücudumuzun çalışmasında ve çevremizdeki önemi (tahtaya yaz)

Bu konuları (tahtaya yazılan) öğrenememenizin başlıca nedenleri neler olabilir?

- **Öğretim strateji, yöntem ve teknikleri**

Dersler işlenirken sizler sadece dinlediniz mi, yoksa derse aktif olarak katıldınız mı? (frekans al)

(Alternatif: Karşılıklı iletişim içinde mi dersleriniz yapıldı?)

Derse aktif olarak katıldıysanız öğretmeniniz bu katılımı sağlamak için ne tür uygulamalar yaptı?) (tahtaya yazdır)

(Sonda: Soru sorma, grup çalışması yapma, proje, poster hazırlama, deney yapma, etkinlikler yapma, oyun oynama, bilim insanlarından örnekler verme vb.) (frekans al)

Bu sayılanlar dışında sizin eklemek istediğiniz şeyler var mı?

Derste yaptığınızı söylediğiniz bu aktivitelerden memnun kaldınız mı? (frekans al)

(Alternatif: Hoşunuza gitti mi? İlgi çekici geldi mi?)

Bu yaptığınızı söylediğiniz aktiviteleri ünitedeki hangi konu veya konuları öğrenirken yaptınız? (tahtaya yazılanların yanına söylenilen konuları yaz)

Yapılan bu aktivitelerin konuları anlamanıza yardımı olduğunu düşünüyor musunuz? (frekans al)

Fiziğin doğası ünitesinin bu şekilde aktiviteler kullanılarak işlenmesini ister misiniz? (frekans al)

Fiziğin doğası ünitesindeki hangi konularda başka ne tür aktiviteler yapılmasını istersiniz?

- **Materyaller, Teknolojik araç-gereçler**

Bu ünite anlatılırken herhangi bir materyal, teknolojik araç-gereç kullanıldı mı? (frekans al) Neler kullanıldı?

(Sonda: Modeller, çalışma kağıtları, kaynak kitaplar, akıllı tahta, video, power point sunuları, simülasyon, vb.)

Bu sayılanlar dışında kullanılan materyal, teknolojik araç-gereç var mı?

Bu söylediğiniz materyal, teknolojik araç-gereçler bu ünitedeki hangi konu veya konuları öğrenirken kullanıldı? (tahtaya yazılanların yanına söylenilen konuları yaz)

Derste kullanılan bu materyal, teknolojik araç-gereçlerden memnun kaldınız mı? (frekans al)

(Alternatif: Bu araç-gereçlerin kullanılmasının konuları anlamanıza yardımı olduğunu düşünüyor musunuz?) (frekans al)

Fiziğin doğası ünitesinin bu şekilde işlenmesini ister misiniz? (frekans al)

Fiziğin doğası ünitesindeki hangi konularda başka ne tür materyal, teknolojik araç-gereçler kullanılmasını istersiniz?

- **Ölçme-değerlendirme**

Öğretmeniniz sizin ön bilgilerinizi ölçmek için herhangi bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (placement)

(Sonda: Yetenek testi, seviye tespit sınavı, temel matematik işlem becerisi, ölçme becerisi, vb.)

Öğretmeniniz bu üniteyi işlerken sizin zorlandığınız konuları ortaya çıkarmaya yönelik bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (diagnostic)

(Sonda: Kavram yanılgısı testi, sözlü, vb.)

Öğretmeniniz ünite süresince neyi öğrendiğinizi ve/veya öğrenemediğinizi ölçmeye yönelik bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (formative)

(Sonda: quizler, deneme testleri, ödev, soru-cevap, kısa / uzun cevaplı yazılı, sözlü, vb.)

Öğretmeniniz sizi değerlendirdikten sonra ünitedeki belli konuları anlamadığınızı görüp bu konulara tekrar geri döndü mü? (frekans al)

Öğretmeniniz fiziğin doğası ile ilgili soruların sorulduğu not verme amaçlı bir değerlendirme yaptı mı? (frekans al) Ne yaptı? (summative)

(Sonda: başarı testi, yazılı sınav, performans, ürün seçki dosyası-(portfolyo), kavram haritaları, yapılandırılmış grid, tanılayıcı dallanmış ağaç, proje, drama, poster, grup değerlendirmesi, bireysel değerlendirme, sözlü, vb.)

Sizi değerlendirmede kullandığı soru türleri nelerdi?

(Sonda: çoktan seçmeli, doğru-yanlış, eşleştirme, boşluk doldurma, açık uçlu sorular, vb.)

Öğretmeniniz sizi daha önce alışık olmadığınız bir şekilde değerlendirdi mi? (frekans al) Nasıl?

Öğretmeniniz bu ünitede verdiği ödevleri sadece yapıp yapmadığınıza bakıp değerlendirmenin dışında bunları nasıl yaptığınıza da bakarak sizi değerlendirdi mi?

Bahsedilenler dışında ölçme ve değerlendirme ile ilgili olarak eklemek istediğiniz bir şey var mı?

Fiziğin doğası ünitesinde kullanılan bu ölçme ve değerlendirme yöntemlerinden memnun kaldınız mı? (frekans al)

(Alternatif: Hoşunuza gitti mi?)

Fiziğin doğası ünitesinde nasıl değerlendirilmek isterdiniz?

2. BÖLÜM

- **Genel değerlendirme**

Fiziğin doğası ünitesini öğrenmek sizce önemli midir? (frekans al) Neden?

Bu üniteyi öğrenmenizin size ne tür katkılar sağlayacağını düşünüyorsunuz?

Fiziğin doğası ünitesi anlatılırken öğrenmenizi ciddi olarak etkileyen olumlu ve olumsuz yönler nelerdi? Neden?

(Olumlu yönler, olumsuz yönler)

Fiziğin doğası ünitesinin daha iyi öğretilmesi için önerileriniz neler olabilir?

APPENDIX M

TREATMENT FIDELITY EXPERT OPINION FORM

MESLEKİ GELİŞİM EĞİTİMİNDE YAPILACAKLARLA İLGİLİ UZMAN GÖRÜŞÜ

Değerli Uzman,

Hazırlanacak mesleki gelişim eğitimi (MG) için alan yazından, ihtiyaç analizi anketinden, eğitimden önceki öğretmen gözlemleri, öğrenci mülakat ve başarı testinden gelen sonuçlara göre oluşturulan karekteristikler aşağıdaki tabloda başlıklar halinde verilmiştir. Eğitimde olması düşünülen her bir karekteristiğin eğitime sistematik bir şekilde nasıl entegre edileceği ise altındaki açıklamada mevcuttur. Size göre:

Bu karekteristikler bir mesleki gelişim modeli oluşturmak için kullanılabilecek karekteristikler olabilir mi?
Bu karekteristikler altlarında verilen açıklamalar dikkate alındığında, mesleki gelişim programına uygun bir şekilde entegre edilmiş olur mu?

Bu soruları düşünerek aşağıdaki tabloyu doldurmanızı istemekteyiz. Ayrıca sizden gelecek öneriler doğrultusunda bundan sonra geliştirilecek eğitimlerin daha da zenginleştirilmesi hedeflenmektedir. Lütfen, ilgili sütunlardaki "Evet", "Hayır" veya "Kısmen" seçeneklerinden birini seçerek değerlendirmenizi yapınız. "Hayır" ya da "Kısmen" olarak belirttiğiniz veya ek açıklama yapma gereği duyduğunuz kısımlar için "Açıklamalar/Öneriler" bölümüne dönütlerinizi yazınız. Teşekkürler.

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Karekteristikler ve açıklamaları	Başlık olarak verilen bir MG karekteristiği olabilir mi?	Yapılan açıklamayla verilen karekteristik MG programına entegre edilmiş olur mu?	Açıklamalar/Öneriler
Öğretmenlerin ihtiyaçlarını dikkate alma Eğitim öncesi üniteye özel ihtiyaçlar (kazanım/ beceri, öğretim stratejisi (yöntem, metot, teknik, vb.), materyal/teknoloji ve ölçme değerlendirme konuları üzerine eğitim ihtiyacı), kişisel ve genel ihtiyaçlar (ulaşım, toplantı yeri, vb.), istek ve öneriler (kim tarafından verilmeli, rolünüz, ürünler, süre, dayanışma, değerlendirme, destek, vb.) belirlenecek. Öğretmenlerin önceki eğitimlerle ilgili tecrübeleri (eğitimlerin yılı, konusu, türü, verimliliği, yaşanan sorunlar, vb.) ortaya çıkarılacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	

Öğrencilerin ihtiyaçlarını dikkate alma Üniteye özel ihtiyaçlar (öğrenemedikleri konular, vb.) istek ve öneriler (derslerin nasıl işlenmesi, değerlendirilmesi, ne tür materyallerin kullanılması ile ilgili, vb.) öğrencilere sorularak belirlenecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Öğretmeni değişime ikna etme Her öğretmene sınıf gözlemleri, başarı testi, öğrenci mülakat sonuçları ve toplanan defterlerle ilgili raporlar delil olarak verilecek. Yapılan telefon görüşmeleriyle öğretmenlere ilk gözlemlere ait sonuçlar detaylıca açıklanacak. Kendi durumlarının farkına varmaları ve kanıtlar sunularak eğitime daha fazla motive olmaları sağlanacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
M.E.B desteği Öğretmenlere katılım için görevlendirme izni ve sertifika verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Uzman (akademisyen) / Öğretmen desteği			
a. Çalıştaylar İki alanında uzman, bir doktora yapan akademisyen (araştırmacı) tarafından öğretmenlerin ihtiyaç duyduğu konularda eğitim verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
b. Materyal/kaynak desteği Araştırmacı ve bazı öğretmenler tarafından etkili görülen somut materyaller (kaynak kitaplar, dergiler, laboratuvar araç-gereçleri, videolar, simülasyonlar, sunumlar, çalışma yaprakları, sınavlar, vb.) paylaşılacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
c. Kolay erişim imkanı Öğretmenler her an araştırmacıya ve birbirlerine (elektronik ortamlar, telefon, vb. aracılığıyla) soru sorup, materyal paylaşımı yapabilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Okul desteği			
a. Katılım kolaylığı Öğretmenlerin eğitime gelebilmeleri için gerekli düzenlemeler (toplantı ve nöbet günleri, sınav görevleri ayarlamaları, vb.) yapılacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
b. Araştırmacı için uygulama kolaylığı Veri toplamada araştırmacıya kolaylık (öğretmenlere 9. sınıf verilmesi, gözlem ve mülakatların rahat bir şekilde yapılması) sağlanacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Araştırmacı tarafından dönüt Araştırmacı tarafından süreç boyunca geliştirilen materyallere yazılı ve sözlü olarak dönüt verilecek. Her bir öğretmene ortalamada; yazılı olarak 14 mail, 10 facebook mesajı, 1 kez ders değerlendirme formu ile; sözlü olarak 5 kez yüz yüze, 8 defa telefonla görüşülerek dönüt sağlanacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Diğer öğretmenler tarafından dönüt Her bir öğretmene diğer öğretmenler tarafından yazılı olarak ders değerlendirme formu ile eğitimler esnasında sözlü olarak yüz yüze dönüt verilecek. Ayrıca facebook yolu ile de dönüt sağlanacak. Kendi aralarında bir araya gelen öğretmenlerin de birbirlerine geri bildirimleri olacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Öğretmenin kendisi tarafından dönüt Her bir öğretmen hazırladığı ders anlatımına 1 kez ders değerlendirme formu ile dönüt verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	

Uygulama fırsatı Her öğretmene hazırladığı 1 saatlik dersi, 1 kez araştırmacı ve diğer öğretmenlerin önünde sınıf ortamındaymış gibi anlatma fırsatı sağlanacak. Öğretmenler süreçte bazen birlikte, bazen de bireysel olarak çalışma yaprakları (bulmaca, birim tablosu, vb. hazırlama), etkinlikler (basit sarkaç, vb.) geliştirirecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Programın planlı ve esnek olması Programın içeriği ve amaçları araştırmacı tarafından önceden oluşturulacak (planlı). Eğitim için uygun gün ve saatler öğretmenlerin isteğine göre ayarlanacak (esnek). Yüz yüze eğitimler dışında öğretmenlerin hazırlanma süreçleri ise bazen planlı (facebook paylaşımları, telefon vb.) bazen de öğretmenlerin talepleri üzerine esnek bir yapıda olacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Öğretmenin uygulamasının planlı ve esnek olması Eğitimde her öğretmenden en az 1 ders sunumu yapması istenecek (planlı). Ders anlatımı için kazanımların, uygulanacak öğretim stratejisinin ve değerlendirme türünün seçimi öğretmenlerin kendi isteklerine bırakılacak (esnek).	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Uzun zamanlı olması Haziran dönemi 20 saat, Eylül dönemi 12 saat toplam 32 saatlik yüz yüze eğitim yapılacak. Buna ilaveten yaz tatilinde (2 ay) öğretmene hazırlanma zamanı verilecek. Yüz yüze olmayan iletişimler sayesinde öğretmenlerin ders anlatımlarına hazırlanmalarına imkan verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Sürekli (devam eden) bir yapısı olması Eğitimin bir kez yapılıp bırakılmadan, sonrasında öğretmenin kendi sınıfında uygulama sürecinde de değerlendirilmesi yapılacak ve bu sürecin hem yüz yüze seminerlerle hemde yüz yüze olmayan iletişimlerle hayat boyu devam eden bir yapısı olduğunu göstermek amacıyla sınıf uygulama sonuçları kendileriyle paylaşılacak, eğitim sonrası düşünceleri alınacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Sınıf uygulamasına yakın zamanda eğitim verilmesi Öğretmenler tarafından üniteyi sınıf ortamında anlatacakları zamana 1 hafta kala örnek ders anlatımları yapılacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Fizik Bilimine Giriş ünitesini merkeze alması Fizik Bilimine Giriş konusunda eğitim verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Öğretim programına uyumlu olması Spesifik olarak 9. sınıf Fiziğin Doğası (yeni öğretim programında Fizik Bilimine Giriş) ünitesi seçilecek. Öğretim programında belirlenen şekliyle ünitedeki kazanımlar (bilgi/beceri) ve bu kazanımlar öğretilirken kullanılabilecek öğretim stratejileri, materyal/teknoloji, ölçme/değerlendirme yaklaşımları eğitim programının konu içeriğini oluşturacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Etkin/üretken çalışma Öğretmenleri sürece dahil edecek bireysel ve grup olarak toplam 12 etkinlik yapılacak, somut materyaller geliştirilecek. Çoklu sunum örnekleri sağlanacak. Ör: Basit sarkaç etkinliği eğitimde hem simülasyon yoluyla hem de somut materyallerle yapılacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	

Bireysel olarak da 8 öğretmen seçtiği kazanıma özgü öğretim stratejisi, materyal/teknoloji kullanarak 1 ders sunumu hazırlayacak, 3 öğretmen ise seçtiği ölçme/değerlendirme amacına uygun ölçme aracı hazırlayacak. Bu hazırlık sürecinde yüz yüze olmayan süreçte öğretmenlerin çalışmalarının devamı sağlanacak. (facebook, telefon vb. aracılığıyla).			
Derinlemesine tartışma Öğretmenler eğitim içinde yapılan etkinliklere tartışarak, sorgulayarak katılacak, etkinliklerin geliştirilmesi için öneri ve dönütler verilecek. Kendi ders sunum materyallerini hazırlarken yüz yüze veya yüz yüze olmayan etkileşimlerle araştırmacıya soru sorarak, dönüt isteyerek aktif olarak sürece katılacaklar. Her bir öğretmen diğer meslektaşlarının hazırladığı ders anlatımlarına dönüt verip, soru sorup tartışarak görüşlerini ifade edecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Çoğunlukla öğretmenler tarafından eğitimin devam ettirilmesi Bir eğitmenin merkezde olduğu geleneksel eğitimlerden ziyade, bu eğitim çoğunlukla öğretmenler tarafından beraberce yürütülecek, birbirlerinden öğrenerek sürece aktif olarak katılacaklar. Öğretmenler arasında herhangi bir hiyerarşik fark gözetilmeyecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
İşbirliği Öğretmenlerin ellerindeki mevcut materyaller ve üretilen ürünler paylaşılacak. Hem yüz yüze hem de yüz yüze olmayan etkileşimlerle birlikte çalışılarak ünitenin zengin bir şekilde aktarılmasına katkı sağlanacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Motivasyon sağlama			
Ödül olarak sertifika verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
Etkili iletişim			
1. seminer öncesi			
a. Öğretmen-öğretmen arasında iletişim Öğretmenler kendilerini tanıtacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
b. Öğretmen-eğitmen arasında iletişim Amaçlar önceden açıklanacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
1. seminer sırasında			
a. Öğretmen-öğretmen arasında iletişim 1.Bilgi alışverişi sağlanacak. 2. Dönüt verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
b. Öğretmen-eğitmen arasında iletişim 1.Bilgi paylaşımı sağlanıp, dönüt/destek verilecek. 2.Soru-cevap iletişimi olacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
1. seminer sonrasında/ II. Seminer öncesinde			
a. Öğretmen-öğretmen arasında iletişim 1.Bilgi paylaşımı sağlanacak. 2. Dönüt verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	

b. Öğretmen-eğitmen arasında iletişim 1.Bilgi paylaşımı sağlanıp, dönüt/destek verilecek. 2.Soru-cevap iletişimi olacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
II. seminer sırasında			
a. Öğretmen-öğretmen arasında iletişim 1.Bilgi alışverişi sağlanacak. 2. Dönüt verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
b. Öğretmen-eğitmen arasında iletişim 1.Bilgi paylaşımı sağlanıp, dönüt/destek verilecek. 2.Soru-cevap iletişimi olacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
II. seminer sonrasında			
a. Öğretmen-öğretmen arasında iletişim 1.Bilgi alışverişi sağlanacak. 2. Dönüt verilecek.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	
b. Öğretmen-eğitmen arasında iletişim 1.Bilgi paylaşımı sağlanıp, dönüt/destek verilecek. 2.Soru-cevap iletişimi olacak.	Evet ☐ Hayır ☐ Kısmen ☐	Evet ☐ Hayır ☐ Kısmen ☐	

APPENDIX N

TREATMENT VERIFICATION OPINION FORM

MESLEKİ GELİŞİM EĞİTİMİNDE YAPILANLARLA İLGİLİ ÖĞRETMEN GÖRÜŞÜ

Değerli Öğretmenim,

Sizinle iletişimde olduğumuz tüm süreci düşünüp, aşağıdaki tabloda yaptıklarım sütununda yazılanların yapılıp yapılmadığı ile ilgili görüşlerinizi belirtmenizi istemekteyiz. Ayrıca sizden gelecek öneriler doğrultusunda bundan sonra geliştirilecek eğitimlerin daha da zenginleştirilmesi hedeflenmektedir. Lütfen, ilgili sütundaki "Evet", "Hayır" veya "Kısmen" seçeneklerinden birini seçerek değerlendirmenizi yapınız. "Hayır" ya da "Kısmen" olarak belirttiğiniz veya ek açıklama yapma gereği duyduğunuz kısımlar için "Açıklamalar/Öneriler" bölümüne dönütlerinizi yazınız. Görüşünüzü istediğimiz sorular için de yine aynı bölüme düşüncelerinizi belirtiniz. Teşekkürler.

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Yaptıklarım	Yaptıklarım sütununa yazılanlar yapıldı mı?	Açıklamalar/Öneriler
Öğretmenlerin ihtiyaçlarını dikkate alma Eğitim öncesi üniteye özel ihtiyaçlar (kazanım/ beceri, öğretim stratejisi (yöntem, metot, teknik, vb.), materyal/teknoloji ve ölçme değerlendirme konuları üzerine eğitim ihtiyacı), kişisel ve genel ihtiyaçlar (ulaşım, toplantı yeri, vb.), istek ve öneriler (kim tarafından verilmeli, rolünüz, ürünler, süre, dayanışma, değerlendirme, destek, vb.) belirlendi. Öğretmenlerin önceki eğitimlerle ilgili tecrübeleri (eğitimlerin yılı, konusu, türü, verimliliği, yaşanan sorunlar, vb.) ortaya çıkarıldı.	Evet ☐ Hayır ☐ Kısmen ☐	
Öğrencilerin ihtiyaçlarını dikkate alma Üniteye özel ihtiyaçlar (öğrenemedikleri konular, vb.) istek ve öneriler (derslerin nasıl işlenmesi, değerlendirilmesi, ne tür materyallerin kullanılması ile ilgili, vb.) öğrencilere sorularak belirlendi.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile eğitim öncesi sizin ve öğrencilerinizin ihtiyaçları dikkate alınmaya çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında sizin ve öğrencilerinizin ihtiyaçlarını dikkate alma adına yapıldığını düşündüğünüz başka bir şey oldu mu?		
Sizin ve öğrencilerinizin ihtiyaçlarının dikkate alınması için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz başka bir şey varsa lütfen yazınız.		

