TEACHING PRACTICES ENHANCING STUDENTS' AFFECTIVE CHARACTERISTICS RELATED TO PHYSICS

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ABSTRACT

TEACHING PRACTICES ENHANCING STUDENTS' AFFECTIVE CHARACTERISTICS RELATED TO PHYSICS

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This study was aimed to provide insight about affective teaching practices that influence students' affective characteristics in physics lessons using mixed methodology. Affective characteristics consisted of attitudes and motivation. For this purpose Keller's ARCS (attention, relevance, confidence, satisfaction) model was revised by adding Communication category. The Affective Teaching Practices Questionnaire, including these categories, was administered to 1,138 students and 31 physics teachers in Ankara. Moreover, the Affective Characteristics Questionnaire was administered to students to find out the relationship between students' affective characteristics and their perceptions about the teaching practices used by teachers.

Four physics teachers, who were performing teaching practices frequently, were purposefully selected according to results of quantitative phase. In qualitative phase, observations were conducted in these teachers' classrooms to find out teaching practices used to enhance affective characteristics and their effects. Besides, interviews were conducted to support observations.

The quantitative data were analyzed by descriptive statistics, while qualitative data were analyzed by cross case analysis. Results revealed that affective teaching practices are related to students' affective characteristics. Assisting comprehension and providing role models to students are effective for enhancing affective characteristics. Similarly, providing students concrete materials; arousing their inquiry; organizing what is taught from simple to difficult; attributing success to effort; relating topic to students' experience; stating clearly what is expected of students; providing feedback; using positive outcomes; giving enough time to students; using clear, understandable, fluent language in lessons; caring about teaching; being self-confident; caring about students; and providing an atmosphere suitable for learning are also effective.

Keywords: Physics Education, Affective Teaching Practices, Attitude towards Physics, Motivation in Physics, the ARCS Model.

ÖZ

ÖĞRENCİLERİN FİZİKLE İLGİLİ DUYUŞSAL ÖZELLİKLERİNİ ARTTIRAN ÖĞRETİM UYGULAMALARI

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Bu çalışmanın amacı öğrencilerin fizik derslerindeki duyuşsal özelliklerini etkileyen duyuşsal öğretim pratiklerini (güdüleme stratejileri) belirlemektir. Duyuşsal özellikler tutum ve motivasyondan oluşmaktadır. Bu amaçla nicel ve nitel araştırma yöntemleri birlikte kullanılmıştır. Dikkat çekme, ilişkilendirme, güven ve tatmin kategorilerinden oluşan Keller'in ARCS modeli, iletişim kategorisi eklenerek geliştirilmiştir. Bu kategorileri içeren Duyuşsal Öğretim Pratikleri Anketi, Ankara ilindeki 1138 öğrenciye ve 31 fizik öğretmenine uygulanmıştır. Ayrıca, öğrencilerin duyuşsal karakteristikleri ve fizik öğretmenleri tarafından kullanılan duyuşsal öğretim pratikleri arasındaki ilişkiyi belirleyebilmek için Duyuşsal Özellikler Anketi de öğrencilere uygulanmıştır.

Farklı türdeki okullarda çalışan ve duyuşsal öğretim pratiklerini sıklıkla kullanan dört fizik öğretmeni, nicel safhanın sonuçlarına göre nitel safha için seçilmiştir. Nitel safhada, bu öğretmenlerin öğrencilerinin duyuşsal özelliklerini geliştirmek amacıyla

kullandıkları öğretim pratiklerini belirlemek için gözlemler yapılmıştır. Ayrıca bu gözlemleri desteklemek için öğretmen ve öğrencilerle görüşmeler yapılmıştır.

Nicel veriler betimleyici istatistiklerle analiz edilirken nitel veriler karşılaştırmalı durum analiziyle değerlendirilmiştir. Bulgular öğretmenlerin fizik derlerinde kullandıkları duyuşsal öğretim pratikleri ile öğrencilerin fizikle ilgili duyuşsal özellikleri arasında bir ilişki olduğunu göstermiştir. Ayrıca, anlamaya yardımcı olan öğretim pratikleriyle öğrencilere model (örnek) olmak öğrencilerin duyuşsal özelliklerini etkileyen öğretim pratikleridir. Öte yandan, öğrencilere somut materyaller sağlamak, sorular yöneltmek, öğretilenleri kolaydan zora doğru düzenlemek, öğrencilerin başarılarını onların çabalarına atfetmek, konuyu öğrencilerin deneyimleri ile ilişkilendirmek, öğrencilerden ne beklendiğini açıkça belirtmek, dönüt vermek, olumlu çıktıları kullanmak ve öğrencilere yeterli zaman vermek etkili öğretim pratikleri arasında yer almaktadır. Yine açık, anlaşılır, akıcı bir dil kullanmak; işinden keyif almak; kendine güvenmek; öğrencilerine önem vermek ve öğrenme için uygun bir ortam sağlamak öğrencilerin duyuşsal özelliklerini etkilemede önem taşımaktadır.

Anahtar Kelimeler: Fizik Eğitimi, Duyuşsal Öğretim Pratikleri, Fiziğe karşı Tutum, Fizik Motivasyonu, ARCS modeli.

To my family

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ATPQ: Affective Teaching Practices Questionnaire

ACQ: Affective Characteristics Questionnaire

ARCS model: Attention, Relevance, Confidence and Satisfaction model.

CHAPTER 1

INTRODUCTION

1.1 Background to the Study

Many countries include affective (attitudinal and motivational) objectives in their science curricula, however there are not many studies dealing with how to improve students' science related affect. As Koballa and Crawley (1985) stated, the assumption that students' affective characteristics will improve when they learn more science is no longer valid for all age groups. It is due to the fact that science achievement influences students' science related affective characteristics at early ages and later this relationship changes direction. In other words, affective characteristics of the students influence their science achievement in last years of high school and at the university (Abak, 2001; Dogan, 2005; Wilson, 1983). All these imply that, if the students do not achieve in science in the early ages, they won't be able to achieve in science later. The future science achievement is influenced by the students' affective characteristics as mediating factors. Thus, it might be expected to find that the teaching practices affecting science achievement also affect students' science related affect at early ages, whereas it is not reasonable to expect the same for older students.

The affective characteristics selected for this study were selected in line with the previous modeling study (Gungor, Eryilmaz & Fakioglu, 2007). They are students' physics interest, aspiring extra-activities related to physics, importance of physics, physics anxiety, physics test anxiety, physics achievement motivation, student motivation in physics, self-esteem (composed of physics self-efficacy and physics self-concept) which combine to form the latent variable affective characteristics as can be seen in Figure 1.1. Moreover, there are interrelations between them.

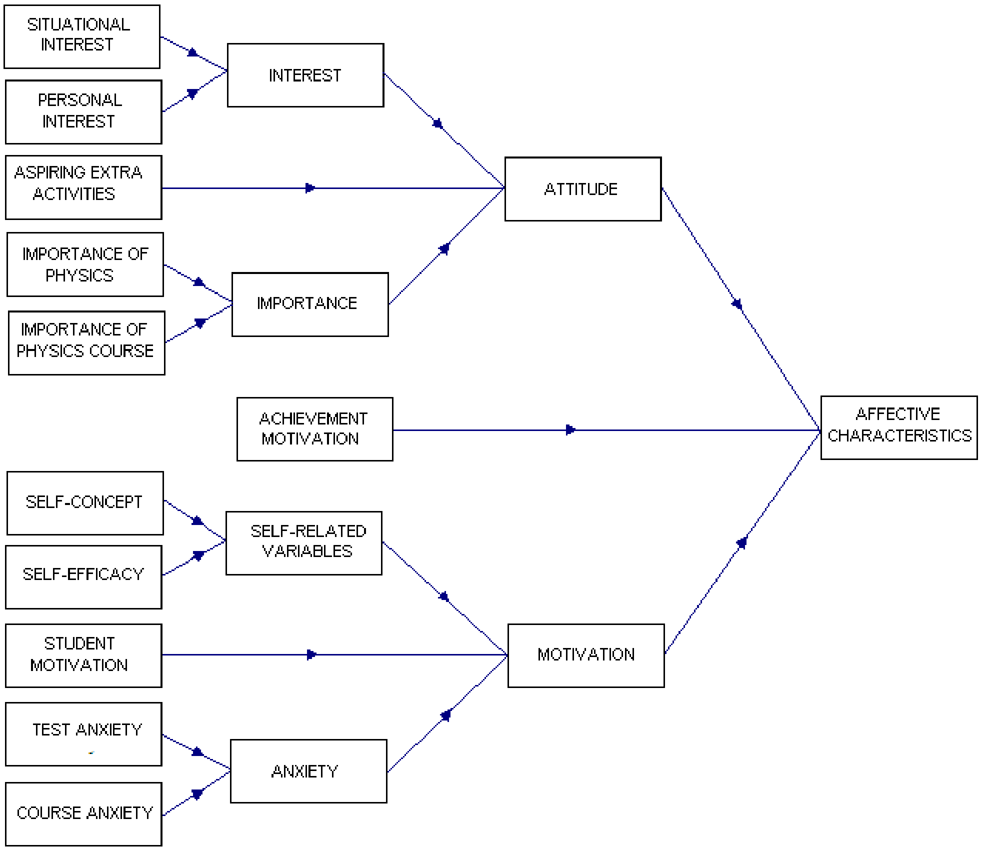

Figure 1.1 The latent variable: affective characteristics (Gungor et al., 2007)

In the science education literature there is a wide range of studies dealing with the effects of teaching practices on science achievement (for example Escalada & Zollman, 1997; Gibson & Chase, 2002; Jarvis & Pell, 2005; Lin, 1998). On the other hand, few studies dealt with the effects of the teaching practices on students' science related affective characteristics (Newbill, 2005). There are also a limited number of studies dealing with the effects of other factors such as parents' attitudes towards science and the learning environment on students' science related affective characteristics (Haladyna, Olsen, & Shaughnessy, 1982; Nolen, 2003). There are also some studies which were not derived from attitude change theories or from instructional theories for attitude change or from motivational theories. Increase in attitudes and motivation was assumed to be a side-effect. In many of these studies the main purpose was to improve achievement, moreover attitudes and motivation were measured as controlling variables.

Theories of motivation deal with why and how people choose, perform, and persist in various activities; consequently, they provide information about how to motivate people (Guilloteaux, 2007). Some of these theories also deal with attitudes, beliefs and values. In this study, attitude change theories are considered separately. On the other hand, among functional theories under the attitude change theories some motivational constructs are also considered.

The major attitude change theories in the social psychology literature include Cognitive Dissonance Theory, Cognitive Balancing, Motivational Constructs, Conflict Theory, Self-Perception Theory, Social Judgment Theory, Social Learning Theory and Elaboration Likelihood Model. Also, the Yale Communication and Attitude Change Program contributed to the attitude change literature. Whereas, the major motivational theories (and constructs) might be listed as the Attribution Theory, Expectancy-value Models of Motivation, Social Cognitive Theory (Self-efficacy, Self-regulation, and Volition), Goal Orientation Theories, and Intrinsic Motivation (Curiosity and arousal, Locus of control theory, Self-determination theory). The instructional implications of both attitude change theories and motivational theories were investigated to find out teaching practices to enhance students' affect.

Keller's ARCS model, on the other hand, offers affective teaching practices for enhancing students' motivation. The ARCS model consists of four components: attention, relevance, confidence, and satisfaction. These components are the four major conditions that should be met in order to motivate students and sustain their motivation. Moreover, each component has several subcomponents. Attention component includes teaching practices related to incongruity and conflict, concreteness, variability humor, inquiry, and participation; relevance incorporates practices related to experience, present worth, future usefulness, need matching, modeling, and choice; confidence includes practices related to learning requirements, difficulty, expectations, attributions, and self-confidence; whereas satisfaction incorporates practices related to natural consequences, positive consequences, avoidance of negative influences, and scheduling.

In fact, the ARCS model offers an eclectic solution to motivational problems in the classroom (Keller, 1987a). It incorporates various constructs and theories in the motivation literature. Indeed, the model incorporates some of the instructional implications offered by attitude change theories. Thus, this model was taken as a reference frame for the teaching practices used in this study. But the affective teaching practices were not limited with the teaching practices provided by the ARCS model. Several attitude change theories and motivation theories were reviewed and the teaching practices derived from them were also incorporated into the ARCS model. Many of the teaching practices fit the model, since the model is eclectic.

Therefore, what Keller defined as motivational strategies, are named as affective teaching practices in this study, in line with the previous studies (Fraser, 1981; Gungor et al., 2007; Kremer & Walberg, 1981; Uguroglu & Walberg, 1979). There is no consistency in the literature about the definition of constructs such as affect, attitude and motivation. As can be seen in Figure 1.1, affect is defined as a broader construct, and attitude and motivation are sub-dimensions of this broader construct in the current study. This approach is consistent with Krathwohl, Bloom and Masia (1964).

In the literature, there were many instruments were named as attitude scales, and in these studies attitude was defined as a multidimensional construct consisting of sub-dimensions such as motivation, interest, importance, self-confidence, self-concept, anxiety, and enjoyment (Aiken, 1979; Gogolin & Swartz, 1992; Schibeci & Riley, 1986). However, in this study, attitude is defined rather narrowly, and what these studies define as attitude is defined here as affect, consistent with Martin and Briggs (1986).

There was one study dealing with improving students' motivation and achievement by using the ARCS model in chemistry courses (Feng & Tuan, 2005). Feng and Tuan (2005) designed 10-hour unit about acids and bases for low-interest and low-motivation students in 11th grade by using the ARCS model, and found that students' motivation and achievement increased significantly.

Besides, there were several ARCS related studies in different subjects such as distance education (Huett, Moller, Bray, Young, & Huett, 2006), computer based instruction in economics (Shellnut, Knowlton & Savage, 1999), statistics (Capshew, 2005; Means, Jonassen & Dwyer, 1997), library education (Small, 1999; Small, Zakaria & El-Figuigui, 2004), research design (Astleitner & Lintner, 2001), archeology (Keller, Deimann & Liu, 2005; Deimann, 2005). Small (1999) and Small et al. (2004) investigated the motivational strategies used by librarians in their information literacy skills instruction. Small (1999) found that approximately half of the strategies used by librarians were to get and sustain attention and interest. Among these attention strategies inquiry arousal, perceptual arousal, and variability strategies were used frequently. On the other hand, relevance, confidence and satisfaction strategies were used less frequently.

Small et al. (2004) determined that the percentages of strategies used by the librarians were consistent: they used attention strategies most frequently, satisfaction strategies least frequently, and relevance and confidence strategies were about even. Most frequently used subcomponents were attention-perceptual arousal, confidence-success opportunities, attention-inquiry arousal, and relevance-goal orientation. Moreover, all participants frequently used relevance-goal orientation and confidence-success opportunities. On the other hand, few relevance-motive matching and confidence-learning requirements were used; whereas there was a considerable lack of relevance-motive matching, relevance-familiarity, confidence-personal control, satisfaction-natural consequences strategies, satisfaction-positive consequences, and satisfaction-equity strategies. Besides, few or no confidence-personal control, satisfaction-natural consequences, and satisfaction-equity strategies were used.

On the other hand, several researchers (Koballa, 1984, 1986, 1992; Koballa & Shrigley, 1983; Martin, 1985; Newbill, 2005; Shrigley, 1976, 1978, 1982; Steiner, 1980) dealt with some of the attitude change theories in the science education literature. Koballa (1984, 1986), Shrigley (1976, 1978, 1982), Martin (1985) dealt with persuasive communication. These studies were based on Yale Communication and Attitude Change Program. Moreover, Steiner (1980) investigated the effect of induced cognitive dissonance on school-related attitudes. The study was based on Festinger's cognitive dissonance theory (1957). Newbill (2005) stated that her study stemmed from Kamradt and Kamradt's structured design (1999). Although they were inspired by some other ideas, they did not cite many sources in their description of the theory (Newbill, 2010).

The only researchers dealing with enhancing the affective aspects of physics courses was Häussler and Hoffmann (2002). They investigated the effects of an intervention project that focused on enhancing girls' interest, self-concept, and achievement in physics in Germany. There were several treatments in the intervention. Students' immediate and long-term achievements, interest in physics, competence, and physics-related self-concept were assessed several times. Their results revealed that their intervention significantly improved most of these indicators for both girls and boys in the experimental group.

More explicitly, physics interest scores of all the groups, except one of the treatment groups decreased significantly in the posttest and control group students had the largest decrease. They concluded that splitting physics classes in halves might have increased interest in physics. Girls in the same treatment group reported their competence gain through physics in the posttest was significantly higher than their expected competence through physics in the pretest. Moreover, there was no difference between the experimental and control groups after the first unit whereas later girls of the experimental groups reported their physics instruction as more motivating compared to boys. Besides, they concluded that just after one school year of traditional physics instruction girls have lost their confidence in being good achievers in physics.

1.2 Research Problems

1. What are physics teachers' and 9th grade students' perceptions about the frequently used teaching practices enhancing students' physics related affective characteristics in Çankaya district of Ankara?
2. What are physics teachers' and 9th grade students' perceptions about the effective teaching practices to enhance students' physics related affective characteristics in Çankaya district of Ankara?
3. What is the relationship between 9th grade students' physics related affective characteristics and their perceptions about the affective teaching practices used by their physics teachers in Çankaya district of Ankara?
4. What are the teaching practices that four purposefully selected "good" physics teachers frequently use to enhance students' physics related affective characteristics?
5. How do students react to teaching practices that four purposefully selected "good" physics teachers frequently use?

First, second, and third research problems initiate the quantitative part of the thesis. Affective Teaching Practices Questionnaire was administered to 9th grade students and their teachers to answer the first research problem and to find out the "good" physics teachers for the qualitative phase of the study, and to answer second research question. In order to answer the first research question, students responded how frequently their teacher practiced the given teaching practice; and to answer the second research question the students responded how effective the given teaching practice was on their affect.

The qualitative part of the thesis is initiated by the third and the fourth research problems. In order to answer the third and fourth research problem, classroom observations were conducted in four classrooms, in four different types of schools. The physics teachers of these four classrooms were among the most frequently practicing the affective teaching practices according to their students' responses. Thus, they were assumed to be "good" physics teachers. Moreover, teacher and student interviews were conducted to answer the third and fourth research questions.

1.3 Definition of Important Terms

Affective characteristics related to physics: The affective characteristics related to physics in this study refers to the combination of students' perceptions about how important the physics courses are, how much they like extra activities related to physics, interest in physics courses, student motivation in physics, achievement motivation in physics courses, physics-self (self-concept and self-efficacy), and their anxiety in physics courses. It is measured with the items in the affective characteristics scale.

Affective teaching practices: Teaching practices, strategies and teacher behaviors related to student affect which were derived from attitude change and motivation theories literatures.

Attitude toward physics: "An attitude is a mental or neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related (Allport, 1935, p. 804). In this study the stimulus is physics.

Motivation in physics: "Broadly considered, motivation is the process of arousing, sustaining, and regulating activity, a concept limited to some aspect such as the energetics of behavior or purposive regulation" (Good, 1973, p. 375). "Motivation may be viewed as referring to the contemporaneous, dynamic factors that influence such as the choice, initiation, direction, magnitude, persistence, resumption, and quality of goal directed (including cognitive) activity" (Dweck & Elliot, 1983, p. 645). Motivation is the determinant of the magnitude and direction of behavior or “choices people make as to what experiences or goals they will approach or avoid and the degree of effort they will exert in that respect” (Keller, 1983, p. 389). Motivation, in educational settings, can be defined as a student’s desire to learn the topic (Keller & Subhiyah, 1993). Direction of motivation refers to goal orientation (Keller & Burkman, 1993).

The ARCS (attention, relevance, confidence, and satisfaction) components: Attention, relevance, confidence and satisfaction are the components of the ARCS model.

Attention: Attention is defined as capturing of the students’ interest and stimulating the curiosity of learning (Keller, 1987a, b).

Relevance: Relevance refers to the learner’s perception of consistency of instructional requirements with their goals, correspondence with their learning styles and linked to their prior experiences (Keller, 2004).

Confidence: Confidence refers to “perceived likelihood of success, and the extent to which success is under learner control” (Keller, 1983, p. 395).

Satisfaction: Satisfaction refers to “combination of extrinsic rewards and intrinsic motivation, and whether these are compatible with the learner’s anticipations.” (Keller, 1983, p. 395).

1.4 Significance of the Study

Developing more positive affective characteristics related to physics has two main reasons. First is that, affective characteristics are assumed to be closely related to physics achievement. Bloom (1976) stated that about 25% of achievement might be attributed to the students’ affective characteristics. Accordingly, it is expected that by improving students’ physics related affective characteristics, their physics achievement will increase indirectly. Second is that, affective characteristics (i) influence a person’s ability to participate effectively in a democratic society, (ii) are necessary for a healthy and effective life, and (iii) interact with occupational and vocational satisfaction (Payne, 1977). Even if there were no relationship between the affective characteristics and achievement, this is still a very important perspective for science and thus, physics education. It is due to the fact that the aim of science courses is not transforming knowledge to the students anymore. Instead, they focus on providing an environment for students where they can acquire some skills, attitudes, values etc.

Ninth grade students were selected for this study since these students haven't chosen their branch in the high school, thus have a larger variance with respect to their affective characteristics. Moreover, the instructional practices in courses like physics, chemistry, and mathematics might influence their branch decision. Thus, what happens in this initial grade was critical in students' lives. Four types of schools were selected because the students' affective characteristics and thus the teachers' affective practices might differ for these groups.

The teachers were determined according to the students' responses about the frequency of their teachers' use of affective teaching practices in the ATPQ. Moreover, these four teachers from four school types were selected since they were assumed to provide more information to the study. The learner characteristics in these four schools are different from each other. Thus, the teaching practices were expected to differ in these four schools.

Besides, physics courses are compulsory in the ninth grade in Turkey. Many of the ninth grade students find the physics courses irrelevant to them, complain about the courses, exhibit low engagement in courses, and choose other branches than science in the 10th grade to stay away from the physics courses. All these represent a significant problem for teachers, students and researchers. Moreover, when thinking about the quality of the instruction in the classroom, it is not possible to ignore student motivation, engagement, and enjoyment which are aspects of affective domain.

However, there are not many studies dealing with how to enhance students' affective characteristics in the science and/or physics education literature, even though the affective outcomes are included in the new science and also in the new physics curriculum in many countries and in Turkey. Thus, this study is expected to fill this gap by providing information about the teaching practices enhancing students' affective characteristics. Furthermore, this study investigates how teachers use the affective teaching practices to enhance their students' attitudes towards physics and motivation physics classes. Thus, it will provide some information about teaching practices used good physics teachers in physics classrooms, in different school types. This information might be useful for physics teachers to enhance their students' affective characteristics, and for researchers and policy makers, and physics education departments to find and the gaps.

CHAPTER 2

REVIEW OF THE LITERATURE

The social psychology literature has the origins of research related to attitude, attitude change, motivation and enhancement of motivation. These studies also have some reflections on education, especially in instructional design research. This chapter is also organized in this rationale: the theoretical background from the social psychology literature about attitudes and attitude change is presented first, then the instructional implications, lastly the research related to these instructional implications are presented.

Consistently theoretical background from the social psychology literature about motivation theories and constructs is presented first, then the instructional implications, and lastly the research related to these instructional implications are presented. Under the motivation theories and constructs Keller's ARCS (attention, relevance, confidence, and satisfaction) model is presented, even though it is neither a theory nor a construct, it integrates several theories and constructs in the motivation literature and provides framework for this study.

2.1 Attitudes and Attitude Change Theories

Most of the researchers agree that attitudes have three components: affective, behavioral, and cognitive. The affective component consists of one's feelings or emotions toward the attitude object. The behavioral component refers to one's action tendencies toward the object. On the other hand, the cognitive component refers to one's ideas and beliefs about the object. Oskamp (1977) listed several features of the attitudes as:

- Attitudes are relatively stable.
- Attitudes are evaluative.
- Attitudes are learned through actual and vicarious experiences.
- Attitudes are inferred based on observable responses.
- Attitudes have "motivating or driving force" that they influence behavior.

According to Martin and Briggs (1986), motivational or cognitive perspective, or the two perspectives together can be used to define attitudes. "Attitude sets can influence a variety of behaviors, but not be directed toward an inclusive goal. Attitudes are composed of three components, affective, cognitive, and behavioral, that influence to a greater or lesser degree particular types of attitudes and therefore, the change strategies that are best used with each" (p.107).

There is a wide range of studies dealing with changing the attitudes of individuals in the psychology literature since Allport's study in 1920's as cited in Petty and Wegener (1998). These studies yielded many theories about attitude change and also formation. There are different kinds of classifications of the attitude change theories. According to Martin and Briggs (1986) attitude change theories can be categorized into two broad categories: behavioral and cognitive theories. The behavioral theories focus on environmental or societal influences whereas cognitive theories deal with factors such as personality traits and structures, the brain, cognitive structures, and types of attributions. Hovland's research on communicator (source) credibility and persuasive message, and theories dealing with external stimuli like reinforcement and modeling were mentioned among behavioral theories. On the other hand, cognitive theories focus on internal factors like personality traits and structures, mental states, and types of attributions.

Martin and Briggs (1986) categorized attitude change theories into four groups: behavioral, balance or consistency, type or functional, and miscellaneous. Among miscellaneous theories they mentioned attribution theory. However, they focus on five theories that have instructional implications: the Yale Communication and Attitude

Change Program, Social Learning Theory, Dissonance Theory, Cognitive Balancing Theory, and Social Judgment Theory. They stated that the first one is not actually a theory, it is a behavioral approach for attitude change; the second is interactionist theory; the third and fourth are consistency theories; and the last theory offers a different approach for determining instructional implications.

Simonson and Maushak (2002) categorized attitude change theories as consistency theories, learning theories, social judgment theories, and functional theories. Farris (n.d), on the other hand, included a wider range of theories under six categories as consistency theories, nonconsistency theories, functional theories, cognitive and perceptual theories, behavioristic theories, and social judgment theory.

Focusing mostly on theories listed by Martin and Briggs (1986), and Simonson and Maushak (2002), several other theories are listed to present a comprehensive framework:

a. Behavioral Theories: These theories are also known as stimulus-response theories. Based on learning theories and the processes used by the learning theories, they focus on finding communication characteristics and an appropriate way to measure the stimulus condition effective for attitude change (Martin & Briggs, 1986).

i. The Yale Communication and Attitude Change Program: It is sometimes referred as Reinforcement Theory, however, it is not an actual theory; it was acknowledged “as an empirically-based program or approach to attitude change” (Martin & Briggs, 1986, p. 118). “Who says what to whom with what effect?” is the basic question summarizing this approach. Martin and Briggs (1986) summarized Hovland and colleagues’ (i.e. Hovland, Janis & Kelley, 1953) research about the source (communicator), the message, the audience, and the audience reaction in a persuasive communication. The Yale program emphasizes the importance of addressing the cognitive component of attitudes to change them. Attitude change occurs through reinforcement, and by opinion or belief change; thus “an individual must attend, comprehend, accept, and retain the message” (Martin & Briggs, 1986, p. 129).

b. Balance or Consistency Theories: They deal with internal factors to change attitudes. The basic assumption of these theories is that people search for internal consistency. Two of the consistency theories are:

i. Cognitive Dissonance Theory: Festinger (1957) stated two assumptions of the theory. First assumption is that people feel psychologically uncomfortable in the presence of dissonance, thus, people are motivated to reduce the dissonance and achieve consonance. Second, “when dissonance is present, in addition to trying to reduce it, the person will actively avoid situations and information which would likely increase the dissonance” (Festinger, 1957, p.3). Dissonance refers to inconsistency, and consonance refers to consistency. There are several ways to reduce dissonance. It can be reduced by changing a behavior or attitude, changing environment, or adding a new cognitive element.

ii. Cognitive Balancing: Martin and Briggs (1986) stated that this theory is similar to the Cognitive Dissonance theory; however, it deals with both the affective and cognitive components of attitudes to change them. They added if attitudes are unbalanced, attitude holder will attempt to balance them. Heider (1946) stated that “either the dynamic characters will change, or the unit relations will be changed through action or through cognitive reorganization. If a change is not possible, the state of imbalance will produce tension…. A tendency exists to make the different dynamic relations agree with each other by means of cognitive restructuring (excuses or rationalizations)” (p. 108). If a change is not possible, the state of imbalance will produce tension.

c. Type or Functional Theories: According to functional theories attitudes fulfill different psychological needs and different functions. Different approaches should be used to change attitudes with different functions.

i. Motivational Constructs: Katz (1960) listed and explained four major functions of the attitudes according to their motivational basis. They are adjustment, ego defense, value expression and knowledge. Function of adjustive attitudes is satisfying needs. Removing needs, creating new needs and new levels of aspiration, shifting rewards and punishments, emphasizing new and better paths for need satisfaction are the conditions for attitude change. Function of ego defense category is protecting the attitude holder against internal conflicts and external dangers. Removing threats, ventilating feelings (catharsis), and acquiring self-insight into defense mechanism are conditions for altering ego defensive attitudes.

Value expression category deals with attitudes related to "maintaining self-identity, enhancing favorable self-image; self-expression and self-determination" (Katz, 1960, p. 192). Value expressing attitudes change, if (i) the attitude holder has some degree of dissatisfaction with himself/herself, (ii) new attitude is more appropriate for the attitude holder, and (iii) control of all environmental verifications weakens the old values. The utility of knowledge category is "need for understanding, for meaningful cognitive organization, for consistency and clarity" (Katz, 1960, p. 192). In other words, it deals with the attitudes that "help us to understand our world and to make sense of occurrences around us. They provide consistency and clarity in our explanation and interpretation of events" (Oskamp, 1977, p. 50). This kind of attitudes change if the new information or changed environment creates some vagueness or more meaningful information about the problems is gathered by the attitude holder.

ii. Conflict Theory: According to Suedfeld (1971/2007) this theory assumes that new information causes challenge for prior attitudes and actions, hence, to deal with this challenge and the resulting conflict, people try to find and evaluate alternatives. The five stage process to solve the conflict is proposed (Suedfeld, 1971/2007, p. 44): (i) appraisal of the challenge, (ii) appraisal of alternatives, (iii) selection of the best alternative, (iv) commitment to a new policy, and (v) evaluation of the system in place.

d. Nonconsistency Theories: These theories deal with learning and cognition focusing on adaptive significance of attitudes to attitude holder.

i. Self-Perception Theory: There are two postulates of the theory: first one states that people “come to “know” their own attitudes, emotions, and, other internal states partially by inferring them from observations of their own overt behavior and/or the circumstances in which this behavior occurs” and second postulate states “to the extent that internal cues are weak, ambiguous, or uninterpretable, the individual is functionally in the same position as an outside observer” (Bem, 1972, p. 5).

e. Social Judgment Theory: Simonson and Maushak (2002) summarized Sherif and Hovland’s (1961) theory. They expressed that prior attitudes serve as judgmental standards and anchors that influence the perceived location of a persuasive communication that involves new attitudes. Located in the latitude of acceptance, persuasive communication is assimilated towards person’s prior attitudes. If it is judged to be fair and unbiased, attitude change occurs. Latitude widths influence if the persuasive communication will be assimilated or contrasted. When greater assimilation takes place, persuasive communication is evaluated more positively. Thus, greater amount of attitude change occur.

f. Social Learning Theory: Pintrich and Schunk (2002) stated that including self-efficacy and self-regulatory processes, Bandura developed the original theory by Rotter. They explained the basic idea of the theory as people have expectations about the potential outcomes of their behaviors, and behave regarding their expectations and the value of these outcomes. Bandura (1977) stated that reinforcement is considered as a “motivational device rather than as an automatic response strengthener” (p. 193). According to Bandura, there are four factors influencing behavior and attitude: performance accomplishment (direct experience), vicarious experience (modeling), verbal persuasion and emotional arousal. However, according to Martin and Briggs (1986) this theory does not focus on attitudes and attitude change mainly, attitudes are regarded as behavior.

g. Elaboration Likelihood Model: The model is an eclectic approach to attitude change, and it incorporates many of the theories in the attitude change literature such as self-perception and cognitive dissonance (Petty et al., 2004). The model has seven postulates (Petty & Caccioppo, 1986):

1. People are motivated to hold correct attitudes.
2. Although people want to hold correct attitudes, the amount and nature of issue-relevant elaboration in which people are willing or able to engage to evaluate a message vary with individual and situational factors.
3. Variables can affect the amount and direction of attitude change by (i) serving as persuasive arguments, (ii) serving as peripheral cues, and/or (iii) affecting the extent or direction of issue and argument elaboration.
4. Variables affecting motivation and/or ability to process a message in a relatively objective manner can do so by either enhancing or reducing argument scrutiny.
5. As motivation and/or ability to process arguments is decreased, peripheral cues become relatively more important determinants of persuasion. Conversely, as argument scrutiny is increased, peripheral cues become relatively less important determinants of persuasion.
6. Variables affecting message processing in a relatively biased manner can produce either a positive (favorable) or negative (unfavorable) motivational and/or ability bias to the issue-relevant thoughts attempted.
7. Attitude changes that result mostly from processing issue-relevant (central route) will show greater temporal persistence, greater prediction of behavior, and greater resistance to counterpersuasion than attitude changes that result mostly from peripheral cues.