Öğretmeni değişime ikna etme Her öğretmene sınıf gözlemleri, başarı testi, öğrenci mülakat sonuçları ve toplanan defterlerle ilgili raporlar delil olarak verildi. Yapılan telefon görüşmeleriyle öğretmenlere ilk gözlemlere ait sonuçlar detaylıca açıklandı. Kendi durumlarının farkına varmaları ve kanıtlar sunularak eğitime daha fazla motive olmaları sağlandı.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile kendi durumunuzun farkına varmanız sağlanmaya çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında kendi durumunuzun farkına varmanız adına yapıldığını düşündüğünüz başka bir şey oldu mu?		
Kendi durumunuzun farkına varmanız için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz başka bir şey varsa lütfen yazınız.		
M.E.B desteği Öğretmenlere katılım için görevlendirme izni ve sertifika verildi.	Evet ☐ Hayır ☐ Kısmen ☐	
Uzman (akademisyen) / Öğretmen desteği		
a. Çalıştaylar İki alanında uzman, bir doktora yapan akademisyen (araştırmacı) tarafından öğretmenlerin ihtiyaç duyduğu konularda eğitim verildi.	Evet ☐ Hayır ☐ Kısmen ☐	
b. Materyal/kaynak desteği Araştırmacı ve bazı öğretmenler tarafından etkili görülen somut materyaller (kaynak kitaplar, dergiler, laboratuvar araç-gereçleri, videolar, simülasyonlar, sunumlar, çalışma yaprakları, sınavlar, vb.) paylaşıldı.	Evet ☐ Hayır ☐ Kısmen ☐	
c. Kolay erişim imkanı Öğretmenler her an araştırmacıya ve birbirlerine (elektronik ortamlar, telefon, vb. aracılığıyla) soru sorup, materyal paylaşımı yapabildi.	Evet ☐ Hayır ☐ Kısmen ☐	
Okul desteği		
a. Katılım kolaylığı Öğretmenlerin eğitime gelebilmeleri için gerekli düzenlemeler (toplantı ve nöbet günleri, sınav görevleri ayarlamaları, vb.) yapıldı.	Evet ☐ Hayır ☐ Kısmen ☐	
b. Araştırmacı için uygulama kolaylığı Veri toplamada araştırmacıya kolaylık (öğretmenlere 9. sınıf verilmesi, gözlem ve mülakatların rahat bir şekilde yapılması) sağlandı.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile hem size hem de araştırmaya destek sağlanmaya çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında destek sağlama adına yapıldığını düşündüğünüz başka bir şey oldu mu?		
Destek sağlamak için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz başka bir şey varsa lütfen yazınız.		
Araştırmacı tarafından dönüt Araştırmacı tarafından süreç boyunca geliştirilen materyallere yazılı ve sözlü olarak dönüt verildi. Her bir öğretmene ortalamada; yazılı olarak 14 mail, 10 facebook mesajı, 1 kez ders değerlendirme formu ile; sözlü olarak 5 kez yüz yüze, 8 defa telefonla görüşülerek dönüt sağlandı.	Evet ☐ Hayır ☐ Kısmen ☐	

Diğer öğretmenler tarafından dönüt Her bir öğretmene diğer öğretmenler tarafından yazılı olarak ders değerlendirme formu ile eğitimler esnasında sözlü olarak yüz yüze dönüt verildi. Ayrıca facebook yolu ile de dönüt sağlandı. Kendi aralarında bir araya gelen öğretmenlerin de birbirlerine geri bildirimleri oldu.	Evet ☐ Hayır ☐ Kısmen ☐	
Öğretmenin kendisi tarafından dönüt Her bir öğretmen hazırladığı ders anlatımına 1 kez ders değerlendirme formu ile dönüt verdi.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile size dönüt sağlanmaya çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında size dönüt sağlama adına yapıldığını düşündüğünüz başka bir şey oldu mu?		
Dönüt sağlamak için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz bir şey varsa lütfen yazınız.		

Programın planlı ve esnek olması Programın içeriği ve amaçları araştırmacı tarafından önceden oluşturuldu (planlı). Eğitim için uygun gün ve saatler öğretmenlerin isteğine göre ayarlandı (esnek). Yüz yüze eğitimler dışında öğretmenlerin hazırlanma süreçleri ise bazen planlı (facebook paylaşımları, telefon vb.) bazen de öğretmenlerin talepleri üzerine esnek bir yapıdaydı.	Evet ☐ Hayır ☐ Kısmen ☐	
Öğretmenin uygulamasının planlı ve esnek olması Eğitimde her öğretmenden en az 1 ders sunumu yapması istendi (planlı). Ders anlatımı için kazanımların, uygulanacak öğretim stratejisinin ve değerlendirme türünün seçimi öğretmenlerin kendi isteklerine bırakıldı (esnek).	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile hem programın hem de sizin uygulamalarınızın planlı ve esnek olmasına çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında hem programın hem de sizin uygulamalarınızın planlı ve esnek olması adına yapıldığını düşündüğünüz başka bir şey oldu mu?		
Hem programın hem de sizin uygulamalarınızın planlı ve esnek olabilmesi için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz bir şey varsa lütfen yazınız.		
Uzun zamanlı olması Haziran dönemi 20 saat, Eylül dönemi 12 saat toplam 32 saatlik yüz yüze eğitim yapıldı. Buna ilaveten yaz tatilinde (2 ay) öğretmene hazırlanma zamanı verildi. Yüz yüze olmayan iletişimler sayesinde öğretmenlerin ders anlatımlarına hazırlanmalarına imkan verildi.	Evet ☐ Hayır ☐ Kısmen ☐	
Sürekli (devam eden) bir yapısı olması Eğitimin bir kez yapılıp bırakılmadan, sonrasında öğretmenin kendi sınıfında uygulama sürecinde de değerlendirilmesi yapıldı ve bu sürecin hem yüz yüze seminerlerle hemde yüz yüze olmayan iletişimlerle hayat boyu devam eden bir yapısı olduğunu göstermek amacıyla sınıf uygulama sonuçları kendileriyle paylaşıldı, eğitim sonrası düşünceleri alındı.	Evet ☐ Hayır ☐ Kısmen ☐	
Sınıf uygulamasına yakın zamanda eğitim verilmesi Öğretmenler tarafından üniteyi sınıf ortamında anlatacakları zamana 1 hafta kala örnek ders anlatımları yapıldı.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile eğitimin sürdürülebilir olmasına çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında eğitimin sürdürülebilir olması adına yapıldığını düşündüğünüz başka bir şey oldu mu?		
Eğitimin sürdürülebilir olması için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz bir şey varsa lütfen yazınız.		
Uygulama fırsatı Her öğretmene hazırladığı 1 saatlik dersi, 1 kez araştırmacı ve diğer öğretmenlerin önünde sınıf ortamındaymış gibi anlatma fırsatı sağlandı. Öğretmenler süreçte bazen birlikte, bazen de bireysel olarak çalışma yaprakları (bulmaca, birim tablosu, vb. hazırlama), etkinlikler (basit sarkaç, vb.) geliştirdi.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile öğrenilenleri uygulama fırsatı sağlanmaya çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	

Eğitime aktif olarak katılımınızı sağlamak için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz bir şey varsa lütfen yazınız.		
İşbirliği Öğretmenlerin ellerindeki mevcut materyaller ve üretilen ürünler paylaşıldı. Hem yüz yüze hem de yüz yüze olmayan etkileşimlerle birlikte çalışılarak ünitenin zengin bir şekilde aktarılmasına katkı sağlandı.	Evet ☐ Hayır ☐ Kısmen ☐	
Motivasyon sağlama		
a. Ödül olarak sertifika verildi.	Evet ☐ Hayır ☐ Kısmen ☐	
Etkili iletişim		
1. seminer öncesi		
a. Öğretmen-öğretmen arasında iletişim Öğretmenler kendilerini tanıttı.	Evet ☐ Hayır ☐ Kısmen ☐	
b. Öğretmen-eğitmen arasında iletişim Amaçlar önceden açıklandı.	Evet ☐ Hayır ☐ Kısmen ☐	
1. seminer sırasında		
a. Öğretmen-öğretmen arasında iletişim 1.Bilgi alışverişi sağlandı. 2. Dönüt verildi.	Evet ☐ Hayır ☐ Kısmen ☐	
b. Öğretmen-eğitmen arasında iletişim 1.Bilgi paylaşımı sağlanıp, dönüt/destek verildi. 2.Soru-cevap iletişimi oldu.	Evet ☐ Hayır ☐ Kısmen ☐	
1. seminer sonrasında/ II. Seminer öncesinde		
a. Öğretmen-öğretmen arasında iletişim 1.Bilgi paylaşımı sağlandı. 2. Dönüt verildi.	Evet ☐ Hayır ☐ Kısmen ☐	
b. Öğretmen-eğitmen arasında iletişim 1.Bilgi paylaşımı sağlanıp, dönüt/destek verildi. 2.Soru-cevap iletişimi oldu.	Evet ☐ Hayır ☐ Kısmen ☐	
II. seminer sırasında		
a. Öğretmen-öğretmen arasında iletişim 1.Bilgi alışverişi sağlandı. 2. Dönüt verildi.	Evet ☐ Hayır ☐ Kısmen ☐	
b. Öğretmen-eğitmen arasında iletişim 1.Bilgi paylaşımı sağlanıp, dönüt/destek verildi. 2.Soru-cevap iletişimi oldu.	Evet ☐ Hayır ☐ Kısmen ☐	
II. seminer sonrasında		
a. Öğretmen-öğretmen arasında iletişim 1.Bilgi alışverişi sağlandı. 2. Dönüt verildi	Evet ☐ Hayır ☐ Kısmen ☐	

Yukarıdakilerin dışında öğrenilenleri uygulama fırsatı sağlama adına yapıldığını düşündüğünüz başka bir şey oldu mu?	
Öğrenilenleri uygulama fırsatı sağlamak için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz bir şey varsa lütfen yazınız.	

Fizik Bilimine Giriş ünitesini merkeze alması Fizik Bilimine Giriş konusunda eğitim verildi.	Evet ☐ Hayır ☐ Kısmen ☐	
18)Öğretim programına uyumlu olması Spesifik olarak 9. sınıf Fiziğin Doğası (yeni öğretim programında Fizik Bilimine Giriş) ünitesi seçildi. Öğretim programında belirlenen şekliyle ünitedeki kazanımlar (bilgi/beceri) ve bu kazanımlar öğretilirken kullanılabilecek öğretim stratejileri, materyal/teknoloji, ölçme/değerlendirme yaklaşımları eğitim programının konu içeriğini oluşturdu.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile fizik bilimine giriş konusu merkeze alınmaya çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında fizik bilimine giriş konusu merkeze alma adına yapıldığını düşündüğünüz başka bir şey oldu mu?		
Fizik bilimine giriş konusunun merkeze alması için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz bir şey varsa lütfen yazınız.		
Etkin/üretken çalışma Öğretmenleri sürece dahil edecek bireysel ve grup olarak toplam 12 etkinlik yapıldı, somut materyaller geliştirildi. Çoklu sunum örnekleri sağlandı. Ör: Basit sarkaç etkinliği eğitimde hem simülasyon yoluyla hem de somut materyallerle yapıldı. Bireysel olarak da 8 öğretmen seçtiği kazanıma özgü öğretim stratejisi, materyal/teknoloji kullanarak 1 ders sunumu hazırladı, 3 öğretmen ise seçtiği ölçme/değerlendirme amacına uygun ölçme aracı hazırladı. Bu hazırlık sürecinde yüz yüze olmayan süreçte öğretmenlerin çalışmalarının devamı sağlandı.(facebook, telefon vb. aracılığıyla).	Evet ☐ Hayır ☐ Kısmen ☐	
Derinlemesine tartışma Öğretmenler eğitim içinde yapılan etkinliklere tartışarak, sorgulayarak katıldı, etkinliklerin geliştirilmesi için öneri ve dönütler verdi. Kendi ders sunum materyallerini hazırlarken yüz yüze veya yüz yüze olmayan etkileşimlerle araştırmacıya soru sorarak, dönüt isteyerek aktif olarak sürece katıldı. Her bir öğretmen diğer meslektaşlarının hazırladığı ders anlatımlarına dönüt verdi, soru sorup tartışarak görüşlerini ifade etti.	Evet ☐ Hayır ☐ Kısmen ☐	
Çoğunlukla öğretmenler tarafından eğitimin devam ettirilmesi Bir eğitmenin merkezde olduğu geleneksel eğitimlerden ziyade, bu eğitim çoğunlukla öğretmenler tarafından beraberce yürütüldü, birbirlerinden öğrenerek sürece aktif olarak katıldılar. Öğretmenler arasında herhangi bir hiyerarşik fark gözetilmedi.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile sizin eğitime aktif olarak katılımınız sağlanmaya çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında eğitime aktif olarak katılımınızı sağlama adına yapıldığını düşündüğünüz başka bir şey oldu mu?		

b. Öğretmen-eğitmen arasında iletişim 1.Bilgi paylaşımı sağlanıp, dönüt/destek verildi. 2.Soru-cevap iletişimi oldu.	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıda yapılanlar ile sizin de dahil olduğunuz bir öğrenme grubu oluşturulmaya çalışılmıştır. Bu yapılanlar size yeterli geldi mi?	Evet ☐ Hayır ☐ Kısmen ☐	
Yukarıdakilerin dışında bir öğrenme grubu oluşturma adına yapıldığını düşündüğünüz başka bir şey oldu mu?		
Bir öğrenme grubu oluşturmak için yukarıdakilerin dışında yapılsaydı iyi olurdu dediğiniz bir şey varsa lütfen yazınız		

APPENDIX O

THE FIRST VERSION OF PROFESSIONAL DEVELOPMENT PROGRAM EVALUATION INTERVIEW PROTOCOL

Hizmet-içi Eğitimin Değerlendirilmesi ile ilgili Öğretmen Görüşme Formu

Öğretmenin adı-soyadı: .... Tarih/süre (başlangıç-bitiş): ....

GİRİŞ:

Değerli Öğretmenim,

Katıldığınız hizmet-içi eğitimin başlangıç aşamasından itibaren sizlerin ihtiyaçları dikkate alınmaya çalışılmış, dersleriniz gözlemlenmiş, öğrencilerinizin üniteye özel istek ve önerileri tespit edilmiş ve başarıları ölçülmüştür. Elde edilen bilgiler ile Fizik Bilimine Giriş Ünitesi içerikli bir hizmet-içi eğitim programı geliştirilmiştir. Bu eğitimin sınıf içi uygulamalarınıza olumlu yönde katkı sağlaması, derslerinizi daha zenginleştirmesi ve buna bağlı olarak ünitede öğrencilerinizin başarılarını arttırması hedeflenmiştir. Ünitenin öğretilmesinde bilgi, beceri ve deneyim kazanabilmeniz amacıyla;

- Kazanımlar (bilgi/beceri)
- Öğretim yöntem/teknikleri (etkinlik, aktiviteler)
- Teknoloji/materyal
- Ölçme/değerlendirme yaklaşımları olarak verilen 4 boyutta çalışmalar yapılmıştır.

Yapacağım bu görüşme iki bölümden oluşmaktadır: İlk bölümde hizmet-içi eğitimin ünitenin işlenmesine olan etkisini ölçen, ikinci bölümde ise eğitimin etkili ve verimli olup olmadığını değerlendiren sorular bulunmaktadır. Bu sorularla görüşlerinizi alarak yapılan hizmet-içi eğitimi değerlendirmek istemekteyim.

Görüşmede verdiğiniz tüm bilgiler gizli tutulacak ve sadece bu araştırma kapsamında kullanılacaktır. Sonuçların raporlanmasında isimleriniz kesinlikle yazılmayacaktır. Zamanı daha iyi kullanmak ve yanıtlarınızı ayrıntılı bir şekilde almak adına izin verirseniz görüşmeyi kaydetmek istiyorum. Görüşmeye başlamadan önce bana sormak istediğiniz herhangi bir sorunuz var ise cevaplamak isterim. Katkılarınız için şimdiden çok teşekkür ederim.

I. Bölüm: Ünitenin işlenmesinde hizmet-içi eğitimin etkisini değerlendiren sorular

1. Bu dönem fizik bilimine giriş ünitesini daha çok öğrenci merkezli mi yoksa öğretmen merkezli mi işlediniz? Açıklayınız.

2. Hizmet-içi eğitimi aldıktan sonra sınıf-içi uygulamalarınızda meydana gelen olumlu ve olumsuz değişimi;

a) Ünitenin içeriği (kazanım/bilgi, beceri) bakımından değerlendiriniz. Bu boyutta öğrencilerinizin karşılaştığı zorluklar oldu mu? Açıklayınız.

b) Kullandığınız öğretim yöntem/teknik (etkinlik, aktiviteler) bakımından değerlendiriniz. Bu boyutta öğrencilerinizin karşılaştığı zorluklar oldu mu? Açıklayınız.

c) Kullandığınız teknoloji/materyal bakımından değerlendiriniz. Bu boyutta öğrencilerinizin karşılaştığı zorluklar oldu mu? Açıklayınız.

d) Kullandığınız ölçme/değerlendirme yaklaşımları (Ön bilgi ölçme amaçlı, zorlanılan konuları ortaya çıkarmaya yönelik, süreçte neyin bilinip /bilinmediğini ölçme amaçlı, not verme amaçlı değerlendirme) bakımından değerlendiriniz. Bu boyutta öğrencilerinizin karşılaştığı zorluklar oldu mu? Açıklayınız.

3. Hizmet-içi eğitimde üzerinde durulan 4 boyut (konu bilgisi, öğretim yöntem/teknik, teknoloji materyal kullanımı ve ölçme/değerlendirme yaklaşımları) için bu sene yapamayıp önümüzdeki dönemlerde farklı olarak yapmayı düşündüğünüz birşeyler var mı? Varsa bunları bu yıl neden yapamadığınızı da belirterek kısaca açıklayınız.

II. Bölüm: Etkililik ve verimlilik açısından hizmet-içi eğitimini değerlendiren sorular

4. Yapılan bu hizmet-içi eğitim beklentilerinizin ne kadarını karşıladı?

5. Daha önceki hizmet-içi eğitimlerde görmeyip bu eğitimde gördüğünüz güçlü ve zayıf yönler nelerdir? Açıklayınız.

6. Aşağıdaki tablonun ilk sütununda verilen ifadelere ne ölçüde katıldığınızı 5 (Kesinlikle katılıyorum), 4 (Katılıyorum), 3 (Kararsızım), 2 (Katılmıyorum), 1 (Kesinlikle katılmıyorum) şeklinde verilen derecelendirmelerden birini seçerek belirtiniz. 3 ve 3 ün altında yapacağınız işaretlemelerinizin nedenini kısaca açıklayınız.

İfadeler	Katılım dereceniz
Eğitim uygun bir zamanda yapıldı	(5) (4) (3) (2) (1)
Eğitimin süresi yeterliydi.	(5) (4) (3) (2) (1)
Eğitimin yapıldığı mekan ile ilgili herhangi bir sorun yaşamadım.	(5) (4) (3) (2) (1)
Eğitimdeki içerik benim için yeterliydi.	(5) (4) (3) (2) (1)
Eğitimde ortaya çıkan ürünleri derslerimde kullandım	(5) (4) (3) (2) (1)
Eğitimde kullanılan materyaller öğrenmeme yardımcı oldu.	(5) (4) (3) (2) (1)
Eğitim ile bu üniteye ilgim daha fazla arttı.	(5) (4) (3) (2) (1)
Eğitim sonrası bu ünitenin öğretilmesinin gerekli olduğunu anladım.	(5) (4) (3) (2) (1)
Eğitimi yürüten araştımacı ve eğitimi veren akademisyenler bana katkı sağladı.	(5) (4) (3) (2) (1)
Eğitime katıldığım için memnunum.	(5) (4) (3) (2) (1)
Meslektaşlarıma böyle bir eğitime katılmalarını tavsiye ederim.	(5) (4) (3) (2) (1)
Eğitim sonrası ihtiyaç duyduğum konular olduğunda eğitime katılan diğer öğretmen ve akademisyenlerle iletişim kuracağım.	(5) (4) (3) (2) (1)

7. Katıldığınız bu hizmet-içi eğitimi değerlendirmek adına belirtmek istediğiniz başka görüş ve önerileriniz var mı? Kısaca açıklayınız.

APPENDIX P

THEANALYSIS OF THE EXPERT OPINION FOR PROFESSIONAL DEVELOPMENT PROGRAM EVALUATION INTERVIEW PROTOCOL

HİZMET-İÇİ EĞİTİMİN DEĞERLENDİRİLMESİ İLE İLGİLİ ÖĞRETMEN GÖRÜŞME FORMU UZMAN GÖRÜŞLERİ ANALİZİ

- II. Bölüm 6. Soruda derecelendirmeler daha açık olacak şekilde aşağıya doğru sıralanmıştır.
- Bazı cümlelerde düzenleme ve düzeltmeler yapılmıştır.
- II. Bölümde bulunan maddeler şıklar şeklinde verilmiştir.

APPENDIX Q

THE FINAL VERSION OF PROFESSIONAL DEVELOPMENT PROGRAM EVALUATION INTERVIEW PROTOCOL

Hizmet-içi Eğitimin Değerlendirilmesi ile ilgili Öğretmen Görüşme Formu

Öğretmenin adı-soyadı: .... Tarih/süre (başlangıç-bitiş): ....

GİRİŞ:

Değerli Öğretmenim,

Katıldığınız hizmet-içi eğitimin başlangıç aşamasından itibaren sizlerin ihtiyaçları dikkate alınmaya çalışılmış, dersleriniz gözlemlenmiş, öğrencilerinizin üniteye özel istek ve önerileri tespit edilmiş ve başarıları ölçülmüştür. Elde edilen bilgiler ile Fizik Bilimine Giriş Ünitesi içerikli bir hizmet-içi eğitim programı geliştirilmiştir. Bu eğitimin sınıf içi uygulamalarınıza olumlu yönde katkı sağlaması, derslerinizi daha zenginleştirmesi ve buna bağlı olarak ünitede öğrencilerinizin başarılarını arttırması hedeflenmiştir. Hizmet-içi eğitimde;

- Kazanımlar (bilgi/beceri)
- Öğretim yöntem/teknikleri (etkinlik, aktiviteler)
- Teknoloji/materyal
- Ölçme/değerlendirme yaklaşımları olarak verilen 4 boyutta çalışmalar yapılmıştır.

Yapacağım bu görüşme iki bölümden oluşmaktadır: İlk bölümde hizmet-içi eğitimin ünitenin işlenmesine olan etkisini ölçen, ikinci bölümde ise eğitimin etkili ve verimli olup olmadığını değerlendiren sorular bulunmaktadır. Bu sorularla görüşlerinizi alarak yapılan hizmet-içi eğitimi değerlendirmek istemekteyim.

Görüşmede verdiğiniz tüm bilgiler gizli tutulacak ve sadece bu araştırma kapsamında kullanılacaktır. Sonuçların raporlanmasında isimleriniz kesinlikle yazılmayacaktır. Zamanı daha iyi kullanmak ve yanıtlarınızı ayrıntılı bir şekilde almak adına izin verirseniz görüşmeyi kaydetmek istiyorum. Görüşmeye başlamadan önce bana sormak istediğiniz herhangi bir sorunuz var ise cevaplamak isterim. Katkılarınız için şimdiden çok teşekkür ederim.

I. Bölüm: Ünitenin işlenmesinde hizmet-içi eğitimin etkisini değerlendiren sorular

1. Bu dönem fizik bilimine giriş ünitesini daha çok öğrenci merkezli mi yoksa öğretmen merkezli mi işlediniz? Açıklayınız.

2. Hizmet-içi eğitimi aldıktan sonra sınıf-içi uygulamalarınızda meydana gelen olumlu ve olumsuz değişimi;

a) Ünitenin içeriği (kazanım bilgi, beceri) bakımından değerlendiriniz. Bu boyutta öğrencilerinizin karşılaştığı zorluklar oldu mu? Açıklayınız.

b) Kullandığınız öğretim yöntem/teknik (etkinlik, aktiviteler) bakımından değerlendiriniz. Bu boyutta öğrencilerinizin karşılaştığı zorluklar oldu mu? Açıklayınız.

c) Kullandığınız teknoloji/materyal bakımından değerlendiriniz. Bu boyutta öğrencilerinizin karşılaştığı zorluklar oldu mu? Açıklayınız.

d) Kullandığınız ölçme/değerlendirme yaklaşımları (Ön bilgi ölçme amaçlı, zorlanılan konuları ortaya çıkarmaya yönelik, süreçte neyin bilinip /bilinmediğini ölçme amaçlı, not verme amaçlı değerlendirme) bakımından değerlendiriniz. Bu boyutta öğrencilerinizin karşılaştığı zorluklar oldu mu? Açıklayınız.

3. Hizmet-içi eğitimde üzerinde durulan 4 boyut (konu bilgisi, öğretim yöntem/teknik, teknoloji materyal kullanımı ve ölçme/değerlendirme yaklaşımları) için bu sene yapamayıp önümüzdeki dönemlerde farklı olarak yapmayı düşündüğünüz birşeyler var mı? Varsa bunları bu yıl neden yapamadığınızı da belirterek kısaca açıklayınız.

II. Bölüm: Etkililik ve verimlilik açısından hizmet-içi eğitimini değerlendiren sorular

4. Yapılan bu hizmet-içi eğitim beklentilerinizin ne kadarını karşıladı?

5. Daha önceki hizmet-içi eğitimlerde görmeyip bu eğitimde gördüğünüz güçlü ve zayıf yönler nelerdir? Açıklayınız.

6. Aşağıdaki tablonun ilk sütununda verilen ifadelere ne ölçüde katıldığınızı;

5 : Kesinlikle katılıyorum
4 : Katılıyorum
3 : Kararsızım
2 : Katılmıyorum
1 : Kesinlikle katılmıyorum şeklinde verilen derecelendirmelerden birini seçerek belirtiniz. 3 ve 3'ün altında işaretleme yaptıysanız nedenini kısaca açıklayınız.

İfadeler	**Katılım dereceniz**
a) Eğitim uygun bir zamanda yapıldı.	(5) (4) (3) (2) (1)
b) Eğitimin süresi yeterliydi.	(5) (4) (3) (2) (1)
c) Eğitimin yapıldığı mekan ile ilgili herhangi bir sorun yaşamadım.	(5) (4) (3) (2) (1)
d) Eğitimdeki içerik benim için yeterliydi.	(5) (4) (3) (2) (1)
e) Eğitimde ortaya çıkan ürünleri derslerimde kullandım	(5) (4) (3) (2) (1)
f) Eğitimde kullanılan materyaller öğrenmeme yardımcı oldu.	(5) (4) (3) (2) (1)
g) Eğitim ile bu üniteye olan ilgim daha fazla arttı.	(5) (4) (3) (2) (1)
h) Eğitim sonrası bu ünitenin öğretilmesinin gerekli olduğunu anladım.	(5) (4) (3) (2) (1)
i) Eğitimi yürüten araştımacı ve eğitimi veren akademisyenler bana katkı sağladı.	(5) (4) (3) (2) (1)
j) Eğitime katıldığım için memnunum.	(5) (4) (3) (2) (1)
k) Meslektaşlarıma böyle bir eğitime katılmalarını tavsiye ederim.	(5) (4) (3) (2) (1)
l) İlerde ihtiyaç duyduğum konular olduğunda eğitime katılan diğer öğretmen ve akademisyenlerle iletişim kuracağım.	(5) (4) (3) (2) (1)

7. Katıldığınız bu hizmet-içi eğitimi değerlendirmek adına belirtmek istediğiniz başka görüş ve önerileriniz var mı? Kısaca açıklayınız.

APPENDIX R

CODING MANUAL OBSERVATION FORM

GÖZLEM FORMU KODLAMA KILAVUZU

Gözlem formunda “Gözlem tablosu 1 (Kazanım, bilgi/beceri)” bölümü

Tam ve eksik aynı anda kodlanamaz.

Tam ve hatalı aynı anda kodlanamaz.

Eksik ve hatalı aynı anda kodlabilir.

Tam ve sınırlarından fazla aynı anda kodlanabilir.

Eksik ve sınırlarından fazla aynı anda kodlanabilir.

Hatalı ve snırlarından fazla aynı anda kodlanabilir.

Hiç ile sınırlarından fazla aynı anda kodlanabilir (kazanım yerine kazanımdan farklı birşey anlatılırsa).

Beceri kazanımları kendi kodlandığı yerde değil de başka yerde (başka bir kazanım ile başka bir hafta) verilmiş ise, orda verildi diye belirtilecek. Fakat istenilen yerde verilmedi ise verilmedi olarak işaretlenecek.

Kazanım ifadeleri verildi de öğretmenin açıkça ne öğrenileceğini öğrenciye söylemesi beklenmektedir.

Kodlama yaparken öğrenci-öğretmen diyaloglarında öğrencilerin verdiği örnekleri öğretmen onaylayıp ekleme açıklama yapıyor ise öğretmen söylemiş, onun zenginliği olarak alınacak. Yine öğrencinin hatalı söylediğini öğretmen onaylamış ise de bu öğretmenin eksisi olacak.

Ana kazanım içerisindeki alt kazanımlar farklı sırayla anlatılabilir.

Konu spesifik alınan kararlar (Kazanımların verilmesi ile ilgili alınan kararlar)

Türetilmiş büyüklükler temel büyüklükleri açıklamak için kullanılabilir. Onun dışında detaylı anlatım beklenmemektedir (var ise sınırlarından fazla) (yeni 9.1.1.4- eski 2.4).

“Bilimsel bilgiyi, bir hipotezi delillerle desteklenirse artık o kanun, teori olur” şeklinde verilen bilgi doğru kabul edilecektir (Hipotez, kanun teori arasındaki ilişki, yeni 9.1.1.2-eski 2.7, 2.8).

Hipotez, gözlem, deney, matematik, modelleme kanun ve teori, bilimsel bilginin oluşumu anlatılırken kullanılan kavramlar olarak kabul edilecektir (yeni 9.1.1.2-eski 2.7, 2.8).

Matematik yardımcı bir araç, gerekli bir araç değildir olarak kabul edilecektir (yeni 9.1.1.2-eski 3.2).

Matematiksel modellemede aynı zamanda modelin sonucunda bir çıkarım yapması gerekiyor. Veri toplayacak analiz edecek ölçüm yapacak ilişkiyi görecek sonraki yıl ögreneceği bir konu ile ilgili bir modelleme olabilir (yeni 9.1.1.3-eski 3.1)

SI anlatılırken MKS, CGS birim sistemlerinden bahsedilebilir (yeni 9.1.1.4- eski 2.4).

Birimlerin alt ve üst katları anlatılırken Piko, nano, vb. verilebilir (yeni 9.1.1.4- eski 2.4).

Birim dönüştürme yapıldıysa, değerlendirmeye alınmayacaktır (yeni 9.1.1.4-eski 2.4)

Gözlem formunda "Gözlem tablosu 2 (Öğretim stratejisi)" bölümü

Her bir kazanım için kullanılan öğretim stratejisi:

R Öğrenci katılımını gerektiren

NR Öğrenci katılımını gerektirmeyen

olarak değerlendirmeye alınacaktır.

Öğrenci katılımının sağlandığı stratejiler daha çok öğrenciyi merkeze alan aktif katılımın sağlandığı öğretmenin bütün sınıfı derse aktiviteye kattığı durumda kodlanacaktır.

Öğrenci katılımını gerektirmeyen stratejiler ise öğretmen merkezli olarak kullanılan çok seyrek öğrenci katılımına imkan sağlayan durumlarda kodlanacaktır.

Yukarıda verilem yaklaşımların niteliği için amaca ne kadar hizmet edip etmediği kriter olarak alınmıştır. Bu kriter ise yöntemin niteliği değerlendirilirken incelenecektir.

Basitten karmaşığa, yakından uzağa, bilinenden bilinmeye olarak isimlenen metodolojiler somuttan soyuta ilkesi olarak alınacaktır.

Ödev (türü ne olursa olsun) öğrencinin derse hazır gelmesini sağlamaya çalışan bir aktivite olarak yöntem teknik altında kodlanacaktır.

Öğretmenin konu tekrarı (nerede yapılırsa yapılsın) yöntem teknik altında kodlanacaktır (Tekrar: bir önceki ders ile ilgili konu anlatımı veya soru-cevap olabilir).

Kullanılan öğretim stratejilerini nitelik olarak değerlendirirken kullanılan puanlama kriterleri

Aşağıda genel kriterler başlığı altındakiler ünite boyunca kullanılan öğretim stratejilerin tümü için geçerlidir. Öğretim stratejisi olarak kullanılan tekrarlar ve verilen ödevler için de ayrı kriterler oluşturulmuştur. Verilen her bir kriter için ilgili kazanımda kullanılan strateji:

3:İyi: Tam uygulandı
2:Orta: Eksik uygulandı
1: Zayıf: Çok eksik uygulandı
0: Hiç: Uygulanmadı (İlgisiz-konu dışı)

şeklinde verilen derecelendirmeye göre değerlendirilecektir. Ağırlıklı puanların hesaplanmasından elde edilen toplam puan ise gözlem formundaki ilgili yere yazılacaktır.

Gözlem formunda "Gözlem tablosu 4 (Ölçme/değerlendirme)" bölümü

Formatif amaçlı amaçlı bir değerlendirme bire bir kazanım bazında olmasa da paketler halinde de yapılabilir. Ör: 9.1.1.1. i açıklamalarıyla beraber verdi 9.1.1.2.1 ye geçmeden formatif yaptı.

Formatifi ödev olarakta verebilir, hangi aracı kullanıldığı önemli olmayacaktır.

Formatif ya da summatif olarak belirlenmeyen kararsız durumlarda işaretleme yapılmayacaktır.

Bir ölçüm aracı aynı anda iki amaçlı kullanılabilir.

Her haftaya bir önceki dersle başlamak, geçmiş ile geleceği ilişkilendirmek ölçme/değerlendirme kısmına değil, metot kısmına kodlanacaktır.

Kullanılan ölçme/değerlendirmeyi nitelik olarak değerlendirirken kullanılan puanlama kriterleri

Aşağıda genel kriterler başlığı altındakiler ünite boyunca kullanılan ölçme/değerlendirme tekniklerinin tümü için geçerlidir. Verilen her bir kriter için ilgili kazanımda kullanılan ölçme/değerlendirme:

3:İyi: Tam uygulandı
2:Orta: Eksik uygulandı
1: Zayıf: Çok eksik uygulandı
0: Hiç: Uygulanmadı (İlgisiz-konu dışı)

şeklinde verilen derecelendirmeye göre değerlendirilecektir. Ağırlıklı puanların hesaplanmasından elde edilen toplam puan ise gözlem formundaki ilgili yere yazılacaktır.

Genel kriterler	***Puan***	***Ağırlık***	***Toplam***
Ölçme/değerlendirme yapılış amacına hizmet etti. Açıklama: Ön bilgi/beceri düzeyini ölçerek gruplama amaçlı değerlendirme (gruplama) Zorlanılan konuları ortaya çıkarmaya yönelik ölçme-değerlendirme (diagnostik) Öğrenme sürecinde neyin bilinip/bilinmediğini belirlemeye yönelik ölçme ve değerlendirebilme (formatif) Genelde ünite sonunda veya ünite içinde ulaşılan en son düzeyi belirlemeye yönelik not verme amaçlı ölçme-değerlendirme (summatif)		2	
Kullanılan ölçme/değerlendirme türü amaca (kazanımı ölçmeye, gruplamaya, vb.) hizmet etti.		6	
Sorular/ödevler açık ve anlaşılırdı.		1	
Sorular/ödevler günlük hayatla ilişkiliydi.		1	
Soruların içerdiği bilgiler doğruydu.		1	
Kapsam geçerliliği vardı (summatif amaçlı bir sınav ise). Uyarı: Sınavın uygulandığı ana kadar olan kazanımlar dikkate alınacaktır. Summatif amaçlı ise %80 ve üzeri geçerlik 3, %50 kapsam geçerliği 2, bu oranın altındakiler 1 olarak değerlendirilecektir.		6	
Yapılan sınavda farklı türde sorular vardı (summatif ise).		1	
Genel toplam:			

Genel kriterler	*Puan*	*Ağırlık*	*Toplam*
Seçilen strateji amaca (kazanımı sunmaya) hizmet etti.		6	
Öğrencilerin ilgisini çekti.		1	
Öğrencilerin bireysel olarak derse katılımını sağladı.		1	
		Genel toplam:	24
Tekrarlar (Bir önceki ders ile ilgili konu anlatımı veya soru-cevap olabilir)			
Ana kavramların tümü tekrarlandı.		6	
Öğrenci tekrarı yaptı, soru sorulmuş ise çözdü.		1	
		Genel toplam:	21
Ödevler			
Kazanımların gerçekleştirilmesine faydalı olabilecek ödevler verildi.		1	
Ödevlere dönüt verildi.		1	
		Genel toplam:	6

Gözlem formunda "Gözlem tablosu 3 (Materyal/teknoloji)" bölümü

Ders esnasında görülmeyen bir materyal/teknoloji oldu ise o da ilgili kazanımda verilmiş olarak kabul edilecektir (başka bir derste izlenilen video, vb).

Kullanılan öğretim materyal/teknolojiyi nitelik olarak değerlendirirken kullanılan puanlama kriterleri

Aşağıda genel kriterler başlığı altındakiler ünite boyunca kullanılan materyal/teknolojilerin tümü için geçerlidir. Kullanılan kitap materyalleri için de ayrı kriterler oluşturulmuştur. Verilen her bir kriter için ilgili kazanımda kullanılan materyal/teknoloji;

3:İyi: Tam uygulandı
2:Orta: Eksik uygulandı
1: Zayıf: Çok eksik uygulandı
0: Hiç: Uygulanmadı (İlgisiz-konu dışı)

şeklinde verilen derecelendirmeye göre değerlendirilecektir. Ağırlıklı puanların hesaplanmasından elde edilen toplam puan ise gözlem formundaki ilgili yere yazılacaktır.

Genel kriterler	*Puan*	*Ağırlık*	*Toplam*
Seçilen materyal/teknoloji amaca (kazanımı sunmaya) hizmet etti.		6	
Öğrencilerin ilgisini çekti.		1	
Öğrencilerin bireysel olarak derse katılımını sağladı.		1	
		Genel toplam:	24
Kitaplar			
Ders içinde aktif (önemli yerleri okuma, işaretleme, vb.) kullanıldı.		1	
Ders dışında aktif (önemli yerleri okuma, işaretleme, vb.) kullanıldı.		1	
		Genel toplam:	6

APPENDIX S

SAMPLE CODING SCHEMA FOR CONTENT/SKILL DIMENSION

Konu (Kazanımlar, bilgi/beceri)

2012-2013 veriler:

																		Toplam
TAM	2012	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	6
		Beceri	FTTÇ- 1a,b,c,d; BİB- 1a,b,c,d	FTTÇ- 1p		FTTÇ- 1p	FTTÇ- 2b, c	FTTÇ- 1b	BİB- 1b	FTTÇ- 1e,f,g	PÇB- 1d, 2c; FTTÇ- 1b	PÇB- 3a, c	PÇB- 3a, c; BİB- 2a	PÇB- 1f, 2a;	PÇB- 2a,e,3f			F:2 /10 2
	2013	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	12
		Beceri	FTTÇ- 1a,b,c,d; BİB- 1a,b,c,d	FTTÇ- 1p		FTTÇ- 1p	FTTÇ- 2b,c	FTTÇ- 1b	BİB- 1b	FTTÇ- 1e,f,g	PÇB- 1d, 2c; FTTÇ- 1b	PÇB- 3a, c	PÇB- 3a, c; BİB- 2a	PÇB- 1f, 2a;	PÇB- 2a,e,3f			F:8/10 B:4/5 P:4/8 16

																		Toplam
EKSİK	2012	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	9
		Beceri	FTTÇ- 1a,b,c,d; BİB- 1a,b,c,d	FTTÇ- 1p		FTTÇ- 1p	FTTÇ- 2b, c	FTTÇ- 1b	BİB- 1b	FTTÇ- 1e,f,g	PÇB- 1d, 2c; FTTÇ- 1b	PÇB- 3a, c	PÇB- 3a, c; BİB- 2a	PÇB- 1f, 2a;	PÇB- 2a,e,3f			F:3
	2013	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	2
		Beceri	FTTÇ- 1a,b,c,d; BİB- 1a,b,c,d	FTTÇ- 1p		FTTÇ- 1p	FTTÇ- 2b, c	FTTÇ- 1b	BİB- 1b	FTTÇ- 1e,f,g	PÇB- 1d, 2c; FTTÇ- 1b	PÇB- 3a, c	PÇB- 3a, c; BİB- 2a	PÇB- 1f, 2a;	PÇB- 2a,e,3f			0

																		Toplam
HATALI	2012	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	2
		Beceri	FTTÇ- 1a,b,c,d; BİB- 1a,b,c,d	FTTÇ- 1p		FTTÇ- 1p	FTTÇ- 2b, c	FTTÇ- 1b	BİB- 1b	FTTÇ- 1e,f,g	PÇB- 1d, 2c; FTTÇ- 1b	PÇB- 3a, c	PÇB- 3a, c; BİB- 2a	PÇB- 1f, 2a;	PÇB- 2a,e,3f			0
	2013	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	1
		Beceri	FTTÇ- 1a,b,c,d; BİB- 1a,b,c,d	FTTÇ- 1p		FTTÇ- 1p	FTTÇ- 2b, c	FTTÇ- 1b	BİB- 1b	FTTÇ- 1e,f,g	PÇB- 1d, 2c; FTTÇ- 1b	PÇB- 3a, c	PÇB- 3a, c; BİB- 2a	PÇB- 1f, 2a;	PÇB- 2a,e,3f			0

																		Toplam
SINIRLARINDAN FAZLA	2012	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	3
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			0
	2013	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	0
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			0

																		Toplam
HİÇ	2012	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	0
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			F:6 B: 2 P:8 16
	2013	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	0
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			F:3 B:2 P:4 9