2.1.1 Teaching Practices Derived from Attitude Change Literature

Martin and Briggs (1986) summarized Yale communication and attitude change program and four attitude change theories that have instructional implications. These theories were the Yale communication and attitude change program, dissonance theory, cognitive balancing, social judgment theory, and social learning theory. Martin and Briggs listed the implications of Hovland's Yale Program as (p. 129): (i) providing both a question and an answer in the communication, (ii) engaging the learners in *mental rehearsal* of the attitude, (iii) providing *incentives* for making a new response, that is, for bringing about acceptance of the new opinion, (iv) using a credible *source*, (v) avoiding high fear and manipulative communications, (vi) presenting two-sided arguments, and (vii) providing for overt verbalization (might be in the form of role-playing). Implications of the Festinger's dissonance theory were listed as (p. 130): (i) providing cognitive elements that reduce (or increase) dissonance (depending on desired attitude change), (ii) inducing action dissonant with attitude so attitude will change, (iii) providing opportunities for choice since best results occur in ***free choice*** rather than compliant situations, and (iv) providing alternatives for decision making.

On the other hand, implications of cognitive balancing theory were (Martin & Briggs, 1986, p. 131): (i) extending the conceptual arena of the individual by relating the attitude object to a variety of issues and/or other attitude objects, (ii) motivating the learner to think about elements in the cognitive arena by presenting communications that demonstrate imbalance, (iii) asking learner to explain his "psycho-logical" thinking, that is, how she/he is relating the elements, (iv) assisting learner in differentiating cognitive elements by redefinition of the cognitive and/or affective components, and establishing a subordinate structure that relates the inconsistent units. Implications of Sherif and Hovland's Social judgment theory were listed as (Martin & Briggs, 1986, p. 132): (i) making persuasive communication in the latitude of acceptance, (ii) within latitude of acceptance, making as large a discrepancy as possible for greatest change, (iii) persuasion will succeed when it moves in small modest steps, and (iv) broadening latitude of acceptance by successive approximations. Finally, the implications of Bandura's Social learning theory were using (Martin & Briggs, 1986, p. 133): (i) direct reinforcement, (ii) extinction, (iii) vicarious reinforcement and extinction through modeling, (iv) instructions, rules, or communications, and (v) social role modeling.

In 1993, Bednar and Levie, synthesizing the social psychology literature, listed 22 principles under three categories: designing persuasive messages, the source of the persuasive message, modeling appropriate behavior, and creating and managing dissonance. The principles under the first category were related to the source of the persuasive message, content of the message, channel of the message, and the receiver of the message. The principles stated that (i) the credibility, which refers to expertise and trustworthiness, and attractiveness of the source is important, (ii) the learners should identify themselves with the source, (iii) two-sided arguments are slightly more effective than one-sided messages, (iv) explicitly stated conclusions are more effective, (v) only one or two repetitions have additional effect, and (vi) only face-to-face communication is more effective in persuasive communication, other channels such as television, print, or as human senses such as vision, hearing were mentioned to have equal effect.

The principles under the second category described how to use modeling effectively for attitude change. The principles in this category stated that (i) the credibility of the model is important, (ii) learners should identify themselves with the model, and (iii) role-playing and active participation are influential strategies. The principles under the third category were derived from the cognitive dissonance theory of Festinger. The principles in the third category were listed as: (i) free choice is important; and (ii) an adequate level of reward or punishment should be used so that the attitude could be internalized. Social approval might be used as an adequate reward. Finally, several instructional strategies for affective outcomes from several other studies were mentioned to have in common: (i) opportunities for free choice and learner control, (ii) success opportunities, and (iii) lessons presenting and confronting alternative perspectives.

Simonson and Maushak (2002) cited the six guidelines, Simonson developed for designing instruction for attitudinal outcomes and they added that two reasons for developing the guidelines were: designing instruction and testing the effectiveness of the guidelines. They also presented supporting research studies for each guideline. They derived the Model of Cumulative Effect for designing mediated messages for attitude change from Simonson's guidelines for designing instruction for attitudinal outcomes, integrating recent social psychology literature and effective techniques from the instructional design research. They organized the guidelines for designing mediated messages for attitude change into two categories: message design and learner involvement. According to this model at least one guideline should be selected from each category, and integrating more guidelines appropriately in the instruction increases the possibility of attitude change. The guidelines for designing mediated messages to change attitudes were listed under two categories: message design guidelines and learner involvement guidelines.

The message design guidelines were listed as: (i) learners are persuaded, and react favorably, when mediated situations include the discovery of useful new information about a topic; (ii) attitude change is likely because of, and learners react favorably to, mediated situations involving the use of instructional technologies that are authentic, relevant to them, and technically stimulating; and (iii) learners are positively affected when persuasive messages are encountered in mediated situations that are as authentic and credible as possible. Whereas the learner involvement guidelines were listed as: (i) learners who are involved in a situation requiring their participation in the planning, production or delivery of media-based instruction are likely to react favorably to the situation and to the message delivered by the media; (ii) learners who experience purposeful emotional involvement or arousal during media-rich instructional situations are likely to change their attitudes in the direction advocated in the situation; and (iii) learners who participate in situations where technology-based instructional situations are openly critiqued in an attitudinally appropriate way are likely to develop favorable attitudes toward the situations and toward the message.

Miller (2005), on the other hand, stated that the instruction designed for attitude change should have three qualities: (i) use follow-up activities and open ended questions; (ii) use realistic types of media devoid of contradictory cues; and (iii) create an aroused state in the learner through emotional and intellectual involvement.

There were several studies dealing with how to enhance students' interest, since interest is considered as a subdimension of attitude in this study it is also presented. For example, Schraw, Flowerday, and Lehman (2001) recommended ways to improve situational interest (i) offering meaningful choices to students, (ii) using well-organized texts, (iii) selecting texts that are vivid, (iv) using texts that students know about, (v) encouraging students to be active learners, and (vi) providing relevance cues for students.

2.1.2 The Effect of Attitude Change Studies in Education

There are also a limited number of studies which dealt with some of these theories in the science education literature (Koballa, 1984, 1986, 1992; Koballa & Shrigley, 1983; Martin, 1985; Newbill, 2005; Shrigley, 1976, 1978; Shrigley, 1982; Steiner, 1980). Moreover, Häussler and Hoffmann's research in 2002 was included since it was dealing with many aspects of physics attitude (such as interest), and also self-concept.

Shrigley was among the first researchers in science education dealing with changing attitudes. He conducted several studies (for example in 1976, 1978, & 1982) for attitude change in science education. These studies stemmed mostly from the Yale Communication and Attitude Change Program. In 1976, he investigated the communicator characteristics among third-year elementary education students. The sample of the study consisted of 286 preservice teachers in four institutions. His results revealed that a credible science methods instructor should (i) have taught science to children; (ii) model teaching modes similar to those prepared for children; (iii) refer to practical teaching activities; (iv) assume some responsibility to teach science content and to assist science professors in designing college science courses; and (v) assist student teachers and inservice teachers.

A few years later, Shrigley (1978) designed a questionnaire to investigate the characteristics of a persuasive communication and reviewed the literature for credible communicator and communication. In the first part of the study, he asked the "science educators to write three brief statements they have used as they persuaded teachers of the need to teach science to children" (p. 336); then he grouped these answers and determined the characteristics of a persuasive communication. The questionnaire was sent to 53 national leaders in science education who were offering science methods courses, and 35 were returned. Examining the answers, Shrigley concluded that there were 11 categories: scientific literacy (develop logical thinking critical thinking, creativity, metacognition, intellectual skills, controlling one's destiny), processes of science (inquiry skills, hands-on experimentation, problem solving, real not vicarious experiences), motivational experiences (exciting, enjoyable, enhance curiosity, high interest level), support to other subjects (enriches math, language and other subjects; interdisciplinary, substance for basic skills, provide balance in school offerings), coping with technological change, content (scientific principles, understanding physical and natural environment, concrete link to everyday life), science is humanizing, wonder and orderliness of God's creation, readiness for future science courses, vocational purposes, and miscellaneous (statements that lacked clarity). The percentages of each category were 21%, 20%, 16%, 14%, 10%, 8%, 3%, 1%, 1%, 1%, and 5% respectively. He listed the six components of a persuasive communication as: (i) science develops logical and critical thought, a means to independent learning; (ii) science provides the active, hands-on experiences necessary for children to practice inquiry skills; (iii) science is motivating; it enhances the curiosity of children; (iv) science supports and enriches other areas of the elementary school curriculum; (v) science learnings are necessary for coping with the crises expected in our technological society; and (vi) science provides the child a necessary conceptual understanding to the physical and natural environment.

In the second part of the study, Shrigley (1978) reviewed the learning theory among attitude change theories in the social psychology literature and listed 12 generalizations from social psychology literature, and he added implications and recommendations for each generalization. The generalizations and Shrigley's implications and recommendations were:

1. An expert and trustworthy source will be more effective in changing attitudes in the direction advocated than a lesser credible source (cited from Cohen, 1964 and Aronson, 1976).
2. The influence of credibility on the attitude of recipients seems to dissipate three or four weeks after the communication (cited Kiesler et al., 1969). When designing attitude change research retention should also be tested.
3. The greater the discrepancy between the communicator and the recipients' initial position, the greater the change in attitude, provided the communicator is also highly credible (cited from Aronson, 1976). Science educators seemed justified in supporting a point of view in their persuasive communication that might be quite divergent from that of their audiences.
4. A person's attitudes are influenced by the reference people or groups to which he belongs (cited from Sherif, 1976).
5. Playing an active verbal role in the communication process can affect attitude (cited from Janis & King, 1954). Furthermore, if a person plays a verbal role counter to his beliefs, he begins to believe the counterinformation resulting in a change toward the new point of view. Role playing might be a means of changing attitude science education.
6. To an intelligent audience the communicator should not draw conclusions directly but let the recipients do this implicitly (cited from Zimbardo & Ebbesen, 1969).

7. To an intelligent audience the communicator should give both sides to an argument (cited from Aronson, 1976).
8. Communications that arouse fears can result in an attitude change if the communicator is also successful in suggesting action that will alleviate emotional tension (cited from Hovland et al., 1953). The fear-arousing element of persuasive communication is the thought that learning science is important for the survival of the society.
9. Persons of low self-esteem are more susceptible to persuasive influence than those with a high self-esteem (cited from Cohen, 1964 and Aronson, 1976).
10. Persons with an excessive respect for and obedience to authority, as well as an attitude of cynicism, are more susceptible to a persuasive communication (cited from Cohen, 1964).
11. Because our [American] culture encourages women to be acquiescent, females seem more susceptible to persuasive communication than males (cited from Cohen, 1964).
12. The reward that causes people to respond to a persuasive communication can be direct or anticipated (cited from Zimbardo & Ebbesen, 1969). Reinforcement by some direct means seems to be unlikely for preservice teacher unless a course grade might be considered the reward. Inservice teachers could realize many forms of reward from a science supervisor who promised science equipment, free inservice training and subscriptions to professional journals. An anticipated reward could be social in nature or self-approval, simply agreement with the communicator's point of view.

Later, Shrigley (1982) also investigated the communicator and communication characteristics for changing attitudes of preservice elementary teachers toward metric conversion. He surveyed 139 preservice elementary teachers for the communicator characteristics in the first part of the study and 45 mathematics educators for communication characteristics in the second part of the study.

Shrigley (1982) administered a questionnaire consisting of three subscales: basic qualification, teaching and research, and commitment. According to the responses of the preservice elementary teachers a credible communicator had (i) background in mathematics and science, (ii) fluency in metrics, (iii) capability of thinking metrically, (iv) a record of excellent teaching, (v) previous teaching of metric measurement to children, (vi) responsibility for teaching metric content in methods courses and (vii) an open enthusiasm for metric conversion.

He also included an open ended question asking two brief, persuasive statements about the importance of metric conversions. He grouped the answers into eight categories and concluded that a persuasive communication about metric conversion should include: (i) consistency with American monetary system, (ii) ease of conversion of units than English, (iii) ease of teaching and learning than English measurement, less need for common fractions, (iv) usage of most nations and usage of scientists for decades, (v) contemporary use by American industry, (vi) facilitation of world trade and communication, and (vii) future need of children since mandated by educational agencies.

In 1983, Koballa and Shrigley investigated the effect of two kinds of persuasive communications on 180 preservice elementary teachers' the attitudes toward energy conservation. This study also stemmed from the Yale Communication and Attitude Change Program. There were two treatments in the study: integrated and conventional communications. There was also a control group. Equal number of concrete, concrete differentiator, and abstract thinkers were randomly assigned to one of three groups: control, conventional communication, and integrated communication. All the groups were exposed to videotapes about 13 minutes. The control group was exposed to a videotape developed for elementary teachers not related to energy conservation. The conventional communication group was exposed to a videotape including seven belief statements recorded by one of the researchers. The integrated communication group was exposed to a videotape describing the relationship of the conventional communication statements with the subscales of the attitude scale. They administered the Energy Conservation Attitude Scale as a pretest, posttest and delayed posttest three weeks following the treatment.

Their results revealed that (i) both treatments were equally effective and significantly more effective compared with the control case in attitude change, $t(171) = 5.43$, $p < .01$; (ii) after three weeks the treatment effects continued, $t(171) = -4.22$, $p < .01$; (iii) the integrated treatment had no effect on concrete differentiators' attitude scores neither on posttest nor on the delayed posttest both compared with the pretest scores, $t(171) = .32$, $p < .05$; (iv) when pretest and delayed posttest scores were compared, attitude change was more likely for abstract thinkers presented with integrated communication, $t(171) = -0.241$, $p < .01$, and for concrete thinkers presented with nonintegrated communication, $t(171) = -2.55$, $p < .01$.

Afterwards, Koballa (i.e. 1984, 1986, & 1992) also investigated the persuasive communication in science education. The studies he conducted in 1984 and 1986 were stemmed from the Yale Communication and Attitude Change Program. In the study he conducted in 1992, he reviewed the social psychology literature about persuasion and related concepts mentioning also about the learning theory and the Yale Communication and Attitude Change Program. In 1984, Koballa investigated the effect of one-sided and two-sided persuasive messages on 85 preservice elementary teachers' attitudes toward energy conservation. The subjects were categorized as developmentally or nondevelopmentally advanced according to their scores on Knowledge about Energy Conservation Subscale of the Energy Inventory. A modified version of Energy Conservation Attitude Scale was administered three times: as a pretest, three weeks before the treatment; as a posttest, immediately after the treatment; and as a delayed posttest four weeks after the treatment.

The one-sided communication was the video used by Koballa and Shrigley in 1983. Four communicator credibility factors were considered developing the video about seven belief statements supporting energy conservation. The videotape of two-sided communication was similar to the one-sided communication, only counterarguments were integrated. Both videos were about 10 minutes long.

Koballa conducted ANOVA to compare the effects of two types of persuasive communications. However, the sample sizes in neither of the groups were enough to conduct parametric statistics. He concluded that: (i) according to the posttest results, two-sided persuasive communication was more effective in changing attitude than one-sided persuasive communication for all subjects, $F(3, 54) = 9.27$, $p < .01$; $t(27) = -3.43$, $p < .01$; $t(27) = -4.35$, $p < .01$, respectively; (ii) four weeks after treatment, the positive attitude change dissipated for all subjects in two-sided communication group, $t(14) = 3.29$, $p < .01$; $t(14) = 4.11$, $p < .01$, respectively ; and (iii) one-sided communication was not effective changing subjects' attitudes according to posttest results, however nondevelopmentally advanced subjects exhibited a gain four weeks after the treatment, $t(13) = -2.29$, $p < .05$.

Later in 1986, Koballa investigated the effect of self-generated thoughts on salience of two-sided persuasive messages of 58 preservice elementary teachers' attitudes toward energy conservation. The experimental group watched a videotaped persuasive communication which continued about 10 minutes. The persuasive communication included both pro- and counter-arguments of necessity of energy conservation and sharing them with children. Just after the persuasive communication, the subjects had 5 minutes to either subvocally rehearse the favorable arguments presented or list their thoughts. The arguments were (i) most of our energy sources are nonrenewable, (ii) conservation of energy buys the time needed for the design of alternative energy sources, (iii) conserving is a morally and economically sound practice, (iv) excesses in energy consumption will negatively affect future generations, (v) wise decision making regarding energy use comes about as a result of accurate information, (vi) the conservation of energy is integrally related to the total scope of global environmental concerns, and (vii) energy conservation needs to be a universal habit.

The Attitude toward Energy Conservation Scale was administered to the subjects three weeks before the treatment and just after the treatment. Koballa, used ANCOVA to compare the effects of subvocal rehearsal and listing thoughts. However, the sample sizes in neither of the groups were enough to conduct parametric statistics. He stated that the scores ranged between 48 and 75 on pretest, and between 53 and 81 on the posttest. The mean score of the subvocal rehearsing group was 62.85 ($SD = 6.12$) on the pretest and 70.19 ($SD = 5.45$) on the posttest whereas the thought listing group had a mean score of 63.50 ($SD = 7.04$) on the pretest and 69.82 ($SD = 6.97$) on the posttest. He concluded that there was no significant difference between the two treatment groups when the pretest scores were controlled ($F(1, 47) = 1.74$, $p > .05$).

Moreover, Koballa (1986) analyzed the thoughts listed by the subjects. The thoughts were classified as favorable or unfavorable by 22 judges and 112 thoughts were classified as favorable and 17 were classified as unfavorable. He calculated the partial correlation between the number of favorable thoughts listed and attitude change by partialing out the subjects' pretest scores and concluded that the relationship was significant.

In 1992, Koballa reviewed the social psychology literature about persuasion and related concepts. He mentioned about the learning theory and the Yale Communication and Attitude Change Program. He concluded that most attitudes of teachers and students were not results of planned efforts due to three reasons. First reason was that there is no agreement about the attitudes that should be intentionally taught or modified. Second was that the strategies to teach or modify attitudes are not known by the science educators. Third reason was that many science educators have several misconceptions about persuasion. One misconception was that persuasion was viewed as an unpleasant social influence similar to coercion, indoctrination, and brainwashing. Another misconception was related with the ethics of persuasion process. Koballa, stated that many strategies teachers use, were coercive; persuasion and instruction were similar since they both require conscious cognitive activity, and it was possible to be ethical when persuading people.

In 1990, Demers and Shrigley focused on a different aspect of the Yale Communication and Attitude Change Program. They conducted a study to investigate the effect of two channels of communication (videotape and written channels of communication) on preservice elementary teachers' attitudes toward science teaching. They administered science attitude scale as a pretest, posttest, and delayed posttest. The sample of the study consisted of 66 preservice elementary school teachers. They concluded that videotape and written channels of communication were equally effective in changing science attitudes.

Martin (1985) investigated the effects of perceived communicator credibility on attitudes toward science and science education. His study also stemmed from the Yale Communication and Attitude Change Program. His sample consisted of 25 preservice elementary teachers who were enrolled to an elementary science methods course. His treatment consisted of three phases: science methods instruction including science planning in the campus for seven weeks (phase 1); preservice elementary teacher science instruction of students in elementary schools for following two weeks (phase 2); and a science fair in the campus and evaluative feedback session during the final week of the quarter. In fact, there was no specifically designed treatment for attitude change; the effect of an ongoing science methods course was investigated.

He administered Moore's Science Teaching Attitude Scale to the students and communicators. There were two subscales in the questionnaire: attitude toward science and attitude toward elementary science teaching. He developed a seven-space semantic differential instrument to assess the preservice elementary teachers' perceptions of communicator credibility. There were two-concepts in this instrument: science and science teaching.

The first posttest was administered after phase 1 and the second posttest after phase 2. The results of the study revealed that the students' attitudes toward science did not change significantly (Mpre=78.64, $Mpost_1$=81.40, $Mpost_2$=81.40), however their attitudes towards science teaching significantly increased after each phase of the study (Mpre=53.64, $Mpost_1$=59.80, $Mpost_2$=64.20). Moreover, the students ranked the communicators as science instructor, university supervisor, graduate assistant, unit evaluator, peer team member, and cooperating teacher, from most credible to least credible respectively. The graduate assistant and a university supervisor were also rated as highly credible by the students. This ranking did not change after phase 1 and phase 2. He also compared the students' science attitude and science teaching attitude mean scores (for pretest and posttests) with their most credible communicators'. He concluded that the study provided support for credibility principle in general; however it was not the only reason for attitude change. Since the study was weak in design and the sample size was small, it can be viewed as a starting point, however the results were inconclusive.

On the other hand, Steiner (1980) investigated the effect of induced cognitive dissonance on school-related attitudes. The study was based on Festinger's (1957) theory. The sample of the study consisted of 135 ninth-grade life science students. Students were categorized as having high or low attitudes toward science as a school subject, and high or low attitudes toward school lunch before the treatment. Thus there were four classifications: high science attitude-high lunch attitude; high science attitude-low lunch attitude; low science attitude-high lunch attitude and low science attitude-low lunch attitude. Eighty students were randomly assigned to two treatments: lunch or science. The remaining students were assigned to the control group. Attitude toward school lunch was included in the study for two reasons: to hide the purpose of the treatments and to check the validity of the theory with another school-related subject.

The students in the science treatment group were expected to prepare a videotape praising science and promoting their peers to enroll science courses, whereas the students in the lunch treatment were expected to prepare a videotape praising school lunch program and promoting their peers to eat school lunch. The treatments continued about one hour. Each student with the researcher prepared the videotapes involving positive attitudes toward lunch or science as determined before. The treatments finished in ten successive school days.

Mean score of pretest for science treatment group was 47.5 and standard deviation was 16.3 (N=33) while mean score of pretest for nontreatment group was 46.4 and standard deviation was 14.5 (N=45). Mean score of posttest for science treatment group was 51.2 and standard deviation was 17.7 while mean score of pretest for nontreatment group was 46.5 and standard deviation was 16.1.

Steiner conducted ANCOVA controlling for the pretest scores for each variable and concluded that science treatment was effective changing students' attitudes toward science positively while lunch treatment was effective changing students' attitudes toward school lunch positively.

More recently, Newbill (2005) studied instructional strategies to improve women's attitudes toward science in her enlightening PhD thesis. She developed two instructional modules caring with three recommendations from the literature: (i) addressing the emotions that are relevant to learners' existing attitudes, (ii) involving credible and attractive women role models, and (iii) addressing the functions of the existing attitudes. She listed 15 guidelines for improving women's attitudes toward science in line with these recommendations.

The researcher selected two topics relevant to introductory geology and chemistry classes. These topics were scientists and minerals. The Scientists module aimed to enhance attitudes toward the normality of scientists, by presenting information about ten scientists who were chosen because of their appeal to the sample. The were young, normal and attractive people with interesting hobbies. Six were women four were men. The Minerals module was aimed to enhance attitudes toward the social value of science. There were benefits of minerals which affect society in the module. Usefulness for teaching basic concepts and local relevance was criteria designing the module, and 15 guidelines were used developing all the content. Moreover, two other modules were designed for the control group. However, the researcher paid attention to incorporate the guidelines for improving women's attitudes toward science in these modules.

The instructional strategy used in the study was based on Kamradt and Kamradt's model. Although they were inspired by some other ideas, they did not cite sources from attitude change theories in their description of their theory (Newbill, 2010). The model was simplified into four steps: (i) activate the attitude; (ii) diagnose the dissonant component; (iii) address the most dissonant component; and (iv) consolidate the attitude. In order to achieve the first step, Newbill designed an introduction to inform students that they were going to complete a science module.

The sample of the study consisted of 281 undergraduate geology and chemistry students at two universities, and 40.3% were men whereas 59.7% were women. The experimental group consisted of 139 students while the control group consisted of 143 students due to loss of subjects. The students were randomly assigned to experimental or control groups. Moreover, experimental group was randomly divided into two groups. First group completed the Scientists module at the beginning and the Minerals later, and the second group vice versa. In the first week the researcher administered the pretest, second week the first module, third week the second module, and finally the fourth week the posttest. Measuring tools used in the study were a demographics questionnaire, the Test of Science Related Attitudes developed by Fraser in 1978, and the instructional materials used in the modules.

The quantitative results of the study revealed that there was (i) no significant difference in attitude change between experimental group and control group, $t(280) = 1.424$, $p > .05$; (ii) no significant difference in attitude change between women in the experimental group and in the control group, $t(167) = 0.894$, $p > .05$; (iii) no significant difference in attitude change between the experimental and control groups of the participants whose initial attitudes were negative, $t(61) = 0.712$, $p > .05$; (iv) no significant difference in attitude change between women in the control and groups whose initial attitudes were negative $t(39) = 0.735$, $p > .05$; (v) significant difference in attitude change on normality of scientists subscale, between the group and the control group, $t(274) = 3.661$, $p < .05$, (vi) significant difference in change between males' and females' in the experimental group in favor of females, $= 2.016$, $p < .05$; (vii) significant difference in attitude change between males' and females' in the control group in favor of females $t(141) = 2.355$, $p < .05$; (viii) no significant difference in attitude change between males and females whose initial were negative in the experimental group, $t(24) = 1.463$, $p > .05$; (ix) no significant difference in attitude change between males and females whose initial attitudes were negative in the control group, $t(35) = .913$, $p > .05$; (x) no significant difference males' and females' scores on any specific subscale in the experimental group; (xi) significant difference between males' and females' scores on the normality, $t(137) = 2.833$, $p < .05$, and leisure interest, $t(138) = 1.998$, $p < .05$ subscales in the control in favor of women in both scales.

The content analysis of journals was conducted to identify the attitude change processes, to validate structured design proposed by Kamradt and Kamradt, to identify impeding conditions for attitude change, and to determine the qualitative differences between males' and females' responses if present. Eighteen participants from the experimental group were selected for content analysis: nine participants whose attitudes toward the normality of scientists improved the most and nine participants whose attitudes changed the least. Attitude change was measured by the normality subscale of the Test of Science Related Attitudes. Qualitative results of the study revealed that (i) students whose attitudes changed wrote significantly more in journaling activities associated with the modules, (ii) the guidelines worked exactly as predicted for some students.

Häussler and Hoffmann (2002) investigated the effects of an intervention project focused on enhancing girls' interest, self-concept, and achievement in physics in Germany. Twelve classes of six physics teachers (three female & three male) in six schools participated the study. The experimental group consisted of 150 girls and 139 boys. The classes in the experimental group were assigned to three different experimental treatments: first group was divided into two halves in second hour of each week (coeducated half class), second group was divided into gender groups in the second hour of each week (monoeducated half class), and the third group was instructed all together (coeducated whole class). The same teacher continued instructing the two halves at different times in the divided classrooms. Seven other classes of six physics teachers (one female; five male) in two schools were assigned as the control group. There were 103 girls and 64 boys in the control group. The intervention continued one school year (in 1992-1993 school year) about 60 class-hours in 7th grade. There were five units in 7th grade: Sound and Noise, Force and Velocity, Heat Transport, Electricity and Magnetism, and Straight Propagation of light.

To promote girls' interest and self-concept, they designed the intervention program according to the following recommendations of research results they have conducted previously in Germany: (a) changing the curriculum in line with girl' interests and experiences, (b) training the teachers to support girls' physics related self-concept, and (c) changing organizational setting to improve girls' self-concept about physics. They also determined and used the following guidelines to promote interest in physics courses: (i) provide opportunities to marvel; (ii) link content to prior experiences for both boys and girls; (iii) provide first-hand experiences; (iv) encourage discussions and reflections on the social importance of physics; (v) connect physics with applications; (vi) show physics in relation to the human body; and (vii) demonstrate the benefit and use of treating physics quantitatively.

In 1991-1992 school year, teachers of the experimental groups were trained weekly. While the intervention was going on, the teachers were continuing biweekly training and the classrooms were visited by the researchers for supervision. However, the teachers of the control groups were not trained.

Data were collected at the beginning of seventh grade before starting the physics course, immediately after each of teaching units, at the end of seventh grade, and at the end of the eighth grade. The measuring tools consisted of the physics interest scale, the motivational impact of a teaching unit, school related self-concept, physics-related self-concept, competence gain scale, and achievement tests. The test for motivational impact of a teaching unit included items related to further occupation with the content of unit outside school, sensed personal benefit, sensed emotional climate, and topic specific interest.

The results of the study indicated that boys (M=71.4) had significantly higher mean scores in the physics interest scale than girls (M=67.8) in the pretest. There were no significant differences between experimental and control groups in the pretest scores. Physics interest scores of all the groups, except monoeducated group decreased significantly in the posttest and control group students had the largest decrease. They concluded that splitting physics classes in halves might have increased interest in physics.

There was no difference between the experimental and control groups after the first unit. Girls in the experimental and control groups found physics instruction less motivating when compared to boys ($p<0.01$). However, later girls of the experimental groups reported their physics instruction as more motivating compared to boys. The differences between the girls' and boys' scores in heat and electricity units were no more significant.

The self-concept tests were administered at the end of the school year. They compared the school- and physics-related self-concept scores of the students. The difference between school- and physics-related self-concept was not affected by the intervention for boys; however for girls in the control group, this difference was negative and larger. They concluded that just after one school year of traditional physics instruction girls have lost their confidence in being good achievers in physics ($p<.001$).

Before the intervention, students were asked to what extent they expected to learn something immediately useful for them or something they could use later in life; after the intervention, they were asked to what extent they sensed a competence gain through physics. Girls in the monoeducated group reported their competence gain through physics in the posttest was significantly higher than their expected competence through physics in the pretest ($p = .01$). The other differences were not significant.

Achievement scores of boys and girls in monoeducated classes were significantly higher than other groups. There was a difference between boys and girls, in favor of boys, however it was not significant. The difference between the coeducated classes (divided and whole) was not significant. The differences between control classes and coeducated experimental classes were not significant, either. In both groups, girls' achievement was significantly lower.

They reported that the experimental groups were significantly better than control classes in the achievement posttest ($p \leq .001$) and they explained this result was due to the curriculum, which was designed for students' interest and relation with everyday life, aided retention and reactivation of knowledge. There was no significant difference between the boys' achievement scores in different treatment groups, monoeducated girls' achievement was significantly better. In monoeducated group, there was no significant difference between boys and girls ($p = .064$). Delayed posttest, consisting of the same 16 items, was administered at the end of the next school year. Experimental groups got nearly the same scores with the posttest and they were still significantly better than control groups ($p \leq .001$).

The studies in science education literature dealing with changing students' attitudes mostly stem from the Yale Communication and Attitude Change Program (i.e. Demers & Shrigley, 1990; Koballa, 1984, 1986; Koballa & Shrigley, 1983; Martin, 1985; Shrigley, 1976, 1978, 1982). These studies investigated the characteristics of a credible communicator (Shrigley, 1976, 1978), characteristics of persuasive communication (Shrigley, 1978), characteristics of a credible communicator and persuasive communication for changing attitudes toward metric conversion (Shrigley, 1982), effects of two kinds of (integrated and nonintegrated) persuasive communication on attitudes toward energy conservation (Koballa & Shrigley, 1983), effects of two kinds of (one-sided and two-sided) persuasive communication on attitudes toward energy conservation (Koballa, 1984), effects of self-generated thoughts (sub-vocal rehearsal and listing thoughts) on salience of two-sided persuasive messages on attitudes toward energy conservation (Koballa, 1986), effects of two channels of communication (videotape and written) on attitudes toward science teaching. Martin (1985) investigated the effects of perceived communicator credibility on attitudes toward science and science education an ongoing science methods course. Moreover, Shrigley (1978) and Koballa (1992) reviewed learning theory among attitude change theories.

On the other hand, Steiner (1980) investigated the effect of induced cognitive dissonance on attitude toward science and school lunch. This study was based on Festinger's cognitive dissonance theory (1957), whereas Newbill (2005) stated that her study stemmed from Kamradt and Kamradt's structured design (1999). However, Kamradt and Kamradt did not explicitly state which attitude change theories their theory was based on (Newbill, 2010). However, it can be inferred that the structured design stems from the Yale Communication and Attitude Change Program, and functional theories. Newbill (2005) investigated the effects of instructional strategies to improve women's attitudes toward science in two topics (one geology and one chemistry topic).

However, there were no studies in physics education literature to change students' attitudes toward physics stemming from the attitude change literature. One study related to physics was conducted by Häussler and Hoffmann (2002) to enhance girls' interest and self-concept in physics classes according to the recommendations of research results previously conducted in Germany.

2.2 Motivational Theories and Constructs

Motivation is viewed as a process; however, it is not directly observable, it is inferred from behaviors such as choice of task, effort, persistence, and expressions (Pintrich & Schunk, 2002). Physical activities such as effort and persistence, and mental activities including planning, rehearsing, organizing, monitoring, and solving problems etc. are indicators of motivation. “Instigated” and “sustained” activities are also indicators of motivation.

Pintrich and Schunk also referred to the historical theories of motivation such as behavioral and cognitive theories (i.e. Freud’s theory), conditioning theories (i.e. classical conditioning, operant conditioning) drive theories (i.e. incentive motivation), purposive behaviorism (i.e. expectancy learning), arousal theories (i.e. optimal level arousal), cognitive consistency (i.e. balance theory, cognitive dissonance theory), functional autonomy of motives, and humanistic theories (i.e. Maslow’s hierarchy of needs). They also mentioned about the metatheoretical models: mechanistic, organismic, and contextual. However, they focus on expectancy-value models, attribution theory, social cognitive theory, role of goals and goal orientation, intrinsic motivation, and role of interest and affect in achievement motivation.

Brophy (1998), on the other hand, mentioned about the behavior reinforcement theories, need theories, goal theories, intrinsic motivation theories, Keller’s model, and Wlodkowski’s model; however, he emphasized goal orientations (i.e. causal attributions, self-efficacy perceptions), extrinsic incentives and intrinsic motivation. Moreover, he suggested strategies for supplying extrinsic motivation, enhancing intrinsic motivation, and stimulating students’ motivation to learn.