																		Toplam
KAZANIM İFADELERİ	2012	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	7
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			0
	2013	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	13
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			0

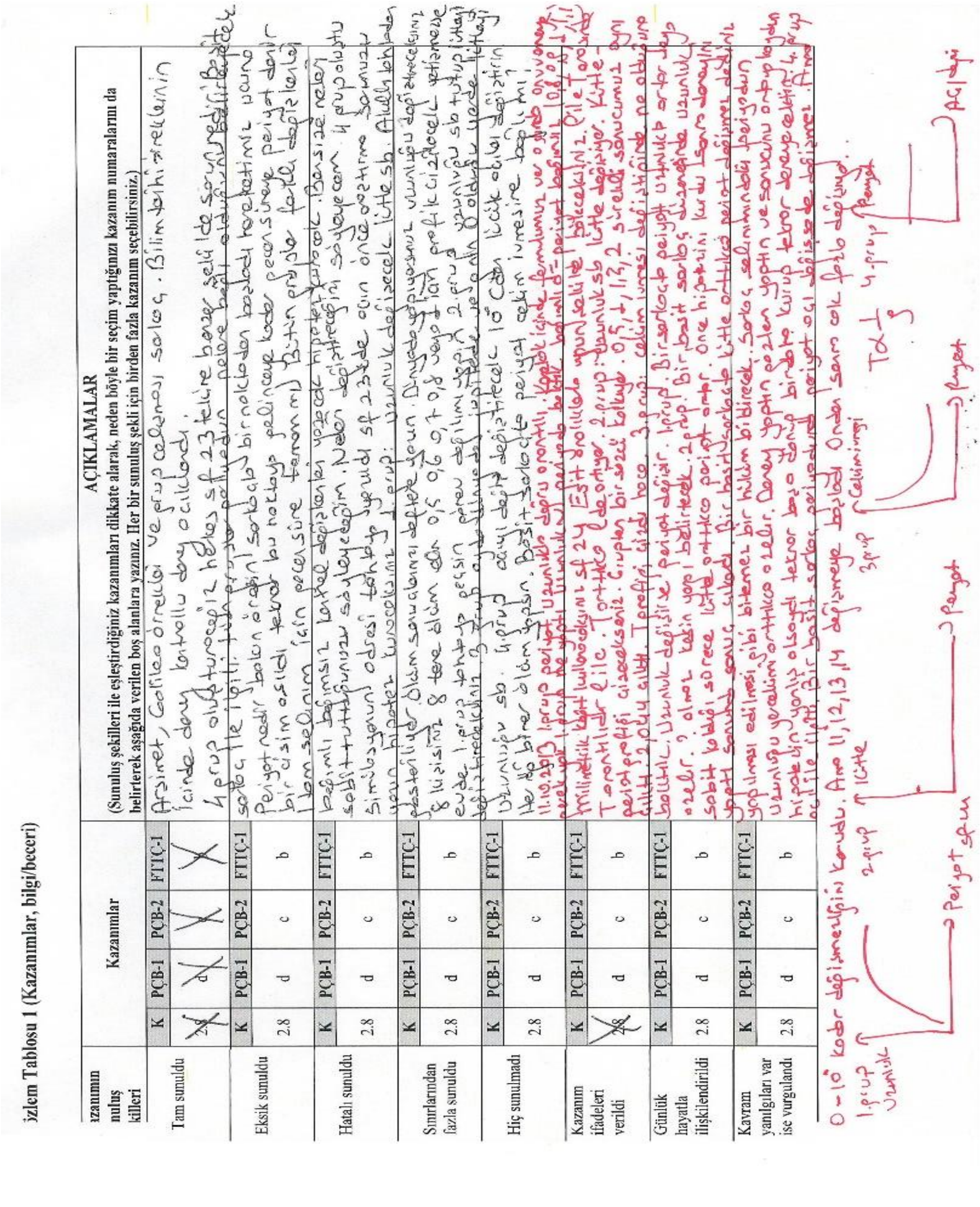
																		Toplam
GÜNLÜK HAYAT	2012	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	5
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			0
	2013	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	9
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			0

																		Toplam
KAVRAM YANILGILARI, UYARILAR	2012	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	4
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			0
	2013	Kazanım	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	O11	O12	O13	O14	O15	4
		Beceri	FTTÇ-1a,b,c,d; BİB-1a,b,c,d	FTTÇ-1p		FTTÇ-1p	FTTÇ-2b, c	FTTÇ-1b	BİB-1b	FTTÇ-1e,f,g	PÇB-1d, 2c; FTTÇ-1b	PÇB-3a, c	PÇB-3a, c; BİB-2a	PÇB-1f, 2a;	PÇB-2a,e,3f			0

No	Kavram yanılgıları/uyarılar	2012	2013
O7	2.2 ! Nitel ve nicel gözlemlerin birbirinin karşıtı olmadığı, aynı zamanda ikisinin de kullanılabileceği vurgulanır.	Verdi, eksik	Verdi
O5	4.1 ? Fizik ve teknoloji aynı şeylerdir.	Vermedi	Vermedi
O8	2.7 ? Tüm araştırmalarda tek bir bilimsel yöntem kullanılır.	Verdi, hatalı	Verdi
	? Kuramlar doğrulandığında yasalara dönüşür.	Verdi , hatalı	Verdi
	! Fizik ilkeleri, yasaları ve kuramları keşfedilirken insanların hayal gücü ve yaratıcılığının etkisi göz ardı edilmemelidir.	Vermedi	Verdi, eksik
	! Yasaların kurama veya kuramların yasaya dönüşemeyeceği vurgulanır.	Verdi, hatalı	Verdi, eksik
O9	! Hipotez, kuram ve yasa arasındaki farklar vurgulanır.	Verdi, hatalı	Verdi, hatalı
O11	3.1? Modeller gerçeği birebir temsil ederler.	Verdi, eksik	Verdi

APPENDIX T

DETAILED CODING EXAMPLE OF THE OBSERVATION FORM



özlem Tablosu 1 (Kazanımlar, bilgi/beceri)

ızanım nuluş killeri	Kazanımlar				AÇIKLAMALAR (Sunuluş şekilleri ile eşleştirdiğiniz kazanımları dikkate alarak, neden böyle bir seçim yaptığınızı kazanım numaralarını da belirterek aşağıda verilen boş alanlara yazınız. Her bir sunuluş şekli için birden fazla kazanım seçebilirsiniz.)
	K	PÇB-1	PÇB-2	FTTÇ-1	
Tam sunuldu	2.8	d	c	b	
Eksik sunuldu	2.8	d	c	b	
Hatalı sunuldu	2.8	d	c	b	
Sınırlarından fazla sunuldu	2.8	d	c	b	
Hiç sunulmadı	2.8	d	c	b	
Kazanım ifadeleri verildi	2.8	d	c	b	
Günlük hayatla ilişkilendirildi	2.8	d	c	b	
Kavram yanılgıları var ise vurgulandı	2.8	d	c	b	

APPENDIX U

PERMISSION FROM MoNE

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

Sayı : B.08.4.MEM.0.06.20.01-60599/ 81176 02/11/2012
Konu : Araştırma İzni
Özlem OKTAY

ORTA DOĞU TEKNİK ÜNİVERSİTESİNE
(Öğrenci İşleri Daire Başkanlığı)

İlgi: a) MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2012/13 nolu genelgesi.
b) Üniversitenizin 23/10/2012 tarih ve 12384 sayılı yazısı.

Üniversiteniz doktora öğrencisi Özlem OKTAY' ın **"İhtiyaç analizine dayalı geliştirilen hizmet içi eğitim programının fizik öğretmenlerinin sınıf içi uygulamalarına ve öğrencilerin başarılarına etkisi"** konulu araştırması ile ilgili çalışma yapması Müdürlüğümüzce uygun görülmüş ve araştırmanın yapılacağı İlçe Milli Eğitim Müdürlüğüne bilgi verilmiştir.

Mühürlü anketler (29 sayfadan oluşan) ekte gönderilmiş olup, uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitiminde iki örneğinin (CD/disket) Müdürlüğümüz Strateji Geliştirme Bölümüne gönderilmesini rica ederim.

Müberra OĞUZ
Müdür a.
Şube Müdürü

EKLER :
Anket (29 sayfa)

İl Milli Eğitim Müdürlüğü-Beşevler
Bilgi İçin:Nermin ÇELENK
Tel : 221 02 17
istatistik06@meb.gov.tr

APPENDIX V

PERMISSON OF IN-SERVICE TRAINING WORKSHOP FROM MoNE

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

Sayı : 44794289/774.01.04/1286110 07/06/2013
Konu: Fizik Bilimine Giriş Ünitesi Semineri

Sayın; Özlem OKTAY
Ortadoğu Teknik Üniversitesi OFMAE Bölümü Oda No: EF-212

İlgi : a) Valilik Makamının 06/06/2013 tarih ve 44794289/774.01.03/1267068 sayılı yazısı
b) Hizmetiçi Eğitim yönetmeliği
c) Özlem OKTAY'ın 03/06/2013 tarihli dileçesi

Ortadoğu Teknik Üniversitesi Eğitim Fakültesi OFMAE bölümünde düzenlenmesi uygun görülen 2013061377-2013061378 faaliyet numaralı "Fizik Bilimine Giriş Ünitesi Semineri" ile ilgili ilgi (a) Valilik onayı, program, görevlendirme listesi ve katılımcı listeleri ekte gönderilmiştir.

Kursiyerlere, eğitim merkezine ve eğitim merkezi müdürüne; eğitim yöneticisi ve eğitim görevlilerine, gerekli duyurunun yapılmasını ve faaliyet bitiş tarihinden itibaren en geç bir hafta içerisinde yönetici dosyasının Müdürlüğümüz İnsan Kaynakları Şubesi 4'e teslim edilmesini rica ederim.

Bekir YILMAZ
Müdür a.
Şube Müdürü

EKLER :
1- Valilik Onayı (1 adet)
2- Görevlendirme ve İsim Listesi (5 sayfa)
3- Program (2 sayfa)

Güvenli Elektronik İmzalı
Aslı İle Aynıdır.
10/6/201

Yaşar SUBAŞI
Şef

Bu belge, 5070 sayılı Elektronik İmza Kanununun 5 inci maddesi gereğince güvenli elektronik imza ile imzalanmıştır
Evrak teyidi http://evraksorgu.meb.gov.tr adresinden 37c9-6e3b-31e5-879c-073b kodu ile yapılabilir.

MEB.Beşevler Kampüsü İ-Blok 06648 Yenimahalle/ANKARA
Elektronik Ağ: www.meb.gov.tr
e-posta: hizmetici06@meb.gov.tr

Ayrıntılı bilgi için: Selda SELVİ VHKİ
Tel: (0 312) 212 76 41
Faks: (0 312) 212 76 41

APPENDIX W

NOP UNIT OBJECTIVES IN 2011 PHYSICS CURRICULUM

9. Sınıf Fizik Dersi Öğretim Programı

E. Öğrenci Kazanımları

1. ÜNİTE: FİZİĞİN DOĞASI

KAZANIMLAR	AÇIKLAMALAR
1. Fiziğin uğraş alanı ile ilgili olarak öğrenciler; 1.1 'Fizik nedir?' sorusuna cevap arar (FTTÇ-1.a,b,c,d; BİB-1.a-d). 1.2 Fiziğin, evrendeki nesne, olgu ve olayları değişik alt alanlarda incelediğinin farkına varır. 1.3 Fizikteki yasa (kanun) ve kuramların (teorilerin); kimya, biyoloji ve diğer bilim dallarındaki bazı olayları açıklamakta da kullanıldığına örnekler verir (FTTÇ-1.p; TD-2.e). **2. Fiziğin doğası ile ilgili olarak öğrenciler;** 2.1 Gözlem (nitel ve nicel) ve deney yapmanın fizikteki yeri ve önemini açıklar (FTTÇ-1.b). 2.2 Fiziksel olayların nicel gözlemlerinin nitel gözlemlerinden daha kesin ve objektif olduğunu karşılaştırmalar yaparak fark eder (BİB-1.b). 2.3 Fizikteki bazı temel büyüklükleri uygun ölçme aracı ve birim kullanarak ölçer (PÇB-1.f, 2.a; FTTÇ-1.h). 2.4 Fizikteki bazı temel büyüklüklerin birimlerini SI birim sisteminde tanımlayarak alt ve üst katlarına dönüştürür. 2.5 Yapılan her ölçümde hata olabileceğini ve bu hatanın ölçme yönteminden, ölçümü yapandan, ölçme aletinden ve ortamdan kaynaklandığını açıklar (PÇB-2.a,e, 3.f). 2.6 Fizikteki büyüklükleri skaler ve vektörel olarak sınıflandırır. 2.7 Fizik ilkelerine, yasalara ve kuramlara ulaşılırken bilimsel yöntemlerin kullanıldığının farkına varır (FTTÇ-1.e,f,g). 2.8 Belirlenen hipotezlerin ve kuramların sınanması için deneyler yapıldığını ifade eder (PÇB-1.d, 2.c; FTTÇ-1.b). **3. Fizikte Modelleme ve Matematiğin Yeri ile ilgili olarak öğrenciler;** 3.1 Fizik olaylarını açıklarken gerektiğinde modelleme ve matematiğin kullanıldığını örneklerle açıklar (PÇB-3.a,b,c; BİB-2.a). 3.2 Matematiğin; fizik yasa ve kuramlarının ifadelerinde vazgeçilmez bir dil olduğunu örneklerle açıklar (PÇB-3.a,b,c). **4. Fizik, Günlük Yaşam ve Teknoloji ile ilgili olarak öğrenciler;** 4.1 Fiziğin teknolojik gelişmelerdeki, teknolojik gelişmelerin de fiziğin gelişimindeki etkilerinin farkına varır (FTTÇ-2.a,b,c,d,e; TD-2.a,b, 3.c). 4.2 Vücudumuzun çalışmasında, yakın çevremizde ve yaşantımızda önemli yer tutan fizik ilke ve yasalarını örneklerle fark eder (FTTÇ-1.p; TD-2.c).	⇤⇥ **1.2** Alt alanlar ; Mekanik, Elektrik, Manyetizma, Optik, Termodinamik, Atom fiziği, Nükleer fizik ve Katıhal fiziği ile sınırlandırılmalıdır. Alt alanların ayrıntılı açıklamalarına girilmez [!] **1.3** Fen ve Teknoloji dersi kapsamında ve/veya güncel yaşamdan örnekler verilir. [!] **2.2** Nicel ve nitel gözlemlerin birbirinin karşıtı olmadığı, aynı zamanda ikisinin de kullanılabileceği vurgulanır. ⇤⇥ **2.3** Kütle, zaman, uzunluk, sıcaklık ve akım şiddeti ölçümlerine girilir; ışık şiddeti ve madde miktarı (mol) ölçümlerine girilmez. [!] **2.3** Yaygın olarak kullanılan çeşit kollu terazi, analog ve dijital banyo terazilerinin nasıl çalıştıkları açıklanır. ⇤⇥ **2.3** Binicili teraziler ile ilgili problem çözümlerine girilmez. [N] 2.3 Guillaume - 1920 ⇤⇥ **2.5** Heisenberg belirsizlik ilkesi ve dolayısı ile olayın doğasından kaynaklanan hatalara girilmez. ⇤⇥ **2.6** Vektörel işlemlere girilmez. ??? **2. 7** "Tüm araştırmalarda tek bir bilimsel yöntem kullanılır.", "Kuramlar doğrulandığında yasalara dönüşür." [!] **2.7** Bu kazanım, PÇB kazanımlarının tamamını içerdiğinden bilimsel yöntemin aşamaları özet olarak verilir. [!] **2.7** Fizik ilkeleri, yasaları ve kuramları keşfedilirken insanların hayal gücü ve yaratıcılığının etkisi göz ardı edilmemelidir. [!] **2.7** Yasaların kurama veya kuramların yasaya dönüşemeyeceği vurgulanır. [!] **2.8** Hipotez, kuram ve yasa arasındaki farklar vurgulanır. [!] **2.8** Fen ve Teknoloji dersi kapsamında ve/veya güncel yaşamdan örnekler verilir. 🔄 **4.2** 9. Sınıf, Enerji Ünitesi

🔄: Ders İçi İlişkilendirme, [N]: Nobel Fizik Ödülü, ⊡: Diğer Derslerle İlişkilendirme, ???: Kavram Yanılgısı, [!]: Uyarı, ⇤⇥: Sınırlamalar

APPENDIX X

GENERAL INFORMATION ABOUT WORKSHOP I

Haziran Dönemi

FİZİK BİLİMİNE GİRİŞ HİZMET İÇİ EĞİTİMİ KURSU PROGRAMI

EĞİTMENLER: Arş. Gör. Özlem Oktay
[redacted]
ve bütün katılımcı öğretmenler

Genel Açıklamalar:

Bu etkinlik gönüllülük esasına göre katılan öğretmenlerin 9. sınıf fizik öğretim programında bulunan fizik bilimine giriş ünitesindeki ihtiyaçları belirlenerek hazırlanmıştır. İhtiyaçların belirlenmesinde katılımcı öğretmenlerin görüşleri alınmış, dersleri gözlemlenmiş, öğrenci başarıları araştırılmış ve öğrencileriyle görüşmeler yapılmıştır. İlgili literatür çalışmaları incelenerek bir hizmet içi eğitim modeli ortaya çıkarılmıştır. Bu eğitim ile öğretmenlerimizin sınıf içi uygulamalarına olumlu yönde katkı sağlayacağı, derslerini çok daha zenginleştireceği buna bağlı olarak da öğrencilerinin başarısına olumlu bir etki yapacağı hedeflenmektedir. Gerçekleştirilecek faaliyetler onların motivasyonunu artıracak ve süreç sonunda ders içinde kullanacakları somut materyaller geliştirilmesi sağlanacaktır. Katılımcı öğretmenlerimize hizmet içi eğitim sonrasında da gerekli yardım devam ettirilecektir.

Bu hizmet içi eğitim;

- İçeriğin katılımcıların önceden belirlenen ihtiyaçlarına göre oluşturulan,
- Öğretmenlerin sınıf içi uygulamalarını ve öğrencilerinin başarısını göz önünde bulundıran,
- Öğretmenlerin zenginliklerinden yararlanılan ve onları eğitim süresince birer eğitmen kılan,
- Gelişimi sağlamak amacıyla eğitim süresi ve sonrasında destek sağlayan,
- Hem teorik boyutta hem de uygulama ağırlıklı aktif öğrenmeyi temel alan,
- Bildiklerini ve öğrendiklerini uygulama fırsatı sunan,
- Katılımcıların genel ihtiyaçlarını dikkate alan (ör; ortamın fiziksel koşulları)
- Eğitimin öncesinde, sürecinde ve sonrasında iletişimi sağlayan,
- Planlı olduğu kadar esnek bir programı olan,
- Eğitim süreci sürekli ve düzenli olarak devam eden,
- Bireysel çalışmalar yanında grup çalışmalarıyla takım ruhunu ön plana çıkaran,
- Katılımcılara hem öğrenen hem de eğitmen rolünü yükleyen,
- Eğitim öncesi, süresi ve sonrasında farklı ölçme-değerlendirme yaklaşımlarını kullanan,
- Eğitim sonunda ürün ortaya koyan,
- Üniversite ve Milli Eğitim Bakanlığı işbirliği içerisinde organize edilen,

yeni bir modeldir.

1

Programın kapsamı:

Bu hizmet içi eğitimde fizik öğretmenlerinin Fizik bilimine giriş ünitesinin öğretilmesinde bilgi, beceri ve deneyim kazanabilmeleri amacıyla aşağıda verilen 4 boyut kapsamında çalışmalar yapılacaktır. Bu boyutlar:

- Kazanımlar (bilgi/beceri)
- Öğretim yöntem/teknikleri (etkinlik, aktiviteler)
- Teknoloji/materyal
- Ölçme/değerlendirme alanlarından oluşmaktadır.

PROGRAM

Gün	Zaman	Konu	Eğitimci
11.06.2013 Salı	13:30-17:30	1. Oturum: Fizik Bilimine Giriş ünitesindeki kazanımlar (bilgi/beceri)	Özlem Oktay
13.06.2013 Perşembe	13:30-17:30	2. Oturum: Fizik Bilimine Giriş ünitesinde kullanılabilecek yöntem/teknik (etkinlik-aktivite) ve materyaller	Özlem Oktay
17.06.2013 Pazartesi	13:30-17:30	3. Oturum: Fizik Bilimine Giriş ünitesinde kullanılabilecek yöntem/teknik (etkinlik-aktivite) ve teknoloji	Özlem Oktay
19.06.2013 Çarşamba	13:30-17:30	4. Oturum: Bilim ve bilimsel bilgi hakkında karşılaşılan kavram yanılgıları.	
21.06.2013 Cuma	13:30-17:30	5. Oturum: Ölçme/değerlendirme yaklaşımları	

Not: Eğitim faaliyetleri Orta Doğu Teknik Üniversitesi Eğitim Fakültesi, OFMAE Bölümü dersliklerinde yapılacaktır.