Eccles and Wigfield (2002) reviewed research on motivation, beliefs, values, and goals. They included the recent research related to developmental and educational psychology and divided the theories into four categories: theories that deal with expectancies for success (self-efficacy theory and control theory), theories that deal with task value (intrinsic motivation, self-determination, flow, interest, and goals), theories that deal with expectancies and values (attribution theory, the expectancy-value models and self-worth theory), and theories incorporating motivation and cognition (social cognitive theories of self-regulation and motivation, and theories of motivation and volition).

Focusing on the categorization of theories listed by Eccles and Wigfield (2002), major motivational are listed to present a comprehensive framework. Moreover, curiosity and arousal theories, and the equity theory are also briefly explained since they are related to this study.

a. Theories that deal with expectancies for success: These theories deal with the beliefs of the individual about the question "Can I do this task?" Two theories that deal with expectancies for success are self-efficacy theory and control theories.

i. Self-efficacy: It refers to one's beliefs about his/her capabilities to organize and execute the courses of action required to manage prospective situations (Bandura, 1986). Bandura's self-efficacy theory is related to expectancies for success. According to Bandura (1977) there are two kinds of expectancy beliefs: outcome expectations that are beliefs that certain behaviors have certain consequences, and efficacy expectations that are beliefs about one's ability to perform the necessary activities to produce the outcomes.

Bandura added that self-efficacy is not the only determinant of behavior, however, if the individual has appropriate skills and adequate incentives, efficacy expectations are the overriding determinant of activity choice, effort expended, and persistence.

Bandura (1994) listed sources of self-efficacy beliefs as: (i) mastery experience, (ii) vicarious experiences provided by social models, (iii) social persuasion, and (iv) reduction of negative affect. He added that the most effective source was the mastery experience.

ii. Control theories: Pintrich and Schunk (2002) summarized the logic behind these theories as: individuals having external locus of control think that outcomes cannot be determined by their actions and they don't have the control to change them, on the other hand, individuals having internal locus of control think that outcomes are determined by their actions and they have the control.

b. Theories that deal with task value: These theories include goal orientation theories, intrinsic motivation (including self-determination and flow theory), and interest.

i. Goal Orientation Theories: Murray's taxonomy of needs and Maslow's hierarchy of needs are among the antecedents of goal orientation theories, since both needs and goals have motivational influence on behavior. Maslow (1943) lists basic needs as the physiological needs, the safety needs, the love needs, the esteem needs and the need for self-actualization. The order of these needs is important since the first one is a lower need compared to the second one. If the lower needs (i.e. safety needs) are not satisfied, the higher needs (i.e. self-esteem needs) will not be satisfied, either.

Various goal orientation theories exist in the literature; however, the common point of all is the goal orientation concept, which deals with the purpose behind engaging in achievement performance (Pintrich & Schunk, 2002). For example Midgley et al. (1998) categorized achievement goal orientations as: (i) task goal orientation that is the goal to develop ability, (ii) ability-approach goal orientation that is the goal to demonstrate ability, and (iii) ability-avoid goal orientation that is the goal to avoid the demonstration of lack of ability.

On the other hand, Brophy and Ames (2005) mentioned about mastery or performance goals. Students having mastery goal orientation view activities as opportunities to learn or develop their skills; whereas students having performance goal orientation regard "achievement activities as tests of their ability to perform, as opportunities to demonstrate their ability, or as challenges to their ability" (Brophy & Ames, 2005, p. 11). They also added that outcomes (both learning related and motivational) are best enhanced when students have mastery goal orientation instead of performance goal orientation and the theory is more relevant to learning than testing situations. The influences of the environmental factors are also included in the theory.

ii. Intrinsic Motivation: Intrinsic motivation is described as "doing something because it is inherently interesting or enjoyable" (Ryan & Deci, 2000). There are various theories and motivational construct related to intrinsic motivation.

- Self-determination theory: According to Pintrich and Schunk (2002) the theory proposes that people "have a need to be autonomous and engage in activities because they want to" (p. 257). Ryan and Deci (2000) stated that they categorize motivation according to the reasons or goals behind the action, and the most common classification is intrinsic motivation and extrinsic motivation. The theory proposes that there are three kinds of extrinsic motivation: external regulation that is related to behaviors motivated by an external demand or an external reward, introjected regulation that is related to behaviors motivated by some internal regulation but under pressure to attain ego-enhancements or pride or to avoid guilt or anxiety, and identification that is related to behaviors motivated by identified regulations fully assimilated to the self for its instrumental value with respect to some outcome separate from the behavior.

  Three psychological needs the theory deals with are: need for competence, autonomy, and relatedness. Autonomy refers to internal perceived locus of causality in terms of attribution theory (Ryan & Deci, 2000). Competence need refers to the "need to feel and to be competent in their interactions with others, with tasks and activities, and with the larger context… The last basic need, relatedness, refers to need to belong to a group" (Pintrich & Schunk, 2002, p. 257).

- Flow theory: Csikszentmihalyi, Abuhamdeh and Nakamura (2005) stated that sometimes people, even though they do not receive external rewards, perform time consuming, difficult, and dangerous activities. The reason underlying such behavior was stated to be the flow experience that is "a subjective state that people report when they are completely involved in something to the point of forgetting time, fatigue, and everything else but the activity itself" (Csikszentmihalyi et al., 2005, p.600). The added that flow results in three subjective features: the merging of action and awareness, a sense of control, and an altered sense of time. They stated that challenge has an important function in the flow experience. People facing challenge develop better skills; however the activity is still involving. In order to maintain the flow experience, they must face new challenges. Eventually, this succession increase competence.

iii. Interest theories: "Interest is the accompaniment of the identification, through action, of the self with some object or idea for the maintenance of a self-initiated activity. Self-initiated activity is essential component of interested behaviors" (Dewey, 1913, p.14). Interest is a content-specific concept (Schiefele, 1991).

There are two dimensions of interest personal interest and situational interest. Personal interest is people's interest they bring to some environment or context whereas situational interest is acquired by participating in an environment or context (Mitchell, 1993). Thus, personal interest is relatively stable.

c. Theories dealing with expectancies and values: Several theories integrate expectancy and value constructs. Two of these theories are:

i. Attribution theory: Among the initial studies about the learned helplessness Seligman's study should be cited. Seligman's learned helplessness (1975), theory deals with the behavioral and psychological effects of events that are uncontrollable. The theory lists three main effects of uncontrollable events: (i) produce passivity, (ii) inability to learn that responding is effective, (iii) and emotional stress in animals, and depression in man. According to Pintrich and Schunk (2002) this theory might be mentioned among the antecedents of the attributions; since it deals with the causal explanations of the uncontrollable events, and these explanations influence expectations about the future events.

According to attribution theory people are motivated to understand and master themselves and their environment, to predict and control future events, and act as naïve scientists especially seeking causal determinants of both their own and others' behavior (Pintrich & Schunk, 2002). Pintrich and Schunk defined attributions as the perceived causes of outcomes, and emphasized that they don't have to be the actual causes, thus the attribution theory is "a phenomenological theory of motivation that gives precedence to individual's construction of reality, not reality per se" (p. 95), however, this inaccuracy is not important for an attribution to have psychological and behavioral outcomes from a motivational point of view.

Weiner (2005) listed three causal dimensions that have cross-situational generality as locus, stability, and controllability. Locus dimension categorizes the location of a cause as within the person or outside the person. Stability dimension categorizes causes as changing over time or not cause. Controllability dimension categorizes causes as under control of people or not. The stability dimension captures whether causes change over time or constant over time. Ability and effort are classified as internal causes, however ability is stable whereas effort is unstable, effort is controllable while luck is uncontrollable. Effort, ability, task difficulty, and luck are cited as the most important achievement attributions (Weiner, 1992).

The stability dimension has more influence on expectancies for success, the locus dimension has more influence on self-esteem related affect, and controllability dimension has more influence on social related affect. Eccles and Wigfield (2002) described these influences: internal attributions of success increase self-esteem, whereas external success attributions increase appreciation; internal failure attributions result shame while external failure attributions result anger.

ii. Expectancy-value models of motivation: Pintrich and Schunk (2002) defined expectancy component as “the constructs related to the beliefs about competence to do the task” (p. 403) and value component as individuals’ perceptions about why they want to accomplish an achievement task. Ford (1992) mentioned Atkinson, Feather, and McClelland among the first researchers who dealt with expectancy-value model. McClelland integrated need for achievement and need to avoid failure in his achievement motivation theory in 1953; later in 1957, Atkinson improved this theory and built theory of achievement motivation (Guilloteaux, 2007).

Pintrich and Schunk (2002) reviewed the early research on expectancy-value and concluded that “these early models of motivation stressed the importance of the individual’s perceptions and beliefs as mediators of behavior, thereby focusing on the subjective and phenomenological psychology of the individual” (p. 59). They stated that these models separated beliefs about capability of a task (probability and expectancy for success) and beliefs about the importance, value, and desire to do the task (motives, incentive value) and assumed that motivated behavior is the multiplicative combination of the two. Hence, people who feel capable of doing a task, may not value it, thus do not engage in it; and people who value a task may feel incapable of doing it, thus with expectation of failure less likely to engage in it. They added that current research follows the same approach including contextual factors.

According to the current expectancy-value model developed by Eccles and her colleagues (i.e. Eccles & Wigfield, 2002) expectancies and values are assumed (i) to directly influence performance, persistence, and task choice; and (ii) to be influenced by task-specific beliefs such as perceptions of competence, perceptions of the difficulty of different tasks, and individuals’ goals and self-schema. These social cognitive variables are influenced by individuals' perceptions of others' attitudes and expectations for them, by their affective memories, and by their own interpretations of their prior achievement outcomes. Individuals' task perceptions and interpretations of their prior outcomes are assumed to be influenced by socializer's behavior and beliefs and by cultural environment and unique historical events.

Expectancy for success refers to perception of competence on an upcoming task in the future. The focus of the model is on efficacy expectations. Eccles and Wigfield (2002) defined the four components of task-value: (i) attainment value refers to personal importance of doing well on the task, (ii) utility value refers to the relation of task to current and future goals, for example career goals, (iii) intrinsic value refers to the enjoyment of performing the activity or the personal interest in the subject, (iv) cost refers to "the negative aspects of engaging in the task, such as performance anxiety and fear of both failure and success, as well as the amount of effort needed to succeed and the lost opportunities that result from making one choice rather than another" (p.120).

d. Theories incorporating motivation and cognition: These theories in general have two concerns: "how motivation gets translated into regulated behavior, and how motivation and cognition are linked" (Eccles & Wigfield, 2002, p. 124). Social cognitive theories of self-regulation and motivation, and theories of motivation and volition are listed among the theories incorporating motivation and cognition.

i. Self-regulation: According to Zimmerman (1998) self-regulation refers to the students' self-generated beliefs, feelings, and behaviors for achievement of goals. Zimmerman (1990) added the three characteristics of self-regulated students: they use self-regulated learning strategies, they respond to self-oriented feedback about effectiveness of learning, and they engage in interdependent motivational processes. Schunk (2001) emphasized that motives (achievement-related cognitions, beliefs, intentions, and affects) along with actions should be regulated.

The three important processes in self-regulated learning are (Eccles & Wigfield, 2002): self-observation that is examination of one's own activities, self-judgment that is comparison of one's performance with a standard or others' performance, and self-reactions that is one's reactions to the outcomes of the performance. Schunk (1990) pointed out that proximal, specific, and challenging goals are most effective enhancing children's motivation and self-efficacy.

ii. Volition: The conceptual basis of the volition is based on Kuhl's research in 1980's. Volition refers to the tendency to maintain focus and effort toward goals despite potential distracters (Corno, 1994). More recently, Corno (2001) stated that self-regulated learning have common features with the volitional control.

e. Curiosity and arousal theories: Pintrich and Schunk (2002) explained Berlyne's theory among optimal level of arousal theories under arousal theories. Arousal corresponds to drive: the internal force that search for sustaining homeostasis, or optimal states of bodily mechanisms. According to the theory, maintaining an optimal level of arousal is desired since people are bored due to low level arousal whereas people are motivated to lower high level arousal. Behavior is motivated to explore novel and incongruous stimuli, which increases arousal. Moreover, other factors such as ambiguity and surprise have effect on arousal.

f. Equity theory: Ford (1992) mentioned Adams' research in 1963 and 1965 among the first studies about the equity theory. He stated that the equity theory, being a work motivation theory, is still accepted among the major theories in that field. He added that the theory shed important light on how workers will react motivationally to different kinds of compensation circumstances. Cited from Huseman, Hatfield and Miles (1987), the theory proposes that equity is the major concern in many compensation situations.

2.2.1 Teaching Practices Derived from Motivation Theories and Motivational Constructs

There is enough number of studies dealing with the implications of the motivational theories and motivational constructs in education literature. Among them, Brophy (1998), Pintrich and Schunk (2002), and Wlodkowski (2008) provide a comprehensive scaffolding of the related literature. Brophy (1998) listed implications for the classroom related to four theories of motivation: behavior reinforcement, needs, goals and intrinsic motivation. According to behavior reinforcement theory, the teacher should cue and reinforce desired behavior to enhance their motivation. On the other hand, according to needs theories, the teacher should satisfy competing needs of the students, hence students can focus on mastery- and achievement-related needs, and the teacher should design curriculum and instruction to help students to accomplish achievement-related needs without facing too much difficulties. According to goal theories, the teacher should coordinate classroom climate, curriculum, instruction, and assessment practices to encourage students to adopt learning goals rather than performance or work-avoidant goals. To enhance intrinsic motivation of the students the teacher should highlight curriculum content and learning activities that are related to students' interests, and provide opportunities for the students to choose what to do and to exercise autonomy in doing it.

Pintrich and Schunk (2002), on the other hand, listed teaching practices related to a larger variety of motivational theories with results of research related to motivation. The motivational practices were related to conditioning theories, arousal theories, humanistic theories, expectancy-value models, attribution theory, modeling, model characteristics, goal setting, motivated learning, cooperative groups, goal content theory, personal responsibility, intrinsic motivation, use of rewards, flow theory, test anxiety, democratic leadership, self-efficacy , and situational and personal interest. Some of the strategies they listed were related to choice and control, teacher enthusiasm, feedback, variability, and creating disequilibrium.

Wlodkowski (2008) listed 60 motivational strategies under four major motivational conditions that are establishing inclusion among learners, helping learners develop positive attitudes toward learning experience, enhancing meaning in learning activities, and engendering learners' competence. Inclusion strategies and attitude development strategies were stated to be useful at the beginning of the learning activities whereas meaning enhancement strategies were useful during the learning activities. The competence strategies were more useful ending learning activities.

There are two purposes of the inclusion strategies: to engender an awareness and feeling of connection, and to create a climate of respect. The attitude development strategies, on the other hand, are useful for creating a favorable disposition toward the learning experience through personal relevance and volition; explicitly, they were listed to serve four purposes: to build a positive attitude toward the subject, to develop self-efficacy for learning, to establish challenging and attainable learning goals, and to create relevant learning experiences. The four purposes of meaning enhancement strategies are: to maintain learners' attention, to evoke and sustain learners' interest, to deepen learners' engagement and challenge, and to enhance learners' adaptive decision making. Finally, the competence related strategies are useful for creating an impression that learners are successful in learning something they value; in other words, the strategies were listed to serve three purposes: to engender competence with assessment, transfer, and communication and rewards. Some of the strategies he recommended were using K-W-L strategy, concept maps, case study methods, collaborative and cooperative learning, authentic performance tasks, self-assessment methods, multiple intelligences theory, and effective feedback. Moreover, he mentioned equity in several strategies.

Wlodkowski also mentioned that a motivating instructor has the following characteristics and skills: expertise, empathy, enthusiasm, clarity, and cultural responsiveness. Expertise refers to knowledge and preparation of the instructor. The strategies related to expertise are: (i) to show learners that you know something beneficial for learners, (ii) to show learners you know your subject well, and (iii) be prepared to convey and construct knowledge through an instructional process. Empathy refers to understanding and compassion. The motivational strategies listed were: (i) to have realistic understanding of learners' goals, perspectives, and expectations for what is being learned, (ii) to adapt instruction to the learners' level of experience and skill development, and (iii) continuously consider the learners' perspectives and feelings.

Enthusiasm refers to commitment and expressiveness. The strategies related to teacher enthusiasm are: (i) to value what you teach for yourself as well as for the learner; (ii) display your commitment with appropriate degrees of emotion and expressiveness. Cited from Larkins (1985) indicators of teacher enthusiasm are (Wlodkowski, 2008, p. 74): (i) speaking with some variation in tone, pitch, volume, and speed; (ii) gesturing with arms and hands; (iii) moving about the room to illustrate points and to respond to questions; (iv) making varied, emotive facial expressions as called for; and (v) displaying energy and vitality. Wlodkowski added that learners are likely to model their instructor's emotions and attitudes, when they perceive him/her as expert and emphatic.

Clarity is related to organization of the lesson and language used in the classroom. The strategies listed related to clarity were: (i) to plan and conduct instruction so that all learners can follow and understand, and (ii) provide a way for learners to comprehend what has been taught if it is not initially clear. Finally, cultural responsiveness refers to respect and social responsibility. The strategies related to cultural responsibility are: (i) to create a safe, inclusive, and respectful learning environment, (ii) engage the motivation of all learners, and (iii) to relate course content and learning to social concerns of learners and broader concerns of society.

2.2.2 The ARCS Model

Each motivational theory has suggestions for enhancing motivation. However, there is one instructional model developed by Keller (1987c) called the ARCS model. Keller (1987a) stated that no macro theories or models were developed to address the question of how to produce instruction for enhancing students' motivation. The implementation studies were limited in number and quality, and it was not clear for designers and teachers how many or what types of teaching practices to use with their students. Moreover, these studies did not incorporate important principles from different areas of motivational research.

Keller (1987a) stated that he developed the ARCS model in response to a request to find (i) effective ways of enhancing learners' motivation, and (ii) systematic ways of identifying and solving problems with learners' motivation. The ARCS model includes prescriptive strategies but the model as a whole cannot be classified as a prescriptive model. Rather Keller (1987b) stated that the model is heuristic and a problem-solving approach to the affective (motivational) problems.

The model is grounded in expectancy-value theory. This theory assumes that people are motivated to engage in an activity when they think it satisfies their personal needs (value aspect), and when they have a positive expectancy for success (the expectancy aspect).

Keller (1987a) expressed that the model is a synthesis of variables that includes most of the areas of research on motivation. Keller (1983) stated that the value category of the model is related to various theories and constructs such as Berlyne's curiosity and arousal (1965), Maslow's hierarchy of needs (1954), McClelland's achievement motivation (1976), and research related to attitudes, beliefs, and values such as Murray's (1938), Rogers's (1969), Feather's (1975), Rokeach's (1973) works. He also stated that expectancy category of the model is related to theories and constructs such as Rotter's locus of control (1966, 1972), Weiner's attribution theory (1974), Bandura's self-efficacy (1977), Seligman's learned helplessness (1975), Adam's equity theory (1965), and studies related to other influences on expectancy for success or failure such as Jones's (1977), and Perlmuter and Monty's (1977) work.

Keller (2004) added that authentic learning experiences from the constructivist literature by Duffy et al. (1993), McClelland's (1984) study related to needs for achievement, affiliation and power, and flow theory of Csikszentmihalyi (1990) were helpful understanding relevance component of the ARCS model. Keller (2008) also stated that recently volition research by Kuhl (1987) and self-regulation research by Corno (2001) and Zimmerman (1998) were incorporated in the model.

In the light of these, the ARCS model is considered as an eclectic approach for affective design of instruction. Keller (1987a) stated that all the strategies used in the model were derived from the research findings and from practices that have resulted in motivated learners. He obtained “strategy statements from research studies in the primary areas of research on human motivation from practical handbooks, and from interviews with practitioners.”

Later these statements were categorized into the four categories and to several subcategories. Keller (1987a) divided value category into two subcategories called interest and relevance. Expectancy category was the third subcategory. A fourth subcategory called outcomes was added to the model. Later, he changed the name of the first subcategory as attention, expectancy as confidence, and outcomes subcategory as satisfaction to “strengthen the central feature of each and to generate a useful acronym.”

Consequently, the categories of the ARCS model were: attention, relevance, confidence, and satisfaction. They were obtained from four major conditions that should be fulfilled for learners to become and remain motivated. Keller (1987a, 2008) explains each of the conditions and presents sample “motivational strategy prescriptions” for each condition.

Attention is the first component of the model. It is a prerequisite for learning. The concerns of attention strategies are: getting students’ attention, arousing their curiosity, and actively engaging them throughout the period of instruction (Keller, 2008). Keller (1983) stated that it is relatively easy to get attention than to sustain it during the instruction. Moreover, it is also important not to over stimulate the students. The aim here is to find a balance between boredom and indifference versus hyperactivity and anxiety. Interesting graphics, animation, or any kind of event that introduces incongruity or conflict is useful in getting students’ attention. “A deeper level of attention, or curiosity, is aroused by using mystery, unresolved problems, and other techniques to stimulate a sense of inquiry in the learner" (Keller, 2008, p. 177). Inquiry, participation and variability related practices are especially useful in sustaining learners' attention.

Relevance is the second component of the ARCS model. Keller (2008) stated that teaching practices establishing links between students' goals, learning styles, and prior experiences, and the instructional environment including content, teaching strategies, social organization are useful for building relevance. Relevance of the content with the present and future career opportunities might be presented to establish relevance. The only way to establish relevance is not the content to be relevant. The way it is presented might be also relevant to the learners. In other words, when the instruction offers opportunities to satisfy learners' needs like need for achievement or need for affiliation, students feel that the instruction is relevant.

The third component of the ARCS model is confidence. Students' confidence might be enhanced by promoting positive expectancies for success and promoting impression that they can achieve if they exert reasonable amount of effort.

Satisfaction is the last component of the ARCS model. In order to have learners satisfied, extrinsic rewards should be used in a way that they do not deteriorate intrinsic motivation and should be corresponding to the learner's expectations. Explicitly, extrinsic rewards should be used with care. When learners are intrinsically satisfied, extrinsic rewards might be demotivating (Smith & Ragan, 1999). Scheduling of the reinforcements used is also important. Moreover, students must feel that appropriate amount of work is required, grading should be fair, and the objectives should be consistent with the content and evaluation to provide satisfaction.

There are subcomponents of each ARCS component according to Keller (1987a). Incongruity and conflict, concreteness, variability, humor, inquiry, and participation are subcomponents of the attention component. Experience, present worth, future usefulness, need matching, modeling, and choice are subcomponents of the relevance component. Learning requirements, difficulty, expectations, attributions, and self-confidence are subcomponents of confidence component. Natural consequences, unexpected rewards, positive outcomes, avoidance of negative influences, and scheduling are subcomponents of the satisfaction component.

On the other hand, Keller (1987b) listed different subcomponents for the components. Perceptual arousal, inquiry arousal, and variability were listed as subcomponents of attention. Goal orientation, motive matching, and familiarity were subcomponents of relevance. Learning requirements, success opportunities, and personal control were subcomponents of confidence. Finally, natural consequences, positive consequences, and equity were subcomponents of satisfaction. However, Keller (1999) acknowledged that the model might be organized into several sub categorization schemas. In fact, most of the strategies were similar in both sub categorization schemas. For example humor in the first schema was included in perceptual arousal, and modeling was considered in motive matching subcomponent. Table 2.1 summarizes the subcomponents presented in the first schema.

Table 2.1 Summary of the ARCS components

Attention	Relevance	Confidence	Satisfaction
Incongruity and conflict	Experience	Learning requirements	Natural consequences
Concreteness	Present worth	Difficulty	Unexpected rewards
Variability	Future usefulness	Expectations	Positive outcomes
Humor	Need matching	Attributions	Avoidance of negative influences
Inquiry	Modeling	Self-confidence	Scheduling
Participation	Choice		

The strategies for enhancing motivation were presented under subcategories of the ARCS model by Keller (1987a) and they were presented in Table 2.2.

Table 2.2 The ARCS model: Sub-categories and strategies under each category (Keller, 1987a, p. 4-5)

Attention Strategies
A1: Incongruity, Conflict
A1.1 Introduce a fact that seems to contradict the learner's past experience. A1.2 Present an example that does not seem to exemplify a given concept. A1.3 Introduce two equally plausible facts or principles, only one of which can be true. A1.4 Play devil's advocate.
A2: Concreteness
A2.1 Show visual representations of any important object or of set of ideas or relationships. A2.2 Give examples of every instructionally important concept or principle. A2.3 Use content-related anecdotes, case studies, biographies, etc.
A3: Variability
A3.1 In stand up delivery, vary the tone of your voice, and use body movement, pauses and props. A3.2 Vary the format of instruction (information presentation, practice, testing, etc.) according to attention span of the audience. A3.3 Vary the medium of instruction (platform delivery, film, video, print, etc.) A3.4 Break up print materials by use of white space, visuals, tables, different typefaces, etc. A3.5 Change style of presentation (Humorous-serious, fast-slow, loud-soft, active-passive, etc.). A3.6 Shift between student-instructor interaction and student- student interaction.
A4: Humor
A4.1 Where appropriate, use plays on words during redundant information presentation. A4.2 Use humorous introductions. A4.3 Use humorous analogies to explain and summarize.
A5: Inquiry
A5.1 Use creativity techniques to have learners create unusual analogies and associations to the content. A5.2 Build in problem solving activities at regular intervals. A5.3 Give learners the opportunity to select topics, projects and assignments that appeal to their curiosity and need to explore.
A6: Participation
A6.1 Use games, role plays, or simulations that require learner participation.
Relevance Strategies
R1: Experience
R1.1 State explicitly how the instruction builds on the learner's existing skills. R1.2 Use analogies familiar to the learner from past experience. R1.3 Find out what the learners' interests are and relate them to instruction.
R2: Present Worth
R2.1 State explicitly the present intrinsic value of learning the content, as distinct from its value as a link to future goals.

Table 2.2 (continued)

R3: Future Usefulness
R3.1 State explicitly how the instruction relates to future activities of the learner. R3.2 Ask learners to relate the instruction to their own future goals (future wheel).
R4: Need Matching
R4.1 To enhance achievement striving behavior, provide opportunities to achieve standards of excellence under conditions of moderate risk. R4.2 To make instruction responsive to the power motive, provide opportunities for responsibility, authority, and interpersonal influence. R4.3 To satisfy the need for affiliation, establish trust and provide opportunities for no-risk, cooperative interaction.
R5: Modeling
R5.1 Bring in alumni of the course as enthusiastic guest lecturers. R5.2 In a self-paced course, use those who finish first as deputy tutors. R5.3 Model enthusiasm for the subject taught.
R6: Choice
R6.1 Provide meaningful alternative methods for accomplishing a goal. R6.2 Provide personal choices for organizing one's work.
Confidence Strategies
C1: Learning Requirements
C1.1 Incorporate clearly stated, appealing learning goals into instructional materials. C1.2 Provide self-evaluation tools which are based on clearly stated goals. C1.3 Explain the criteria for evaluation of performance.
C2: Difficulty
C2.1 Organize materials on an increasing level of difficulty; that is, structure the learning material to provide a 'conquerable' challenge.
C3: Expectations
C3.1 Include statements about the likelihood of success with given amounts of effort and ability. C3.2 Teach student how to develop a plan of work that will result in goal accomplishment. C3.3 Help students set realistic goals.
C4: Attributions
C4.1 Attribute student success to effort rather than luck or ease of task when appropriate (i.e. when you know it's true!). C4.2 Encourage student efforts to verbalize appropriate attributions for both success and failures.
C5: Self-Confidence
C5.1 Allow students opportunity to become increasingly independent in learning and practicing a skill. C5.2 Have students learn new skills under low risk conditions, but practice performance of well-learned tasks under realistic conditions. C5.3 Help students understand that the pursuit of excellence does not mean that anything short of perfection is failure; learn to feel good about genuine accomplishment.

Table 2.2 (continued)

Satisfaction Strategies
S1: Natural Consequences
S1.1 Allow a student use a newly acquired skill in a realistic setting as soon as possible.
S1.2 Verbally reinforce a student's intrinsic pride in accomplishing a difficult task.
S1.3 Allow a student who masters a task to help others who have not yet done so.
S2: Unexpected Rewards
S2.1 Reward intrinsically interesting task performance with unexpected, non-contingent rewards.
S2.2 Reward boring tasks with extrinsic, anticipated rewards.
S3: Positive Outcomes
S3.1 Give verbal praise for successful progress or accomplishment.
S3.2 Give personal attention to students.
S3.3 Provide informative, helpful feedback when it is immediately useful.
S3.4 Provide motivating feedback (praise) immediately following task performance.
S4: Negative Influences
S4.1 Avoid the use of threats as a means of obtaining task performance.
S4.2 Avoid surveillance (as opposed to positive attention).
S4.3 Avoid external performance evaluations whenever it is possible to help the student evaluate his or her own work.
S5: Scheduling
S5.1 Provide frequent reinforcements when a student is learning a new task.
S5.2 Provide intermittent reinforcement as a student becomes more competent at a task.
S5.3 Vary the schedule of reinforcements in terms of both interval and quantity.

2.2.3 The Effect of Motivation Enhancement Studies in Education

There were many studies in education area dealing with how to motivate students. There were several studies dealing with motivational strategies in various subject areas such as computer engineering laboratory course (Zhang, 2003) and English as a second language (Guilloteaux, 2007; Ruesch, 2009). There was one study dealing with enhancing motivation in science courses (Jackman, Townsend & Hamilton, 2009). There was another study dealing with enhancing motivation and achievement of students by using ARCS model in chemistry courses (Feng & Tuan, 2005). Furthermore, there were many ARCS related studies in various subjects such as distance education (Huett, et al., 2006), computer based instruction in economics (Shellnut, Knowlton & Savage, 1999), statistics

(Capshew, 2005; Means, Jonassen & Dwyer, 1997), library education (Small, 1999; Small, Zakaria & El-Figuigui, 2004), research design (Astleitner & Lintner, 2001), archeology (Keller, Deimann & Liu, 2005; Deimann, 2005). On the other hand, Korur (2006) investigated the effects of physics teacher characteristics on students' motivation.

Among these studies the studies having closest relationships with the current study are presented. The studies dealing with motivation in science courses (Feng & Tuan, 2005; Jackman et al, 2009) were included. Moreover, Small (1999) and colleagues' (2004) studies were included since they were also methodologically related to this study. Guilloteaux's (2007) PhD thesis dealing with motivation in English courses was included since it was comprehensive and methodologically close to this study. Korur's (2006) also provide background for motivation in physics classrooms, thus it was included.

The only study dealing with the effects of the ARCS model in science education literature was conducted by Feng and Tuan (2005). They investigated the effects of the ARCS model on 11th graders motivation and achievement in chemistry courses. They designed 10-hour unit about acids and bases for low-interest and low-motivation class. There were 51 students in the experimental group whereas 50 students in the control group.

In the treatment, for getting and sustaining students' attention (i) they included student-centered experiments; (ii) moreover, they asked questions and encouraged students to find solutions to their problems. To relate what students learn to students' interests and experiences, they provided (i) concrete examples and analogies, (ii) daily life use, (iii) lab investigation, (iv) goals of the lesson, and (v) encouraged students to establish attainable goals for themselves. For enhancing confidence they (i) adjusted the difficulty of the tasks, (ii) gave timely and positive feedback, (iii) provided opportunity to practice and acquire new skills under low-risk conditions, (iv) set appropriate expectations for students when completing assignments, performing presentations, conducting discussions, and taking tests, (v) instructed important lab skills step by step.

For satisfaction, they (i) used verbal praise, (ii) used material or symbolic rewards, (iii) used incentives and (iv) allowed students to presents their results in front of their peers, (v) used grades, designing a cooperative test, making performance requirements consistent with stated expectations, and providing consistent measurement standards for all tasks and accomplishments.

They administered Student Motivation toward Science Learning questionnaire and teacher-designed achievement tests as a pretest and posttest to both experimental and control groups. The motivation questionnaire consisted of six subscales: self-efficacy, active learning strategy, science learning value, performance goal, achievement goal, and learning environment stimulation. The achievement pretest measured students' prior knowledge about acids and bases concepts with multiple choice questions. The posttest included 40 conceptual multiple choice questions.

They conducted t-tests to compare experimental and control groups' pretest scores and posttest scores of motivation subscales. They concluded that there were no significant differences between the groups before the treatment while there were significant differences between the groups after the treatment for six subscales of the motivation questionnaire ($p < .05$). They also conducted paired t-test to compare the pretest and posttest results of the experimental group. They concluded that there were significant differences in self-efficacy (Mpre = 3.41, Mpost = 3.59), active learning strategy (Mpre = 3.82, Mpost = 3.93), science learning value (Mpre = 3.74, Mpost = 3.94) subscales whereas no significant differences in performance goal (Mpre = 2.23, Mpost = 2.12), achievement goal (Mpre = 3.93, Mpost = 3.93), and learning environment stimulation (Mpre = 3.61, Mpost = 3.62) subscales.

Moreover, they conducted ANOVA to compare experimental and control groups' achievement scores. There were no significant differences between the two groups before the treatment ($F = 1.01$, $p > .05$) while there were significant differences between the two groups after the treatment ($F = 5.15$, $p < .001$). Moreover, when the two groups' posttest scores were compared using pretest scores as a covariate, the difference between the experimental and control group was significant ($F(1,100) = 16.70$, $p < .001$). The mean score of the experimental group was 68 in the pretest and 64.9 in the posttest while the control groups' mean scores were 68.49 in the pretest and 59.9 in the posttest.

In general, the results of the study revealed that students' motivation and achievement increased significantly. Moreover, students' engagement time during the treatment increased compared to before treatment time.