APPENDIX Y

SUMMARY RESULTS OF TEACHERS' CLASSROOM OBSERVATIONS

Değerli öğretmenim, aşağıda özet şeklinde verilen gözlem sonuçları sadece sizlerle bulunabildiğim dersler ölçüsünde ve alınabilen notlar çerçevesinde oluşturulmuştur, gözden kaçan ve yeterince ifade edilemeyen kısımlarında olabileceği ihtimalini lütfen göz önünde bulundurunuz.

Kazanım (bilgi beceri)

Kazanım no	☺	😐	Gözlenemedi	Kazanım dışı
1.1		FTTÇ1d	FTTÇ1b,c, BİB1a,b,c,d	
1.2				
1.3	Örnekler	FTTÇ1p		4.2 vücudumuzun çalışması örnekleri, matematik bilimlerin dili vurgusu
2.1, 2.2	Nitel-nicel farkı,açıklama uyarı	BİB1b	FTTÇ1b	
2.3, 2.4	Ölçme araçları vurgusu Alt üst katın anlamı	6 temel büyüklükten bahsedildi (madde miktarı yok) PÇB 1f (sözlü ifade)	2.3; PÇB2a, dijital ve analog terazilerin nasıl çalıştıkları açıklanmadı	
2.5		PÇB 2e (sözlü ifade)	PÇB 2a, PÇB3f (detaylı gözlenemedi)	
2.6				Bazı örnekler (ör:ivme)
2.7, 2.8			Açıklamalar-uyarılar, hipotez tanımı dışında yasa teori ve aralarındaki farklar PÇB 1d,2c; FTTÇ1b,e,f,g	
3.1	Modelleme tanımı		PÇB3a,b,c, BİB2a	Model, hedef, kaynak
3.2			PÇB3a,b,c	
4.1		FTTÇ 2a,b,c	FTTÇ 2d, 2e	
4.2			Vucudumuzun çalışmasında kullanılan fizik ilke ve yasaları	

1.1 kazanımı ile verilmeyen FTTÇ1b kazanımı 1.2 kazanımdan sonra verildi☺

1.2 Atom fiziği ile nükleer fizik karıştırılıyor vurgusu ☺

Fizikokimya gibi iç içe geçmiş bilimler var ☺

2.7 ve 2.8: "Teori geniş bir evreni kapsıyorsa yasa olur" Esen yayınları, 6 basamağı sırasıyla iyi bilin vurgusu☹

"Bilimsel yöntemde tek bir yöntem vardır" ☹

Yöntem/Teknik (etkinlikler, aktiviteler)

Genel olarak düz anlatım ve öğrenci merkezli soru-cevap tekniği kullanılmıştır.
4.1 Bilim tarihi (Galileo teleskobu-Hubble teleskobu)

Ödevler

Konu sonlarında düzenli olarak ödev veriliyor.

Tekrarlar

Derse bir önceki dersin tekrarı ile başlanıyor.

Materyal/Teknoloji

Öğretmenin kendi notları
Dosya yayınları (bazı hatalı sorular içermekte, ör: sf. 27 2.7, 2.8 kazanımları ile ilgili)
Esen yayınları video izletme (2.3, 2.4, 2.6, 4.1, 4.2)

Ölçme/Değerlendirme

2 öğrenciye sözlü notu verildi.
Not verme amaçlı yapılan sınavda kapsam geçerliği % 80 olarak tespit edilmiştir. Boşluk doldurma, çoktan seçmeli, doğru yanlış türünde sorular kullanılmıştır.

Genel Olarak;

Ders boyunca düzenli dönüt alınıyor. Farklı soru türleri sorulup, ödevler düzenli kontrol ediliyor. Her ders öncesi diğer dersin tekrarı yapılarak konular arası bağlantılar iyi kuruluyor. Yöntem olarak soru cevap tekniği kullanılmakta. Akılda kalıcılğı sağlamak için bazen duyu (t)uyu=nitel tarzı şifrelemeler kullanılıyor. Öğrencileri aktif derse katacak farklı öğretim yöntemleri de kullanılabilir. Yukarıda kazanımlar için verilen gözlem sonuçlarına göre beceri kazanımları daha çok derslere yedirilebilir. Teknolojik kaynaklar kullanılmakta. Ek materyaller olarak çalışma yaprakları hazırlanabilir. Öğrencilerin seviyelerine uygun konu ile ilgili araştırma ödevleri verilebilir. Bu ünite için farklı amaçlı ölçme/değerlendirme yaklaşımları (gruplama amaçlı, zorlanılan konuları ölçmeye yönelik, süreci değerlendirmeye yönelik) kullanılabilir. Ünite yaklaşık olarak 10 saatte bitti.

APPENDIX Z

SUMMARY RESULTS OF STUDENTS' GROUP INTERVIEWS

Örnek-9A

Öğrencilerle yapılan ders değerlendirme görüşmelerinin sonuçları ve defterlerin incelenmesi

Konular - Öğrenemediğini düşünen öğrenci yüzdesi (%)

Fiziğin tanımı	% 61
Fiziğin alt alanları	% 83
Fiziğin diğer bilim dallarıyla ilişkisi	% 56
Fizikteki temel büyüklükler, bunların ölçülmesi ve birimleri	% 72
Birimlerin dönüştürülmesi	% 78
Skaler ve vektörel büyüklükler	% 44
Bilimsel yöntem ve basamakları	% 61
Hipotezin tanımı	% 56
Teorinin tanımı	% 28
Yasanın tanımı	% 28
Fizikte matemetiğin kullanımı	% 50
Fizik ve teknoloji arasındaki ilişki	% 44
Fizik ilke ve yasalarının vücudumuzun çalışmasında ve çevremizdeki önemi	% 83

Açıklama: %10'un üzerinde olan veriler yazılmıştır.

Bu konuları öğrenemediğini düşünen öğrencilerin söylediği bazı nedenler

- Fiziğin tanımı, alt alanları ve diğer bilim dallarıyla ilişkisi çok hızlı geçildi, az örnek verildi.

Ünitede derslerin işlenişi ile ilgili öğrenci düşünceleri

Aktif katılım sağlandı.	% 44
Soru-cevap tekniği kullanıldı.	% 28

Öğrencilerin üniteye karşı tutumu

Sınıf mevcudunun %80' i ünitenin güncel hayat ile ilgili ve genel kültür açısından önemli olduğunu söylediler.

Ünitenin işlenişine yönelik öğrenci istekleri

- Deneyler, etkinlikler yapılması
- Görsel öğelerin daha fazla kullanılması
- Derste yapılan ekstra şeylerden sözlü notu alma

Defterlerin incelenmesi (2 defter)

☺

Deftere yazdırılanlar ve derste tahtaya yazılanlar aynen not alınmış.

Defterler arası içerik farklılıkları yok. Konular başlıklar halinde kısa ve öz olarak not tutturulmuş.

☹

Konu içeriğinin çoğunun deftere yansıtılmasına rağmen bazı eksikler var (ör:hipotez, teori, yasa kavramları, 4.2 kazanımı ile ilgili bilgiler).

APPENDIX AA

SUMMARY RESULTS OF STUDENTS' ACHIEVEMENT TEST

9M

FİZİĞİN DOĞASI ÜNİTESİ BAŞARI TESTİ SONUÇLARI

Kazanım (bilgi/beceri)	Doğru yapan öğrenci yüzdesi (%)		Yanlış yapan öğrenci yüzdesi (%)		Bilmiyorum işaretleyen öğrenci yüzdesi (%)		Boş bırakan öğrenci yüzdesi (%)	
	Ön-test	*Son-test*	*Ön-test*	*Son-test*	*Ön-test*	*Son-test*	*Ön-test*	*Son-test*
1.1	30	45	54	55	10		6	
1.2	38	59	20	25	23	16	19	
1.3	21	12	45	52	12	10	23	26
2.1	69	79	16	21	8		7	
2.2	56	47	44	48		5		
2.3	23	22	75	78	2			
2.4	6	17	24	49	40	25	30	9
2.5	4	28	28	62	36	10	32	
2.6	12	28	28	67	56	5	4	
2.7	49	80	36	17	13	3	2	
2.8	39	36	36	51	22	6	3	7
3.1	77	81	16	18	5	1	2	
3.2	36	47	44	48	12	5	8	
4.1	27	43	26	14	10	13	37	30
4.2	57	66	24	22	10	11	9	1
FTTÇ1								
a	30	45	54	55	10		6	
b	48	51	32	49	11		9	
c	32	24	44	76	12		12	
d	44	45	32	52	12	3	12	
e	24	52	32	38	16	10	28	
f	24	52	32	38	16	10	28	
g	24	52	32	38	16	10	28	
h	23	22	75	78	2			
p	26	30	42	45	12	11	20	14
FTTÇ-2								
b	29	45	28	24	9	5	34	26
c	24	41	23	18	11	6	42	35
BİB-1								
a	64	67	28	33	8			
b	64	67	28	33	8			
c	64	67	28	33	8			
d	64	67	28	33	8			
BİB-2								
a	10	6	48	19	14	14	28	26
PÇB-1								
d	14	14	67	67	5	5	14	14
f	23	22	75	78	2			
PÇB-2								
a	23	16	75	52	2	10		22
c	64	86	16	10	8	4	12	
e	34	62	24	33	26	5	16	
PÇB-3								
a	29	34	32	26	17	10	22	13
c	10	6	48	19	14	14	28	26
f	4	28	28	62	36	10	32	

APPENDIX AB

GENERAL NOTES 1 (DELIVERING CONTENT/SKILL OBJECTIVES)

Genel notlar 1 (kazanım, bilgi/beceri)

- Kazanım ifadeleri konunun anlatılma biçimine göre ilgili yerde açıkça ifade edilmelidir.

(Öğrencilere sorulduğunda bazı konuların işlenilmediği söylenilmiştir. Örneğin, 4.2 kazanımı çoğunlukla 1.1,1.2 ve 1.3 kazanımlarında verildiği halde açıkça ifade edilmemesi, öğrencide konunun işlenilmediği yargısına varmasına neden olmuştur.)

- Beceri kazanımlarına bilgi kazanımları gibi mümkün olduğunca yer verilmelidir.

(Eski programdaki FTTÇ, BİB, PÇB kazanımlarından uygun olanlar yeni programda ilgili yerlere kodlanmıştır. Beceri kazanımları öncelikle önerilen yerlerde, istenildiği taktirde ise uygun görülen başka kazanımlarla birlikte verilmelidir.)

- Konu dışı tartışmalar, seviye üstü bilgiler ve konu içinde kısaca bahsedilmesi gereken kısımların ayrıntılı olarak anlatılmasından kaçınılmalıdır.

(Isı-sıcaklık, mutlak sıcaklık, kütle-ağırlık, nükleer santraller avantaj/ dezavantajları, termodinamik 0,1,2 yasası, Angström uzunluk birimi, fotometreler, Kelvin, Celcius termometrelerinin oluşturulması, ölçeklendirilmesi, akım çeşitleri (doğru, alternatif), eşit zıt vektörler ve özellikleri, terazi problemlerinin çözümü, momentum kavramları, alan hacim dönüşümleri, genel ve özel görelilik teorileri, vb. Fen ve Teknoloji (yeni adıyla Fen Bilimleri) dersi kapsamında ve/veya güncel yaşamdan örnekler kullanımına özen gösterilmesi.)

- Eski programda bloklar arası (4 blok) kazanımlardaki yer değiştirmeler (önce veya sonra anlatımlar) çok önerilmemiştir. Yeni programda da bu noktaya dikkat edilmelidir. Bloklar arasında uygun gördüğümüz yerlerde ise kazanımların sıralarında değişiklikler yapabiliriz.

(1.3 anlatılırken 3.1 ve 3.2 nin anlatılması istenmeyen bir durumken, 1.1 kazanımından sonra 1.3 ve sonrasında 1.2 nin anlatılması olabilir.)

DİKKAT!

APPENDIX AC

MODIFIED VERSION OF THE ISOP THE UNIT CURRICULUM OBJECTIVES CONSIDERING THE NOP UNIT

FİZİĞİN DOĞASI & FİZİK BİLİMİNE GİRİŞ

9. SINIF	2007 ÖĞRETİM PROGRAMI	2013 ÖĞRETİM PROGRAMI
Adı:	Fiziğin Doğası	Fizik Bilimine Giriş
Programdaki yeri:	1.ünite	1.ünite
Kazanım sayısı:	15	4
Ders saati:	9	8

9.1.1.1. Fizik biliminin amacının farkında olur (1.1) **ve fiziği diğer disiplinlerle** (1.3) **ve teknoloji ile ilişkilendirir** (4.1).

a. Öğrencilerin "Fizik nedir?", "Neden ve niçin fizik öğrenmeliyim?' sorularına cevap aramaları sağlanır. (1.1) (FTTÇ-1a,b,c,d) (BİB-1a,b,c,d) (4.2) (FTTÇ-1.p)
b. Öğrencilerin fizik bilimine değer vermeleri ve fizik biliminin uygulama alanları ile ilgili farkındalık oluşturmaları sağlanır. (1.2) (1.3) (FTTÇ-1.p)
c. Öğrencilerin fizik bilgisinin tarih boyunca gelişiminin farkında olmaları için bilim tarihinden örnekler sunulur. (FTTÇ-1a,b,c,d)
ç. Öğrencilerin tarih boyunca teknolojide ve fizik biliminde meydana gelen gelişmelere öncülük eden kişi ve olayları tartışmaları sağlanır. (4.1) (FTTÇ-2b,c)
d. Öğrencilerin farklı meslek dallarında fizik biliminin rolünü araştırmaları sağlanır. (BİB-1a,b,c,d)

9.1.1.2. Bilimsel bilginin ortaya çıkışında ve gelişiminde gözlem, (2.1) (FTTÇ-1b) (2.2) (BİB-1b), **deney,** (2.8), **matematik** (3.2) (PÇB-3a, c) **ve rasyonel düşüncenin rolünün farkında olur.**

a. Öğrencilerin bilimin belirli bir yöntem takip etmediğini anlayabilmeleri için bilim tarihinden örnekler sunulur. (2.7) (FTTÇ-1e,f,g)
b. Öğrencilerin bilimsel bilginin gelişim sürecini fark etmelerini sağlayan etkinlikler yapılır. (2.8) (PÇB-1d) (PÇB-2c) (FTTÇ-1b)
c. Öğrencilerin delil ve çıkarım arasındaki ilişkiyi tartışmaları sağlanır.

9.1.1.3. Fizik olaylarını açıklarken gerektiğinde matematik ve modellemelerin kullanılmasının gerekliliğini fark eder. (3.1) (PÇB-3a, c) (BİB-2a)

9.1.1.4. Ölçüm yapmanın ve birim sisteminin kullanılma gerekliliğini açıklar. (2.3) (PÇB-1f) (PÇB-2a) (2.5) (PÇB-2a,e) (PÇB-3f)

a. Bilim tarihinden örnekler vererek öğrencilerin temel birimleri ortaya çıkaran ihtiyacı fark etmeleri sağlanır.
b. Öğrencilerin temel büyüklüklerin birimlerini SI birim sisteminde tanımlamaları sağlanır. (2.4)
c. Fiziksel büyüklüklerin skaler ve vektörel olarak sınıflandırılmasının nedenleri açıklanır. (2.6)
ç. Öğrencilerin fen bilimleri dersinde öğrendikleri büyüklükler üzerinden örnekler verilir.
d. Birim dönüştürme (2.4) ve vektörel işlemlere (2.6) girilmez.

APPENDIX AD

2013 9th GRADE ISOP UNIT OBJECTIVES

Ortaöğretim Fizik Dersi Öğretim Programı

9. SINIF FİZİK DERSİ ÖĞRETİM PROGRAMI

Temel düzey olan 9. sınıf fizik dersi öğretim programı fen bilimleri dersi öğretim programının devamı niteliğindedir. Bu programın en genel amacı bilimsel okur-yazarlığın geliştirilmesidir. 9. sınıf fizik derslerinde öğrenciler yaşamlarında sıklıkla karşılaştıkları olayları ve problemleri bilimsel bilgiler ışığında açıklayabilmeli, yorumlayabilmeli ve çözümler üretebilmelidir. 9. sınıf fizik derslerinde öğrencilerin detaylı matematiksel işlemlere girmeden fizik bilimi içinde yer alan madde, enerji, kuvvet ve hareket ile ilgili temel kavramları anlamlandırmaları hedeflenmektedir. Temel düzey fizik derslerinde öğrencilerin sadece zihinsel alanda bir gelişim sağlamaları değil, aynı zamanda duyuşsal ve psikomotor alanlarda da ilerlemeleri sağlanmalıdır. Fiziğin günlük hayatla ilişkisi kurularak fiziğin sınıf dışına taşınabileceği ve etrafımızda gerçekleşen olayları açıklayan bir bilim dalı olduğu anlayışı geliştirilmelidir.

Üniteler ve Zaman Dağılımı

Ünite No	Ünite Adı	Kazanım Sayısı	Süre	
			Ders Saati	Yüzde (%)
1	Fizik Bilimine Giriş	4	8	11,1
2	Madde ve Özellikleri	8	12	16,7
3	Kuvvet ve Hareket	13	20	27,8
4	Enerji	6	14	19,4
5	Isı ve Sıcaklık	12	18	25,0
	Toplam	43	72	100

9.1. Fizik Bilimine Giriş

Bu ünitede öğrencilerin; fizik biliminin amacının, bilimsel bilginin gelişim sürecinin ve fiziksel büyüklüklerin özelliklerinin farkında olmaları amaçlanmıştır. Ünitenin diğer amaçları ise öğrencilerin fiziğin diğer bilim alanları ve teknolojiyle olan ilişkilerini görmeleri ve fizik bilimine yönelik olumlu değerler geliştirmeleridir.

Kavramlar/Terimler: Bilim, gözlem, deney, ölçme, modelleme, birim sistemleri, vektörel ve skaler büyüklükler
Önerilen Süre: 8 saat

9.1.1. Fizik Bilimine Giriş

9.1.1.1. Fizik biliminin amacının farkında olur ve fiziği diğer disiplinlerle ve teknoloji ile ilişkilendirir.

a. Öğrencilerin "Fizik nedir?", "Neden ve niçin fizik öğrenmeliyim?' sorularına cevap aramaları sağlanır.

b. Öğrencilerin fizik bilimine değer vermeleri ve fizik biliminin uygulama alanları ile ilgili farkındalık oluşturmaları sağlanır.

c. Öğrencilerin fizik bilgisinin tarih boyunca gelişiminin farkında olmaları için bilim tarihinden örnekler sunulur.

ç. Öğrencilerin tarih boyunca teknolojide ve fizik biliminde meydana gelen gelişmelere öncülük eden kişi ve olayları tartışmaları sağlanır.

d. Öğrencilerin farklı meslek dallarında fizik biliminin rolünü araştırmaları sağlanır.

9.1.1.2. Bilimsel bilginin ortaya çıkışında ve gelişiminde gözlem, deney, matematik ve rasyonel düşüncenin rolünün farkında olur.

a. Öğrencilerin bilimin belirli bir yöntem takip etmediğini anlayabilmeleri için bilim tarihinden örnekler sunulur.

b. Öğrencilerin bilimsel bilginin gelişim sürecini fark etmelerini sağlayan etkinlikler yapılır.

c. Öğrencilerin delil ve çıkarım arasındaki ilişkiyi tartışmaları sağlanır.

9.1.1.3. Fizik olaylarını açıklarken gerektiğinde matematik ve modellemelerin kullanılmasının gerekliliğini fark eder.

9.1.1.4. Ölçüm yapmanın ve birim sisteminin kullanılma gerekliliğini açıklar.

a. Bilim tarihinden örnekler vererek öğrencilerin temel birimleri ortaya çıkaran ihtiyacı fark etmeleri sağlanır.

b. Öğrencilerin temel büyüklüklerin birimlerini SI birim sisteminde tanımlamaları sağlanır.

c. Fiziksel büyüklüklerin skaler ve vektörel olarak sınıflandırılmasının nedenleri açıklanır.

ç. Öğrencilerin fen bilimleri dersinde öğrendikleri büyüklükler üzerinden örnekler verilir.

d. Birim dönüştürme ve vektörel işlemlere girilmez.