More recently, Jackman, et al. (2009) designed a treatment to enhance students' motivation in science courses. They designed a 9-week treatment for low achieving 10th grade students' to enhance an adaptive approach to studying science in New Zealand and their results were interesting. The treatment was designed to enhance three motivational elements: academic self-efficacy, academic task-value, and a mastery goal orientation. It was also designed to teach two cognitive strategies of academic goal setting and the use of self-generated annotated diagrams. Their sample consisted of 94 low achieving students. The experimental group consisted of 64 students in three classrooms and the control group consisted of 30 students in one classroom.

The treatment was described in a single interactive workshop of approximately one hour. They taught the students how to create self-motivating statements to enhance students' self-efficacy, to reflect on and record the personal value of each science topic as they approached it during the term to enhance academic task-value, to use verbal statements directed at mastering a task that would satisfy their curiosity, or deepen their understanding, or improve their competence about each science topic and also to strive for good grades as hallmarks of personal progress not for comparison or competitions with others as mastery goal strategy. Moreover, academic goal setting strategies included "how to set and achieve short-term and medium-term academic goals, the need for regular and systematic reflection about the progress toward these goals, how to readjust goals when necessary, how to deal with failure or error, and to predict and prepare for potential obstacles to learning" (p. 152). Jackman et al. (2009) also explained "the value of annotative diagrams, how to generate diagrams for each science topic, and how to use them for revision" (p. 152). Besides, they gave students' a booklet explaining the strategies with examples of their implications for science. Science teachers of the experimental groups also attended the workshop since they were expected to reinforce and facilitate the use of these strategies.

Jackman et al. (2009) administered tests to experimental and control groups to investigate the differences in students' motivational, cognitive strategy, and achievement three times as pretest, posttest and at the middle of the treatment. They also collected weekly journal reports about the use and benefits of the strategies and concepts. The results of the study was interesting that the treatment resulted in increase in motivation for students with maladaptive approach to learning (i.e. give up quickly in difficult work), on the other hand increase in achievement for students with adaptive approach. However, they did not report the statistics for these results; they referred to another study for the details of the analyses and results.

On the other hand, Small (1999) investigated motivational strategies used by library media specialists and resulting on- and off-task behaviors of students. Eight graduate students, who were trained, observed librarians and the students attending the sessions eighty-six times. Interviews were conducted with the librarians before and after the observations. Two raters independently coded data according to ARCS categories and subcategories after they were trained.

The results of the study revealed that librarians used approximately 24 motivational strategies per lesson; a total of 2,026 motivation strategies, and 1,136 of the strategies they used were to get and sustain attention and interest. Among these attention strategies, 581 were inquiry arousal strategies such as questioning and problem-posing strategies; 287 were perceptual arousal (e.g., novelty, humor, enthusiasm), and 268 were variability strategies (e.g., variations in media, grouping of students, methods). On the other hand, 331 relevance, 299 confidence and 260 satisfaction strategies were observed. The satisfaction strategies were categorized into two types of motivators: intrinsic (4) and extrinsic motivators (256). Results of this analysis revealed that librarians used significantly more rewards than punishments.

A total of 225 on-task student behaviors (such as interacting directly with the assigned activity and responding to a question) were observed whereas 38 off-task behaviors (such as talking about a nonrelevant topic and staring out a window) were observed. The observed behaviors were performed by all or most of the observed students rather than of individual students. The recorded behaviors were categorized as on-task (187.83 %) or off-task (38.17 %) behaviors.

In a similar study, in 2004, Small et al. investigated the motivational strategies used by community college librarians in their information literacy skills instruction, and how those techniques differ from those used by school librarians. The motivational strategies were again categorized by the components and subcomponents of the ARCS model. Ten librarians were observed, and interviewed before and after the observations. Each librarian was observed for 10 sessions. Moreover, a brief interview was conducted with one randomly selected student from each observed lesson. The student was asked to categorize the lesson in terms of interest and confidence building and to describe its benefits. Data were collected in one academic year.

Their results were also similar to Small's results in 1999. They determined 1,423 ARCS strategies. Among these strategies, there were 754 (53%) attention strategies, 341 (24%) relevance, 278 (20%) confidence, and 50 (4%) satisfaction strategies. When examined for each librarian, the total number of motivational strategies used ranged from 99 to 292 for 10 sessions. The percentages of strategies used by the participants were consistent, most frequently attention strategies were used, least frequently satisfaction strategies used, and relevance and confidence strategies were about even.

Almost half of the attention strategies used were categorized as perceptual arousal such as novelty, humor, enthusiasm, emphasizing important information; and the rest of the attention strategies used were inquiry arousal (e.g., problem solving, questioning) and variability strategies (e.g., variety of media, student grouping, teaching methods). These results were consistent with librarians' perceptions about their teaching philosophy and favorite methods in the pre-and post-observation interviews.

The subcomponents consistently used frequently by all participants were relevance-goal orientation (e.g., role models, link to future goal) and confidence-success opportunities (e.g., practice opportunities, summaries). On the other hand, few relevance-motive matching (e.g., matching examples to student interests) and confidence-learning requirements strategies (e.g., specifying learning expectations) were used. Few or no confidence-personal control (e.g., joint setting of learning goals), satisfaction-natural consequences (e.g., opportunities to apply newly learned knowledge), and satisfaction-equity strategies (e.g., consistency of learning goals and lesson content) were used. The most frequently used subcomponents were attention-perceptual arousal (348 times), confidence-success opportunities (242 times), attention-inquiry arousal (220 times), and relevance-goal orientation (208 times). There was a serious lack of relevance-motive matching, relevance-familiarity, confidence-personal control, satisfaction-natural consequences strategies, satisfaction-positive consequences, and satisfaction-equity strategies used. Among the satisfaction strategies used 50 were categorized as: intrinsic and extrinsic motivation strategies.

One librarian had the highest percentage of on-task behaviors among all participants and the lowest amount of faculty participation, and was reported to have had a slightly more balanced approach in incorporating all of the ARCS components into the instruction. Another librarian had almost as many off-task as on-task behaviors and used PowerPoint for every class session. Thus they concluded that the number of strategies was not related to students' motivation.

Later, in 2007, Guilloteaux investigated relationship of the motivational practices used by English as a foreign language teachers and students' second language learning motivation in South Korea in her comprehensive PhD thesis. In the first phase of the study, a self-report motivation questionnaire was administered to 1381 students, and motivational strategies used by 27 teachers in 20 different schools were observed by using the Motivation Orientation of Language Teaching. Students' motivation was also observed by using the same instrument. There were 25 observed motivational strategies: signposting, social chat, stating the communicative purpose or utility of activity, establishing relevance, promoting integrative values, promoting instrumental values, arousing curiosity or attention, scaffolding, promoting cooperation, promoting autonomy, referential questions, group work, pair work, tangible reward, personalization, element of interest-creativity-fantasy, intellectual challenge, tangible task product, individual competition, team competition, neutral feedback, process feedback session, elicitation of self or peer correction, effective praise, and class applause.

Students in a classroom were assumed to have high motivation if at least 2/3 of the students paid attention or participated in classroom activities and at least 1/3 were volunteering to speak in front of the class for a significant amount of the lesson. Self-report motivation questionnaire consisted of attitudes toward the second language course, linguistic self-confidence, and anxiety.

The results of the study indicated that teacher's motivational practice correlated significantly and positively with both the students' self-reported motivation and the students' motivated behavior. The correlation coefficient between students' motivated behavior and the teacher's motivational practice was .61. The correlation between the students' self-reported motivation and teacher's motivational practice was .31.

The multiple correlation coefficient between teacher's motivational practice, the students' self-reported motivation, and the students' motivated behavior was 0.63 ($p < .001$). Moreover, multiple regression analysis revealed that there is a moderately high, significant part correlation value between the students' motivated behavior and the teacher's motivational practice after partialling the students' self-reported motivation. She concluded that the teachers' motivational teaching practice is directly related to students' motivated behavior.

In the second phase of the study, three high- and three low-motivation student groups were selected from the initial sample and were compared to determine students' interpretations and understandings of the quality of their second language instructional contexts in relation to their motivation and motivated classroom behavior. There were 255 students in the second phase of the study. Motivational goals scale consisting of Milieu-Related Goal Orientation, Classroom Mastery Goal Structure, Classroom Performance Goal Structure, Performance Approach Goal Orientation, and Work Avoidance Orientation subscales was administered to the students.

The results of the second phase of the study revealed several differences between the groups: (i) the mean score of low-motivation groups ($M = 3.43$, $SD = .94$, $N = 116$) was slightly higher than the mean score of high-motivation groups ($M = 3.13$, $SD = 1.08$, $N = 97$) on Work Avoidance scale, $t(211)=-2.18$, $\eta^2= .022$; (ii) consistently more frequent negative emotional profiles were observed in the low-motivation groups than in the high-motivation groups in lessons; (iii) the high-motivation group students most frequently reported that they think their teachers cared about them because their English lessons were interesting and fun; and (iv) high-motivation group teachers were observed to teach English as a means of communication, whereas low-motivation group teachers were observed to teach English as a body of knowledge.

In a study more closely related to physics, Korur (2006) investigated the relationship between effective physics teacher characteristics and students' motivation from both teachers' and students' perspectives. In the first part, he determined the effective teacher characteristics quantitatively. In the second part, he investigated the interaction between their characteristics and students' motivation in two physics teachers' classrooms qualitatively. The Effects of Teachers' Characteristics on High School Students' Physics Achievement and Motivation Questionnaire was administered to 285 physics teachers from 95 public high schools.

The results of the study showed that there were 38 effective physics teacher characteristics related to students' motivation in physics. These characteristics were categorized under eight categories. These categories were: possessing and transferring subject matter knowledge, knowledge of profession and teaching techniques, using technology in the classroom, enthusiasm for teaching, activities for meaningful classroom management, personal characteristics, and attitude toward discipline in the class.

According to teachers and students two most effective categories were teachers' subject matter knowledge and their personal characteristics, and the most effective teacher characteristics affecting students' motivation were lecturing reluctantly, using offensive language to students, being interested in some students more than the whole class, answering students' questions related to physics easily, making the physics lesson interesting by giving examples from daily life. He also stated that according to teachers, answering students' questions related to physics easily, lecturing reluctantly, making the physics lesson interesting by giving examples from daily life, using offensive language to students, getting angry with students' faults, and shouting at or hitting the students that are disturbing the classroom atmosphere were the five characteristics that strongly affect, negatively or positively, both students' motivation and achievement in physics. These five characteristics were in line with the categories of the physics teacher characteristics that are: possessing and transferring the subject matter knowledge, classroom management, enthusiasm for teaching, and activities for meaningful learning.

In addition, qualitative data were collected by observations of the two physics classrooms and interviews with the two case teachers and their students. Teacher 1 was observed for 11 weeks and Teacher 2 was observed for 10 weeks. In the qualitative part, cross case analysis were conducted. The physics teacher displaying mostly the positive characteristics exhibited the characteristics under activities for meaningful learning category and did not exhibit the negative characteristics under personal characteristics category. The physics teacher, who displayed mostly the negative characteristics, exhibited the characteristics under the knowledge of profession and teaching techniques category and also exhibited the negative characteristics under attitudes toward discipline in the class category.

He concluded that student motivation was likely to increase, when teachers provide activities, and if they do not display fed up or tired behavior, or allow boring work. On the other hand, students' motivation was likely to decrease when teachers display negative characteristics especially related to management or discipline problems, if they shout or hit the students. Interestingly, according to the students' responses, whether their teachers have positive or negative effective physics teacher characteristics, they were unsatisfied with their current situation. When their teacher mostly exhibited the positive effective characteristics, students preferred to stay calm and be more passive, and did not like to be constantly forced by the teacher to share their ideas. When their teacher mostly exhibited negative effective characteristics, students preferred to participate more and be more active, and they were unsatisfied if their teacher avoided asking questions or had difficulty in solving the problems.

However, there were no studies specifically designed to enhance students' motivation in physics courses, and nor were there any studies conducted to investigate the teaching practices enhancing motivation used by the teachers in the physics courses. The only study in physics education literature was conducted by Korur (2006), however he did not derived the teaching practices from the motivation literature. Instead he derived effective physics teacher characteristics related to students' motivation.

Besides, there were few studies in science education literature dealing with enhancing students' motivation. Jackman et al., (2009) dealt with enhancing motivation in science courses while Feng and Tuan (2005) used the ARCS model to improve students' motivation and achievement in chemistry. On the other hand, there were several studies related to the ARCS model in different subject areas. Among these, Small (1999) and Small et al. (2004) investigated the motivational strategies used by librarians in their information literacy skills instruction. Moreover, there were studies investigating teaching practices enhancing motivation in different subject areas such as English as a second language (i. e. Guilloteaux, 2007).

2.3 Summary of the Literature Review

There were several studies dealing with changing students' attitudes towards science in the literature. Most of these studies stemmed from the Yale Communication and Attitude Change Program (i.e. Demers & Shrigley, 1990; Koballa, 1984, 1986; Koballa & Shrigley, 1983; Martin, 1985; Shrigley, 1976, 1978, 1982). These studies dealt with the characteristics of a credible communicator (Shrigley, 1976, 1978), characteristics of persuasive communication (Shrigley, 1978), characteristics of a credible communicator and persuasive communication for changing attitudes toward metric conversion (Shrigley, 1982), effects of two kinds of (integrated and nonintegrated) persuasive communication on attitudes toward energy conservation (Koballa & Shrigley, 1983), effects of two kinds of (one-sided and two-sided) persuasive communication on attitudes toward energy conservation (Koballa, 1984), effects of self-generated thoughts (sub-vocal rehearsal and listing thoughts) on salience of two-sided persuasive messages on attitudes toward energy conservation (Koballa, 1986), effects of two channels of communication (videotape and written) on attitudes toward science teaching and the effects of perceived communicator credibility on attitudes toward science and science education in an ongoing science methods course (Martin, 1985).

One study (Steiner, 1980) was based on Festinger's cognitive dissonance theory (1957) and investigated the effect of induced cognitive dissonance on attitude toward science and school lunch. On the other hand, Newbill (2005) investigated the effects of instructional strategies to improve women's attitudes toward science in two topics (one geology and one chemistry topic). She stated that her study stemmed from Kamradt and Kamradt's structured design (1999). The structured design stems from the Yale Communication and Attitude Change Program, and functional theories of attitude change. Another study, related to physics was conducted by Häussler & Hoffmann (2002) to enhance girls' interest and self-concept in physics classes. The intervention was designed according to the recommendations of research results previously conducted in Germany.

Conversely, there were few studies in science education literature dealing with enhancing students' motivation. Jackman et al., (2009) dealt with enhancing motivation in science courses whereas Feng and Tuan (2005) used the ARCS model to improve students' motivation and achievement in chemistry. However, there were several ARCS related studies in different subject areas. Among these studies, Small (1999) and Small et al. (2004) investigated the motivational strategies used by librarians in their information literacy skills instruction. Also, there were several studies dealing with motivational strategies in various subject areas such as English as a second language (Guilloteaux, 2007). Moreover, Korur (2006), investigated relationship the between effective physics teacher characteristics and students' motivation from both teachers' and students' perspectives.

CHAPTER 3

METHODOLOGY

The research design and its features have been described in this chapter. At the beginning of the chapter the research design is summarized. Then, the quantitative methodology and the qualitative methodology are discussed separately.

3.1 Research Design

This study started with the aim of influencing students' affective characteristics related to physics. However, during the literature review it was obvious that there were no studies dealing with the effects of teaching practices on affective characteristics in physics classrooms, moreover, the teaching practices influencing the students' physics related affective characteristics were not clear. Thus, one hidden purpose of the study was to collect the teaching practices that were presented to be influential on affective characteristics of the students from the literature. At this stage, the study changed its direction and aimed to find out the actual teaching practices in the physics classrooms, and compare them with the teaching practices listed in the attitude change and motivation literature to be effective on students' affective characteristics.

Hence, mixed methodology was the research design of this study. More explicitly, qualitative and quantitative research designs were used together to investigate the research questions. Quantitative research design was used to investigate physics teachers' affective teaching practices, students' current physics related affective characteristics, and their relationship. In the methodology of quantitative phase, quantitative research methods, population and sample, measuring tools, validity and reliability of quantitative phase, data collection, data analysis, and the assumptions of the quantitative phase were presented.

Qualitative research design was used to gain understanding of affective teaching practices used for enhancing students' affective characteristics and their effects on the students' affective characteristics related to physics. In the methodology of qualitative phase, qualitative research methods, selection of teachers for qualitative phase, participants, validity and reliability of qualitative phase, data collection strategies including field entry, data analysis, researcher's role and ethical issues, and strengths and limitations of the study were presented.

3.2 Methodology of Quantitative Phase

3.2.1 Quantitative Research Methods

A survey is described as a systematic method for collecting information mostly from a sample (sometimes from the whole population) for constructing quantitative descriptors of the characteristics of the relevant population (Groves et al., 2009). There are two main types of surveys: cross-sectional and longitudinal. In cross-sectional surveys, questionnaires are administered at one point in time (Fraenkel & Wallen, 1996). Cross-sectional survey was the research method of the quantitative phase of this study. Questionnaires were administered at one point in time to answer quantitative research problems, and to select the teachers to be observed in qualitative phase. The questionnaires consisted of closed-ended items to access a larger sample.

3.2.2 Population and Sample

In the quantitative part of the study, two sampling types were used: purposeful sampling and two stage sampling. At the beginning of the study, 14 teachers in 10 schools were purposefully selected, since these teachers were recommended by their colleagues as “good physics teachers”. Four of these teachers were teaching physics at public high school, four were at public Anatolian high schools, one was at private Anatolian high schools, and one was at private science high school. However, two of these teachers were not offering 9th grade physics course, so they were eliminated from the study. List of the schools where purposefully selected teachers work are presented in Appendix A.

On the other hand, Fraenkel and Wallen (1996) recommended selecting the sample randomly in survey research, if it is possible. According to their recommendation, to find out other “good physics teachers” that might be present in the population, some of the sample was selected by two stage sampling. For these purposes, the schools were selected by stratified random sampling according to the school type in the first stage. Table 3.1 presents the school types, number of schools, number of classes and number of students in each school type for population and for sample after the missing data analysis. The total sample size of the students was planned to be 10% of the population. Moreover, for each school type, about half of the schools in the population were planned to be involved in the sample.

At this stage, 30 schools were selected among 48 schools by stratified random sampling. The names of these schools are also presented in Appendix A. One school, which was selected purposefully, was also selected randomly. The classrooms, in which the questionnaires were administered, were selected conveniently in the second stage.

Table 3.1 School types, number of schools, number of classes and number of students in each school type for population and sample

School Type	Population			Sample			Sample-Population Ratio for Students
	# of schools	# of classes	# of students	# of schools	# of classes	# of students	
Public	21	263	7902	10+4*	17	503	.06
Public Anatolian	10	48	1440	4+3*+1**	9	244	.17
Total Public	31	311	9342	22	26	747	.08
Private Anatolian	17	50	1000	7+1*	12	135	.14
Private Science	9	11	318	5	8	216	.68
Total Private	26	61	1318	13	20	341	.26
Total	48	361	10660	35	46	1138	.11

*4 public schools, 4 public Anatolian high schools and 1 private Anatolian school were selected purposefully.
**One school selected both randomly and purposefully.

Consequently, at the beginning of the study it was planned to collect data from 38 schools, which were either selected purposefully or randomly according to the school type. However, I was able to collect data from 35 schools, 14 being public high schools, eight public Anatolian high schools, eight private Anatolian high schools, and five private science high schools. Nine of these schools were selected purposefully: four being public high schools, four being public Anatolian high schools, and one being private Anatolian high school. The data were collected from 46 classrooms among 361 classrooms in the population. On the other hand, the total number of teachers, whose students responded the questionnaires, was 36. This is because in some of the schools the number of students in one classroom was small; so whenever possible, I administered the questionnaires in more than one classroom. For example, in one school, the data were collected in three different classrooms of one teacher.

The population of the 9th grade students consisted of 10,660 students in Çankaya district in Ankara. The sample consisted of 1,138 students. However, four of the purposefully selected schools in the sample were in other districts of Ankara. They are also presented in Appendix A.

There were several demographic questions at the first part of the questionnaires. The sample consisted of 545 female students (47.9%), 580 male students (51.0%), and 13 students did not report their gender. The percentage of the students who reported their age as 14 was 1.1%, 77.9% of the students reported it to be 15, 17.8% reported it to be 16, 1.4% of the students were 17 years old, and 1.8% of the students did not report their ages.

The percentage of the students who reported that they loved their teachers quite a lot was 34.3%, 33.5% of the students reported that they loved their teachers a lot, 21.4% reported that they loved their teacher a little, and 8.1% reported that they did not love their teachers.

The percentage of the students who reported that they wanted to choose science branch in 10th grade was 42.7%, 25.6% of the students reported that they wanted to choose mathematics branch, 10.7% reported that they wanted to choose social branch, 0.7% reported that they wanted to choose foreign language branch, 0.1% reported that they wanted to choose arts branch, and 17.8% reported that they did not decide which branch to choose in 10th grade.

Table 3.2 presents some of these characteristics of students sorted according to teachers. Each teacher's mean scores according to their students' responses to how much they love their physics teacher was presented in the table. The maximum score a teacher could obtain was 4 whereas the minimum score was 1. The teachers' mean scores ranged between 1.65 for Teacher 15 and 3.90 for Teacher 28. Number of the students in each teachers group ranged between 16 for Teacher 33 and 49 for Teacher 10.

Table 3.2 Some characteristics of students sorted according to teachers

Teacher (Gender)	School (Type)	N	Love teacher	Grade1	Grade2	AFF	INT	IMP	ANX	AMT	SCN	SMT
			M (SD)	M (SD)	M (SD)	M	M	M	M	M	M	M
1 (M)	1 (H)	33	2.52 (.84)	NA	NA	3.00	2.55	2.93	2.87	3.69	3.19	3.00
2 (M)	2 (H)	33	2.82 (.95)	9.42 (5.54)	NA	3.00	2.91	3.08	2.91	3.60	2.56	2.95
3 (M)	2 (H)	30	2.40 (.89)	29.09 (19.52)	NA	3.23	2.86	3.00	3.17	3.74	3.16	3.26
4 (M)	3 (A)	28	3.00 (.72)	70.82 (13.98)	NA	3.31	3.22	3.18	2.29	4.02	3.45	3.47
5 (M)	4 (H)	35	3.62 (.55)	42.68 (20.13)	NA	3.41	3.65	3.34	1.88	4.20	3.38	3.97
6 (M)	5 (A)	28	2.75 (.75)	72.68 (16.90)	NA	3.24	2.95	3.01	2.13	4.26	3.79	3.41
7 (F)	6 (A)	30	2.67 (.61)	75.64 (10.01)	NA	3.28	3.37	3.03	1.89	4.47	3.77	3.22
8 (M)	7 (A)	26	2.35 (.98)	49.62 (17.02)	NA	3.27	2.83	2.89	3.30	4.13	3.35	3.15
9 (M)	8 (H)	28	3.21 (.69)	37.40 (24.35)	NA	3.25	3.04	3.10	2.61	4.06	3.48	3.46
10 (M)	9 (H)	49	2.65 (.95)	35.24 (24.21)	38.38 (23.79)	3.15	2.85	3.13	2.84	3.66	3.22	3.32
11 (M)	9 (H)	24	3.00 (.98)	41.39 (23.80)	35.83 (14.04)	3.29	2.98	2.99	2.58	3.68	3.24	3.23
12 (M)	10 (A)	28	3.32 (.55)	83.63 (11.19)	NA	3.21	3.24	3.00	1.70	3.85	3.70	3.63
13 (M)	11 (A)	31	2.71 (.69)	82.00 (21.05)	NA	3.18	2.90	3.05	1.96	4.13	3.85	3.30
14 (F)	12 (H)	33	2.91 (.84)	37.00 (23.07)	NA	3.35	3.23	3.25	2.43	4.06	3.33	3.26
15 (M)	13 (H)	25	1.64 (.64)	38.92 (17.51)	NA	2.98	2.30	2.88	2.86	3.83	2.95	3.16
16(M)	14 (A)	29	3.21 (.56)	60.61 (14.83)	NA	3.11	3.40	3.13	2.52	3.21	3.26	3.09
17 (M)	15 (H)	37	3.51 (.69)	57.06 (20.06)	61.64 (25.09)	3.54	3.64	3.28	1.99	4.39	4.04	3.75
18 (F)	16-17 (PS)	33	3.42 (.79)	73.03 (17.50)	72.52 (16.08)	3.32	3.39	3.11	1.79	4.18	4.02	3.64
19 (M)	18 (H)	25	2.72 (1.14)	45.75 (20.54)	NA	3.17	2.83	2.90	2.73	3.71	3.51	3.27
20 (M)	19 (H)	32	2.31 (.82)	29.48 (21.87)	NA	3.34	2.96	2.90	3.29	3.75	3.34	3.53
21 (F)	20 (H)	27	1.85 (.50)	52.38 (28.54)	NA	3.03	2.44	3.06	3.34	3.65	3.05	2.74
22 (M)	21 (H)	32	3.69 (.54)	31.45 (21.82)	38.83 (21.49)	3.24	3.49	3.09	2.02	3.97	3.73	3.48
23 (M)	22 (H)	23	2.61 (.94)	40.75 (26.11)	31.10 (24.84)	3.10	3.05	3.08	2.56	3.46	3.26	3.21
24 (F)	22 (H)	18	2.28 (1.02)	34.75 (25.52)	36.65 (22.39)	3.14	2.78	2.84	2.54	4.02	3.37	3.38
25 (F)	23 (A)	42	1.90 (.98)	57.76 (21.38)	58.29 (21.21)	3.21	2.80	2.98	3.20	3.82	3.61	2.97
26 (M)	24 (P)	27	3.59 (.57)	59.28 (20.40)	56.52 (22.97)	3.28	3.43	3.14	2.07	4.04	3.53	3.55
27 (F)	25 (P)	36	2.72 (.78)	51.11 (29.91)	63.71 (29.43)	3.06	3.91	2.97	2.24	4.09	3.47	2.72
28 (M)	26 (S)	31	3.90 (.30)	84.59 (11.14)	75.84 (16.84)	3.67	3.66	3.39	1.65	4.60	4.39	4.23
29 (M)	27-28 (PS)	48	2.91 (.96)	36.07 (27.69)	49.88 (29.30)	3.27	2.91	3.15	3.02	3.80	3.51	3.13
30 (M)	29 (H)	25	2.76 (.93)	29.24 (19.40)	36.83 (17.55)	3.16	3.18	3.06	2.55	3.83	3.20	3.41
31 (M)	30 (P)	42	3.76 (.43)	60.35 (20.29)	57.11 (17.25)	3.40	3.61	3.22	1.83	4.36	3.61	3.76
32 (M)	31 (S)	19	3.63 (.60)	60.56 (21.31)	62.75 (23.89)	3.48	3.43	3.20	1.67	4.30	4.15	3.93
33 (F)	32 (P)	16	3.75 (.77)	42.09 (26.66)	48.50 (27.71)	3.34	3.43	3.10	2.20	4.02	3.10	3.07
34 (F)	33 (S)	48	3.04 (.58)	72.48 (17.60)	72.89 (16.09)	3.33	3.08	3.11	2.97	4.02	3.74	3.16
35 (F)	34 (P)	32	3.06 (.91)	60.61 (20.28)	61.62 (17.45)	3.34	3.13	3.32	2.82	3.82	3.66	3.35
36 (F)	35 (P)	23	3.70 (.56)	15.59 (28.19)	24.70 (33.21)	3.21	3.14	3.11	2.35	4.21	3.26	3.09

Grade 1: First physics examination grade, Grade 2: Second physics examination grade, AFF: Affective characteristics, INT: Interest in physics, IMP: Importance of physics, ANX: Anxiety in physics, AMT: Achievement motivation in physics, SCN: Self-concept in physics, SMT: Student motivation in physics, NA: Not announced or not administered, M: Male, F: Female, H: Public high school, A: Public Anatolian high school, P: Private Anatolian high school, S: Private science high school

Teachers numbered 18 and 29 were teaching physics in both private Anatolian high school and private science high school. Number of students in School 16 and School 17, where Teacher 18 was working, were small. Thus, the data collected from both groups of students were integrated. The questionnaires collected from 40 students in the other private Anatolian high school (Teacher 29 in Table 3.2) were mixed up by the school administration. Thus, it was not possible to find out if these students were in private Anatolian high school or private science high school. Thus they were only omitted from the analyses related to school type.

Moreover, students' mean physics scores ranged between 9.42 for Teacher 2 and 84.59 for Teacher 28. One of the teachers did not announced students' first examination results. Some of the students' second examination results were not announced or administered when the data were collected whereas 19 teachers announced. Mean of the second physics examinations ranged between 24.70 for Teacher 36 and 75.84 for Teacher 28.

Besides, students' mean scores on the Affective Characteristics Questionnaire were also calculated for each teacher. The maximum score a teacher could obtain was 5 whereas the minimum score was 1. The mean scores ranged between 2.98 for Teacher 15 and 3.67 for Teacher 28 for the total scale. For interest in physics courses subscale the mean scores ranged between 2.3 for Teacher 15 and 3.66 for Teacher 28, for importance of physics courses subscale the mean scores ranged between 2.84 for Teacher 24 and 3.39 for Teacher 28, for achievement motivation in physics courses the mean scores ranged between 3.21 for Teacher 16 and 4.60 for Teacher 28, for self-concept in physics courses the mean scores ranged between 2.56 for Teacher 2 and 4.39 for Teacher 28, for student motivation in physics subscale the mean scores ranged between 2.72 for Teacher 27 and 4.23 for Teacher 28, and for anxiety in physics courses subscale the mean scores ranged between 1.65 for Teacher 28 and 3.34 for Teacher 21 (lower score indicates lower anxiety).

On the other hand, the physics teachers of the same classrooms were also planned to be included in the quantitative phase of the study. However, several teachers did not want to participate in the study or did not want to spend time for responding the questionnaires. As a result, 31 teachers among 36 completed the questionnaires. There were several demographic questions at the first part of the teacher version of the questionnaires. Among the 36 physics teachers whose students participated in the study, 25 (69%) were male while 11 (31%) were female teachers. Furthermore, 19 (63%) teachers were graduated from education faculties while 11 (37%) graduated from faculty of arts and sciences. One of the teachers who responded the questionnaires did not answer this question. Moreover, 21 (67%) of the teachers had bachelor's degrees, eight (26%) had masters degrees, and two had (7%) doctoral degrees. The age distribution of these teachers is presented in Figure 3.1.

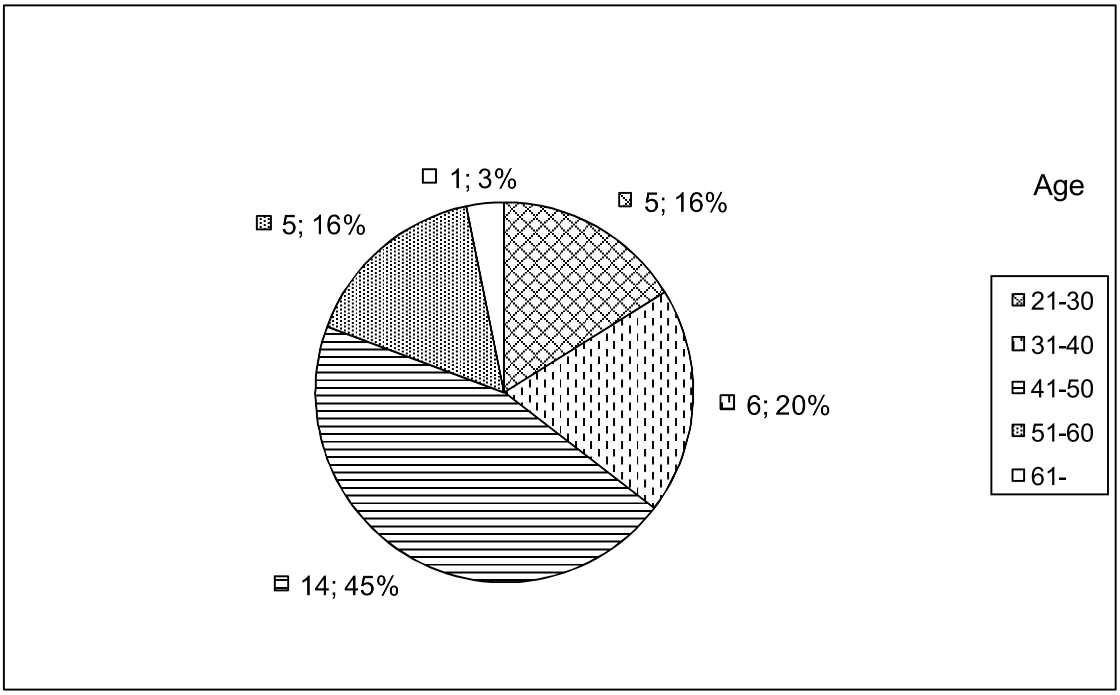

Figure 3.1 Age distribution of teachers

As can be seen in the figure nearly two-thirds of the teachers were more than 40 years old. Moreover, in Figure 3.2 these teachers' experiences are presented in years. As can be seen in the figure 75% of the teachers had more than 10 years teaching experience.