APPENDIX AE

COMMON TOPICS IN THE 2011 NOP AND THE 2013 ISOP UNITS

2013	2011	Ortak (genel)	Ortak (spesifik) O: Observation
9.1.1.1. Fizik biliminin amacının farkında olur. 9.1.1.1.a. Öğrencilerin "Fizik nedir?", "Neden ve niçin fizik öğrenmeliyim?' sorularına cevap aramaları sağlanır.	1.1'Fizik nedir?' sorusuna cevap arar (FTTÇ-1.a,b,c,d; BİB-1.a-d). 4.2 Vücudumuzun çalışmasında, yakın çevremizde ve yaşantımızda önemli yer tutan fizik ilke ve yasalarını örneklerle fark eder (FTTÇ-1.p) 4.2 9. Sınıf, Enerji Ünitesi (Açıklama-ders içi ilişkilendirme)	Fizik bilimi ve amacı	O1:Fizik nedir? O2:Fizik biliminin amacı (neden ve niçin fizik öğrenmeliyim?)
9.1.1.1.Fiziği diğer disiplinlerle ilişkilendirir. 9.1.1.1.b. Öğrencilerin fizik bilimine değer vermeleri ve fizik biliminin uygulama alanları ile ilgili farkındalık oluşturmaları sağlanır.	1.2 Fiziğin evrendeki nesne, olgu ve olayları değişik alt alanlarda incelediğinin farkına varır. 1.2 Alt alanlar; Mekanik, Elektrik, Manyetizma, Optik, Termodinamik, Atom fiziği, Nükleer fizik ve Katıhal fiziği ile sınırlandırılmalıdır. Alt alanların ayrıntılı açıklamalarına girilmez. (Açıklama-sınırlama) 1.3 Fizikteki yasa (kanun) ve kuramların (teorilerin); kimya, biyoloji ve diğer bilim dallarındaki bazı olayları açıklamakta da kullanıldığına örnekler verir (FTTÇ-1.p) 1.3 Fen ve Teknoloji dersi kapsamında ve/veya güncel yaşamdan örnekler verilir. (Açıklama-uyarı)	Fiziğin uygulama alanları ve diğer disiplinlerle ilişkisi	O3:Fiziğin uygulama alanları, alt alanlar O4:Fiziğin diğer disiplinlerle (kimya, biyoloji, vb.) ilişkisi
9.1.1.1. Fiziği teknoloji ile ilişkilendirir. 9.1.1.1.ç. Öğrencilerin tarih boyunca teknolojide ve fizik biliminde meydana gelen gelişmelere öncülük eden kişi ve olayları tartışmaları sağlanır.	4.1Fiziğin teknolojik gelişmelerdeki, teknolojik gelişmelerin de fiziğin gelişimindeki etkilerinin farkına varır (FTTÇ- 2.b,c)	Fizik ve teknoloji ilişkisi	O5:Fizik ve teknoloji ilişkisi
9.1.1.2. Bilimsel bilginin ortaya çıkışında ve gelişiminde gözlem,	2.1 Gözlem (nitel ve nicel) ve deney yapmanın fizikteki yeri ve önemini açıklar (FTTÇ-1.b).	Bilimsel bilginin	O6: Bilimsel bilginin ortaya

deney, matematik ve rasyonel düşüncenin rolünün farkında olur.	2.2 Fiziksel olayların nicel gözlemlerinin nitel gözlemlerinden daha kesin ve objektif olduğunu karşılaştırmalar yaparak fark eder (BİB-1.b). 2.2 Nicel ve nitel gözlemlerin birbirinin karşıtı olmadığı, aynı zamanda ikisinin de kullanılabileceği vurgulanır. (Açıklama-uyarı)	ortaya çıkışında ve gelişiminde gözlemin rolü	çıkışında ve gelişiminde gözlemin rolü O7:Nitel-nicel gözlem ilişkisi
9.1.1.2.a. Öğrencilerin bilimin belirli bir yöntem takip etmediğini anlayabilmeleri için bilim tarihinden örnekler sunulur.	2.7 Fizik ilkelerine, yasalara ve kuramlara ulaşılırken bilimsel yöntemlerin kullanıldığının farkına varır (FTTÇ-1.e,f,g). 2. 7 "Tüm araştırmalarda tek bir bilimsel yöntem kullanılır." (Açıklama-kavram yanılgıları) "Kuramlar doğrulandığında yasalara dönüşür." (Açıklama-kavram yanılgıları) 2.7 Bu kazanım, PÇB kazanımlarının tamamını içerdiğinden bilimsel yöntemin aşamaları özet olarak verilir. (Açıklama-sınırlama) 2.7 Fizik ilkeleri, yasaları ve kuramları keşfedilirken insanların hayal gücü ve yaratıcılığının etkisi göz ardı edilmemelidir. (Açıklama-sınırlama) 2.7 Yasaların kurama dönüşemeyeceği vurgulanır. (Açıklama-sınırlama) 2.7 Kuramların yasaya dönüşemeyeceği vurgulanır. (Açıklama-sınırlama)	Bilimsel yöntemler, bilginin ortaya çıkışı ve gelişimi	O8: Bilimsel yöntemler, bilginin ortaya çıkışı ve gelişimi (yasa, kuram, hayal gücü ve yaratıcılık)
9.1.1.2. Bilimsel bilginin ortaya çıkışında ve gelişiminde gözlem, deney, matematik ve rasyonel düşüncenin rolünün farkında olur. 9.1.1.2.b. Öğrencilerin bilimsel bilginin gelişim sürecini fark etmelerini sağlayan etkinlikler	2.8 Belirlenen hipotezlerin ve kuramların sınanması için deneyler yapıldığını ifade eder (PÇB-1.d, 2.c; FTTÇ-1.b). 2.8 Hipotez, kuram ve yasa arasındaki farklar vurgulanır. (Açıklama-uyarı) 2.8 Fen ve Teknoloji dersi kapsamında ve/veya güncel yaşamdan örnekler verilir. (Açıklama-uyarı)	Bilimsel bilginin ortaya çıkışında ve gelişiminde deneyin rolü	O9: Bilimsel bilginin ortaya çıkışında ve gelişiminde deneyin rolü (hipotez, kuram yasa arasındaki farklar)

yapılır.			
9.1.1.2. Bilimsel bilginin ortaya çıkışında ve gelişiminde gözlem, deney, matematik ve rasyonel düşüncenin rolünün farkında olur.	3.2 Matematiğin; fizik yasa ve kuramlarının ifadelerinde vazgeçilmez bir dil olduğunu örneklerle açıklar (PÇB-3.a, c).	Bilimsel bilginin ortaya çıkışında ve gelişiminde matematiğin rolü	O10: Bilimsel bilginin ortaya çıkışında ve gelişiminde matematiğin rolü
9.1.1.3. Fizik olaylarını açıklarken gerektiğinde matematik ve modellemelerin kullanılmasının gerekliliğini fark eder.	3.1 Fizik olaylarını açıklarken gerektiğinde modelleme (I) ve matematiğin (II) kullanıldığını örneklerle açıklar (PÇB-3.a, c; BİB-2.a).	Fizikte matematik ve modellemeler in kullanımı	O11: Fizikte matematik ve modellemelerin kullanımı
9.1.1.4. Ölçüm yapmanın ve birim sisteminin kullanılma gerekliliğini açıklar.	2.3 Fizikteki bazı temel büyüklükleri uygun ölçme aracı ve birim kullanarak ölçer (PÇB-1.f, 2.a; FTTÇ-1.h). 2.3 Kütle, zaman, uzunluk, sıcaklık ve akım şiddeti ölçümlerine girilir; ışık şiddeti ve madde miktarı (mol) ölçümlerine girilmez. (Açıklama-sınırlama) 2.3 Binicili teraziler ile ilgili problem çözümlerine girilmez. (Açıklama-sınırlama) 2.5 Yapılan her ölçümde hata olabileceğini ve bu hatanın ölçme yönteminden, ölçümü yapandan, ölçme aletinden ve ortamdan kaynaklandığını açıklar (PÇB-2.a,e, 3.f). 2.5 Heisenberg belirsizlik ilkesi ve dolayısı ile olayın doğasından kaynaklanan hatalara girilmez. (Açıklama-sınırlama)	Fizikteki bazı temel büyüklükleri n ölçülmesi, ölçmede hata ve birim sisteminin kullanımı	O12:Fizikteki bazı temel büyüklüklerin ölçülmesi ve birim sistemi O13: Ölçmede hata ve hata kaynakları
9.1.1.4.b. Öğrencilerin temel büyüklüklerin birimlerini SI birim sisteminde tanımlamaları sağlanır.	2.4 Fizikteki bazı temel büyüklüklerin birimlerini SI birim sisteminde tanımlayarak (I) alt ve üst katlarına dönüştürür (II)	Fizikteki bazı temel büyüklükleri	O14: Fizikteki bazı temel büyüklüklerin

		n birimlerini SI birim sisteminde tanımlama	birimlerini SI birim sisteminde tanımlama
9.1.1.4.c. Fiziksel büyüklüklerin skaler ve vektörel olarak sınıflandırılmasının nedenleri açıklanır. 9.1.1.4.d. Vektörel işlemlere girilmez.	2.6 Fizikteki büyüklükleri skaler ve vektörel olarak sınıflandırır. 2.6 Vektörel işlemlere girilmez. (Açıklama-sınırlama)	Fizikteki büyüklükleri skaler ve vektörel olarak sınıflandırma	O15:Fizikteki büyüklükleri skaler ve vektörel olarak sınıflandırma

APPENDIX AF

ACTIVITY 1 AND 2 WORKSHEETS

ETKİNLİK 1

Uluslar arası Birim Sistemi (SI) temel büyüklükler tablosu

Temel Büyüklük	Sembolü	Temel Birim	Sembolü

ETKİNLİK 2

Skaler-vektörel büyüklükler tablosu

Skaler Büyüklükler	Vektörel Büyüklükler

APPENDIX AG

SELF EVALUATION FORM ABOUT THE SESSIONS OF WORKSHOP I

OTURUMUN DEĞERLENDİRİLMESİ

Bugün katılmış olduğunuz oturumu, aşağıda geçen ifadelerle "1"'den "5"'e kadar derecelendirerek değerlendiriniz.

	1	2	3	4	5
1. Eğitimde geçen zaman etkin kullanıldı.					
2. Katılımcılar birbirleriyle iletişim kurabildi.					
3. Oturumun amacına ulaşıldı.					
4. Süre yeterliydi.					
5. Öğrendiklerim bana katkı sağladı.					
6. Oturuma katıldığım için memnunum.					

Yukarıda bahsi geçen konular dışında <u>olumlu ve/veya olumsuz</u> eklemek istediğiniz hususlar var ise;

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Katkılarınız için teşekkür ederiz.

APPENDIX AH

GENERAL NOTES 2 (THE USE OF INSTRUCTIONAL STRATEGY)

Genel notlar 2 (yöntem/teknik)

- Geleneksel öğretim yöntemlerinin yanında kazanımların doğasına uyan öğrenciyi aktif derse katacak öğrenci merkezli farklı öğretim yöntemleri kullanılmalıdır.

(Kazanıma uygun olarak daha çok indüktif (öğrenci merkezli), gerektiğinde ise dedüktif (öğretmen merkezli) yaklaşımlar kullanılmalıdır, Örneğin: 1.3, 2.3 kazanımları.

Kitap okuma parçaları, çalışma yaprakları okunduktan ya da anlatıldıktan sonra öğrencinin düşüncelerini almak, konuşturmak aktifliği sağlayabilir.)

- Kullanılan yöntem/teknikler (etkinlik, demolar, vb.) konu anlatılırken ilgili yerde verilmelidir.

- Ödevler yeri geldiğinde kullanılmalı, verildiği zaman ise kontrol edilmelidir.

(Konuya ait, sınırı aşmayan bilgi ve beceriyi geliştirmeye yönelik ödevler verilmeli, bireysel eksiklikler var ise ödevler öğrenciye özel düzenlenmelidir.)

- Araştırma ödevleri konuya uygun ise verilebilir.

(Kısa sürede kontrol edilebilen ödevlere, dersin bazı bölümlerinde öğrenciye konuşma fırsatı sağlanarak dönüt verilebilir.)

- Tekrarlar yapılmalı, mümkünse öğrenciye yaptırılmalıdır.

DİKKAT !

APPENDIX AI

SIMPLE PENDULUM ACTIVITY WORKSHEET

Etkinlik: Basit Sarkaç

İlgili Olduğu Kazanımlar: 9.1.1.2, 9.1.1.3
Etkinlikte Kullanılan Yöntem/Teknik: Sorgulayıcı Araştırma

Araç-Gereçler:
Bir adet lastik top (veya ping-pong topu), kronometre (cep telefonlarının birçoğunda da bulunmaktadır), metre, terazi (eşit kollu veya dijital), naylon ip, makas, açıölçer, mili metrik grafik kağıdı veya hesap çizelgesi programları (M.S. Excel gibi), internet erişimi olan bilgisayar.

Amaçlar:
Öğrencilerin,

- Bilimsel bilginin ortaya çıkışında gözlem ve deneyin rolünü kavraması,
- Bilimsel süreç becerilerini kullanması (gözlem, hipotez kurma, ölçme, veri toplama, verileri kaydetme, veri işleme ve model oluşturma, yorumlama, sonuç çıkarma ve sunma becerileri)

Etkinliğin Yapılışı:
Öğrenciler lastik top ve naylon ip ile bir sarkaç oluştururlar. Gönüllü bir öğrenciden bu sarkacı alıp sınıfta bulunan bir sıranın üzerine çıkması istenir. Daha sonra ikinci bir gönüllü öğrencinin düşey doğrultuda dengede olan sarkaçtan yaklaşık 1 metre uzakta durması sağlanır. Üçüncü bir öğrenci ise, ikincisi ile aynı mesafede zıt yönde topu yüzüne kadar çekip ileri doğru itmeden serbest bir şekilde bırakır.
Öğretmen sınıfta öğrencilerle birlikte aşağıda yazılı soruları tartışır:

1. Topun karşında bulunan öğrenciye top çarpar mı?
2. Top salınıma bırakıldığında bundan sonraki hareketi için ne söyleyebilirsiniz?
3. Top bırakıldığı noktaya tam bir salınım yapıp geri döndüğünde ne kadar süre geçer?
4. Topun tam bir salınım yapması için geçen süreyi etkileyebilecek nedenler neler olabilir?

4.soru için öğrencilerden gelen yanıtlar tahtaya yazılır ve öğretmen 4-5 kişilik gruplardan, sarkacın kütlesi, ipin uzunluğu, bırakma açısı, yerçekimi ivmesi nedenlerinden birisini seçmelerini ister (Eğer bu nedenlerden birisi öğrencilerden gelmediyse, öğretmen bu nedenin de salınım süresini etkileyebileceğini ifade ederek bu nedeni de tahtaya yazar).

Araştırma sorusu: Basit sarkacın salınım süresini nelere bağlıdır?

1. **Yol:** Her bir grup okuldaki laboratuvar şartlarının ve zamanın uygun olması durumunda ifade edilen problemin çözümüne yönelik bir deney tasarlar.
2. **Yol:** http://phet.colorado.edu/tr/simulation/pendulum-lab web sayfasından (veya uygun başka bir basit sarkaç simülasyonu) basit sarkaç simülasyonu kullanılabilir.

Öğretmenin Rolü: Öğrencilerin bilimsel bilgiye ulaşmasında yol göstericidir. Deney düzeneklerinin kurulması veya simülasyon programının kullanılmasında gerektiğinde yardımcı bir rol üstlenmelidir.

Çalışma Kâğıdı 1

(Sarkacın kütlesi ve sarkacın salınım süresi arasındaki ilişkiyi çalışan grup için)

Tasarlayacağınız deneyde veya basit sarkaç simülasyonunda neyi öğrenmek istediğinizi aşağıdaki tabloya kısaca yazınız.

Ne öğrenmek istiyoruz?
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Deneyle ilgili kuracağınız hipotezinizi aşağıdaki boşluğa yazınız.

Hipotez
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Bu deneydeki bağımlı ve bağımsız değişken(ler)i aşağıdaki tabloya yazınız.

Bağımlı değişken(ler)	**Bağımsız değişken(ler)**	**Sabit değişken(ler)**

Deneyin yapılışı:

Simülasyon programında kütle dışında diğer parametreleri <u>belirli bir değerde sabit tutunuz</u>. Kütle butonundan sarkacın kütlesine bağlı olarak salınım süresini tespit ederek aşağıdaki tabloyu doldurunuz. Sarkacın salınım süresi için sağ sütunda yeşil bir tablo üzerinde verilmiş olan “zaman ölçer” seçeneğinin üzeri tıklanmalı ve sarkacın ucunda bulunan kütle üzerine bilgisayarın faresi basılı tutup sağa veya sola çekilerek bırakıldıktan sonra zaman ölçer üzerinde "başlat"a basılmalıdır

Sarkacın kütlesi (kg)	**Salınım süresi (s)**

Bir önceki basamakta elde ettiğiniz bulgulardan salınım süresinin sarkacın kütlesine bağlı grafiğini çiziniz. Grafik çiziminizi mili metrik kağıt üzerinde ya da bilgisayar ortamında yapabilirsiniz.

Etkinlik sonunda bu derste öğrendiklerimizi aşağıdaki tabloya yazalım.

Ulaştığımız sonuç (çıkarım)
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Çalışma Kâğıdı 2

(İpin uzunluğu ve sarkacın salınım süresi arasındaki ilişkiyi çalışan grup için)

Tasarlayacağınız deneyde veya basit sarkaç simülasyonunda neyi öğrenmek istediğinizi aşağıdaki tabloya kısaca yazınız.

Ne öğrenmek istiyoruz?
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Deneyle ilgili kuracağınız hipotezinizi aşağıdaki boşluğa yazınız..

Hipotez
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Bu deneydeki bağımlı ve bağımsız değişken(ler)i aşağıdaki tabloya yazınız.

Bağımlı değişken(ler)	**Bağımsız değişken(ler)**	**Sabit değişken(ler)**

Simülasyon programında ipin uzunluğu dışında diğer parametreleri belirli bir değerde sabit tutunuz. Uzunluk butonundan sarkacın uzunluğuna bağlı olarak salınım süresini tespit ederek aşağıdaki tabloyu doldurunuz. Sarkacın salınım süresi için sağ sütunda yeşil bir tablo üzerinde verilmiş olan "zaman ölçer" seçeneğinin üzeri tıklanmalı ve sarkacın ucunda bulunan kütle üzerine bilgisayarın faresi basılı tutup sağa veya sola çekilerek bırakıldıktan sonra zaman ölçer üzerinde "başlat"a basılmalıdır.

İpin uzunluğu (m)	**Salınım süresi (s)**

Bir önceki basamakta elde ettiğiniz bulgulardan salınım süresinin ipin uzunluğuna bağlı grafiğini çiziniz. Grafik çiziminizi mili metrik kağıt üzerinde ya da bilgisayar ortamında yapabilirsiniz.

Etkinlik sonunda bu derste öğrendiklerimizi aşağıdaki tabloya yazalım.

Ulaştığımız sonuç (çıkarım)
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Çalışma Kâğıdı 3

(Bırakma açısı ve sarkacın salınım süresi arasındaki ilişkiyi çalışan grup için)

Tasarlayacağınız deneyde veya basit sarkaç simülasyonunda ne veya neleri öğrenmek istediğinizi aşağıdaki tabloya kısaca yazınız.

Ne öğrenmek istiyoruz?
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Deneyle ilgili kuracağınız hipotezinizi aşağıdaki boşluğa yazınız..

Hipotez
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Bu deneydeki bağımlı ve bağımsız değişken(ler)i aşağıdaki tabloya yazınız.

Bağımlı değişken(ler)	**Bağımsız değişken(ler)**	**Sabit değişken(ler)**

Simülasyon programında bırakma açısı dışında diğer parametreleri belirli bir değerde sabit tutunuz. Sarkacın üzerine bilgisayarın faresine tıklayarak sola veya sağa çekerek bırakma açısını belirleyiniz. Bırakma açısına bağlı olarak salınım süresini tespit ederek aşağıdaki tabloyu doldurunuz. Sarkacın salınım süresi için sağ sütunda yeşil bir tablo üzerinde verilmiş olan "zaman ölçer" seçeneğinin üzeri tıklanmalı ve sarkacın ucunda bulunan kütle üzerine bilgisayarın faresi basılı tutup sağa veya sola çekilerek bırakıldıktan sonra zaman ölçer üzerinde "başlat"a basılmalıdır

Bırakma açısı (derece)	Salınım süresi (s)

(Uyarı: Basit sarkacın yaptığı küçük genlikli salınımlar ($\theta \sim \leq 10°$) eş zamanlıdır.)

Bir önceki basmakta elde ettiğiniz bulgulardan salınım süresini sarkacı bırakma açısı ile ilişkilendiren bir grafik çiziniz. Grafik çiziminizi mili metrik kağıt üzerinde ya da bilgisayar ortamında yapabilirsiniz.

Etkinlik sonunda bu derste öğrendiklerimizi aşağıdaki tabloya yazalım.

Ulaştığımız sonuç (çıkarım)
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Çalışma Kâğıdı 4

(Yerçekimi ivmesi ile ve sarkacın salınım süresi arasındaki ilişkiyi çalışan grup için)

Tasarlayacağınız deneyde veya basit sarkaç simülasyonunda neyi öğrenmek istediğinizi aşağıdaki tabloya kısaca yazınız.

Ne öğrenmek İstiyoruz?
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Deneyle ilgili kuracağınız hipotezinizi aşağıdaki boşluğa yazınız..

Hipotez
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Bu deneydeki bağımlı ve bağımsız değişken(ler)i aşağıdaki tabloya yazınız.