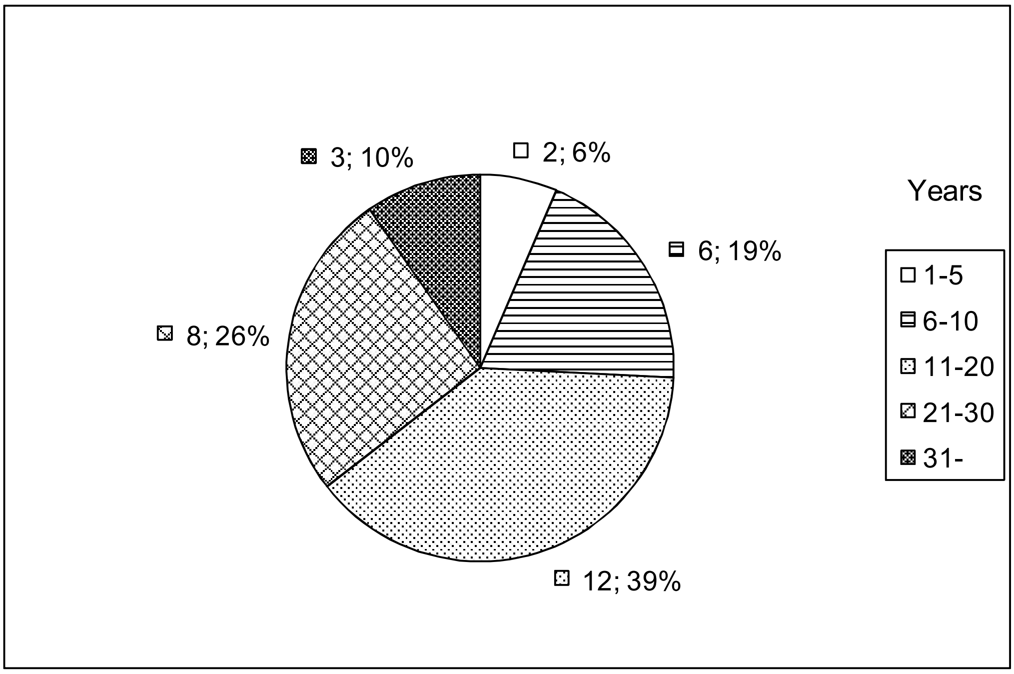

Figure 3.2 Teachers' teaching experience in years

3.2.3 Quantitative Data Collection Instruments

3.2.3.1 Affective Teaching Practices Questionnaire

In order to find out the affective teaching practices frequently performed by physics teachers and the effective practices on students' affective characteristics, the Affective Teaching Practices Questionnaire (ATPQ) was developed for this study. There were two versions of the ATPQ: student version and teacher version. Literature review about attitude and attitude change theories, and motivational theories and constructs resulted in a list of affective teaching practices. The teaching practices were mostly derived from the following studies: Feng and Tuan (2005), Glynn, Aultman and Owens, (2005), Glynn and Koballa (2006), Keller (1987a), Korur (2001), Pintrich and Schunk (2002), Raffini (1996), Wlodkowski (1999), Wongwiwatthananukit and Popowich (2000), and student responses to an open-ended survey were also included in the ATPQ. References of the items are presented in Appendix B.

The open-ended survey was administered in three schools (one science, one Anatolian and one private Anatolian high school) to 57 ninth grade students. The open-ended survey is presented in Appendix C. Students' responses were categorized and added to the list of the affective teaching practices. Thus, the initial item pool consisted of 283 items. Some of the items in the pool were parallel to each other, so they were combined, and after careful examination of these items, 161 items were left. After the second examination of the items with an expert, 140 items were selected.

The final form of the ATPQ consisted of 110 items and five negative items. These negative items were excluded in the analyses since their positives were also included among 110 items. The negative items were constructed to check the reliability of the items. There were five subscales of the questionnaire: communication, attention, relevance, confidence and satisfaction. There were 20 items in communication subscale, 22 items in attention subscale, 27 items in the relevance subscale, 23 items in the confidence subscale, and 18 items in the satisfaction subscale. The final version of the ATPQ is presented in Appendix D.

Expert views were taken as evidence of face validity of the ATPQ. The experts used the expert checklist presented in Appendix E. Six university instructors examined the ATPQ. Five of these six instructors have conducted research about affective domain and two of them offered courses about the affective domain. Moreover, two Turkish language experts, who teach Turkish language related courses at university, also examined the items. The questionnaire was revised according to their recommendations. Additionally, one physics teacher examined the questionnaire, and two 9th grade students read the questionnaire and stated ambiguities in the questionnaire. Final revision of the items was done according to their suggestions.

3.2.3.2 Affective Characteristics Questionnaire

Condensed version of the Affective Characteristics Questionnaire (ACQ) developed by Abak (2003) was used in this study to find out the relationship between affective teaching practices performed by the teachers and students' affective characteristics both reported by the students. There were 25 likert type items in the ACQ (See Appendix D). The items were responded on a five point scale ranging from 1 strongly disagree to 5 strongly agree. The alpha reliability coefficient of the total of 25 items was calculated as .94. On the other hand, the alpha reliability coefficients of the subscales range between .82 for importance of physics courses and .91 for physics anxiety, and are presented in table 3.3.

Table 3.3 Alpha reliability coefficients of the subscales of the ACQ

Subscale	# of items in the subscale	R
Interest in physics courses	4	.89
Importance of physics courses	5	.82
Physics anxiety	4	.91
Physics achievement motivation	4	.87
Physics self-concept	4	.84
Student motivation in physics courses	4	.88

Exploratory factor analysis of the 25 items yielded six factors in the varimax-rotated solution, and all the items loaded in the expected subscales. The factor loadings of the 25 items were ranging from .547 to .844, and they are all in the acceptable range. Communality values (h^2) range from .582 to .838 and all the communality values also fall in the acceptable region. Communality of a variable is defined as the variance explained for the variable using the factors as predictors. Results of the factor analysis are presented in Table 3.4. These results reveal that the subscales of the ACQ are distinct from each other similar to the previous studies. According to the results of factor analysis and reliability analysis, it can be concluded that the questionnaire works as intended for the current sample of this study and the questionnaire measures what it is supposed to measure reliably.

Table 3.4 Varimax-rotated principal component analyses solution for the ACQ

FACTOR (% of variance)	Item #	Loading Coefficient	h^2
Interest in physics courses (11.61%)	1	.844	.838
	2	.684	.756
	3	.729	.790
	4	.678	.705
Importance of physics courses (11.18%)	5	.578	.615
	6	.778	.765
	7	.778	.723
	8	.661	.658
	9	.547	.582
Physics anxiety (14.58%)	10	.798	.712
	11	.839	.793
	12	.832	.818
	13	.828	.784
Physics achievement motivation (12.29%)	14	.791	.745
	15	.805	.775
	16	.755	.675
	17	.766	.757
Physics self-concept (11.57%)	18	.694	.677
	19	.780	.677
	20	.791	.739
	21	.746	.707
Student motivation in physics courses (11.93%)	22	.730	.709
	23	.791	.834
	24	.736	.746
	25	.709	.713

3.2.4 Quantitative Data Collection

In order to conduct research in schools there was a long process starting with a human subjects application form with the appendices including the proposal, instruments to be administered, and informed consent. This form was given to the human subjects' research ethics committee at the university. The study was analyzed there in terms of appropriateness, aim, ethics and other issues. After giving permission they wrote to Evaluation Committee of Ankara Provincial Directorate of National Education for studies that were conducted in Ankara. This committee also examines appropriateness, aim, ethics and other issues related to the study. After giving permissions they write to the District Directorate of National Education where the study was planned to be conducted and the districts to the schools. Moreover, they send a copy of the permission with the instruments approved with a seal back to the university (see Appendix H). This process took about two months time. By this permissions procedure for both quantitative and qualitative phases were granted.

Moreover, some of the private schools also asked for the proposal of the study with the copy of the instruments. I delivered the requested documents to the schools. Some of the school principals wanted to see the permission letter and the approved copies of the instruments. Some school principals were very helpful that I did not have to go to those schools for the second time, they allowed me to administer the questionnaires when I got their schools for their permission. However, I had to go at least two times to many of the schools: once for permission and once for the administration of the instruments. I had to go more than twice to few schools, since they could not arrange their schedules, for example in one school the students had examination in the previous lesson. I did not want to administer the questionnaires in this school since it might affect the results. Thus, I went to this school once again to administer the questionnaires.

Data were collected about the end of the fall semester of 2007-2008 academic year. Students were also asked about their teachers' frequency of using affective practices in the ATPQ, thus they would have some time to observe their teachers by the end of the semester. Administration of both questionnaires continued about 1 class-hour. In some of the schools the number of students in one classroom was small so when possible I administered the questionnaires in more than one classroom. In one of the schools, data were collected in three different classrooms of the same teacher.

Data collected from one of the purposefully selected schools was not included in the data analyses, since the researcher felt that the data were not reliable. In detail, when I went to this school the teacher was really kind to me and was willing to participate in the study. Moreover, he was one of the four teachers that I have observed while piloting the qualitative phase. However at this stage, the school administration was not willing to participate. They did not tell me that they did not want to participate in the study explicitly, however one of the administrators said that so many researchers were coming to their school for data collection and they were tired of the researchers. Still, they told me that they could administer the questionnaires for me. Later, when I went to the school to collect the questionnaires at the appointed time, I felt that one of the administrators himself was completing all of the questionnaires that were to be administered to the students at that school. Thus, the data collected from this school were not included in the analysis.

Three of the private schools that were randomly selected did not allow me to administer the questionnaires. Total number of students in these three schools was about 40 students; consequently, these schools were excluded from the study. Moreover, the percentage of the students attending private schools was 14% in the sample size without these schools. It was larger than 10% of the population and was enough to represent the population. One of these three schools asked me to send the details of my study with a cover letter for permission in their schools. I have delivered a cover letter with details of the study and the questionnaires. Afterward, I have called them and they told me that they lost the documents, so I have sent them the documents for the second time via fax. Later on, I have called them several times in the following weeks. But I was not able to get a response. Meantime my data collection was finished and I was choosing the teachers to be observed. Thus, this school was excluded from the study.

The principal of the other two private schools was the same person and did not want to attend the study. In fact, these two schools were one school with two different types (private and private science). This was a small school; the number of the students in two types of schools was about 10 students. Thus, it was also excluded from the study. However, this school was replaced by another school randomly selected. There were also private and private science classrooms in this school.

Moreover, two private schools did not allow me to enter their classrooms; they wanted to administer the questionnaires themselves. There was no problem in the one school. In the other school, the administrators mixed the data collected from private Anatolian high school students and private science high school students. However, the same teacher was teaching both classrooms, so there was no problem.

Furthermore, some of the teachers completed the teacher version of the ATPQ with their students in the same classroom. Many of them completed the questionnaire separate from the students. Some of the teachers were not present at the schools while I was administering the questionnaires to the students; hence I needed to go to their schools to administer the teacher version separately.

3.2.5 Quantitative Data Analysis

Quantitative data analyses of the study involve descriptive statistics and bivariate correlations. All the quantitative analyses were performed by using statistical package for social sciences (SPSS). Descriptive statistics were conducted to answer the first research question, more explicitly to find out the most effective affective teaching practices on students' attitudes and motivation, and to select the teachers for the qualitative phase. Frequency distribution table was prepared for students' responses to the following question in the ATPQ: "How effective each teaching practice was on students' attitude and motivation".

Significance level was set to .05 at the beginning of the study, since it is the most commonly used value in social sciences. Thus, probability of making Type 1 error (rejecting a true null hypothesis) was set to .05 before the hypothesis testing. Power of the study was set to .99. Thus, probability of making Type 2 error (failing to reject a false null hypothesis) was .01. Moreover, effect size of the study was considered as medium effect size, since there were no related studies in the literature. Medium effect size is $\delta^2 = .15$ (Cohen & Cohen, 1983, p.161). The sample size for the adjusted power and effect size were calculated for 11 variables, and found as 285 for medium effect size. However, in the quantitative phase of the study, the sample size was selected by considering the 10% of the population as described in the population and sample section. Hence, the sample size of the study was larger than the value calculated for medium effect size.

Before starting inferential statistics, missing data analysis were conducted. Many students left blanks in the ATPQ and in the ACS. The missing data were less than 5%, thus replaced with series' mean. However, some of the students did not respond to how effective was each teaching practice on their attitude and motivation. The percentage of missing data were more than 5%, thus those students were omitted from the analyses related to effectiveness of practices.

Moreover, in order to answer the third research question, bivariate correlations were conducted. Bivariate correlations among subscales of the ATPQ and subscales of the ACS were determined.

3.2.6 Assumptions of the Quantitative Phase

The assumptions and limitations of the quantitative phase of this study are listed below:

1. This study is limited to the accessible population stated in population and sample.
2. Students' participation in terms of objectivity and obligation of them is not guaranteed.

3.3 Methodology of Qualitative Phase

3.3.1 Qualitative Research Methods

There are various taxonomies of types of qualitative research (Miles & Huberman, 1994). Case study, ethnography, phenomenology, grounded theory are listed by many researchers (i.e. Creswell, 2003; Denzin & Lincoln, 1994) among qualitative research types. Creswell (2003) also mentioned narrative research whereas Denzin and Lincoln (1994) added ethnomethodology, biographical method, historical method, action and applied research, and clinical research.

A case study is conducted to investigate the phenomenon of interest such as a program, an event, an activity, a process, or one or more individuals deeply (Creswell, 2003). There are two kinds of case studies (Yin, 2003): single or multiple case studies. Yin added that both kinds might be exploratory, descriptive, or explanatory (causal). A multiple site, structured case study design or briefly a multiple case study involves two or more cases. An exploratory case study is designed to define the questions and hypotheses of a subsequent study or to determine the feasibility of the intended research procedures; a descriptive case study is designed to describe a phenomenon completely within its context; whereas an explanatory case study "presents data bearing on cause-effect relationships-explaining how events happened (Yin, 2003, p.5).

Multiple case designs can be selected (i) to reflect a natural variation and thus, the explanations must account for the differences among the cases; (ii) to replicate each other; and (iii) to serve as direct contrasts with each other (Yin, 2004). Moreover, cross-case analyses integrate "the findings from individual case studies and are the most critical parts of a multiple-case study" (Yin, 2003, p.145). Each case study is handled independently in the analysis.

In this study, multiple case study design was used for both descriptive and explanatory purposes. Multiple case design was selected to reflect natural variations among the cases, and to compare the four cases with each other. Thus, cross-case analyses were also conducted. Multiple case studies require more work; however they can strengthen findings and interpretations of the study, and as a side benefit when there is unexpected difficulties with data collection in one case, there is at least one more case to continue (Yin, 2004). The design focused on investigating teachers' affective practices.

Non-participant observation was the main method of data collection; moreover, supplementary interviews with the teachers and students were conducted. Field notes during the classroom observations were taken especially when recording audio, in order to catch the visual practices that are not noticeable in the records. When necessary, field notes were also taken after recording videos. This was because the researcher was using the camera so was not able to write anything while recording videos, in order not to miss the ongoing events in the classroom. When necessary, the researcher asked students or teachers about the events in the classroom just after the course. Interviews with the teachers were audio recorded; on the other hand group interviews with the students were video recorded. Interviews with the teachers and students were semi-structured interviews. Moreover, unstructured interviews with some students were also conducted.

3.3.2 Selection of Teachers for Qualitative Phase

The teachers were determined according to the students' responses to the frequency of teachers' use of affective teaching practices in the ATPQ. Moreover, these four teachers from four school types were purposely selected since they were assumed to provide more information to the study. The learner characteristics in these four schools are different from each other. Thus, the teaching practices were expected to differ in these four schools.

Frequency distribution table was prepared for students' responses to the following question in the ATPQ: "How frequently the teachers used each teaching practice". This table was used to select the four teachers who were going to be observed. Teachers' mean scores of frequency of using affective practices in their physics courses as reported by their students were presented in Table 3.5.

The scores for teachers were calculated by summing all items in a subscale and then dividing this sum to number of items in that subscale. Similarly, for the total scale all items were summed and then divided to number of the questions. Hence the minimum score that a teacher could obtain was 1, and maximum score was 5.

The mean scores of the teachers for total scale and subscales were ranked, and the top ten teachers were signed with a star in the table. According to these rankings teachers numbered 5, 7, 18, 26, 28, and 31 had highest means for total scale and for each subscale. Two of these teachers were female teachers and four were male. These teachers were distributed to all types of schools, thus it was reasonable to include teachers from four different types of schools in the qualitative part of the study.

Teachers' mean scores according to their students' responses ranged between 1.91 for Teacher 8 and 4.44 for Teacher 34 for the communication subscale, for attention subscale the mean scores ranged between 1.44 for Teacher 8 and 3.86 for Teacher 28, for relevance subscale the mean scores ranged between 1.81 for Teacher 8 and Teacher 15 and 4.13 for Teacher 28, for confidence subscale the mean scores ranged between 1.76 for Teacher 15 and 4.10 for Teacher 18, and for satisfaction subscale the mean scores ranged between 1.61 for Teacher 15 and 4.15 for Teacher 28. For the total ATPQ the teachers' mean scores ranged between 1.68 for Teacher 15 and 4.06 for Teacher 28.

Table 3.5 Mean scores for teachers' frequency of use of affective teaching practices reported by their students in the ATPQ

Teacher	Communication	Attention	Relevance	Confidence	Satisfaction	Total
1	2.94	1.99	2.86	2.43	2.28	2.34
2	3.41	2.66	3.22	3.17	2.94	3.08
3	2.81	1.99	2.56	2.51	2.51	2.36
4	3.79	2.74	3.30	3.47	3.49	3.49
5	4.12*	3.25*	4.08*	3.99*	3.98*	3.86*
6	3.75	2.92	3.27	3.39	3.38	3.56
7*	4.25*	3.16*	3.89*	4.00*	3.72*	3.82*
8	1.91	1.44	1.81	1.96	1.92	1.76
9	3.40	2.86	3.40	3.19	3.24	3.27
10	3.32	2.38	2.92	2.75	2.86	2.79
11*	3.98	3.02*	3.93*	4.24*	3.95*	3.82*
12	3.66	2.51	3.19	3.31	3.28	3.31
13	3.26	1.80	2.70	2.83	2.84	2.75
14	3.48	2.11	2.99	3.41	3.28	3.10
15	1.98	1.49	1.81	1.76	1.61	1.68
16	3.96	3.03*	3.43	3.35	3.37	3.40
17	4.02*	3.41*	3.89*	3.76	3.62	3.87*
18	4.07*	3.19*	4.00*	4.10*	3.86*	3.84*
19	2.28	1.56	1.93	2.03	2.28	1.85
20	3.11	2.41	2.82	2.29	2.16	2.56
21	2.40	1.81	2.00	2.10	2.23	2.14
22	4.15*	2.79	3.70	4.00*	3.72*	3.56
23	3.01	2.51	3.27	3.14	3.07	3.22
24	3.35	2.14	3.18	3.09	2.58	3.00
25	2.44	1.76	2.15	2.13	2.17	2.05
26	4.21*	3.48*	3.86*	3.96*	3.72*	3.96*
27	3.53	2.17	3.07	3.11	3.09	2.98
28*	4.21*	3.86*	4.13*	4.11*	4.15*	4.06*
29	3.52	2.69	3.32	3.42	3.24	3.31
30	3.38	2.68	3.31	3.38	3.24	3.01
31*	4.22*	3.64*	4.05*	4.08*	3.92*	3.97*
32	3.97	3.02	3.77	3.73	3.95*	3.65
33	2.65	3.19*	2.54	3.37	3.28	3.39
34	4.44*	2.73	3.94*	4.00*	3.77*	3.80*
35	3.46	2.61	2.91	3.18	3.17	3.20
36	4.17*	3.06*	3.73	3.85*	4.03*	3.99*

* Top ten teachers for each subscale and total scale.

3.3.3 Participants

Purposeful sampling is the main sampling type in most of the qualitative studies. Patton (2002) stated that purposeful sampling is "one of the core distinguishing strategic themes" of qualitative studies (p. 230). In order to gather the maximum amount of information on a phenomenon of interest, a representative case or a random sample may not be the most appropriate strategy (Flyvbjerg, 2006). In purposeful sampling (or information-oriented selection) the basic concern is the amount of information the cases are expected to provide while in random sampling the basic concern is verifying representativeness. Flyvbjerg (2006) added that typical or average cases often do not provide wealthy information whereas unusual or extreme cases often provide wealthier information since they include more actors and more basic mechanisms in phenomenon of interest. He also added that in qualitative research the focus is on identifying the deeper causes behind the phenomenon and its consequences than to describe the indicators of the problem and how frequently they occur whereas random samples often cannot produce such insight; thus "it is more appropriate to select some few cases chosen for their validity" (p. 229).

Accordingly, purposeful sampling was used to select the physics classrooms, which were observed. The purpose was used to collect data from four teachers who use the affective practices most frequently in their physics courses in four different school types.

The teachers were determined according to the students' responses to their teachers' frequency of use of affective teaching practices in the ATPQ. Teachers' mean scores of frequency of using affective practices in their physics courses as reported by their students were presented in Table 3.5. These teachers and their principals were informed about the qualitative part of the study, and their permissions were taken.

However, when I was trying to prepare the schedule for the observations the schedule of Teacher 5 could not be arranged. Thus, this teacher was replaced by another teacher from a public high school. Teacher 11 was the 11th teacher in the Communication subscale. For the total scale and the other subscales he was also among top ten teachers. He and his principal were also informed about the qualitative part of the study and their permissions were taken.

3.3.3.1 Participating schools

There were four different school types also in the qualitative phase of the study. The high school was in another district. There were four physics teachers in the school. The public Anatolian high school was in Çankaya district. There were three physics teachers in this school. Private Anatolian high school was in Çankaya district. There were two physics teachers in the school. Private science high school was in Çankaya district. There were two physics teachers in this school.

3.3.3.2 Teacher-participants

Teachers numbered 7, 11, 28, and 31 were selected. Substitute names were determined for each teacher. Teacher 28 was named as Çağlar, Teacher 7 was named as Eda, Teacher 11 was named as Erkan, and Teacher 31 was named as Alper. While observing these teachers, I noticed that all the teachers had good subject matter knowledge. Even though their styles and personalities were quite different, they all were good at transferring their knowledge.

Çağlar (Teacher 28) was teaching physics at the private science high school. He was about 45 years old and had 25 years of teaching experience. He was graduated from the Middle East Technical University, Faculty of Arts and Sciences, Physics Department. He stated that he had completed pedagogical formation training after he started teaching. He had experience in preparation courses for the university entrance examination for many years. He had been teaching in the same school for about ten years. Moreover, he had masters' degree in Physics. He also had experience in writing physics textbooks and was writing another physics textbook according to the new physics curriculum. The physics teachers in this school were studying on physics experiments with an instructor from the university once a week. Among the four teachers selected for the qualitative phase, Çağlar was the only teacher that I came across by random sampling at the quantitative phase.

Eda (Teacher 7) was teaching physics at the public Anatolian high school. I met the teacher at the preliminary phases of the study, and observed her classrooms several times while developing the checklist. She was 29 years old, and had six years of teaching experience. She was graduated from Gazi University, Faculty of Education, Secondary Science and Mathematics Education Department, Physics Education major. She has been teaching in the same school for about four years, she had experience also as an elementary teacher. Moreover, she had masters' degree in Physics Education. She was very helpful even at the preliminary phases of the study, and she helped me to take permission from her principal to conduct the study and to record videos. She was very enthusiastic about teaching. She also asked me to critique her teaching, since she wanted to improve her teaching.

Erkan (Teacher 11) was teaching physics at the public high school. I observed him several times about one year before the study for another study. He was about 45 years old and had 25 years of teaching experience. He was graduated from Gazi University, Faculty of Education, Secondary Science and Mathematics Education Department, Physics Education major. Moreover, he had experience in writing physics textbooks and was writing another physics textbook according to the new physics curriculum.

Alper (Teacher 31) was teaching physics at a private Anatolian high school. The teacher and I have graduated from the same department, so we have known each other before the study. He was about 33 years old and had 11 years of teaching experience. He was graduated from the Middle East Technical University, Faculty of Education, Secondary Science and Mathematics Education Department, Physics Education major.

He had been teaching in the same high school for about 11 years. However, he also taught in the private science high school in the same school. Moreover, he had masters' degree in Physics education and was about to complete his PhD study while this study was going on. He seemed very serious about his job. He was very helpful, he asked for the permission of the principal of the school for conducting this study and for recording videos by himself.

3.3.3.3 Student-participants

There were 99 student participants in the qualitative phase of the study: 25 students in the public high school, 22 students in the private Anatolian high school, 22 students in private science high school and 30 students in the public Anatolian high school. One of the students in the public Anatolian high school was transferred to this school about 18th April 2008. The composition of the student participants in qualitative phase is described in Table 3.6. There were 12 girls and 13 boys in the public high school, 17 girls and 13 boys in the public Anatolian high school, seven girls and 15 boys in each of private Anatolian high school and private science high school.

Most of the students (73%) were born in 1993, 27% of the entire student participants were born in 1992 and five students did not report their birth years. Moreover, 91% of the students reported that they loved their teachers quite much or much, only 7% of the students reported that they loved their teacher little whereas 2% reported they did not love their teacher. The two students, who reported that they did not love their teachers, were attending the public high school.

On the other hand, 57% of the students reported that they were going to choose science and mathematics branch in 10th grade, 17% reported that they were going to choose mathematics branch, 8% reported they were going to choose social branch, 2% going to choose language branch, and 15% reported that they did not decide yet.

However, the 22 students in the private science high school did not have such an option, they all have to attend science and mathematics branch in 10th grade.

Table 3.6 Composition of student sample

		Public high school	Public Anatolian high school	Private Anatolian high school	Private science high school
Gender	Girl	12 (48%)	17 (57%)	7 (32%)	7 (32%)
	Boy	13 (52%)	13 (43%)	15 (68%)	15 (68%)
Birthdate	1992	11 (46%)	1 (3%)	14 (64%)	-
	1993	13 (54%)	29 (97%)	8 (36%)	22 (100%)
Love teacher	quite much	9	21	15	19
	much	8	6	7	3
	little	5	2	-	-
	not at all	2	-	-	-
Major	science-math	6	17	10	22*
	math	7	4	6	-
	social	7	-	1	-
	language	-	1	1	-
	undecided	4	7	4	-

* No option for other areas

3.3.4 Qualitative Data Collection Instruments

3.3.4.1 Affective Teaching Practices Checklist

The Affective Teaching Practices Checklist was parallel to the ATPQ and presented in Appendix I. The checklist was used for coding the observed affective teaching practices performed by the physics teachers.

3.3.4.2 Indicators of Positive Affective Characteristics Checklist

Indicators of Positive Affective Characteristics Checklist was originally developed by Guilloteaux (2007) as a part of The Motivational Orientation of Language Teaching (MOLT) classroom observation scheme. The observational variables measuring learners' motivated behavior, which was defined as learners' behavioral engagement by Guilloteaux (2007), were taken from the MOLT; and used for coding students' behaviors related to positive affective characteristics. The reason for that is behavioral engagement in instructional events is also accepted as the indicator of students' positive affective characteristics.

Students' level of behavioral engagement in instruction were assessed in terms of the proportion of students who paid attention or actively participated to the lesson, and who volunteered to teacher-fronted activities. Table 3.7 is adapted from Guilloteaux (2007) as a checklist; indicator behaviors of the three variables of students' positive affective characteristics are included in the checklist: attention, participation, and volunteering for teacher-fronted activities. All three variables were encoded using a three level-scale. Guilloteaux (2007) regarded classrooms as highly motivated, if at least 2/3 of the students appear to be paying attention, at least 2/3 of the students actively take part in classroom interaction or work on assigned activity, and at least 1/3 of the students volunteer without the teacher having to force them.

Table 3.7: Checklist of Indicators of Students' Affective Characteristics

School-Date of observation	Indicator Behaviors	Minutes								
		5	10	15	20	25	30	35	40	45
Attention	• Students are looking at the teacher, • Students are following teacher's movements • Students are looking at visual stimuli, • Students are turning to watch another student who is contributing to the task, • Students are following the text being read • Students are making appropriate nonverbal responses (by nodding their heads etc.), • Students are not displaying any inattentive of disruptive behavior.									
• Very low attention • Low attention • High attention	• A few students pay attention • 1/3 to 2/3 of the students pay attention • More than 2/3 of the students pay attention									
Participation	• Students take an active part in classroom interaction, • Students work on assigned activity.									
• Very low participation • Low participation • High participation	• A few students participate • 1/3 to 2/3 of the students participate • More than 2/3 of the students participate									
Volunteering for teacher-fronted activity	• Students volunteer readily to participate in a teacher-fronted activity without the teacher having to coax them in any way									
• No volunteering • Slow volunteering • Eager volunteering	• Students do not volunteer; the teacher has to call on them, • Students need encouragement like 'Come on, you are good students.' etc. before a few of them eventually volunteer. • At least one third of the students volunteer readily without the teacher having to coax them in any way.									

3.3.5 Validity and Reliability of Qualitative Phase

Validity in qualitative research is defined as “the degree to which the interpretations and concepts have mutual meanings between the participants and the researcher” (McMillan & Schumacher, 2001, p. 407). On the other hand, “reliability refers to the degree of consistency with which instances are assigned to the same category by different observers or by the same observer on different occasions (Hammersley, 1992, p. 67). However, Creswell and Miller (2000) stated that there is a confusing range of terms for validity in qualitative research including authenticity, goodness, verisimilitude, adequacy, trustworthiness, plausibility, validity, validation, and credibility. Lincoln and Guba (1985), on the other hand, stated that trustworthiness is related to four issues: truth value of findings, applicability of findings to other contexts or other participants, consistency of the findings with same or similar subjects or contexts in case of replication, and neutrality of the findings (not effected by researchers’ biases). They added that these issues were related to internal validity, external validity, reliability, and objectivity within the conventional paradigm. Moreover, there are various categorizations of the types of validity in qualitative research (i.e. Maxwell, 2002; Yin, 2003).

“If the issues of reliability, validity, trustworthiness, quality and rigor are meant differentiating a 'good' from 'bad' research then testing and increasing the reliability, validity, trustworthiness, quality and rigor will be important to the research in any paradigm” (Golafshani, 2003, p. 603). In other words, there is agreement on the idea that qualitative researchers like quantitative researchers need to establish credibility of their study, and most commonly used strategies for this purpose are member checking, triangulation, thick description, peer reviews, and external audits (Creswell & Miller, 2000).

Patton (2002) stated that triangulation options involve multiple data sources, multiple methods, multiple perspectives, and multiple investigators. “Triangulation is typically a strategy (test) for improving the validity and reliability of research or evaluation of findings" (Golafshani, 2003, p. 603). Bryman (1988/2004) stated that including field notes or extended transcripts would be helpful for the readers to understand the participants' perspectives, and the adequacy of the researcher's interpretations. Additionally, several researchers like McMillan and Schumacher (2001) recommended conducting prolonged and persistent field work, involving participant language and verbatim accounts, reporting low-inference descriptors, mechanically recording data, and searching for and discussing negative cases or discrepant data. Recommendations for establishing validity and credibility in the literature overlap.

Several of these strategies were used in this study. Data were collected by observations and interviews both from students and the teachers (multiple methods and multiple sources), data were recorded mechanically (either audio or video) in all cases, verbatim accounts of conversations were reported in the study, and member checking was done with teachers and students when there was a point to be clarified. The observations continued six weeks in each of the settings, thus prolonged field work is conducted. Moreover, I tried to report description of processes, procedures, and steps of the study in detail, and included the field notes and extended transcripts in Appendix J.

Generalizability, on the other hand, refers to "the extent to which one can extend the account of a particular situation or population to other persons, times, or settings than those directly studied" (Maxwell, 2002, p. 52). Flyvbjerg (2006) stated that "it is incorrect to conclude that one cannot generalize from a single case" (p. 225). He added that "generalizability of case studies can be increased by the strategic selection of cases" (p. 229). Likewise, Miles and Huberman (1994) listed two reasons for conducting cross-case analysis as to enhance generalizability, and to deepen understanding and explanation. Hence, in order to increase the generalizability of the qualitative phase of this study, four teachers who were performing the affective teaching practices frequently from four different school types were selected. Moreover, cross-case analyses are also conducted for this purpose.

3.3.6 Qualitative Data Collection

3.3.6.1 Field entry

Four teachers were observed for about two months in the spring semester of the 2006-2007 school year to get familiar to the classroom environment, and gain understanding of the events in the physics classroom. According to these observations, it was clear that it would not be possible to use a checklist of the teaching practices while the lesson was going on. Thus, in the later observations field notes with audio recordings and video recordings with the permission of both the principals and the teachers were taken.

The permission for the qualitative phase was also taken with the permission of the quantitative phase. The Ministry of Education leaves the decisions about volunteering to the study and recording courses to the principals and the teachers. Teachers numbered 7, 11, 28 and 31, and later their principals were informed about the qualitative part of the study, and their permissions were taken.

Students were familiar to the researcher from the quantitative phase of the study. Thus, there was no need to introduce myself. Still, they were informed about the study in the first lesson observed in their classrooms. Teachers and students were informed that I would observe them in their usual physics lessons. At the beginning of the study two teachers (Eda and Alper) were given the option of being video-recorded since I had personal relationship with them. They accepted it and they also helped me to convince their school principals. However, the other two teachers (Çağlar and Erkan) were only given the option of being audio recorded, since there was no prior rapport with them. They accepted being audio recorded. Later, two teachers were also given the option of being video recorded. Çağlar and his principal accepted it. However, Erkan only accepted to be video-recorded in one class-hour. Students were also informed about confidentiality of the records.

The observations started on 11.03.2008 and ended on 25.04.2008. The timetable of the observations are presented in Appendix K. Totally, 48 hours of physics lessons were observed in four classrooms, 15 hours of these observations were conducted in private science high school whereas 11 class-hours were observed in each of the other three schools. This was because there were three hours of physics lessons a week in the private science high schools while there were two hours of physics lessons in the other school types. To describe the physical setting of each classroom several photographs from the physics lessons are presented in Appendix L.

During the observations, I tried to select unobtrusive positions within the classroom for clear vision of the teacher and the students. Many times, I was sitting at the back or side of the classroom when recording audios. While recording videos, I was standing at the back of the classroom most of the time. I tried to stay uninvolved in the lessons. However, sometimes the teachers were asking questions or directing the attention of the students to me or sometimes especially at the first weeks of the observations the students were interested in me. When necessary, I asked about the events happened in the classroom just after the course. Moreover, supplementary interviews with teachers and students were conducted.

3.3.6.2 Interviews

Interviews with each of the four teachers were conducted after the observations. Teachers were interviewed about the effects of the affective teaching practices they used on their students. The interviews continued about 55 minutes with Çağlar, 56 minutes with Eda, 56 minutes with Alper, and 26 minutes with Erkan. Eda and Çağlar were interviewed in the teachers' room; however there were few disruptions during the interviews, since they were interviewed at the beginning of the summer holiday. Erkan was interviewed in the physics laboratory hence there were no disruptions. On the other hand, Alper was interviewed on the phone, since he was out of the city.

Additionally, interviews with students of the four teachers were conducted after the observations were completed. The students were interviewed about the affective teaching practices used by their physics teachers and their effects on them. In other words, some of the interview questions were intended to confirm the observations. All the student interviews were conducted in students' own classrooms.

In the public Anatolian high school whole class interview was conducted with all the students in the classroom on 27th May 2008. The interview lasted about one class-hour. Moreover, focus group interview with six students from different achievement levels was conducted on 6th June 2008 in the classroom. The interview lasted about one class-hour.

In the public high school, focus group interview with eight students from different achievement levels was conducted on 5th June 2008. The interview lasted about one class-hour. On the other hand, in the private science high school whole class interview was conducted with all students in the classroom on 5th June 2008. This interview also lasted about one class-hour. In private Anatolian high school, focus group interview with five students from different achievement levels was conducted on 12th June 2008. This interview also lasted about one class-hour.

3.3.7 Qualitative Data Analysis

3.3.7.1 Categories and codes of data

Codes and categories parallel to the ATPQ were used. In other words, data were coded according to Communication subscale and the ARCS categories and subcategories. These codes and categories of data are presented in the Affective Teaching Practices Checklist in Appendix I. A total of the 48 hours of data was coded. Sample coding is presented in Appendix M.

Moreover, interrater reliability of the observations was checked. First, two raters independently coded one class-hour video and one class-hour audio transcripts. The Kappa coefficient is used for calculating interrater reliability. The Kappa coefficient was calculated as .63 for these two observers, indicating a substantial agreement. According to Landis and Koch (1977), Kappa coefficients between .61 and .80 indicate a substantial agreement whereas Kappa coefficients larger than .80 indicate an almost perfect agreement. Later, the two raters discussed their codings and had almost full agreement at the end of this process. Among 337 independent codings of the two raters, there were only few disagreements.

On the other hand, students' behaviors related to their affective characteristics were determined by using the scheme used by Guilloteaux (2007).

3.4 Researcher's Role in Qualitative Phase and Ethical Issues

Qualitative research is interpretive in nature and the researcher has sustained an intensive relationship with the participants (Creswell, 2003). Thus, fieldwork variations include six issues to consider (Patton, 2002): role of the observer, perspective (insider vs. outsider), researchers, disclosure of the observer's role (overt vs. covert), duration of observations and fieldwork, and focus of observations (single element vs. holistic view). By clarifying each of these issues respectively, the researcher's role is clarified. First, the researcher was non-participant observer.

Second, the perspective of the researcher was in-between an insider and an outsider, since the researcher herself was also teaching physics, however an introductory physics course to preservice elementary teachers. The courses and students have some common characteristics and some distinct characteristics. Still, the researcher is aware of the problems of teaching physics and student reactions, perceptions and emotions in physics courses. Moreover, the information gathered from this study including the literature review was helpful for professional development of the researcher especially teaching physics and teacher training, and for the physics teachers and educators. In other words, the results of the study were useful for enhancing students' attitudes toward and motivation in learning physics.

Third, the inquiry was mainly conducted by the researcher herself. Fourth, observer's role was almost full disclosure to the participants: all the participants in the study were informed about the main purpose of the study. Fifth, multiple observations continued about six weeks in each of the settings, thus the study is a long term study. Lastly, focus of observations was on single element, on the affective teaching practices.

Creswell (2003) added that gaining entry to the field and ethical issues are elements of researcher's role. Issues related to gaining entry to the field were discussed in data collection. He also recommended the researchers should discuss how they addressed each of the ethical issues raised.

The main issue of research ethics is not to harm (physically or psychologically) anyone as a result of the research (Fraenkel & Wallen, 1996). Since this study investigates the teaching practices in actual physics classrooms, there are several potential ethical issues:

(i) Protecting participants from harm: There was no possible harm involved in this study.

(ii) Confidentiality of research data: Confidentiality of the data was ensured, and the participating students, teachers, and schools were assured that their anonymity would be protected in publications based on the research. The participants were told that participation could be withdrawn at any time.

(iii) Deception of subjects: Teachers, principals, and students were informed about purpose of the study, and about how the data would be used. Only the main purpose of the study was revealed to the participants, however the teacher and students participants have completed the ATPQ before the qualitative phase. Thus, in fact they were also informed about the details of the study. Moreover, there was no problem with explaining the teachers the reason why they were selected for qualitative phase, since they all were among the top teachers according to their students' responses to the frequency of using affective teaching practices. Thus, I think that no deception was involved in this study.

CHAPTER 4

RESULTS

Results of the quantitative and qualitative data are discussed separately. First, results of quantitative data and then the results of qualitative data are presented.

4.1 Results of Quantitative Data

The results are presented separately for each of the three quantitative research problems in this section. The data were obtained from the Affective Teaching Practices Questionnaire (ATPQ) which was developed to find out affective teaching practices frequently used by physics teachers and the most effective affective teaching practices on students' affective characteristics related to physics. The questionnaire was administered to 1,138 students in 9th grade. Moreover, 31 physics teachers completed the teacher version of the questionnaire. Students' responses to the ATPQ were also used for selecting the teachers who were using the affective teaching practices most frequently in their physics lessons.

4.1.1 The Most Frequently Used Teaching Practices that Physics Teachers Use to Enhance Students' Physics related Affective Characteristics

The most frequently used teaching practices according to both students' and teachers' responses are presented in this section. Students' and teachers' responses are presented separately to answer the first research problem, which is "What are physics teachers' and 9th grade students' perceptions about the frequently used teaching practices enhancing students' physics related affective characteristics in Çankaya district of Ankara?".

4.1.1.1 The Most Frequently Used Teaching Practices that Physics Teachers Use to Enhance Students' Physics related Affective Characteristics according to the Students Responses

In the ATPQ the students responded how frequently their physics teachers performed each teaching practice on a 5-point scale ranging from 1 referring to "not at all" to 5 referring to "very frequently". Students reported that their physics teachers performed six of the affective teaching practices very frequently. The mean frequencies of each of these teaching practices were equal to or greater than four. This means that the teachers in the sample either very frequently or frequently used these teaching practices. The most frequently performed affective teaching practices according to students' perceptions are presented in Table 4.1.

Table 4.1 The most frequently used affective teaching practices according to students' responses

Item no	Statement	Category-Subcategory
18	Emphasizes important parts.	Communication
44	Distracts our attention while moving in the classroom. (reverse coded)	Attention
65	Has self-confidence in physics.	Relevance-Modeling
14	Repeats the parts that are not understood.	Communication
21	Explains the logic behind the topic and the formulas.	Communication
58	Gives correct answers to the students' questions about physics topics.	Relevance-Modeling

The most frequently performed teaching practices are under communication, attention, and relevance-modeling categories. "Emphasizing important parts" is the most frequently used affective teaching practice by the physics teachers in the sample. Moreover, “not distracting students’ attention while moving in the classroom”, “having self-confidence”, “repeating parts that are not understood by the students”, “explaining the logic behind the topic and formulas”, and “giving correct answers to the students’ questions about physics topics” are also among the most frequently used affective teaching practices by the physics teachers.

On the other hand, students in the sample reported that their physics teachers used seven of the affective teaching practices not frequently. The mean frequencies of each of these teaching practices were equal to or less than two. This means that the teachers in the sample either very seldom or never used these teaching practices. The least frequently performed teaching practices according to students’ perceptions are presented in Table 4.2.

Table 4.2 The least frequently used affective teaching practices according to students’ responses

Item no	Statement	Category
40	Varies teaching methods.	Attention-Variability
41	Teaches out of the classroom in the laboratory or outside.	Attention-Variability
70	Invites guests like students from the higher grades, people having a physics-related job to share their experiences.	Relevance-Modeling
28	Uses activities like group work, brainstorming, games, simulations, role playing, drama, competition to actively involve students.	Attention-Participation
27	Uses materials and media like over head projector, film, video, computer or computer programs.	Attention-Concreteness
102	Uses unexpected rewards.	Satisfaction-Unexpected rewards
42	Takes us to course related trips, exhibitions, activities in other schools etc.	Attention-Variability

Among the least frequently used teaching practices, three are related to attention-variability (varying teaching methods and learning environments etc.), one is related to relevance-modeling (i.e. inviting guests), one is related to attention-participation (i.e. using activities such as group work, brainstorming, role playing, or competition), one is related to attention-concreteness (i.e. using materials or media like film, computer, or computer programs), and one is related to satisfaction-unexpected rewards.

4.1.1.2 The Most Frequently Used Teaching Practices that Physics Teachers Use to Enhance Students' Physics related Affective Characteristics according to the Teachers' Responses

In the teacher version of the ATPQ, also the physics teachers responded how frequently they practiced each teaching practice on a 5-point scale ranging from 5 referring to "very frequently" to 1 referring to "not at all". Teachers reported that they used 56 of the affective teaching practices very frequently. The mean frequencies of each of these teaching practices were equal to or greater than four. This means that the teachers in the sample either very frequently or frequently used these teaching practices.

The most frequently used affective teaching practices according to teachers' responses were 21, 61, 14, 18, 13, 78, 65, 100, 90, 66, 23, 63, 69, 113, 17, 67, 7, 58, 5, 16, 109, 75, 80, 92, 76, 111, 34, 20, 11, 59, 88, 110, 46, 62, 45, 60, 52, 87, 2, 38, 89, 93, 53, 95, 112, 56, 68, 79, 36, 15, 74, 97, 35, 1, 83, and 85; listed respectively from the most frequent to less frequent. The most frequently used 10 affective teaching practices according to the teachers' perceptions are presented in Table 4.3.

As can be seen in the table the top 10 most frequently used affective teaching practices were under communication category, and relevance-modeling, confidence-difficulty and challenge, confidence-feedback, and satisfaction-positive outcomes subcategories. Teachers' results were including all the affective teaching practices reported as frequent by the students. However, the teachers reported that they used teaching practices more frequently than their students reported.

Table 4.3 The most frequently used affective teaching practices according to teachers' responses

Item no	Statement	Category
21	Explain the logic behind the topic and the formulas.	Communication
61	Care about my job.	Relevance-Modeling
14	Repeat parts that are not understood.	Communication
18	Emphasize important parts.	Communication
13	Use a clear, understandable, fluent and simple language in courses.	Communication
78	Organize materials and practice exercises on an increasing level of difficulty- that is structure the materials to provide a conquerable challenge, over the course life.	Confidence-Difficulty and challenge
65	Have self-confidence in physics.	Relevance-Modeling
100	Appreciate students when they spend effort and achieve something (for example raise their grade from 10 to 50)	Satisfaction-Positive outcomes
90	Provide feedback when students need help solving questions, doing homeworks etc.	Confidence-Feedback
66	Provide role model with my behaviors for the students.	Relevance-Modeling

On the other hand, teachers in the sample reported that they used all of the affective teaching practices frequently while students reported seven practices as not used frequently by their teachers. In other words, mean frequencies of no teaching practices were equal to or less than two; this means that the teachers in the sample reported that they used all of the teaching practices in the ATPQ at least usually in their lessons.

4.1.2 The Most Effective Teaching Practices on Students' Physics related Affective Characteristics

The most effective teaching practices on students' physics related affective characteristics according to both students' and teachers' responses are presented in this section. Students' and teachers' responses are presented separately to answer the second research problem, which is "What are physics teachers' and 9th grade students' perceptions about the effective teaching practices to enhance students' physics related affective characteristics in Çankaya district of Ankara?".

4.1.2.1 Students' Perceptions about the Teaching Practices Affecting Students' Physics related Affective Characteristics

In the ATPQ, the students also responded how each teaching practice affected their attitude and motivation. Students' responded these items on a 5-point scale ranging from 1 referring to "decrease very much" to 5 referring to "increase very much", 3 being "does not affect". Table 4.4 presents the most effective teaching practices affecting students' physics related affective characteristics according to the students' responses.

As can be seen in Table 4.4, the most effective teaching practices are under communication and relevance-modeling categories according to students' responses. Moreover, attention-concreteness, attention-inquiry, relevance-experience, confidence-difficulty and challenge, confidence-attribution, confidence-expectations, confidence-feedback, satisfaction-positive outcomes, and satisfaction-scheduling related teaching practices are reported to be among the most effective on students' attitude and motivation.

There were 31 teaching practices reported as very effective by the students. Among the 21 teaching practices included in the communication category of the ATPQ, 12 are reported to be effective. The most effective communication related teaching practices were: "repeating parts that are not understood", "explaining the logic behind the formulas and the topic", and "emphasizing important parts". Moreover, among 14 modeling related teaching practices, nine are listed among the most effective teaching practices according to students' responses. "Giving correct answers to the students' questions about physics topics", "explaining what is taught in a step by step approach", and "behaving enthusiastically and energetically while teaching" are reported to be the most effective modeling related teaching practices.

Table 4.4 The most effective affective teaching practices on students' affective characteristics according to the students' responses (Frequency ≥ 4 out of 5)

Item no	Statement	Category
14	Repeats the parts that are not understood.	Communication
21	Explains the logic behind the topic and the formulas.	Communication
18	Emphasizes important parts.	Communication
2	Communicates positively.	Communication
58	Gives correct answers to the students' questions about physics topics.	Relevance-Modeling
13	Uses a clear, understandable, fluent and simple language in courses.	Communication
7	Creates an atmosphere suitable for learning.	Communication
67	Explains what he/she teaches in a step by step approach.	Relevance-Modeling
5	Creates an atmosphere for students to ask questions without hesitating.	Communication
16	Distributes or helps students to take clear notes.	Communication
3	Smiles in and out of class.	Communication
20	Solves a lot of questions.	Communication
63	Behaves enthusiastically and energetically while teaching.	Relevance-Modeling
75	Lectures according to the students' level.	Confidence-Difficulty and challenge
62	Enjoys doing his/her job.	Relevance-Modeling
100	Appreciates students when they spend effort and achieve something (for example raise our grade from 10 to 50).	Satisfaction-Positive outcomes
34	Uses questions to make us participate to the course.	Attention-Inquiry
65	Has self-confidence in physics.	Relevance-Modeling
59	Finds answer to the questions he/she could not answer and explains it to us.	Relevance-Modeling
61	Cares about his/her job.	Relevance-Modeling
80	Provide opportunity for students to see everyone who spends effort can be successful.	Confidence-Attribution
1	Behaves patiently.	Communication
111	Allows adequate time for exploration of a topic and for us to ask what we do not understand.	Satisfaction-Scheduling
50	Uses analogies to relate current learning to prior experience.	Relevance-Experience
68	Asks students to explain what they do when they are solving problems at the board.	Relevance-Modeling
69	Helps students learn how to study to be successful.	Relevance-Modeling
90	Provides feedback when we need help solving questions, doing homeworks etc.	Confidence-Feedback
17	Checks if the students follow the lesson or not.	Communication
88	Encourages students by telling you can do it.	Confidence-Expectations
76	Uses materials, activities, homeworks, exam questions matching students' levels.	Confidence-Difficulty and challenge
23	Uses examples, problems, questions related to daily life.	Attention-Concreteness

Four of the six most frequently performed affective teaching practices were also among the most effective teaching practices according to students' responses. These are "repeating parts that are not understood by the students", "explaining logic behind the topic and the formulas", "emphasizing important parts", and "having self-confidence in physics". On the other hand, none of the teaching practices, which were reported to be effective teaching practices, were reported among the least frequently performed teaching practices according to the students.

4.1.2.2 Teachers' Perceptions about the Teaching Practices Affecting Students' Physics related Affective Characteristics

In the teacher version of the ATPQ, the teachers also responded how each teaching practice affected students' attitude and motivation. Teachers responded these items on a 5-point likert scale ranging from 1 referring to "decrease very much" to 5, referring to "increase very much", 3 being "does not affect". Teachers reported 84 of the teaching practices as the most effective teaching practices on students' affective characteristic related to physics.

According to teachers' responses, these teaching practices were 18, 23, 7, 14, 16, 21, 69, 17, 2, 5, 58, 100, 61, 63, 35, 13, 52, 67, 20, 34, 45, 75, 78, 65, 76, 113, 59, 90, 92, 8, 53, 54, 80, 66, 3, 38, 56, 60, 93, 11, 46, 97, 104, 29, 31, 62, 91, 101, 39, 79, 103, 95, 109, 4, 15, 26, 49, 50, 68, 10, 82, 51, 81, 83, 110, 9, 24, 88, 89, 112, 111, 57, 74, 12, 85, 27, 47, 48, 77, 1, 25, 28, 33, and 98; listed respectively from the most effective to the least effective. Mean scores of all these items were larger than or equal to four. This means that they increase students' affective characteristics or increase students' affective characteristics very much. Table 4.5 presents the most effective 15 teaching practices affecting students' physics related affective characteristics according to the teachers' responses. The most effective teaching practices are under the following subcategories:

communication, attention-concreteness, attention-inquiry; relevance-modeling; and satisfaction-positive outcomes.

Students reported 31 affective teaching practices as the most effective in their affective characteristics related to physics while the teachers reported 84 practices as the most effective practices on their students' affective characteristics related to physics. In other words, teachers were thinking that the number of affective teaching practices effective on their students' attitude towards physics and motivation in physics were more than the number their students reported. All of the 31 affective teaching practices which were reported as effective by the students were among the 84 affective teaching practices reported as effective by the teachers.

Table 4.5 The most effective affective teaching practices on students' affective characteristics according to the teachers' responses

Item no	Statement	Category
18	Emphasize important parts.	Communication
23	Use examples, problems, questions related to daily life.	Attention-Concreteness
7	Create an atmosphere suitable for learning.	Communication
14	Repeat the parts that are not understood.	Communication
16	Distribute or help students to take clear notes.	Communication
21	Explain the logic behind the topic and the formulas.	Communication
69	Help students learn how to study to be successful.	Relevance-Modeling
17	Check if the students follow the lesson or not.	Communication
2	Communicate positively.	Communication
5	Create an atmosphere for students to ask questions without hesitating.	Communication
58	Give correct answers to the students' questions about physics topics.	Relevance-Modeling
100	Appreciate students when they spend effort and achieve something (for example raise their grade from 10 to 50)	Satisfaction-Positive outcomes
61	Care about my job.	Relevance-Modeling
63	Behave enthusiastically and energetically while teaching.	Relevance-Modeling
35	Ask questions like "How" and "Why" or support students asking these kinds of questions in order to help them understand the theme deeply.	Attention-Inquiry

According to teachers two of the most frequently performed affective teaching practices were not among the most effective affective teaching practices. These practices are: “not disturbing students’ attention with his/her movements” and “clearly explaining what is expected from the students”. Moreover, eight of the most effective affective teaching practices were not among the most frequently performed affective teaching practices according to teachers’ responses. These are: “smiling in and out of class”, “spending time for speaking to the students one by one or as a group”, “using experiments or demonstrations”, “directing students’ attention to unusual points by using interesting questions, incongruous statements etc.”, “making some alterations according to the flow of the course”, “using verbal praise, personal attention, helpful feedback, and motivating feedback (praise) immediately following task performance”, “using verbal praise, real or symbolic rewards, and incentives, or allowing students to showcase the results of their effort (“show and tell”) to reward their success after instruction”, and “providing motivational feedback when students make mistakes”.

4.1.3 Correlations between the Affective Teaching Practices used by Physics Teachers as Reported by the Students and Students’ Self-reported Affective Characteristics

Correlations between the affective teaching practices used by physics teachers according to students’ responses and students’ self-reported affective characteristics are explored to answer third research question, which is “What is the relationship between 9th grade students’ physics related affective characteristics and their perceptions about the affective teaching practices used by their physics teachers in Çankaya district of Ankara?”. Bivariate correlations between affective teaching practices performed by the physics teachers’ and students’ affective characteristics (both reported by the students) are presented in Table 4.6. Moreover, correlation coefficients between the categories of the affective teaching practices and the subscales of the ACQ are also presented in Table 4.6.

Table 4.6 Bivariate correlations between categories of the ATPQ and subscales of the ACQ

ATPQ / ACQ	Communication	Attention	Relevance	Confidence	Satisfaction	Total
Interest	.53	.54	.55	.52	.51	.56
Importance	.19	.24	.29	.28	.27	.25
Anxiety	-.48	-.35	-.42	-.43	-.48	-.51
Achievement motivation	.29	.25	.33	.36	.35	.35
Self-concept	.25	.23	.29	.29	.25	.33
Student motivation	.27	.29	.32	.30	.34	.34
Affect	.27	.31	.35	.34	.31	.34

According to Cohen (1992), bivariate correlation coefficients .10, .30, and .50 indicate small, medium, and large relationships, respectively. Bivariate correlation coefficients between interest in physics and all categories of ATPQ were high. The coefficients ranged from .51 to .55. Moreover, the correlation coefficient between interest in physics courses and the total score of the ATPQ was also large (.56). On the other hand, bivariate correlation coefficients between importance of physics courses and categories of the ATPQ were all low, ranging between .19 and .29. Furthermore, the correlation coefficient between importance of physics and the total score of the ATPQ was also low (.25). All the coefficients between physics related self-concept and categories of the ATPQ were also small, ranging from .25 to .29. However, the correlation coefficient between self-concept and the total score of the ATPQ was medium size (.33).

On the other hand, bivariate correlation coefficients between anxiety in physics and all categories of the ATPQ were medium size. However, all the signs were negative, as expected, since higher scores indicated higher anxiety. These coefficients ranged from -.48 to -.35. The coefficient between anxiety and the total score of ATPQ was -.51, indicating a high relationship.

Correlation coefficients between achievement motivation in physics courses and two categories of the ATPQ (communication and attention) were low, while correlation coefficients between achievement motivation in physics courses and the other categories (relevance, confidence, satisfaction) were medium. The coefficients ranged from .25 to .36. Moreover, the coefficient between achievement motivation in physics courses and the total score of ATPQ was also medium (.35).

Correlation coefficients between student motivation in physics courses and two categories of the ATPQ (communication and attention) were also low, whereas correlation coefficients between student motivation in physics courses and the other three categories (relevance, confidence, satisfaction) were medium. These coefficients ranged from .27 to .34. Moreover, the coefficient between student motivation in physics courses and the total score of ATPQ was .34, indicating a medium size relationship.

The bivariate correlation coefficients between the total scores of the ACQ and the ATPQ and its categories were also determined. The coefficient between the total score of the ACQ, which is named as affect in Table 4.6, and the total score of the ATPQ was .34, indicating a medium size relationship. Coefficient between the ACQ and communication was low, while all other coefficients were medium. The coefficients ranged from .27 to .35.

4.2 Results of Qualitative Data

This section reports the results of qualitative phase of the study. According to the students' responses to the ATPQ in the quantitative phase, four teachers using the affective teaching practices frequently were selected for the qualitative phase. The selection of these teachers was discussed in Section 3.3.2. Finding the teachers using the affective teaching practices very frequently was among the purposes of the quantitative phase. These four teachers were teaching at different kinds of schools. The data for the qualitative part were obtained from 48 hours of lessons observed in these teachers' classrooms. Data obtained from the observations were the main concern for the analyses. Moreover, interviews with these teachers and their students were conducted to support the data collected from the observations.

Qualitative analytic techniques were used to analyze data collected from these four cases. In the first step of analyses, 110 items in the ATPQ were considered as codes of data, and categories and sub-categories of the questionnaire were considered as the categories of data. Codes and categories of data are presented in Appendix I. These categories and codes were used to analyze the transcripts of audio and video recordings of observations and field notes. Sample coding is also presented in Appendix M. Moreover, as a peer examiner another researcher used the same coding scheme to label transcripts of one class-hour audio and one class-hour video recordings.

First, some background information is presented in this section. Second, the results related to the observed affective teaching practices that four "good" physics teachers performed were presented for each category of the ATPQ. Then, the results related to the students' responses to the frequently performed affective teaching practices were presented for each category of the ATPQ.

4.2.1 Background Information about the Cases

All four teachers were exceptionally good teachers. All of them had profound subject matter knowledge. They all used clear, understandable, fluent language in their lessons. Çağlar stated that he used "Çorum Turkish" that was defining his accent. But it was fluent and understandable; moreover, I was thinking that he was sometimes exaggerating it to be interesting and amusing to the students. In fact, he was interesting and amusing. The other teachers did not have a certain accent. Alper was instructing in English, since it was a private Anatolian high school. But rarely, whenever he felt necessary, he was explaining the topic in Turkish.

The teachers were able to answer most of their students' questions. Moreover, all teachers were organizing what they teach and their examples from simple to difficult. In the interview, Eda explained why she was organizing what she taught in that manner. She emphasized that she was getting prepared before the lesson and organizing the questions from easy to complex. She was trying to help students understand the topic easily and hence enhance their confidence by this way. The following excerpt from the transcripts of audio recording of interview clarifies her ideas.

> R: “I have observed that you organize what you teach from simple to complex.”
> Eda: “I try to organize, as much as possible, I certainly got prepared before coming [to class] that day, which questions I am going to solve, which order I am going to solve them. If one [question] involves the other, certainly I solve the easier one, later I try to pass to the other so that the student understands easily. They say ‘From easy to complex.’ I try to apply that.”
> R: “How does this affect your student?”
> Eda: “Therefore, I am trying to go step by step the student tries to discover the relationship between the previous step and the next step. He/she can say that ‘Oh, we did this like this; we can do this like this. He/she might make interpretation, makes interpretation saying ‘Teacher we did this question like this, we can do this like this.’ Even if he/she can’t find the result, can make interpretation, thus not memorized, I think. But if I do them conventionally, the same kind, or do the difficult one suddenly, he/she might approach with prejudice saying ‘This is hard anyhow, oh, I can’t do this.’ First, if we do several things that he/she can solve, understand easily, his/her confidence might be enhanced, he/she can say ‘I could also do, I can do this, I should try.’ Her/his confidence is enhanced in one hand, on the other hand, it helps understanding easily.”

On the other hand, in the interview Çağlar stated that he thought organizing the topic from easy to difficult is important to enhance students’ confidence, who are not able to answer the questions easily. The following excerpt from the transcripts of audio recording of interview includes his ideas.

> R: “You organize what you teach from easy to difficult?”
> Çağlar: “That is important, very important. It is also in that way in books, etc. Books, tests, worksheets, etc. ‘Very easy’, if you can make [the students] say ‘Oh, it is very easy.’ in the first tests, it is very good. In the first questions, when the kid says ‘It is very easy.’, sometimes very clever students say that ‘But is this asked?’, yes, it is, without hesitating. It should be from easy to difficult, he/she is going to count with his/her fingers saying ‘One, two.’ From very easy to difficult. … The students said “This book is very easy.”… but later many stated that they liked it. … Starting from very easy is an advantage.”
> R: “What is its advantage?”
> Çağlar: “Kid. There will be also people who say that it is very easy, or “Are these done?” Clever students already do, if you do difficult or wherever you start, they

> do. But the purpose is to get the others and make them love the lesson. As I said before, to get meager students. … ”

Çağlar also stated that he got prepared to the lessons before the class while talking about another issue. I have never observed him taking a book or notes with him to the class. The following excerpt from the transcripts of audio recording of interview clarifies his ideas.

> Çağlar: “I always plan what I am going to do next in my mind. It might seem as if I am coming to the class without preparation, but I plan while writing the question on the board that I am going to solve this first, second this example must follow, third this must follow. This must be due to experience.”

All the teachers were giving the impression that they cared about their jobs. Moreover, Eda and Çağlar were enthusiastic, energetic and dynamic in their lessons. In the teacher interview, Eda explained this as “I use all my energy at school, nothing is left to home. I think about myself being a student. … If it is monotonous, dull. … In order to attract student’s attention, to make them participate to the lesson. It is a little bit of my nature, I speak fast, move quickly for example.”

On the other hand, Alper was using variability more than the other teachers. For example he was varying the environment from classroom to laboratory, the method from individual to group work etc. He was also the only teacher using PowerPoint presentations; he used the presentations almost in all lessons observed. Moreover, Eda was varying the presenter: sometimes she was explaining the topic; sometimes the students were explaining the topic.

Though, I have observed all four teachers having some degree of challenge with their students. Eda was having problem with two students who were chatting in the lessons. She was ignoring them to handle the situation. However, these students stated that they were not satisfied with their physics lessons. On the other hand, one other student stated that they deserved what the teacher was doing to them. Moreover, she was punishing the students who were chatting by taking their money. She explained that she was buying rewards to the students who were getting the highest grades with this money.

Alper was giving the impression that he was an authoritarian teacher, because he was very tall. He was having problem with several students. Once he punished two students. He made these students stand on two corners of the classroom. Moreover, once he punished many students, because they were late to the class by making them stand in front of the board.

Çağlar was also giving the impression that he was an authoritarian teacher, since he was elderly. He knew personal information about his students and using these in his lessons. He was usually very patient to his students and communicating positively with them. However, two students at different times during the observations stated that they did not understand what the teacher explained. The teacher said he was not able to understand what the students did not understand. The communication between them was giving the impression that the students were offended by the teacher's behavior. Later, I asked the students if my impression was correct. One did not want to talk about the issue, but the other confirmed that she was offended. However, the teacher was trying to communicate positively with these two students just after these instances.

Moreover, all the teachers were self-confident. Eda stated that she felt confident in physics, because she loved her job; and was a model for her students by being self-confident. The following excerpt from the transcripts of audio recording of interview clarifies her ideas.

> R: "You have self-confidence in physics, I have observed that."
> Eda: "First, I love physics. Sure, I have some deficiencies; there are things that are not clear in my mind. But in general I think that I am good. I love solving different questions-different kinds. This also helps keeping my mind open. I am not overconfident, that I don't have a big confidence, I don't say 'I solve every kind of questions'. But maybe since I love it, in that respect I am confident. I do my job willingly. Maybe it is related to that, being energetic, trying to follow all students. Maybe I love and want everybody to love it."
> R: "How does your self-confidence affect your students?"
> Eda: "They notice me-who has confidence, who doesn't. I know myself. For example, I didn't sleep well that day, for example, I couldn't solve that question. My student doesn't think that 'She doesn't know anything and can't teach me anything.', he/she feels that you, in fact, know it. But you couldn't do it that day. I can share this openly with my students, I can frankly say that 'My mind doesn't

> work now, I couldn't solve it, can I solve it later?'… I try to solve it, if I couldn't. … I say that 'If you get the answer inform me about it.' This is because, first I am self-confident, I know, but I couldn't solve it that time or something that I don't know. I don't think it is a shame or deficiency to say 'I don't know.' 'Look, I don't know this, but I am trying to learn it.', again you are a model to the student, that is, there is no rule like 'I should know everything'. If it were I would be Einstein. I also say that 'There is nothing like you have to solve every question'."

All four teachers were good at classroom management. The atmosphere was suitable for learning, and students were paying attention to what was being explained most of the time in all classes. However, the students in the public high school were less interested in physics course than the students in the other schools. The students in the private Anatolian high school were also not much interested in the course. In contrast, the students in the public Anatolian high school and private science high school were interested in the lesson most of the time as expected, since the students in these two schools were selected by exams. Moreover, there were few distracted students from time to time in these classrooms, too. However, they were not making noise in the classroom or disturbing the lesson. They were sometimes watching out of the window or playing with their cellular phones.

4.2.2 Affective Teaching Practices Frequently Used by "Good" Physics Teachers

Results of both the categories and subcategories of the ATPQ were examined, in order to answer the fourth research problem which is "What are the teaching practices that four purposefully selected "good" physics teachers frequently use to enhance students' physics related affective characteristics?".

In order to reveal consistencies among the cases; under each category, the are presented separately for each case and then they are compared. The frequency of codes with respect to categories and subcategories are discussed for the case, first. Then, the results of the category are presented in detail for the same case; more explicitly, the affective teaching practices frequently observed in lessons are discussed. The teaching practices observed more than 20 times in a teacher's lessons are considered to be frequently observed in each category. How these teachers performed each practice is illustrated with the excerpts of observation transcripts, and then the results of interviews are added to support and clarify them. The results of the four cases for each category are compared and contrasted at the end of each section.

4.2.2.1 Results related to Communication Category

In communication category, 20 affective teaching practices were included. Total frequencies of observed communication related teaching practices in each week of observation are presented in Table 4.7 for four cases. Eda and Alper were observed once a week for six weeks, whereas Çağlar and Erkan were observed twice a week for six weeks. Hence, there were two frequencies for each week in the table for Çağlar and Erkan. Çağlar was observed three hours a week, because there were three hours of physics lessons a week in his school; while the other three teachers were observed two hours a week during the observations, because there were two hours of physics lessons a week in their schools.