Bağımlı değişken(ler)	**Bağımsız değişken(ler)**	**Sabit değişken(ler)**

Simülasyon programında diğer parametreleri sabit tutarak sadece yerçekimi ivmesini Dünya, ay, Jüpiter'de seçerek salınım süresini buna bağlı olarak aşağıdaki tabloyu doldurunuz. Sarkacın salınım süresi için sağ sütunda yeşil bir tablo üzerinde verilmiş olan "zaman ölçer" seçeneğinin üzeri tıklanmalı ve sarkacın ucunda bulunan kütle üzerine bilgisayarın faresi basılı tutup sağa veya sola çekilerek bırakıldıktan sonra zaman ölçer üzerinde "başlat"a basılmalıdır.

Yerçekimi ivmesi (m/s^2)	Salınım süresi (s)
Dünya	
Ay	
Jüpiter	

Not: Jüpiter'deki yerçekimi ivmesi Dünya'dakinin yaklaşık 2,6 katı iken, Ay'da Dünya'nın 1/6'sıdır.

Etkinlik sonunda bu derste öğrendiklerimizi aşağıdaki tabloya yazalım.

Ulaştığımız sonuç (çıkarım)
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Sonuçlar: *(Bütün gruplar ile tartışma yapılacaktır)*

Her grup elde ettikleri bulguları sınıfta paylaşır. Daha sonra salınım süresine etki eden bütün faktörlerin topluca bir değerlendirilmesi yapılarak aşağıdaki tablo doldurulur.

Etkinlik sonunda bu derste öğrendiklerimizi aşağıdaki tabloya yazalım.

Bu deneyde ulaştığımız sonuçlar (çıkarımlar)
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Deneyde sarkacın tam bir salınım yapması için geçen süre ve bu süreyi etkiyen faktörler aşağıdaki şekilde simgelendiğinde,

Salınma süresi =T Sarkacın kütlesi: m yerçekimi ivmesi=g=9,81 m/s^2

İpin uzunluğu=L Bırakma açısı: θ

Değişkenler arası ilişkileri nasıl ifade edebilirsiniz? *Öğrencilerden sözel olarak değişkenler arası ilişkileri (doğru ve/veya ters orantılıdır şeklinde) söylemeleri istenir.*

Veya:

Değişkenler arasındaki matematiksel formül nasıl ifade edilebilir (π=3,14)? *şeklinde bir soru sorulduktan sonra aşağıdaki formül yazılarak,*

$$T^2 = 2\,\pi\,\frac{\text{Değişken veya değişkenler}}{\text{Değişken veya değişkenler}}$$

ilgili değişkenleri formulün uygun olan yerine yazmaları istenir.

Etkinliğin Genişletilmesi

(Sınıf düzeyine bağlı olarak isteğe göre uygulanabilir)

1. Öğrenciler;

- Sürtünmesiz ve yerçekiminin olmadığı ortamlarda deneyin sonuçları üzerinde tartışırlar.
- Tarih boyunca fizik biliminde basit sarkacın uygulama alanlarını ve bunlara öncülük eden bilim insanlarını araştırırlar.
- Bu etkinlikte öğrendikleri bilgileri günlük yaşamda nasıl kullanabileceklerini araştırırlar.

2.

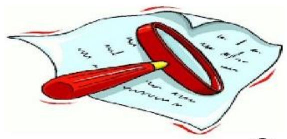
Sarkaçlı duvar saatlerinin diğer duvar saatlerinden farkı, saat içindeki dişlilere bağlı düz bir çubuğun ucunda kütle asılmasıdır. Saat çalışırken çubuk, ucundaki kütle ile belirli bir aralıkta salınır. Duvar saatleri, saniyeleri vurma zamanı değiştirilerek ayarlanırken sarkaçlı saatler, çubuğun ucundaki kütlelerin biraz yukarı çıkarılması veya biraz aşağı indirilmesiyle ayarlanır. Peki, bu durum saatin hızlı veya yavaş çalışmasını nasıl etkiler?

3. Dünya üzerindeki değişik noktalarda yerçekimi ivmesi %0,5'lere kadar değişmektedir. Dolayısıyla, mesela Glasgow, İskoçya'da ($g = 9.81563\ m/s^2$) bulunan hassas bir sarkaçlı saatin, Kahire, Mısır'a ($g = 9.793\ 17\ m/s^2$) getirildiğinde doğru ölçüm yapması için sarkacın boyunu nasıl değiştirilmelidir? *(Sadece kısaltılması veya uzatılması nedeni tartışılmalıdır. Sınıf düzeyine bağlı olarak sayısal değişim araştırma ödevi olarak verilebilir).*

4. Sarkaçlı duvar saati Ay'da Dünya'ya göre; a) aynı saati gösterir, b) geri kalır, c) ileri gider. Cevabınızı kısaca yazınız.

APPENDIX AJ

SCIENCE AND SOCIETY ACTIVITY WORKSHEET



Adınız-Soyadınız:

TOPLUM ÜYESİNE AİT NOTLAR

Bilim insanlarının araştırma yaparken izlediği yollar:

Bilim insanlarının araştırma sürecinde topladığı veriler:

Bilim insanlarının elde ettiği verilerden ulaştıkları sonuçlar (çıkarımlar):

Araştırma sürecinde bilim insanları birbirleriyle iletişime geçti mi? Geçtiyse sonuçlara ulaşmada kurmuş oldukları iletişimin etkisi ne oldu?

Adınız-Soyadınız:

BİLİM İNSANINA AİT NOTLAR

Toplum hakkında araştırma yaparken izlediğiniz yollar:

Araştırma sürecinde topladığınız veriler:

Verilerden elde ettiğiniz sonuçlarınız (çıkarımlarınız):

Araştırma sürecinde diğer bilim insanlarıyla iletişime geçtiniz mi? Geçtiyseniz sonuçlara ulaşmada kurmuş olduğunuz iletişimin etkisi ne oldu?

APPENDIX AK

GENERAL NOTES 3 (THE USE OF MATERIAL/TECHNOLOGY)

Genel notlar 3 (materyal/teknoloji)

- Kazanımlara uygun materyaller seçilmeli, fazla ayrıntı içeren kısımlar izletilmemelidir.
- Görselliği sağlayan, öğrenmeyi kalıcı hale getiren teknoloji destekli materyallerin (video, simülasyon, ppt sunumları, animasyon vb.) konuları anlatırken kullanılması mümkün olduğu sürece sağlanmalıdır.
- Materyallerin çok önce ve çok sonra kullanılmasından ziyade ilgili kazanım anlatıldığı sırada kullanılması önemlidir.
- Materyal/teknoloji kullanılırken mümkün olduğunca üzerinde konuşulup tartışılması, yönteme dahil edilmesi seçilen materyalin etkili kullanımını sağlayabilir.
- İlgili materyalin uygulanmadan önce hatalı bilgi içerip, içermediği kontrol edilmelidir.
- Bir materyal olarak çalışma yaprakları, konuyu özetleyen kısa notlar hazırlanması, öğrencinin dersten sonra konuyu tekrar etme, pekiştirme yapması açısından istenilen bir yaklaşımdır.

  (Yapılan mülakatlarda öğrenciler; defterlerinde olmadığı için bazı konuların işlenmediğini söylemişlerdir. Bazı öğrencilerin defterlerinde ise hatalı ve eksik bilgilerin bulunduğu tespit edilmiştir. Hazırlanacak özet içeren materyallerle söz konusu sorunların düzeltilmesi sağlanabilir.)

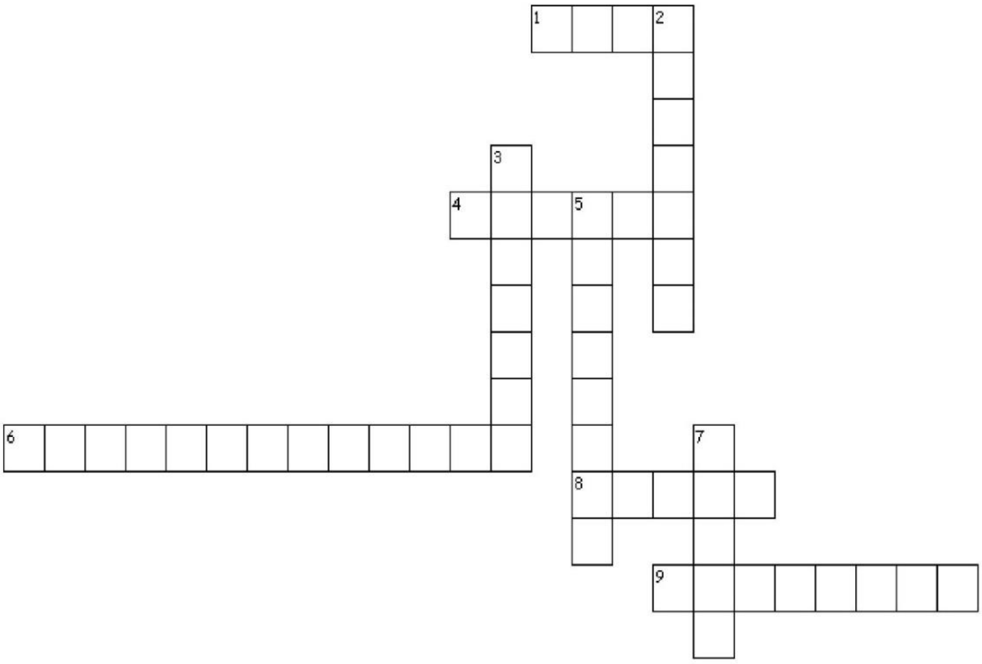
DİKKAT !

APPENDIX AL

PUZZLE ACTIVITY

Fizik Bilimine Giriş Ünitesi Çapraz Bulmaca Etkinliği

(9.1.1.1 kazanımı için oluşturulmuştur)



Soldan sağa

1. Democritus'tan günümüze kadar elde edilen yeni bilgiler ışığında yapısını açıklamak için modellemelerden yararlanılan kimya ve fiziğin ortak konusu

4. Hareket ve kuvvet arasındaki ilişkiyi tanımlayan bilim adamı

6. Islanmayan kumaşın üretilmesinde kullanılan teknoloji

8. Işığın davranışını inceleyen fiziğin alt alanı

9. Projelerini çizerken yük ve malzemelerin fiziksel özelliklerini fizik bilgilerini kullanarak inceleyen bir meslek dalı

Yukarıdan aşağıya

2. Buluttan kopan yağmur damlasının yere hangi hızla düşeceğini inceleyen fiziğin alt dalı

3. Yer kabuğunda meydana gelen kırılmaları, yer kabuğunun yapısı, depremin şiddetini ve oluşturduğu etkileri incelerken fizik bilimini kullanan disiplin

5. Günümüz uzay araştırmalarının vazgeçilmez aracı

7. Doğanın işleyişini anlamaya ve açıklamaya çalışan bilim dalı

APPENDIX AM

GENERAL NOTES 4 (THE USE OF ASSESSMENT)

Ek bilgi

Genel notlar 4 (ölçme/değerlendirme)

Test sonuçlarını sayısallaştırma, durum belirleme işlemine **ölçme**, elde edilen sonuçlardan yola çıkarak öğrenciler hakkında karar verme sürecine de **değerlendirme** denir.

Savunulabilir bir soru yazmak için genel olarak aşağıdaki noktaları dikkate almak gerekmektedir:(Gronlund,1990; Haladayna 1997)

1. Sorunun kapsamı testin amacıyla ve ölçülmek istenen süreçle uyum içerisinde olmalıdır.
2. Sorunun kapsamı konu alanının önemli bir bölümünü yansıtmalıdır.
3. Sorunun kapsamı ilgisiz, yanıt için gerekli olmayan durumları içermemelidir.
4. Belirsiz anlaşılması güç ifadeler kullanılmamalıdır.
5. Ezbere dayalı bilgi yerine temel becerilerde (gözlem tahmin, ölçüm, sınıflandırma vb.) üst düzey süreçlere (değişkenlerin belirlenmesi, hipotez kurma, deneyyapma, modelleme, vb.) ağırlık verilmelidir.
6. Kullanılan dil iletişimi aksatmayacak netlikte ve sadelikte olmalıdır.
7. Testin tümünde bir soruya verilen yanıt diğer sorudaki yanıtı etkileyecek şekilde birbirine bağımlı olmamalıdır.
8. Sorunun kapsamı belli gruplara (cinsiyet gibi) yanlılık yaratacak ifadelerden arınık olmalıdır.
9. Sorular mümkün olduğunca olumlu ifadeler kullanılarak yazılmalıdır, gerekli değilse olumsuz cümle kullanımından kaçınılmalıdır.
10. Soru için seçilen materyaller (okuma metni, deney düzeneği, grafik vs) ilgili yaş grubunun okuma düzeyine, yaşam becerilerine, hayal dünyalarına uygun olmalıdır.

Farklı öğretim tekniklerinin (Yazılı, sözlü sınavlar, ödevler ve projeler, vb.) kullanılması etkili bir ölçme değerlendirme için önemlidir. Ayrıca tek bir soru formatı ile gerçekleştirilen değerlendirme süreci eksik kalır. Öğrencilerin hangi konuları ne düzeyde öğrendiğini ortaya çıkarmak için ne kadar **farklı format (kısa yanıtlı sorular, doğru/yanlış, eşleştirme, çoktan seçmeli, açık uçlu, vb.)** kullanılırsa o kadar iyi olur.

Berberoğlu G.(2006) Sınıf içi ölçme değerlendirme teknikleri. Morpa Kültür Yayınları.

Genel olarak Ölçme/Değerlendirme aşağıdaki 4 amaç için yapılmaktadır:

- Ön bilgi/beceri düzeyini ölçerek gruplama amaçlı değerlendirme yapabilme (gruplama)
- Zorlanılan konuları ortaya çıkarmaya yönelik ölçme-değerlendirme yapabilme (diagnostik)
- Öğrenme sürecinde neyin bilinip/bilinmediğini belirlemeye yönelik ölçme ve değerlendirebilme yapabilme (formatif)
- Ünite sonunda ulaşılan en son düzeyi belirleme amaçlı ölçme-değerlendirme yapabilme (summatif)

APPENDIX AN

ANXIETY/MOTIVATION SURVEY EXAMPLE

Her bir cümleyi dikkatli okuduktan sonra, cümleye ne derecede katıldığınızı veya katılmadığınızı belirtmek için yanındaki seçeneklerden size en uygun olanına ait parantezin içine (X) işareti koyunuz.

Cümleler	**Kesinlikle katılırım**	**Katılırım**	**Kararsızım**	**Katılmam**	**Kesinlikle katılmam**
Fizik bilimine giriş ünitesinde öğrenci motivasyonu					
Fizik bilimine giriş ünitesinde becerilerimi geliştirmek istiyorum.					
Fizik bilimine giriş ünitesi ile ilgili daha çok şey öğrenmek istiyorum.					
Zorunlu derslerimin dışında da fizik bilimine giriş ünitesini almak isterim.					
Eğitim hayatım boyunca mümkün olduğu kadar fizik bilimine giriş ünitesini almak istiyorum.					
Fizik bilimine giriş ünitesinde başarı motivasyonu					
Fizik bilimine giriş ünitesinde başarılı olmak için elimden geleni yaparım.					
Fizik bilimine giriş ünitesinde elimden gelenin en iyisini yapmaya çalışırım.					
Fizik bilimine giriş ünitesinde başarısız olduğumda daha çok çabalarım.					
Fizik bilimine giriş ünitesinde yapılacak iş ne kadar zor olursa olsun, elimden geleni yaparım.					
Fizik bilimine giriş ünitesinde sınav kaygısı					
Yakın bir zamanda olacağım fizik bilimine giriş ünitesindeki sınavı düşünmek beni kaygılandırır.					
Fizik bilimine giriş ünitesinde sınav olmak beni kaygılandırır.					
Fizik bilimine giriş ünitesindeki sınavlar beni korkutur.					
Fizik bilimine giriş ünitesindeki sınava çalışamak beni kaygılandırır.					
Fizik bilimine giriş ünitesindeki sınavlar kendimi sinirli hissetmeme sebep olur.					
Fizik bilimine giriş ünitesine karşı kaygı					
Fizik bilimine giriş ünitesinde kendimi gergin hissederim.					
Fizik bilimine giriş ünitesi ile ilgili derse gitmek beni kaygılandırır.					
Fizik bilimine giriş ünitesi, kendimi rahatsız ve sinirli hissetmeme neden olur.					
Fizik bilimine giriş ünitesi, kendimi tedirgin ve şaşkın hissetmeme neden olur.					
Fizik bilimine giriş ünitesiyle uğraşmak zorunda olmak beni dehşete düşürür.					

APPENDIX AO

DIAGNOSTIC TEST FORMAT EXAMPLE

1) Araştırma laboratuvarlarında kullanılan birçok bilimsel model (örneğin DNA modeli ve atom modeli) gerçeğin kopyasıdır.

(Lütfen A'dan G'ye kadar okuyunuz ve sizin görüşünüze uygun olan bir seçeneği işaretleyiniz).

Bilimsel modeller gerçeğin kopyasıdır.

A. Çünkü bilim insanları böyle söyler.
B. Çünkü birçok bilimsel kanıt onların **gerçek** olduğunu kanıtlamıştır.
C. Çünkü onlar **hayatın gerçekleridir**. Amaçları bize gerçekleri göstermektir.
D. Çünkü onlar bilimsel gözlem ve araştırmalara dayanır.

Bilimsel modeller gerçeğin kopyaları değildir.

E. Çünkü sadece kendi sınırları içinde öğrenme ve açıklamaya yardım ederler.
F. Çünkü onlar da teoriler gibi, zamana ve bilgimizin durumuna göre değişir.
G. Çünkü onlar düşünce ya da tahminlerden oluşur.

Yukarıda size uygun bir seçenek yoksa, lütfen bu konudaki görüşlerinizi aşağıdaki boşluğa yazınız.

…………………………………………………………………………………………………
…………………………………………………………………………………………………

Yukarıdaki soruya verdiğiniz cevaptan ;

a) Kesinlikle eminim b) Eminim c) Emin değilim d) Kesinlikle emin değilim

2) En iyi bilim insanları bilimsel yöntem basamaklarını izleyenlerdir.

(Lütfen A'dan E'ye kadar okuyunuz ve sizin görüşünüze uygun olan bir seçeneği işaretleyiniz).

A. Çoğu bilim insanı, geçerli, açık, mantıklı ve kesin sonuçlar sağlaması nedeniyle ***bilimsel yöntemi*** izler.
B. Okulda öğrendiğimize göre, bilimsel yöntem birçok bilim insanı için uygun olandır (problemi tespit etmek, veri toplamak, hipotez kurmak, kontrollü deney yapmak vs.).
C. En iyi bilim insanları bilimsel yöntemin yanında özgünlük ve yaratıcılığı da kullanacaklardır.
D. En iyi bilim insanları hayal gücü ve yaratıcılığı içeren, ***herhangi bir yöntemle*** sonuca ulaşabilirler.
E. Birçok bilimsel keşif, bilimsel yönteme bağlı kalmadan ***tesadüfen*** keşfedilmiştir.

Yukarıda size uygun bir seçenek yoksa, lütfen bu konudaki görüşlerinizi aşağıdaki boşluğa yazınız.

…………………………………………………………………………………………………
…………………………………………………………………………………………………

Yukarıdaki soruya verdiğiniz cevaptan ;

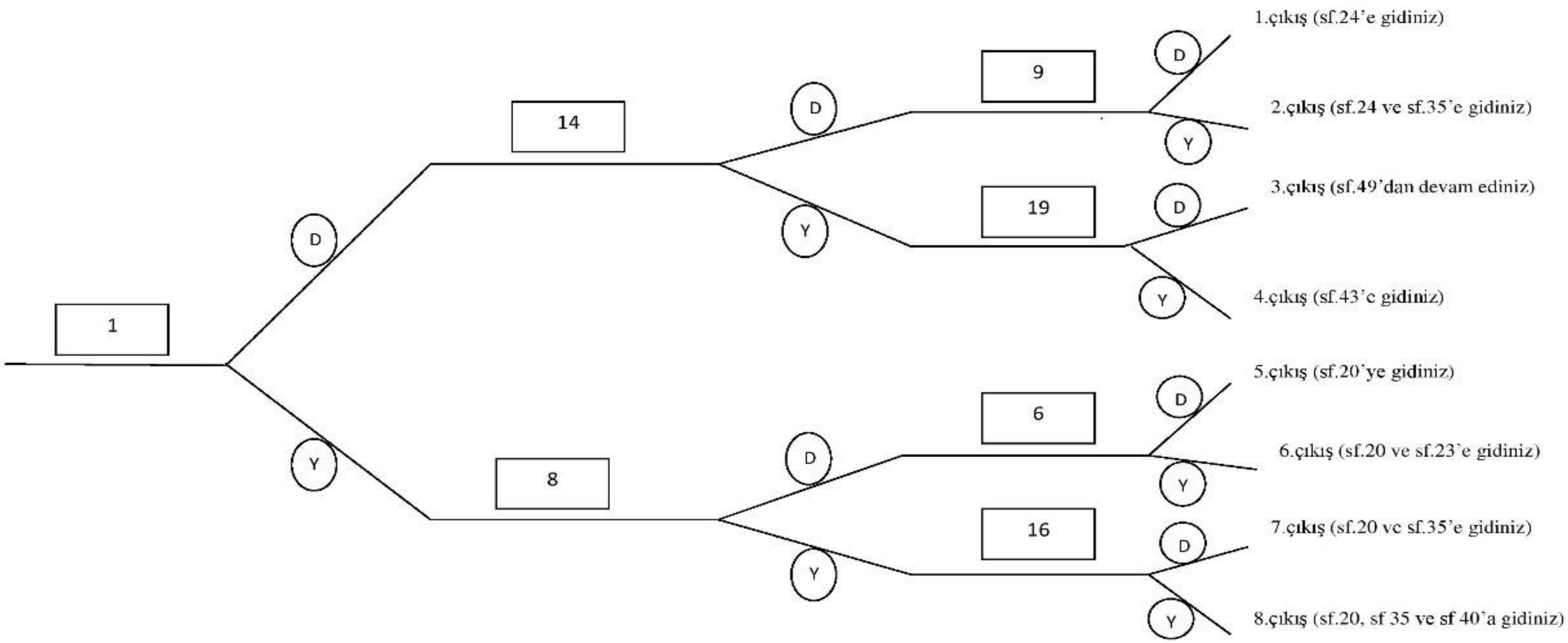
a) Kesinlikle eminim b) Eminim c) Emin değilim d) Kesinlikle emin değilim

APPENDIX AP

BRANCHED TREE EXAMPLE

Açıklama: İfadelerin sol kısmında bulunan ilk numaralar ifadelerin numaraları, altındaki numaralar ise yeni programda ifadelerin ilgili olduğu kazanım numaralarıdır.

	İfadeler
1 **1, 2**	Fizik biliminde sınama, sorgulama doğrulama, yanlışlama ve delillere dayandırma vardır.
2 **1**	Fizikteki bilgiler ivmeli olarak artarak gelişir.
3 **2**	Yeni bir delil ortaya çıktığında mevcut bilimsel bilgi sınanarak düzeltilmez ve yenilenmez.
4 **1**	Fizik bilimindeki bilgiler her şartta geçerli ve mutlak doğrudur.
5 **2**	Gözlem yalnız ölçme araçları kullanılarak yapılır.
6 **2**	Nicel gözlemler nitel gözlemlere göre daha kesin ve objektiftir.
7 **2**	Nitel ve nicel gözlemler birbirinin karşıtı olmamakla beraber aynı zamanda ikiside kullanılabilir.
8 **4**	Yapılan her ölçmede hata vardır.
9 **4**	Ölçmede hata oranlarını azaltmak için yeterli sayıda ölçüm yapılır.
10 **2**	Tüm araştırmalarda tek bir bilimsel yöntem kullanılır.
11 **2**	Teoriler (kuramlar) doğrulandığında yasalara (kanunlara) dönüşür.
12 **2**	Fizik ilke ve yasaları keşfedilirken insanların hayal gücü ve yaratıcılıklarının hiçbir etkisi yoktur.
13 **2**	Yasalar doğrulandığında teorilere dönüşür.
14 **2**	Bilimsel yasalar kesin değişmezdir.
15 **2**	Bilgiye ulaşmak için temel yol deneydir; gözlem matematik ve rasyonel düşüncenin (akıl yolu ile) rolü yoktur.
16 **2**	Teori ve yasalar farklı türden bilgilerdir.
17 **2**	Teoriler gözlenebilen olaylar arasındaki ilişkileri tanımlar.
18 **2**	Yasalar gözlenebilen olayların niye gerçekleştiğini açıklamaya çalışır.
19 **1**	Fizik ve teknoloji karşılıklı etkileşim içindedir.
20 **3**	Modeller gerçeği birebir temsil ederler.
21 1	Fizik ve teknoloji aynı şeylerdir.



1: sf. 20, 14: sf. 24, 8: sf. 35, 9: sf. 35, 19: sf. 43, 6: sf. 23, 16: sf. 40
Eski 9. sınıf M.E.B kitabındaki sayfa numaralarına göre hazırlanmıştır.

APPENDIX AQ

AN EXAMPLE TEST FOR FORMATIVE AND SUMMATIVE PURPOSES

Fizik Bilimine Giriş Sınavı

(Bu sınav, eğitime katılan öğretmenlerimizin not verme amaçlı hazırladıkları ve bizimle paylaştıkları sınavlardan derlenerek oluşturulmuştur.)

Aşağıdaki cümlelerde boş bırakılan yerleri uygun ifadelerle doldurunuz.

1. Madde ve enerji arasındaki ilişkileri inceleyen bilim dalı ……………………………………dır.
2. ………………….; bilimsel bir problemin verilere dayalı olarak kurulan geçici çözüm yoludur.
3. ……………….. fizik yasa ve teorilerinin ifade edilmesinde vazgeçilmez bir dildir.
4. Doğada karşımıza problem olarak çıkan olgu ve olaylara çözüm getirmek, onları anlayıp kavramlarla tanımlayıp ilkelerle açıklamak için izlenen yol …………………………dir.
5. Fizik, kendi yaşantımdaki

1. ………………………………	2. ……………………………………...
3. …………………………….....	4. ……………………………………..

olaylarıyla ilgilenen bir bilim dalıdır.

A) Aşağıdaki cümlelerde doğru olanların başına (D), yanlış olanların başına (Y) yazınız.

1. ( ) Nicel gözlemler nitel gözlemlere göre daha kesin sonuçlar verir.
2. ( ) Bilim insanları, yaptıkları bilimsel çalışmalarda nitel ve nicel gözlemleri bir arada kullanırlar.
3. ( ) Fizikte teorilerin test edilmesi için deney yapmak kaçınılmazdır.
4. ( ) Atom modellerinin zaman içerisinde değişikliğe uğraması fiziğin sorgulanabilir yanlışlanabilir bir yapısı olduğunu ortaya koyar.
5. ( ) Elektrik akımını ölçmek için ampermetre kullanılır.
6. ( ) Bilimsel teoriler zamanla yasa olur.
7. ( ) Bilimde mutlak doğru yoktur.
8. ( ) Tanımlamak için yöne ihtiyaç duyulan büyüklükler vektörel büyüklüktür.
9. ( ) Saat, SI birim sisteminde zaman ölçüsü birimidir.
10. ( ) Yalnızca güncel olaylarla ilgili model oluşturulabilir.
11. ( ) Fizikte modeller kavramın daha iyi anlaşılması için kullanılır.
12. ( ) Enerjinin madde içerisinde nasıl yayıldığını ve iletildiğini inceleyen fizik dalına mekanik denir.

B) Aşağıdaki çoktan seçmeli sorularda doğru seçeneği işaretleyiniz.

1. Çevremizde ve yaşantımızdaki bazı olayların açıklanmasında fizik önemli yer tutmaktadır. Aşağıdaki seçeneklerde verilen örnek olayı açıklayan fizik kavramı hangisinde yanlış olarak verilmiştir?

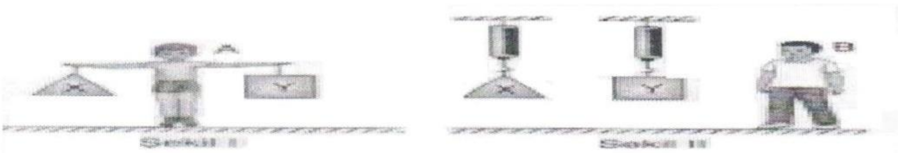
Örnek olay	İlgili fizik kavramı
a) Röntgen cihazı	Dalgalar
b) Tsunami	Kuvvet
c) Emniyet kemeri	Eylemsizlik
d) Mıknatıs	Elektriksel alan
e) Deprem	Dalgalar

2. Aşağıdaki cümlelerin hangisi fiziğin diğer bilim dallarındaki bazı olayları açıklamasına örnek değildir?
   a) Karışımların ayrıştırılması
   b) Gelgit olayı
   c) Bitkilerin köklerinden yapraklarına suyun çıkması
   d) Atmosferin değişimleri
   e) Nükleer santrallerde enerji üretilmesi

3. Atomdan yaklaşık on bin kez küçük olan çekirdeğinin yapısı ve kararsız çekirdeklerin ışımalarını araştıran bilim dalı aşağıdakilerden hangisidir?
   a) Termodinamik
   b) Manyetizma
   c) Atom fiziği
   d) Nükleer fizik
   e) Katı hal fiziği

4. Hipotezle ilgili olarak aşağıdakilerden hangisi yanlıştır?
   a) Gözlem sonucu yapılır.
   b) Deneysel sonuçlara uyabilir.
   c) Aksi ispatlanıyorsa vazgeçilebilir.
   d) Geçici çözümdür, doğruluğu kesinleşmemiştir.
   e) Yeni gerçeklerle hiçbir zaman desteklenmez.

5.



A öğrencisi Şekil I'deki X ve Y cisimlerini kaldırarak Y'nin ağırlığının X'ten büyük olduğunu söylüyor. B öğrencisi ise aynı cisimleri dinamometreye asarak X'in ağırlığının 15 N, Y'nin ağırlığının 25 N olduğunu tespit ediyor.
Buna göre;

I. A öğrencisi nitel gözlem yapmıştır.
II. A öğrencisi nicel B öğrencisi nitel bir gözlem yapmıştır.
III. B öğrencisi nicel gözlem yapmıştır.

yargılarından hangileri doğrudur?

A) Yalnız I
B) Yalnız I
C) Yalnız III
D) I ve II
E) I ve III

6. Aşağıdakilerden hangisi matematiğin fizikte vazgeçilmez bir dil olduğuna örnek değildir?
   a) d=m/v formülü ile yoğunluk, kütle ve hacim arasındaki ilişki ile bulunur.
   b) R=V/I formülü ile direnç, gerilim ve akım şiddeti ile hesaplanır.
   c) G=mg formülü ile ağırlık ile kütle arasındaki ilişki öz bir şekilde verilir.
   d) d maddeler için ayırt edici bir özelliktir.
   e) v=x/t bağıntısı ile birim zamanda alınan yolun hız olduğu ifadesi elde edilir.

7. Aşağıdaki ölçen ölçülen eşleşmelerinden hangisi yanlıştır?
   a) Isı-termometre
   b) Kütle-terazi
   c) Saat-zaman
   d) Ağırlık-dinamometre
   e) Akım şiddeti-ampermetre

8. Aşağıdakilerden hangisi veya hangileri doğrudur?
   I. Bilim insanları, bilimsel teorileri ve yasaları oluştururken hayal güçlerini ve yaratıcılıklarını da kullanırlar.
   II. Bilim insanlarının bilimsel çalışmalarda genellikle izledikleri yol bilimsel çalışma yöntemidir.
   III. Bilimsel bir teori, yeteri kadar deneysel destek bulursa bilimsel bir yasa olabilir.

   a) Yalnız I
   b) Yalnız II
   c) Yalnız II
   d) I ve II
   e) II ve III

9. Güneşin altında aynı süre bekletilen, toprak ve suyun sıcaklık artışlarının aynı olup olmadığı merak edilmektedir. Bunun için özdeş kaplar alınır, bunların birine toprak, diğerine toprakla eşit kütlede su konulur. 6 saat boyunca güneş alacakları bir yerde bekletilir ve saat başı sıcaklıkları ölçülür.
   a) Araştırmada sınanan hipotezi yazınız.
   b) Araştırmada kontrol edilen değişken hangisidir?
   c) Araştırmada bağımsız değişken hangisidir?
   d) Araştırmada bağımlı değişken hangisidir?

10. Terazi, dakika, termometre, ampermetre, saniye, Kelvin, baskül, kronometre, kilogram, miliamper, santimetre, mezura, celcius, kilometre, amper.
   a) Yukarıda verilen ifadelerden sıcaklıkla ilgili olanları aşağıya belirtiniz.
   b) Yukarıda verilen ifadelerden kütle ilgili olanları aşağıya belirtiniz.
   c) Yukarıda verilen ifadelerden uzunlukla ilgili olanları aşağıya belirtiniz.
   d) Yukarıda verilen ifadelerden zamanla ilgili olanları aşağıya belirtiniz.
   e) Yukarıda verilen ifadelerden akım şiddeti ilgili olanları aşağıya belirtiniz.

11. Ölçülen değer ile gerçek değer arasındaki fark aşağıdakilerden hangisidir?
   a) Doğru ölçme
   b) Ölçmede hata
   c) Ölçme tekniği
   d) Ölçme sayısı
   e) Ortalama değer

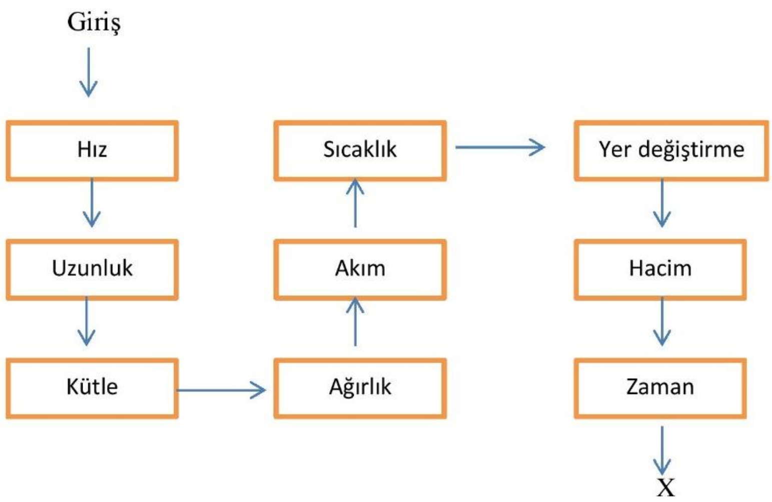
12.

	Temel büyüklük	Skaler büyüklük	Vektörel büyüklük
Kütle	x	x	
Zaman	x	x	
Hız			x
Sıcaklık	xx		
Uzunluk	x		x

Yukarıdaki tabloda verilen büyüklüklerden hangisi yanlış işaretlenmiştir?

   a) Kütle
   b) Zaman
   c) Hız
   d) Sıcaklık
   e) Uzunluk

13.



Pelin, şekilde verilen fiziksel büyüklüklerden okları izleyerek X'e varıyor. Geçtiği büyüklükler skaler ise 10 puan kazanıyor, vektörel ise 5 puan kaybediyor.

Pelin girişten başlayarak okları izlerse X kutusuna vardığında kaç puan toplamış olur?

a) 25   b) 35   c) 40   d) 45   e) 50

C) Aşağıda bulunan açık uçlu soruları kısaca cevaplayınız.

1. "Bilim gözlemle başlar ve alanında en iyi olan bilim insanlarının hepsi iyi bir gözlemcidir. Gözlem yapmak …."

   Yukarıdaki paragrafta boş bırakılan cümle,

   I. Meraklı olmaya sevk eder.
   II. Benzerlik ve farklılıklarının tespit edilmesini sağlar.
   III. Kavramların geliştirilmesine yardım eder.
   IV. Bilgi birikiminin artmasını sağlar.
   V. Araştırma dürtüsünü harekete geçirir.

   ifadelerinden hangileri ile tamamlanabilir?

2. Bir öğrenci;
   I. Arkadaşının boyunu
   II. Karışının uzunluğunu
   III. Bir bilyenin çapını
   IV. Bir tıraş bıçağının kalınlığını

   ölçmek istiyor. Elindeki cetvel, şerit, metre, mikrometre ve kumpas gibi ölçü aletlerinden hangilerini kullanması doğru olur, karşılarına yazınız.

3. Ahmet'in boyunu sınıftaki 5 arkadaşı ölçüyor ve aşağıdaki tabloda verilen değerleri ölçüyor.

Ölçüm yapan kişi	**Ahmet'in ölçülen boyu**
1. Öğrenci	175 cm
2. Öğrenci	177 cm
3. Öğrenci	176 cm
4. Öğrenci	174 cm
5. Öğrenci	178 cm

Yukarıdaki ölçümlerin birbirinden farklı olmasını nasıl açıklarsınız.

4. Skaler ve vektörel büyüklükleri birbirinden ayıran temel fark nedir?

5. Suyun miktarının artırılması kaynama sıcaklığına nasıl etkiler? Sorusuna cevap arayan bir araştırmacının izlemesi gereken bilimsel çalışma yönteminin aşamalarını yazınız.

6. İnsanların yaşam kalitesini artırmada fizik mi daha önemlidir yoksa teknoloji mi? Neden? Kısaca açıklama yapınız.

APPENDIX AR

PRESENTATION EVALUATION FORM (FOR FEEDBACK FROM COLLEAGUES AND SELF EVALUATION)

SUNUM DEĞERLENDİRME (Form 1)

1) Fizik biliminin amacının farkında olur (1.1)

a. Öğrencilerin "Fizik nedir?", "Neden ve niçin fizik öğrenmeliyim?' sorularına cevap aramaları sağlanır. **(1.1) (FTTÇ-1a,b,c,d) (BİB-1a,b,c,d)** (4.2)

c. Öğrencilerin fizik bilgisinin tarih boyunca gelişiminin farkında olmaları için bilim tarihinden örnekler sunulur. **(FTTÇ-1a,b,c,d)**

d. Öğrencilerin farklı meslek dallarında fizik biliminin rolünü araştırmaları sağlanır.**(BİB-1a,b,c,d)**

Kazanımların (bilgi/beceri) sunumu ile ilgili değerlendirme puanınız:

5	4	3	2	1

Yorumlarınız:

Öğretim yöntem/teknik (etkinlik, aktivite) kullanımı ile ilgili değerlendirme puanınız:

5	4	3	2	1

Yorumlarınız:

Teknoloji/materyal kullanımı ile ilgili değerlendirme puanınız:

5	4	3	2	1

Yorumlarınız:

Ben anlatsaydım neyi farklı yapardım?....

PRESENTATION EVALUATION FORM (SELF)

SUNUM DEĞERLENDİRME (Form 1)

1) Fizik biliminin amacının farkında olur (1.1)
a. Öğrencilerin "Fizik nedir?", "Neden ve niçin fizik öğrenmeliyim?' sorularına cevap aramaları sağlanır. **(1.1) (FTTÇ-1a,b,c,d) (BİB-1a,b,c,d) (4.2)**
c. Öğrencilerin fizik bilgisinin tarih boyunca gelişiminin farkında olmaları için bilim tarihinden örnekler sunulur. **(FTTÇ-1a,b,c,d)**
d. Öğrencilerin farklı meslek dallarında fizik biliminin rolünü araştırmaları sağlanır.**(BİB-1a,b,c,d)**

Kazanımların (bilgi/beceri) sunumu ile ilgili değerlendirme puanınız:

5	4	3	2	1

Yorumlarınız:

Öğretim yöntem/teknik (etkinlik, aktivite) kullanımı ile ilgili değerlendirme puanınız:

5	4	3	2	1

Yorumlarınız:

Teknoloji/materyal kullanımı ile ilgili değerlendirme puanınız:	5	4	3	2	1

Yorumlarınız:

Bu sunumu tekrar yapsaydım neyi farklı yapardım?....

APPENDIX AS

TREATMENT VERIFICATION

(RESULT OF RESEARCHER EVALUATION)

	PD characteristics	Face to face	None face to face
	Needs, demands		
1	Consider to the needs of teachers	+	+
2	Consider to the needs of students	+	+
	Awareness		
3	Convince teacher to change	+	+
	Support		
4	Support from MONE	+	+
5	**Support from academicians/ teachers** a. Workshops b. Providing materials/sources c. Easy access to the facilities	+++	+
	Support from schools		
6	a. Easy attendance	+	+
7	b. Easy application for researcher	+	+
	Feedback		
8	Feedback from researcher	+	+
9	Feedback from teachers	+	+
10	Self feedback	+	-
	Opportunity		
11	The opportunity to practice	+	-
	Planned and flexible program		
12	Planned and flexible program	+	+
13	Planned and flexible teacher application	+	-
	Duration		
14	Long term PD	+	+
15	Having an ongoing structure	+	+
16	Giving workshop nearly to the class implementation	+	+
	Content specific PD		
17	Getting to the core of ISOP unit	+	+
18	Aligning with the curriculum	+	+
	Active learning		
19	Effective/productive working	+	+
20	Reflective thinking/discussion	+	+
21	Mostly pursued by teacher	+	+
	Collaboration /Interaction		
22	Collaborate	+	+
23	**Motivation/incentive** a. Giving a certificate as an incentive b. Provided opportunity to see and compare the students' success in their own and different schools	+	+
	Effective communication/Building learning community		
	Before workshop 1		
24	a. Teacher to teacher communication	-	-
25	b. Teacher to instructor communication	+	+
	During workshop I		
26	a. Teacher to teacher communication	+	+
27	b. Teacher to instructor communication	+++	+
	After workshop I / Before workshop II		
28	a. Teacher to teacher communication	+	+
29	b. Teacher to instructor communication	+	+
	During workshop II		
30	a. Teacher to teacher communication	+	+
31	b. Teacher to instructor communication	+	+
	After workshop II		
32	a. Teacher to teacher communication	-	+
33	b. Teacher to instructor communication	-	+

CURRICULUM VITAE

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WORK EXPERIENCE

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2014-2015	Harvard University, School of Engineering and Applied Sciences	Visiting Researcher

FOREIGN LANGUAGES

English

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