Table 4.7 Total frequencies of observed affective teaching practices in Communication category for four cases in each week

	Frequency (Class-hour)							
Case	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Total
Eda	115(2)	109(2)	36(1)	100(2)	115(2)	153(2)	X	628
Alper	60(2)	37(1)	55(2)	22(2)	39(2)	53(2)	X	266
Çağlar	X 29(2)	28(1) 78(2)	X X	22(1) 49(2)	34(1) X	24(1) 88(2)	25(1) 95(2)	479
Erkan	X X	24(1) 22(1)	17(1) 22(1)	18(1) 23(1)	34(1) 28(1)	X 20(1)	27(1) 18(1)	254

X: No observation

As can be seen in Table 4.7, communication related teaching practices were performed 628 times by Eda, 266 times by Alper, 479 times by Çağlar, and 254 times by Erkan during the observations. Eda performed communication related teaching practices more frequently than the other teachers observed. Moreover, all four teachers were using communication related teaching practices consistently and regularly during the observation period.

Observed frequencies of each of the affective teaching practices in communication subscale of the ATPQ for four teachers are presented in Table 4.8. As can be seen in the table, most of the affective teaching practices in communication category were performed frequently by four teachers, while only few practices were observed seldom.

Table 4.8 Frequencies of observed affective teaching practices in Communication category of the ATPQ for four cases

Category	Item #	Eda	Alper	Çağlar	Erkan	SUM
Communication	1	3	3	0	1	7
	2	23	5	10	5	43
	3	33	11	9	0	53
	4	2	2	1	7	12
	5	79	20	17	7	123
	6	0	0	0	0	0
	7	102	42	38	19	201
	8	88	14	13	10	125
	9	2	4	0	6	12
	10	4	0	0	1	5
	11	5	3	7	1	16
	12	0	0	0	1	1
	13	0	0	0	1	1
	14	27	16	22	2	67
	15	13	20	55	28	116
	16	40	12	55	53	160
	17	43	33	36	27	139
	18	51	15	95	21	182
	20	38	13	28	14	93
	21	75	53	93	50	271
	TOTAL	628	266	479	254	1627

The most frequently observed teaching practices are discussed in detail for each case. In order to identify consistencies in four teachers' use of teaching practices related to communication category; the results are presented separately for each case, and then they are compared.

4.2.2.1.1 Eda's case

Eda used communication related teaching practices more frequently than the other teachers. She used teaching practices related to Items 2, 3, 5, 7, 8, 14, 16, 17, 18, 20, and 21 more frequently than the other teaching practices in this category, as presented in Table 4.8. During the observations, she was usually communicating positively (Item 2) and was smiling in class (Item 3). For example, once the teacher was walking around the classroom after she asked a question to the students. One student told her something while she was passing by. She glanced at the student, she was smiling and then she walked up to another student, looked at her notebook, and tweaked her on the cheek. In the following excerpt from the transcripts of audio recording of interview, Eda explained the reason of using positive communication with her students as to motivate them, to increase their interest in the lesson and help them enjoy the lesson.

> R: "Usually I have observed that you had a positive communication with your students, why do you use it?"
> Eda: "To motivate the students. Lesson. To make them love the lesson and also to make them love their teacher. Thus, when they love their teacher, their interest in the lesson increases. … To make the lesson enjoyable, since their interest increases when the lesson is enjoyable. Because, as much they enjoy the lesson, that much they contribute to the lesson, I think. To motivate students. … I want the students to have fun. … Maybe he/she won't do physics but at least he/she will participate to the course, do his/her best, make an effort, does whatever he/she can do, I think."

In the interview, while talking about asking questions without hesitating, one student mentioned that because the teacher was a smiling person, they were able to ask anything confusing them. The following excerpt from transcript of student interview includes this student's ideas.

> S: "We can ask anything confusing us, no questions are left behind. Because, the teacher being a smiling person affects this."

In the informal interviews, students also confirmed that their teacher was smiling most of the time.

Moreover, Eda created an atmosphere for students to ask questions without hesitating (Item 5). She was frequently asking if the students had any problems with what was explained. She was answering any questions about the topic in the classroom and also answering various questions related to physics out of the classroom. More explicitly, I have also seen the teacher answering and solving students' questions in the break time. Students also confirmed that they were able to ask questions without hesitating in the informal interviews. Besides, I have observed her spending time for speaking to students one by one or as a group (Item 8). During the observations, she was giving time to students to solve the questions. Meanwhile she was walking around the classroom, checking students' solutions, and speaking to them one by one or as a small group.

In the interview the teacher explained why she has created an atmosphere for students to ask questions without hesitating and why she was spending time for speaking to students one by one or as a group. She stated that she was using these teaching practices to decrease students' anxiety in physics lessons, and increase their attention and participation and hence increase their interest. She also mentioned that she was using them to make students aware that she cared about the students. In the following excerpt from the transcripts of the audio recording of the interview, her ideas about these teaching practices are included.

> R: "I have observed that your students were able to ask you questions without any hesitation sometimes raising their hands in the classroom and sometimes when you were passing by the students while walking. Why do you [create such an environment]?"
> Eda: "The student should feel relaxed. If there is something that is confusing, he/she should be able to state that comfortably. If not, some part is missing; I move to another topic, the student might be stuck there. Therefore, I want them to ask questions without hesitating. … I emphasize this at different times that 'You don't need to hesitate because of your friends.' If it is not for disturbing the

lesson, they can ask any question for both expressing themselves and contributing to the lesson. Student wants to say that 'I exist.' Moreover, a student who doesn't know anything, who doesn't understand anything cannot ask question. If he/she is able to ask question then there is something in that student, something is formed in his/her head. There are missing things, confusions, but there is something. I think so."
R: "You were spending time for speaking to students one by one both in the classroom and out of the classroom. What was the purpose of this?"
Eda: "Sure. I make observation about the student's state. Second is for example he/she can have difficulty at a little aspect he/she cannot continue, then to help or if there are the mistakes in order to correct. Moreover, when the student feels that he/she is being cared, that he/she is being followed, he/she feels responsible in terms of participation to the lesson. In the lesson, also about that, to the degree that your communication with the student is good, the participation to the lesson is good, the interaction is good. Both in terms of education and instruction you see the consequence of that. Well. If I write [the question] to the board saying 'Let's solve everybody' and wait at the board, maybe the student will behave as if he/she is doing, but not attend or maybe will think that the teacher doesn't care me, in any case. But when I go close to them, when there are things that they couldn't do or when I say things like 'Look, you did this part wrong.', the student thinks that 'The teacher cares me, observes me carefully.' and may behave more interested."

In line with the teachers' opinions, the following excerpt from the student interview confirms that the students do not hesitate to ask questions to their physics teacher, and they have the opportunity to talk to the teacher one by one. One student stated that they did not hesitate to ask questions because their teacher was a smiling person.

R: "Do you hesitate asking your questions in the classroom, by raising your hands?"
S: "We don't hesitate- because my teacher and my friends [say] nothing like 'why don't you understand'. We don't hesitate."
O: "I didn't hesitate."

I have also observed that she was frequently repeating parts that were not understood by the students (Item 14). For example, in the following excerpt from the transcripts of video recordings of the observations, she was repeating parts that were not understood by the students, after she solved a question about image formation in plane mirrors.

> T: “Is there a problem?” asked she after explaining the question.
> B: “Teacher, I did not understand [why] it is downwards.”
> T: “Here is, [object] P’s, PA, here is PB. Okay? First, I will draw PA’s image. What is the distance of PA from the mirror? Half diagonal, I moved another half diagonal; this place is PA’s image.” She was noting on the figure and showing on it while explaining.
> B: “Okay.”
> T: “I will do the same thing for PB. How long? One diagonal, I depart one diagonal. This place is PB’s image.”
> B: “Mirror.”
> T: “Okay, the arrow is with whom? The arrow is on PA or the arrow is on PB?”
> B: “PB.”
> T: “Then I will draw the arrow here. Thus, downwards, then.”
> O: “Teacher.”
> T: “Say it.”
> O: “But, where did we reflect and draw the second images’ image?”
> T: “This mirror, I have completed now, I am finished with the object now.”
> O: “Okay, hı?”
> T: “We are going to get the image of that in this mirror. We count, one diagonal, two diagonals. Then, we are going to depart two diagonals away from the mirror. …. We departed one diagonal, two diagonals. Here is the second image of point.
> K: “Okay?”

In the interview, the teacher explained why she was repeating parts that were not understood. She stated that by using this teaching practice students’ attention is sustained, as well students’ participation, confidence and motivation is enhanced. She was also trying to make students aware that she cared about them. The following excerpt from the audio recording of the transcripts of interview clarifies teacher’s ideas related to the issue.

> R: “When several students did not understand or one student, I have observed that you go close to them and repeat parts that they didn’t understand.”
> Eda: “Yes, yes.
> R: “What purpose,”
> Eda: “When you ignore the student saying that ‘Most of the students understood somehow, what if one student’; that student’s confidence to me might be damaged, confidence to him/herself might be damaged, might also think ‘The teacher doesn’t care me’, might think ‘I am not important anyhow’. But if it is one

person, without spending time, when I pass to the other question and deal with him/her one by one. That is more effective, in fact. As I said before, the student, well, [thinks] 'The teacher values me, cares about me.' The student can or cannot do physics, well, it is not very important, it is a talent issue, I think, but at least as an individual, personality; it contributes to the personality of the student, it contributes in terms of participation to the course. The important thing is that all my students participate to the course as much as they can. As a result, he/she can do physics or not, it is not a big problem for me, only if he/she tries to do something, spends effort. That's my aim, that's why I do, try to do."
R: "You repeat, sometimes you repeat in the classroom."
Eda: "There might be things that you miss but. There might be misunderstandings of the students or while you are trying to say something else, it might have a different meaning. Because of that, you look to the majority, if there are misunderstandings of the majority; you need to correct it immediately."

In focus group interview, the students also confirmed that their teacher was repeating parts that they did not understand.

Furthermore, Eda has created an atmosphere suitable for learning (Item 7) and was checking if the students followed the lesson or not (Item 17). She was frequently warning the students by using their names and saying things like "Youngsters, we are watching the board" or "Girls" when she noticed they were not following the lesson. Moreover, she was asking questions and teasing the students without offending them. Students were following the lesson after they were subject to these kinds of practices.

In the following excerpt from the transcripts of audio recording of interview, the teacher stated that she was checking if the students followed the lesson or not in order to sustain their attention. She also stated that she was trying to make students feel that she followed them and she cared about them.

R: "You were checking if the students followed the lesson or not. Why do you do this?"
Eda: "I am following, every student, 'I care about you.' Even if I don't state this directly, [I show it] with my look, … by touching his/her shoulder, or well, with statements addressing one student by implying another, I try to say to my each student 'I am following you, I care about you, I observe you' By this way, my student don't have the chance to shirk or at least I try to decrease it to the minimum degree. I try to say to every student of me that 'I care about you', I try to say 'I follow you.'"

In the focus group interview, students confirmed that their teacher was checking if they followed the lesson or not by asking questions and teasing them. The following excerpt from the transcripts of the video recording of the interview enlightens the students' views.

> R: "Does she check whether you follow the lesson or not, for example if someone is distracted, interested in something else?"
> Ss: "She asks questions." said several students.
> S: "She notices quickly."
> O: "Sure, she asks questions."
> S: "She teases us."
> R: "Has she done something like that to you?"
> O: "I was distracted. She suddenly asked a question. I was dumbstruck."

In line with the students' claims, I have also observed the teacher teasing the students several times. For example, once she asked one student to cock a snook at her friend who couldn't solve the question and once said 'Dirty' to another. After the lesson I had the opportunity to ask questions individually to three students who were teased during the observations. Each of these students stated that they were not offended by the teacher's teasing, because they were aware that she was joking and trying to encourage them.

On the other hand, I have also observed her helping students to take clear notes (Item 16) during the observations. For example she was dictating the questions by repeating for students to write. She was also emphasizing important parts (Item 18) by making changes in her voice for instance her voice getting louder, dictating for the students to take notes, repeating it, making someone repeat it, practicing herself on the board, writing several words implying the important part or saying things like "Look, this part is important.", "We underline … thickly.", "How many times I said to you?" or "Don't forget." etc. For example, while one student was explaining the sight area in plane mirrors, the teacher emphasized important parts as presented in the following excerpt from the transcripts of video recordings of the observations.

> S: "... The light rays sent from the eye to the two edges of a plane mirror are reflected. The area between these rays and mirror is called the sight area. It is

possible to see the points these reflected rays are passing through and the points in between these points." Student was reading what was on the power point slide.
T: "We underlined the statement of "two edges" in the first sentence thickly."
…
T: "While drawing the area of sight, we send light rays to the edges of the mirror, okay? Not to an ordinary place, edges of the mirror."

In the following excerpt from transcripts of audio recording of teacher interview, while talking about repeating parts that were not understood by the students, she explained that she was also repeating things to emphasize them, and attract students' attention.

T: "Repeating, you need to emphasize that part. Or it is an important thing and student has missed it, by repeating you want to attract attention. For this reason, for focus students' attention."

Besides, in the interview the teacher confirmed that she was helping students to take clear notes and without being asked she stated that she was emphasizing important parts and explained how she was emphasizing important parts. She stated that she was dictating for students to take notes, to emphasize important parts, and to help them remember what was explained later. The following excerpt from the transcripts of audio recording of the teacher interview is in line with my observations.

R: "I have observed you several times dictating something to your students."
Eda: "Important. Unfortunately, our students don't have the habit of taking notes. You emphasize important parts several times but the student does not write this and think that he/she can keep it in his/her mind. But writing is one of the important learning methods first. Second is, in following days the student might say 'Oh, we have taken a note like this, I haven't paid attention to this.' Therefore, I want them to take their own notes, but you see that most of them didn't take notes, you compulsorily announce that 'This is important, let's take a note'."
R: "How do you emphasize important parts?"
Eda: "Important. I repeat the same sentence two or three times. Some of my students take note, but some of my students don't take note and think that 'I can keep it in my mind.' or there might be students who are not aware that they should take notes. Because of that, in order to make sure, dictating notes is better. But I don't dictate everything, only the important parts; because, time doesn't allow that. Moreover, they get used to laziness."
R: "You emphasize important parts."

Eda: "Yes."
R: "How do you do that?"
Eda: "For example I might repeat the same sentence two or three times. Or I say 'Look, this part is important, I highlight this with thick lines.' Besides that for example, well, I might write several words expressing the sentence. I might emphasize like that."

Besides, in the interview the teacher stated that she was emphasizing important parts to attract students' attention. The following excerpt from the transcripts of audio recording of the teacher interview enlightens her ideas.

…
R: "What is your purpose doing this [emphasizing important parts]?"
Eda: "Again to attract attention. To make a flash in student's mind and to make them say 'I should care this, this is important. This is the hint.'"

In the interview, students also confirmed that their teacher was emphasizing important parts by raising her voice, dictating for the students to take notes, repeating it, making students repeat it, practicing by on the board or saying things like "Don't forget". Students' views were confirming the teacher's views. In the following excerpt from the transcripts of video recordings of the focus group interview the students shared their ideas with me.

R: "Does she emphasize important parts?"
Ss: "Yes."
S: "Her voice gets louder."
S: "She makes someone repeat it."
S: "She says it three times. She dictates us to write in our notebooks. She says 'Don't forget.'"
G: "Or we take notes. We understand from her voice getting louder that it is important."
S: "She sometimes does herself on the board if it is something to be practiced, if it is important."
G: "Or she says 'How many times I said to you.'"

I have also observed her solving a lot of questions related to each topic (Item 20). In the following excerpt from the transcript of audio recording of the teacher interview, she confirmed that she was trying to solve as many examples as she can.

R: “I have observed you using more than one example related to a topic, sometimes two, sometimes more than two.
Eda: “The fundamentals of the topic. Yes, my student knows theoretically, even, it is not correct, but might memorize it, but doesn’t know how to apply it. This is somehow related to interpretation, something related to understanding, inferring and reaching the solution. With each different question I solve, he/she gains a different point of view. But there is a problem; time scarcity. Despite of that, as much as possible, at least one question related to each topic. There might be several kinds of questions under each topic. As much as possible, I try to solve every kind of questions, my student sees it. I want he/she can make interpretation, when he/she comes across different types of questions. Moreover, I think it is comprehended better, when we solve as many examples as we can.”

In line with my observations, without being asked about this teaching practice, students also confirmed that their teacher was solving many questions while answering another question in the interview. The following excerpt from the transcripts of video recording of the student interview is related to their opinions about this.

R: “Does your teacher use class time efficiently?”
Ss: “Yes.” said several students.
N: “She does, she solves a lot of questions…”

Moreover, she was explaining the logic behind the topic and the formulas (Item 21). For example, the teacher was explaining the normal in spherical mirrors in the following excerpt from the transcripts of video recordings of the observations.

T: “If you remember, in plane mirrors we were saying that we were drawing the normal perpendicular to the mirror. The same thing is also valid here. When we draw the line that is perpendicular to the mirror, we see that it always passes from the center. It is a geometrical rule. When you send light ray from the center to any point of the circle, it always goes perpendicular. Thus our normal in spherical mirrors will always pass from the center. The normal in spherical mirrors passes from the center.”

In the interview, the teacher explained why she was explaining the logic behind the topic and the formulas. According to the teacher, by explaining the logic behind the topic and formulas, students can make interpretations, they find it easier and think ‘I can find it’, in other words their self-confidence is improved by this way.

R: “You try to explain the logic behind the topic and the formulas.”

Eda: "Yes. When he/she memorizes, he/she might forget easily. But if he/she knows, remembers where it comes from, he might attain it by his/her effort saying 'Oh, yes. I have found it from here.' if it is not an extreme formula. Well, with his/her own logic, he/she should attain the formula and solve that question. Otherwise the student tends to memorize. That is, get lost in the formula."
R: "How does this affect your students?"
Eda: "First, there are plenty of formulas; keeping all in mind is hard for him/her. Therefore, if there is a hint like this, 'Oh, look. We have found it from here.' If he/she finds a hint, his/her self-confidence is improved. Even he/she has forgotten, he/she says 'I can find it.' first; second I think, this develops student's interpretation competence, instead of memorizing he/she can make interpretation, make interpretation, can produce alternatives, can think. I think, it is a situation that develops student's thinking ability, I suppose."

Students confirmed that their teacher was explaining the logic behind the topic and the formulas in the interview. The following excerpt from the transcripts of video recording of the student interview clarifies their ideas.

R: "She explains the logic behind the topic and the formulas?"
Ss: "Yes."
S: "She doesn't make us memorize, but she give the logic to help us remember."
…
B: "I can't memorize things. Last year, our teacher was giving the formulas and saying 'You are going to memorize these.' This teacher gives the logic, I can understand."

4.2.2.1.2 Alper's case

During the observations, Alper used teaching practices 5, 7, 15, 17, and 21 more frequently than the other practices in this category as presented in Table 4.8. I have observed that he has created an atmosphere for students to ask questions without hesitating (Item 5). He was frequently asking if the students had any questions about what was explained. Any questions about the topic were welcomed in the classroom. Moreover, sometimes the students were asking questions not closely related to the topic and he was also answering some of them.

In the following excerpt from the transcripts of audio recording of teacher interview, he shared his opinions about the reasons for creating such an atmosphere. He mentioned that when students were able to ask questions, they learnt better, hence their motivation increased and vice versa.

> R: "I have observed that you created an atmosphere for your students to ask questions comfortably. I would like to ask why you use this teaching practice."
> Alper: "Now, the students learn better in fact, when they are able to ask questions, their motivation increases. If they can't ask questions, that is, if there is a teacher centered teaching, they start to feel distant from the lesson, that is, their motivation connected with this decrease. That's why I created an environment like this."

Moreover, I have observed that he has created an atmosphere suitable for learning (Item 7) and was checking if the students followed the lesson or not (Item 17). He was sometimes warning the students by using their names or using his gestures, and saying things like "Listen to me." In the following excerpt from the transcripts of audio recording of teacher interview, he confirmed that he was paying attention for creating an atmosphere suitable for learning and aware that adolescents have extensive energy, hence trying to canalize their energy into the lesson. He mentioned that using various activities for creating such an atmosphere. In line with his opinions, I have observed him, using activities, group work, competitions, laboratory work, etc. in the lessons, to increase students' participation and attention.

> R: "When I observed your classroom, there were not many students making noise, only a few students trying to disrupt the lesson, that is, usually there was an environment suitable for learning, why do you establish such an environment?"
> Alper: "Now, it is related to the communication between [the teacher and the students], if a good dialogue is formed between the teacher and the student, more precisely, if the student realizes that the teacher wants to teach him/her something or there is a reason that the teacher's presence in that classroom, if students realize, they don't cause many problems in that lesson. I also-as much as possible with the activities intended for the students or speeches directed to them-try to obtain this environment from the first lessons, later, as you said, not many problems arise in lessons."
> R: "And if there are, by addressing students with their names, with some gestures, sometimes 'Listen to me.'"
> Alper: "Absolutely, even you say there are not many problems, related to group of age; that is, in the secondary education kids, they are going to have some kinds of things, some kind of activity in the classroom. In fact, what is important is

canalizing that activity to the lesson, transferring that activity to lesson. Otherwise, if we cannot canalize what we do, that is what we are going to do to a point in the lessons; absolutely the students are going to start making noise, getting apart from the lesson. But if we can even use their activity in the lesson with various activities, then we can be successful."

Moreover, while he was talking about another issue, he mentioned that when he noticed that a student is distracted; to get his/her attention back, he was calling the student to the board. The following excerpt from the transcripts of audio recording of interview indicates teacher's ideas about this point.

Alper: "…Sometimes I see that the student's attention is being distracted, I call him/her to the board, the student suffers, that is he can't do, then I don't give feedback to him/her. Because, he/she hasn't listened to the lesson, he/she has to see that there is a consequence of him/her not listening to the lesson and he/she has to see that before the exam, so that he/she doesn't get a low grade. It is important without saying these words make him/her perceive that 'There are many friends at the back, who can solve this question. If you also listened to the lesson, you could solve the question.' I don't give many feedbacks at that point and I say that 'Follow these well, I am explaining these in the lesson. If you have followed what we did till now, you could have done this.' I say that, without offending too much."

I have also observed him writing clearly and systematically on the board and power point slides (Item 15). In the following excerpt from the transcripts of audio recording of teacher interview, the teacher confirmed that he cared writing systematically and clearly to the board.

R: "What you have written on the power point slides was clear and systematic. Moreover, you were also trying to write clearly and understandably on the board. What is the reason for this?
Alper: "I think using the board systematically is very important. A teacher-that is more correct to say-a teacher's handwriting should be clear. He/she should write the things he/she writes on the board systematically. The student should know where he/she is going to see what. …"

Students also agreed that their teacher was writing clearly and systematically on the board and power point slides in the interview.

I have observed him explaining the logic behind the topic and the formulas (Item 21). For example, teacher was trying to explain point light source in the following excerpt from the transcripts of video recordings of the observations.

T: "Is the sun point light source?"
Ss: "Yes."
S: "No, not point."
T: "Sun, point light source?"
D: "Too big to be point."
T: "With respect to what is it big?" said the teacher.
Students were watching the teacher quietly.
T: "Point light source depends on the object, opaque object in front of it, okay? You may say everything could be a point light source. Don't forget, everything could be a point light source, depends on the object in front of it, like this. Okay?" said the teacher and continued drawing the figure while talking. "If the light source is too small with respect to the object, that would be the point light source. Too, too small. Okay?"
S: "Yes."
T: "But if you use a comparable light source with respect to this, then it would not be a point light source. Understand?" said the teacher and he drew two figures; first a point light source with an object and second a non-point light source with an object. "Even the sun could be a point light source. Point doesn't mean that too small. Point means you that just two rays, two light rays could pass through the object."

In the following excerpt from the transcripts of audio recording of teacher interview, the teacher stated that it was important for the students to understand the logic, behind the topic and formulas, if they don't understand the logic they were failing.

R: "I have observed that you were trying to explain the logic behind the topic and the formulas."
Alper: "Yes, why I do that?"
R: "Yes."
Alper: "Logic behind the formula. Now, the formulas are actually. How hard we try to teach them, they are abstract things for kids, their logic or it is important for the kids to realize something in their heads, since somehow they will have to use them in the problems or in questions they come across. If they don't understand the logic behind the formula or accommodate the formula to their heads, they fail. ..."
…
R: "I have also observed you trying to give the logic behind the topic."

Alper: "…Students insistently want to know the logic behind everything they learn. Since anything that doesn't fit their logic, they don't make a room for it."

In line with my observations, in the following excerpt from the transcripts of video recording of interview, students confirmed that their teacher was explaining the logic behind the topic and the formulas.

R: "Your teacher explains the logic behind the topic and the formulas, do you agree?"
Ss: "Yes." said several students.
R: "You don't say that you don't agree?"
Ss: "No." said several students.
S: "You have to understand the logic."

4.2.2.1.3 Çağlar's case

Çağlar used teaching practices related to the Items 7, 14, 15, 16, 17, 18, 20, and 21 more frequently than the other practices in communication category as presented in Table 4.8. He has created an atmosphere suitable for learning (Item 7) and was checking if the students followed the lesson or not (Item 17). He was warning the students by using their names and saying things like "Listen." and "Have you written?"

Moreover, I have observed him repeating the parts that were not understood (Item 14). For example, in the following excerpt from the transcripts of audio recording of the observations, while he was explaining illumination around a point, he repeated the parts that were not understood by the students.

S: "But teacher."
T: "Yes?"
S: "Here, for example, all the coming rays do not come with an angle of 90 degrees."
T: "I was just saying that. Look. Can you see? If I take such an area, I assume that area is 1 unit, and then if you want to find the illumination that this light source creates, creates in this area. The ray coming from here makes an angle. Therefore I say that minimize this point as small as possible, this point, please minimize, minimize, minimize, minimize, minimize, minimize. Make it this much. Then you cannot draw this ray, you cannot draw these, you cannot draw these, you cannot draw these, these. Only these will be. That is then because the angle here is very close to zero we do what?" He repeated.

Ss: "Perpendicular." said several students.
T: "We can assume it is perpendicular. Could I explain? That's why, when it asks find the illumination in O point, around O point, we assume, how do the light rays emitted from a light source come here?"
Ss: "Perpendicular." said several students.

In line with my observations, in the following excerpt from the transcripts of video recording of whole group interview, without being asked about this teaching practice, while talking about another issue; one student mentioned that the teacher was repeating parts that were not understood.

D: "He does anything he can do for us to understand the topic. Even he explains the topic three times. If we didn't understand something, he solves that question until we understand."

I have also observed him writing clearly and systematically on the board (Item 15). He was writing titles, formulas, solutions of questions clearly, and important notes about the topic. He was sometimes writing questions on the board. Moreover, he was helping students to take clear notes (Item 16). He was making students aware that they should take notes by saying things like "Take note." or "Let's write this, please." Besides, he was dictating the explanations and the questions repeatedly for students to write. He was also emphasizing important parts (Item 18) by repeating, and saying "I am saying again." or "We say it again." etc. in his lessons. He was sometimes emphasizing parts by making changes in tone of his voice. For example in the following excerpt from the transcripts of audio recordings of observations, while he was explaining illumination, he was emphasizing important parts.

T: "The angle between I [incoming ray] and normal of the surface, normal of the surface. … Therefore, I am saying again, if the light rays are coming perpendicular to the surface, kids, we say it again, we say it again, to find this, to find the perpendicular side to the screen, we multiply hypotenuse with cos. That is I, from here to here, around S point, if you multiply hypotenuse with cosines alpha."

Additionally, he was solving a lot of questions in his lessons (Item 20). In the following excerpt from the transcripts of audio recordings of interview, he explained that he was thinking the number of questions he solved in the classroom were not enough, because there was not enough time. He also stated that solving questions was important aspect of learning.

> R: "I have observed you solving a lot of questions in your lessons. Why do you do that?"
> Çağlar: "I know that it is learnt by solving questions. I try to solve as many as time allows, but in 9th grade, the number is small; that is, the class-hours, the class-hours in a week are not much. I can't solve as many as I want to. Questions, by using questions, I can teach a topic by solving question. By solving questions, without explaining I can teach a topic. If there is enough time, really, questions, every kind of questions. By solving questions, solving, solving, by saying 'Almost we solved every kind of questions, what else can be asked here?" we can make him/her solve questions. But I don't think there is enough time. It is not enough."

I have also observed Çağlar explaining the logic behind the topic and the formulas (Item 21). For example, in the following excerpt from the transcripts of audio recordings of the observations, he was explaining the formula of illumination.

> T: "If I is five times increased, E also increases five times. Kids, E is directly proportional to cosine alpha."
> S: "That is when E increases cosine alpha increases."
> T: "Precisely. But, meaning of this, I am going to say and you will get confused. It means inversely proportional with alpha, when the angle decreases cosine increases. Cosine 53 is equal to what?"
> Ss: "Zero point six."
> T: "Zero point six. Cosine 37?"
> Ss: "Zero point eight."
> T: "Zero point eight. What happened when it came from 53 to 37?"
> Ss: "Increased."
> T: "Cosine 30?"
> S: "Square root of three divided by two."
> T: "Cosine zero?"
> Ss: "One." said several students.
> T: "When it comes perpendicular, cosine is zero. That is, the angle with the normal is zero. Okay, E is inversely proportional to the d square. That is, how it is proportional with one divided by d square?"
> Ss: "Directly."
> T: "What does it mean it is directly proportional with one divided by d square?"

Ss: “Inversely proportional.”

In the interview, he explained that it was usual for a physics teacher to explain the logic behind the topic and the formula. In the following excerpt from the transcripts of audio recording of teacher interview, he was explaining his ideas.

> R: “You explain the logic behind the topic and the formula. [Why do you do that?]”
> Çağlar: “I guess everybody explains the logic, [if there is] something illogical, I can’t say ‘Well. That’s the formula, let’s solve.’ If I don’t find where it comes from, if the kid’s logic doesn’t accept that. It can’t be said that ‘Well. That’s the formula, let’s solve. I guess everybody explains the logic. … That would be really illogical.”

4.2.2.1.4 Erkan’s case

Erkan used communication related affective teaching practices frequently. Among these practices he used teaching practices related to Items 15, 16, 17, 18, and 21 more frequently than the others as presented in Table 4.8. I have observed him writing clearly and systematically on the board (Item 15). He was writing the titles, formulas, explanations of the terms in the formulas or figures, and answers of the questions. Moreover, he was sometimes using colored board pencils to draw clear figures for students. In the interview, Erkan admitted that he was trying to write clearly and systematically on the board even though his handwriting was not very clear. In the following excerpt from the transcripts of audio recording of the teacher interview, he explained this.

> T: “In fact my handwriting is not very clear. I try for that. Since the information you give, what you write should be very clear. In terms of visuality, should be satisfying for the student. I try for this, but my handwriting is not clear enough. It should be clearer; especially the figures should address the student.”

In line with my observations, in the focus group interview, students confirmed that their teacher was writing clearly on the board.

During observations, Erkan was also helping students to take clear notes in his lessons (Item 16). He was making students aware that they should take notes by saying things like “Let’s write a note here.” or “Write this.” Moreover, he was dictating the explanations and the questions by repeating for students to write. Most of the time, all the students were writing what he was dictating.

In the interview, the teacher also explained the reason of dictating notes for the students as helping them to study. In fact, he was aware that he shouldn’t dictate as much as he did. The following excerpt from the transcripts of audio recording of the interview indicates this.

> R: “You are dictating your notes to your students.”
> Erkan: “Yes. The dictating occurrence is like that, that is, normally in today’s educational conditions dictating notes should be less, dictating notes by the teacher should be less. However, I know our student profile, if you don’t dictate them; the students do not take notes. Normally, a student in the high school should have that habit, should take notes by him/herself. And, notebooks, they usually use their notebooks to study. But if you do not dictate them, only the solutions of the problems, solutions of the questions. They don’t even write the questions, as a matter of fact. That’s why I make an effort on that issue. That is, I think their notebooks are the most important element in their study, well. The book covers these very broadly, very broadly, the students got lost in the expressions. Because of this I am dictating shortly the parts that I see as important.”

In line with my observations, in the focus group interview, one student stated that the teacher was highlighting the formulas by drawing boxes. In the interview, students confirmed that Erkan was emphasizing important parts and dictated notes to them. Erkan was checking if the students followed the lesson or not (Item 17) during the observations, however he was not doing much for dealing with the students who did not follow the lesson except warning them by their names. For example, one student was talking and not following the teacher, the teacher asked “Hami, have you taken this?” meaning if the student has written what was on the board. Another student was not following the teacher some other time; the teacher asked him ‘Umut, why aren’t you writing?’ However, he did not do anything else about these situations; hence the students continued what they were doing. The following passages from my field notes might clarify teacher's behaviors.

> The students in Erkan's classroom were the least interested students in physics lessons among the four classrooms observed. Sometimes several students were chatting while he was explaining something. However, the distracted students were not causing disruptions in the class. He sometimes ignored the students' undisciplined behaviors. He also ignored some students who did not participate to the discussions.
> ….
> One student took a photo with her cellular phone. When I asked at the end of the lessons, she said she took it by accident and she didn't take photo of a certain thing. Moreover, the same student was playing with her phone from time to time in the previous lessons. However, the teacher didn't notice her or didn't do anything to deal with the situation.

I have also observed him emphasizing important parts (Item 18). He was saying "Look here." or "If you pay attention." and repeating parts that were important. Most of the students were usually paying attention when he was emphasizing parts. For example, during the observations while he was solving a question about the reflection in the prisms he emphasized what was the normal and how they should draw it. My field notes and the excerpts from the transcripts of audio recordings demonstrate how he used this teaching practice and how it affected students.

> T: "When you draw the normal to the surface, you know that you draw the normal perpendicular to the surface, look here, we draw this parallel to the bottom. Here is 90 degrees, since it is an isosceles triangle; these sides are also, how much degrees is this angle?"
> Students stopped making noise.

In the interview, Erkan claimed that he was emphasizing some parts, because he thought they were helpful and students might need them in their prospective education. Besides, he was trying to gain students' attention by emphasizing the important parts. In the following excerpt from the transcripts of audio recording of interview, he points out to this issue.

> R: "You emphasize important parts."
> Erkan: "… I feel some things; I feel that they will be more helpful for the students. I want to underscore them. … Not only in ninth grade, I think they will

face with the topics in their later education, they will face also in the university. Therefore, I need to attract attention by underlining, emphasizing some of the information."

Furthermore, Erkan was explaining the logic behind the topic and the formulas (Item 21) and most of the students were following him usually while he was explaining. For example, in the following excerpt from the transcripts of audio recordings of observations, he was explaining the minimum deviation in prisms on the figure he drew on the board. Students were following him.

T: "… In a prism, in a prism the angle of incidence of light and, angle of incidence of light, let's say in the parenthesis i_1; in a prism the angle of incidence of light and, we said i_1 in parenthesis, the emerging angle." He was dictating notes to the students.
Students were writing what he was saying.
S: "r_2."
T: "r_2. I talk about the emerging angle from the last surface, yes, emerging angle of light from the prism in parenthesis r_2 is equal to each other, in this case, in this case, the deviation angle is called the minimum deviation angle, the deviation angle is called the minimum deviation angle." He started explaining what he dictated. "In the case of minimum deviation this is equal to this; i_1 is equal to r_2, the angle of incidence of light to prism and emerging angle. If these two are equal, these two are also equal, r_1 is equal to i_2. When is this? In case of minimum deviation." He has written the equations after the explanation.
…
Students continued following the teacher.

4.2.2.1.5 Comparing results of Communication category for four teachers

Observed frequencies of teaching practices in communication subscale of the ATPQ for four teachers are presented in Table 4.8. The following affective teaching practices were the most frequently performed communication related teaching practices by all four teachers as can be seen in the table: creating an atmosphere for students to ask questions without hesitating (Item 5), creating an atmosphere suitable for learning, (Item 7), spending time for speaking to the students one by one or as a group (Item8), writing clearly and systematically on the board or slides (Item 15), distributing or helping students to take clear notes (Item 16), checking if the students follow the lesson or not

(Item 17), emphasizing important parts (Item 18), solving a lot of questions (Item 20), and explaining the logic behind the topic and the formulas (Item 21).

Each of the four teachers frequently performed teaching practices related to Items 17 and 21. Three teachers used teaching practices related to Items 7, 15, 16 and 18 frequently. Two of them frequently performed teaching practices related to Items 5, 14, and 20. Item 14 was related to "repeating the parts that are not understood by the students".

4.2.2.2 Results related to Attention Category

There were 22 affective teaching practices in seven subcategories in attention category. These subcategories are: attention, concreteness, incongruity and conflict, humor, variability, participation, and inquiry. Total frequencies of observed attention related teaching practices in each week are presented in Table 4.9 for four cases. Moreover, total frequencies of the subcategories are also presented in the table.

Eda and Alper were observed once a week for six weeks, while Çağlar and Erkan were observed twice a week for six weeks. Hence, there were two frequencies for each week for Çağlar and Erkan in the table. During the observations, Çağlar was observed three hours a week, because there were three hours of physics lessons in a week in his school; while the other three teachers were observed two hours a week, because there were two hours of physics lessons in a week in their schools. The distribution of attention related teaching practices to the observation weeks are also presented in the table.

Table 4.9 Total frequencies of observed affective teaching practices in Attention category and its subcategories for four cases in each week

Category/ Subcategory	Case	Frequency (Class-hour)														Total
		Observation weeks														
		Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Week 7		
Attention	Eda	8(2)		12(2)		3(1)		15(2)		4(2)		14(2)		X		56
	Alper	5(2)		2(1)		7(2)		4(2)		3(2)		6(2)		X		27
	Çağlar	X	13(2)	3(1)	18(2)	X	X	10(1)	13(2)	14(1)	X	6(1)	19(2)	7(1)	19(2)	122
	Erkan	X	X	1(1)	1(1)	2(1)	2(1)	1(1)	4(1)	2(1)	3(1)	X	1(1)	X	X	17
Concreteness	Eda	13(2)		19(2)		6(1)		12(2)		19(2)		18(2)		X		87
	Alper	22(2)		10(1)		38(2)		3(2)		15(2)		29(2)		X		117
	Çağlar	X	10(2)	8(1)	27(2)	X	X	11(1)	17(2)	16(1)	X	7(1)	17(2)	7(1)	28(2)	148
	Erkan	X	X	5(1)	11(1)	9(1)	9(1)	11(1)	11(1)	6(1)	9(1)	X	6(1)	17(1)	10(1)	104
Incongruity & Conflict	Eda	0(2)		0(2)		0(1)		0(2)		0(2)		0(2)		X		0
	Alper	6(2)		0(1)		4(2)		0(2)		2(2)		0(2)		X		12
	Çağlar	X	2(2)	0(1)	2(2)	X	X	0(1)	0(2)	0(1)	X	1(1)	4(2)	1(1)	6(2)	16
	Erkan	X	X	0(1)	0(1)	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	X	0(1)	2(1)	0(1)	3
Humor	Eda	0(2)		0(2)		0(1)		0(2)		0(2)		1(2)		X		1
	Alper	6(2)		1(1)		3(2)		1(2)		0(2)		5(2)		X		16
	Çağlar	X	2(2)	1(1)	3(2)	X	X	0(1)	2(2)	0(1)	X	0(1)	0(2)	0(1)	3(2)	11
	Erkan	X	X	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	X	0(1)	0(1)	0(1)	0
Variability	Eda	0(2)		0(2)		0(1)		0(2)		0(2)		0(2)		X		0
	Alper	1(2)		0(1)		0(2)		4(2)		2(2)		1(2)		X		8
	Çağlar	X	0(2)	0(1)	3(2)	X	X	0(1)	0(2)	0(1)	X	3(1)	1(2)	0(1)	1(2)	8
	Erkan	X	X	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	X	0(1)	0(1)	0(1)	0
Participation	Eda	0(2)		2(2)		1(1)		0(2)		1(2)		4(2)		X		8
	Alper	2(2)		0(1)		1(2)		7(2)		6(2)		2(2)		X		18
	Çağlar	X	1(2)	0(1)	2(2)	X	X	0(1)	2(2)	0(1)	X	0(1)	0(2)	0(1)	1(2)	6
	Erkan	X	X	0(1)	0(1)	0(1)	1(1)	0(1)	0(1)	0(1)	0(1)	X	0(1)	0(1)	0(1)	1
Inquiry	Eda	29(2)		13(2)		12(1)		17(2)		24(2)		28(2)		X		123
	Alper	36(2)		23(1)		40(2)		11(2)		21(2)		39(2)		X		170
	Çağlar	X	41(2)	66(1)	110(2)	X	X	50(1)	93(2)	68(1)	X	81(1)	200(2)	76(1)	163(2)	948
	Erkan	X	X	4(1)	15(1)	12(1)	9(1)	4(1)	18(1)	13(1)	13(1)	X	16(1)	35(1)	18(1)	157
Total	Eda	50(2)		46(2)		22(1)		44(2)		48(2)		65(2)		X		275
	Alper	78(2)		36(1)		93(2)		30(2)		49(2)		82(2)		X		368
	Çağlar	X	145(2)	79(1)	166(2)	X	X	73(1)	128(2)	96(1)	X	98(1)	241(2)	86(1)	213(2)	1259
	Erkan	X	X	10(1)	27(1)	24(1)	21(1)	16(1)	33(1)	21(1)	25(1)	X	22(1)	55(1)	28(1)	282

X: No observation

As can be seen in Table 4.9, attention related teaching practices were performed 275 times by Eda, 368 times by Alper, 1259 times by Çağlar, and 282 times by Erkan during the observations. Çağlar performed attention related teaching practices more frequently than the other teachers observed.

In attention category, affective teaching practices in three subcategories were performed frequently by the teachers during the observations as can be seen in Table 4.9. These subcategories were attention, concreteness, and inquiry. All four teachers consistently and regularly performed teaching practices related to concreteness and inquiry subcategories. Moreover, they all performed teaching practices related to attention subcategory regularly; however Erkan performed them less frequently than the other three teachers.

Observed frequencies of teaching practices in attention subscale of the ATPQ for four teachers are presented in Table 4.10. The most frequently observed teaching practices are discussed in detail for each case. In order to identify consistencies in four teachers' use of teaching practices related to attention category; the results are presented separately for each case, and then they are compared.

Table 4.10 Frequencies of affective teaching practices in frequently observed subcategories of Attention category of the ATPQ for four cases

	Item #	Eda	Alper	Çağlar	Erkan	SUM
Attention	36	49	15	100	16	180
	38	7	12	22	1	42
	TOTAL	56	27	122	17	237
Concreteness	22	0	1	2	0	3
	23	3	27	8	18	56
	25	38	22	33	25	118
	26	46	65	105	61	277
	27	0	2	0	0	2
	TOTAL	87	117	148	104	456
Inquiry	34	108	162	872	140	1282
	35	15	8	76	17	116
	TOTAL	123	170	948	157	1398

4.2.2.2.1 Eda's case

In attention category, the most frequently performed teaching practices were related to Items 25, 26, 34 and 36 by Eda as presented in Table 4.10. I have never observed her disturbing students' attention with her movements (Item 36). For example, she was sitting at the back of the classroom while the students were presenting the topic on the board, and was walking around the classroom and giving feedback while the students were solving questions. In the interview, the teacher stated that she was trying to care about her movements in the classroom. The following excerpt from the transcripts of audio recording of teacher interview clarifies her ideas.

> R: "I have never observed you disturbing your students with your movements. Why do you care that?"
> Eda: "I try to care, but it is related to character. If it is something that I do very much in daily life and it is distracting my student's attention; and I felt that, I try not to do that. But, well, for example, even your dress might influence your student. You see that, while you are explaining something, the student is gazing you. Even this might distract him/her; I think that kind of behaviors are more influential in terms of distracting attention. I try not to do as far as possible. What is normal to you might be abnormal to others. When I notice it, I try not to do it as much as possible. I had been using a word for a period, one of my students counted it. After he/she said it, I tried not to use that word. Since the student stopped following the lesson, and tried to keep how many times I used the word in his/her mind. That means, I distracted his/her attention. I didn't use it as far as possible after he/she said it to me."

Items 25 and 26 were related to concreteness subcategory, while Item 34 was in inquiry subcategory. I have observed her using more than one example in many lessons (Item 25), and using visual materials many of which were drawn on the board by her (Item 26). Moreover, she mentioned about she wasn't satisfied with presenting such figures drawn by her. She shared her ideas in the following excerpt from the transcripts of audio recording of the teacher interview.

> R: "Do you use visuals in your lessons?"
> Eda: "… Only their term projects, presentations, presentations they prepared themselves. In terms of that we use visuals, projection as much as possible."
> R: "… I have observed you drawing the figures on the board."

Eda: “Sure, I find it as ordinary that I didn’t mention about it. … Yes, they are to concretize.”

I also have observed several students using visual materials in their power point presentations, while they were presenting the topic, in line with the teacher’s statements. Moreover, she was frequently using questions to make students participate to the course (Item 34). During the observations, she was sometimes asking questions especially to the students who were not attending the course very much, to make students remember or summarize the topic. For example “Okay, let’s ask Ali. For instance, what was the rule of reflection? Yes, Ali?” In addition, while solving examples, she was asking questions like “I am writing minus one divided by f, one divided by two minus one divided by one. I did the operations; it will be f is equal to two units. All right, which side?”

In the interview, Eda explained why she was using questions. She was using questions to increase student participation and avoid boring the students; hence increasing their attention. The following excerpt from the transcripts of audio recording of teacher interview indicates this.

R: “I have observed you asking questions to your students.”
Eda: “Question-answer is something increasing participation. If I explain [the topic] all the time, my student might get bored. But because they think that ‘The teacher is going to ask me question, thus I need to listen carefully’, I try to use question-answer phenomenon.”

One of the students also confirmed that their teacher was asking questions to them in the interview.

4.2.2.2.2 Alper’s case

In attention category, Alper used teaching practices related to Items 23, 25, 26, and 34 more frequently than the others as presented in Table 4.10. Items 23, 25 and 26 were related to concreteness, while Item 34 was in inquiry subcategory. I have observed him using examples and questions related to daily life (Item 23). For example, in the following excerpt from the transcripts of video recordings of observations, he was explaining umbra and penumbra, he walked toward his table and opened the curtains of the window next to the table and gave examples of different kinds of shadows.

> T: "What do you think this is? This shadow here?" he asked showing the shadow of the cupboard.
> D: "Pen-, penumbra."
> T: "Penumbra isn't it?" he was walking in front of the board. "There is something formed, some umbra formed, but from the other part of the sources, lights, it gets light. This, it is important that you understand this, this. That is, there is no strict condition that the phenomenon we call penumbra is formed. There is nothing like: it is a penumbra, when you obtain this condition. If you illuminate a shadow somehow, a full shadow, umbra means full shadow, if you illuminate, somehow it becomes an umbra. Now, look. That part, because of the cupboard, hah, that wall there, that part of this wall. Look this. Okay, because of that, look, because of that, a shadow is formed, umbra but it doesn't allow this, what? This light coming from those other sides illuminate this part, doesn't it? You cannot call this shadow an umbra anymore, okay? Pen-, penumbra, and okay?" he was pointing to the shadow of the wall and showing where the light came from while talking.

In line with the observations, in the following excerpt from the transcripts of audio recordings of teacher interview, the teacher mentioned that by using daily life examples he was trying to show utility of learning physics, and hence motivate them.

> R: "I have observed that you were frequently giving examples from daily life?"
> Alper: "In physics lesson, there are many topics that we relate, we are going to relate with daily life. … The main purpose of life based physics is also why the kid learns physics. The question all the students ask me 'Teacher, why do we learn these?' You see. 'Why do we learn these?' without making the student ask this question, we are actually giving its answer to the student. If we tie this to the [things we mentioned] earlier, that is, the kid, in fact, asks this 'Why do I give a room in my brain for this? Why do I have to give a room?'. You see. We can find its answer only with the examples from daily life. 'When you face a problem like that or when you make an observation like that, this physical base or physical basis is underlying this. Most of the things you observe in nature or ignore, or avoid thinking, [they] have some physical basis.' If we give answers to these, before the student asks or while teaching, with examples from daily life, then our students get closer to us, then we can motivate the student more easily."

In the focus group interview, without being asked about it, while they were answering another question, students also confirmed that Alper was using daily life examples. In the following excerpt from the transcripts of video recording of interview, one of the students were sharing his ideas about this teaching practice.

> R: "Does he use more than one example, story, joke, anecdote, research etc. while explaining the topic?"
> D: "The lesson passes like that."

In the interview, students also remembered some of the daily life examples that the teacher gave in the classroom. The following excerpt from the video recording of student interview indicates their ideas about using examples from daily life.

> R: "Does your teacher use examples from daily life?"
> S: "Sure. He just used us."
> K: "Glass, expansion, err well, he explained, when the pots are one inside the other, they put into hot water to take out. He explained these. He uses in daily life. He continuously says us that 'Physics is part of daily life, so you can use it.'"

Furthermore, I have observed the teacher using more than one example in many lessons (Item 25). In the following excerpt from the transcripts of audio recording of interview, the teacher clarified what he was thinking about this teaching practice. The teacher stated that a teacher should use more than one example to help students to learn the topic. Moreover, he mentioned that organizing these examples according to their difficulty, and matching the difficulty level of examples with the students' level was important.

> R: "I have observed you using more than one example in your lessons."
> Alper: "More than one example. Now. I try to use a systematic in the examples. That is, the first examples mostly simple, related to a formula that a student has seen recently or a definition that a student has seen recently. In the later include examples directed to a little higher order learning, but sure here is also important. That is, while passing from the first example to the second and to the third, we should analyze well, understand well if the student understood both examples. Here, a glance at the classroom for 5 or 10 seconds, since it is understood from the students, you can understand it from their eyes if they understood or not. Then, instead of increasing the level of the examples maybe might be necessary to continue with same kind of examples, at the same level of learning. But we saw that the students can continue, that is, they can understand, and then it is necessary to support this with higher order examples. That. In my teaching experience in 12 years, I have observed that harder the questions that students are able to cope with, the development in their minds is that much

> They don't have to solve, that is, they don't have to struggle with. I have always said that 'A weight-lifter normally, in the training, lifts much more than he lifts the podium, goes under a much more weight. You also deal with much harder examples that, the problems you come across in the exams or in daily life are easier compared to them.' This means, improving the brain. However, not all levels of students or let's say, not every student in a classroom might handle the same. It should be analyzed well and observed. Absolutely, more than one example should be used. Using only one example only saves the day; that is, passing the topic sloppily. Kids, there are too many kids who study at home. When they go home, seeing at least one example related to a topic will help learning at home."

Besides, to concretize what he explained, he was drawing diagrams, visual materials and concrete materials (Item 26) during the observations. Sometimes he was drawing the figures and sometimes he was using power point slides to show figures.

In the following excerpt from the transcripts of audio recording of interview, the teacher expressed that he was trying to use variation as a teaching practice to sustain students' motivation high, and hence, using diagrams, visual materials or concrete materials were ways for variation.

> R: "I have observed both in power point slides and figures you draw or the materials you bring to the class, even once you have taken the students to the laboratory for example, I have observed that. You were using diagrams, visual materials or concrete materials in your lessons. Why do you use them?"
> Alper: "Yes. Now, there is this thing, 'How is a good physics teacher?' … there is something revealing here, as far as we teach a lesson monotonously or with one method, the student departs that much from us. Departing of student doesn't mean that. Their motivation decrease, we can't obtain a meaningful learning with the students in the classroom, therefore we need to separate that 45 minute lesson into pieces, the teacher should plan this very well. It can't be said that I did this in every lesson, but I was trying to do as much as possible. I might have done it more frequently in the lessons you have observed, but it can't be said that I always do that. But I wish every teacher could do that. That is, we should separate 45 minutes to at least two or three pieces. These two or three piece parts, first a theoretical part that we can explain to the students, a theoretical part. Later, examples supporting the theory, and then what visuals are in our hand supporting these examples, that is it might be experiments, might be slide, might be video, might be demos, whatever is in our hands, we should use them. The reason that I

> have used them in that lesson is not to decrease students' motivation, to keep motivation at higher levels continually. Since if we don't separate 45 minute lesson to two or three parts as I said and go on with theory continually or examples continually or even we continue with experiments, let's think we continually show slides 45 minutes, it will also lower motivation. That is, slides interfering there and then something else entering, an explanation, then the teacher going on the board, that is, there is a movement, a variation in the classroom keeps student's motivation at high levels."

In line with my observations, in the following excerpt from the transcripts of video recording of focus group interview, students confirmed that their teacher was using diagrams, visual materials and concrete materials. Moreover, they mentioned that they have seen some concrete materials in the laboratory. Students were thinking that their teacher used this teaching practice to help them understand the topic better.

> R: "Does your teacher use diagrams, visual materials and concrete materials?"
> K: "We use in the laboratory."
> R: "You use laboratory?"
> S: "Also here [class]."
> R: "All these. For example, I remember in one lesson, he was showing the normal of the mirror, incoming and outgoing rays. He took many students on the board. Someone was holding the glass instead of a mirror, one showed the normal, one drew the incoming and outgoing rays with chalk on the floor."
> K: "It was me."
> R: "Okay."
> R: "You remember?"
> MA: "There."
> M: "Yeah."
> K: "It wasn't drawing."
> R: "I remember you had difficulty. …"

Moreover, I have observed him using questions to make students participate to the course (Item 34). He was sometimes asking questions especially to the students who were not attending the course very much, or to make students remember or summarize the topic. For example, he was saying "Let's summarize what we understood." and asking questions to students. He was also asking questions while introducing a topic such as "… do you know what is light, do you know what is light?", and while solving questions like "Six thousand will be equal to what?"

In the following excerpt from the transcripts of audio recording of interview, the teacher explained that he was using questions to sustain students' motivation at high levels; and to get students' attention again, when they lost it. Besides, he mentioned that he was sometimes giving grades to the students who were giving correct answer to increase students' attention.

> R: "I have also observed you asking questions to your students in your lessons. What was your purpose?"
> Alper: "… But if the teacher doesn't know these, he/she cannot ask questions about what the students didn't learn. The questions that I ask are usually are to keep current motivation of the student at high level. Or at least to [give the impression to] the student that 'Come on, this lesson is also yours. I am in this classroom, but we are going to accomplish this learning together. You also have a contribution in this today.' But most of the time, I ask questions to obtain, well, in the classroom, obtain order, if there is a student who is distracted from the lesson to gain his/her interest again, in the classroom, to protect the order of the classroom. The questions that I ask are mostly for these. Except this, I don't have a very big expectation from the student when I ask a question, that is, since mostly I didn't ask questions intended for evaluation. But sometimes I give students grades, I don't know if I had done but, who give interesting or good answers to the questions I ask. That is, I give 100."
> R: "Yes. I have observed you giving plus or grades."
> Alper: "That is, I give things like that, this, you know, this also helps the kids follow the lesson better, convince them that the things in the lesson are not purposeless, that is the questions asked are not purposeless, the things that the teacher say are not purposeless. Therefore, I think they follow better. In addition, while asking question, students see that there is a reason of their learning. That is, since teaching physics is hard, really hard, the only way of overcoming this difficulty is to share this responsibility with student. When we ask question, what does the student understand? 'So, what the teacher says is not purposeless, my teacher is very good, I need to follow.' Since physics lesson is learned in the lesson. I always say that, 'When you go home, there is no one to teach this lesson to you, whatever you do.' That is, it is very hard to learn it at home, it requires great effort or they should have taken physics course before, they don't have a base. If it was at university level, the kid goes to home and studies. But they see physics for the first time in high school level; therefore, they need to catch those things in the lesson. The main purpose of asking question, asking question is to provide them make that connection."

4.2.2.2.3 Çağlar's case

Çağlar used teaching practices 25, 26, 34, 35, 36 and 38 more frequently than the other practices in attention category as presented in Table 4.10. I have never observed him disturbing students' attention with his movements (Item 36). Moreover, he was using his gestures, mimics, body movements and tone of his voice in accordance with the importance of the theme (Item 38). For example, he was explaining the image formation in concave mirror on the figure of a concave mirror on the board in the following excerpt from the transcripts of video recordings of observations. Most of the students were listening to him.

> T: "If I place the object to the focus, if I take this object and put it to the focus, the image will go where? Like thiiis, where?" he was gesturing out of the board while he was talking.

In the following excerpt from the transcripts of audio recording of interview, he confirmed that he was using his gestures, mimics and voice. Moreover, he stated that he enjoyed his job and teaching physics was easy for him.

> R: "I have frequently observed you using gestures, mimics, body movements but especially tone of your voice in accordance with the importance of the topic."
> Çağlar: "… [Some people] say to me 'But you explain very well in the lesson. How do you do that?' I say … 'I do two gestures, okay? It is done.' Really in the lesson as you said, with gestures, mimics etc. we do that. ..."
> R: "You also increase your voice."
> Çağlar: "Sometimes increase, sometimes decrease."
> R: "Or sometimes you use accent, you especially use accent."
> Çağlar: "I think I am able to do it, when I am lecturing. … Lecturing is really easy. Teaching is a work that I really enjoy very much."

In concreteness subcategory, he was using more than one example in many lessons (Item 25), and visual materials many of which were drawn on the board by him (Item 26). On the other hand, in inquiry subcategory he was using questions to make students participate the course (Item 34) and asking questions like "How" and "Why" in order to help students understand the theme deeply (Item 35). He was using questioning as the basic teaching method in his lessons. In the interview the students also confirmed that he was using questions frequently. Students were participating to the lesson, at least paying attention to the lesson, when he was asking questions. For example, while he was explaining the focus of the convex mirror in the following excerpt from the transcripts of video recordings of observations; he asked several questions to the students.

> T: "Which side is the focus of the convex mirror?
> S: "Back side of it."
> T: "Then is it real or virtual?"
> S: "Virtual."
> T: "Where is its center?"
> Ss: "At the back side." said several students with low voice.

On the other hand, in the following excerpt from the transcripts of video recordings of observations; while he was explaining the reflection in convex mirrors, he asked "why" question to help students understand the topic.

> T: "The incident ray passing through the center that is, you say that? It returns back through itself. Why back through itself?"
> Ss: "It is perpendicular."
> T: "It is perpendicular, well done."

In the interview, the teacher explained why he used questions so frequently. In the following excerpt from the transcripts of audio recording of interview, he stated he was asking questions in order to increase students' participation, and he viewed students' participation important in their learning process.

> R: "I have observed you asking many questions in your lessons. How does this affect your students?"
> Çağlar: "… If you don't involve students in the lesson, it is monotonous anyway. … He/she has to understand the topic in the lesson. When he/she goes home, he/she should solve questions. For this, they have to participate to the course. … Why the kid should write it? First, he/she should understand, according to my logic and then take note, not write, take note of what he/she understood."
> R: "Why is students' participation important?"
> Çağlar: "There is no meaning if he/she doesn't participate, I think. Student by participating. If one could learn by only writing without participating, there would be no school, he/she would open the book, write it and learn it. There is logic of that, only writing. They should participate, discuss. As I always say, I might have said also in the classroom, that I say 'We are friends, I have studied physics more, I know a little more physics than you, kids, we are lecturing

together, I got on the board, saying something. You are going to complete my missing points. I might leave some points incomplete. etc.' I lecture with that logic, everybody should participate, we should lecture together. That's what I do for many years. … I do anything that I can, but sometimes they might not."

Moreover, in the interview the teacher explained why he used "Why" and "How" questions. In the following excerpt from the transcripts of audio recording of interview, he shared his opinions about that with me. He stated that he was trying to help students to make interpretations, instead of just memorizing the formula.

R: "You use "Why" and "How" questions that are used for understanding the topic more deeply."
Çağlar: "… I want them to learn physics knowledge. Away from the logic of memorizing the formula, writing, taking his/her grade and saying 'It doesn't bother me.'; he/she could interpret the events he/she sees in another course, in another medium, in nature, the events in life that he/she lives with, only what he/she learns in physics in another topic. Memorization. Saying 'Okay', suddenly giving the formula 'Let's solve a question', maybe he/she can solve, but I try to make them comprehend the topic, do interpretations. That's what I do."

4.2.2.2.4 Erkan's case

Among the teaching practices in the attention category; Erkan used 25, 26, and 34 more frequently than the others as presented in Table 4.10. Items 25 and 26 were related to concreteness, while Item 34 was in inquiry subcategory. I have observed him using more than one example in many lessons (Item 25) related to concreteness subcategory.

The following excerpt from the transcripts of focus group interview confirms my observations. In the interview, while talking about another issue, one student expressed her ideas about teacher solving many examples without being asked about it. She stated that it helped them understand the topic better, if they see different kinds of questions.

E: "Physics and the other lessons, requires us to solve as many examples, since when we see different kinds of examples, it provides us to understand, comprehend this lesson better."

Related to concreteness subcategory, I have also observed him using visual materials many of which were drawn on the board by him (Item 26). While the teacher was drawing figures, most of the students were also drawing the figures in their notebooks. For example, in the following excerpt from my field notes and audio recording of the observation transcripts, while he was explaining photometer he started to draw the figure. Students were drawing the figure to their notebooks, while he was drawing.

> T: “Draw the figure.” he said while drawing the figure.
> Students started to draw the figure silently.

Moreover, I have observed him using questions to make students participate the course (Item 34). For example, in the following excerpt from the classroom observations, he asked several questions while solving a question on the board.

> T: “What is angle of incidence here?” while solving a question on the board.
> Ss: “Forty.” answered several students.
> Ss: “Fifty.” answered several other students at the same time.
> ….
> T: “This, how many degrees?”
> S: “Forty.”
> S: “All above is forty.”
> T: “All together is 90, so this?
> Students gave different answers at the same time.
> T: “Here?”
> Ss: “Forty.” answered several students.
> S: “Forty five.”
> T: “It must be forty, forty five degree. Where did forty five come from?”
> Students answered with low voice at the same time.

In the interview, the teacher confirmed that he used questions frequently in his lessons, and explained the reason for using questions as to activate the students and to sustain their attention. The following excerpt from the transcripts of audio recording of the interview indicates his ideas about this teaching practice.

> R: “You ask questions to your students to participate them.”
> Erkan: “Yes. I use question-answer method very much. In fact, there are studies about moving our education system to student centered [orientation]. But our conditions are not completely suitable for this. Even it should be student centered;

> the teacher is active in the classroom. That is, it doesn't occur by only students practicing this. That is, the student should be prepared for this, the environment should be ready for this, conditions should be suitable for this. I am trying to make it a little bit more student centered. Question-answer method is to activate the student, student not to sleep in the lesson, not to distract from the lesson. In order to form the state on the student that 'the teacher can ask question to me anytime, that I should follow him'."

4.2.2.2.5 Comparing results of Attention category for four teachers

Observed frequencies of teaching practices in attention subscale of the ATPQ for four teachers are presented in Table 4.10. Two teachers were "not disturbing students' attention with his/her movements" (Item 36) frequently. Eda used this teaching practice 49 times, while Çağlar used 100 times. On the other hand, teaching practice "using gestures, mimics, body movements and tone of voice in accordance with the importance of the theme" (Item 38) was not used as frequently as teaching practice related to Item 36 in attention subcategory. Çağlar was the teacher, who most frequently used teaching practice related to Item 38. He used this teaching practice 22 times.

Observed frequencies of teaching practices in concreteness subscale of the ATPQ for four teachers are also presented in Table 4.10. All four teachers very frequently used "more than one example, stories, jokes, anecdotes, researches etc." (Item 25) and "analogies, diagrams, visual materials or concrete materials" (Item 26). Two of the teachers: Alper and Erkan also used "examples, problems, questions related to daily life" (Item 23) frequently. However, two public school teachers Eda and Erkan never used "sense of mystery" (Item 22), while private school teachers Alper and Çağlar seldom used. Moreover, only Alper used "materials and media like over head projector, film, video, computer or computer programs" (Item 27) but seldom.

Observed frequencies of teaching practices in inquiry subscale of the ATPQ for four teachers are also presented in Table 4.10. All four teachers very frequently used questions in their lessons. They used "questions to make students participate the course" (Item 34) much more frequently than "questions like 'How' and 'Why' or supported students asking these kinds of questions in order to help them understand the theme deeply' (Item 35). Çağlar was using questioning as the basic teaching method in his lessons, thus he was the teacher who used both kinds of questions most frequently among four teachers.

4.2.2.3 Results related to Relevance Category

There were 27 affective teaching practices in seven subcategories in attention category. These subcategories are: relevance, experience, present worth, future usefulness, needs matching, modeling, and choice. Total frequencies of observed relevance related teaching practices in each week of observation are presented in Table 4.11 for four cases. Moreover, total frequencies of the subcategories are also presented in the table.

Eda and Alper were observed once a week for six weeks, whereas Çağlar and Erkan were observed twice a week for six weeks. Hence, there were two frequencies for each week in the table for Çağlar and Erkan. Çağlar was observed three hours a week, since there were three hours of physics lessons a week in his school; while the other three teachers were observed two hours a week during the observations, since there were two hours of physics lessons a week in their schools.

As can be seen in Table 4.11, relevance related teaching practices were performed 344 times by Eda, 180 times by Alper, 305 times by Çağlar, and 170 times by Erkan during the observations. Eda and Çağlar performed relevance related teaching practices more frequently than the other teachers observed. The distribution of relevance related teaching practices to the observation weeks are also presented in the table. The total frequencies of observed teaching practices for four teachers were almost regularly distributed to the observation weeks.

Table 4.11 Total frequencies of observed affective teaching practices in Relevance category and its subcategories for four cases in each week

Category/ Subcategory	Case	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Total
		Frequency (Class-hour) Observation weeks							
Relevance	Eda	45(2)	40(2)	22(1)	16(2)	40(2)	40(2)	X	203
	Alper	23(2)	9(1)	12(2)	2(2)	1(2)	12(2)	X	87
	Çağlar	X 12(2)	5(1) 21(2)	X X	6(1) 8(2)	5(1) X	23(1) 30(2)	6(1) 36(2)	152
	Erkan	X X	6(1) 4(1)	4(1) 6(1)	1(1) 15(1)	13(1) 7(1)	X 9(1)	7(1) 2(1)	74
Experience	Eda	7(2)	5(1)	14(2)	4(2)	3(2)	5(2)	X	38
	Alper	25(2)	5(1)	12(2)	2(2)	1(2)	12(2)	X	57
	Çağlar	X 4(2)	0(1) 12(2)	X X	0(1) 4(2)	1(1) X	4(1) 7(2)	2(1) 8(2)	42
	Erkan	X X	2(1) 9(1)	2(1) 4(1)	6(1) 4(1)	2(1) 2(1)	X 2(1)	14(1) 0(1)	47
Present Worth	Eda	1(2)	0(2)	3(1)	1(2)	0(2)	0(2)	X	5
	Alper	2(2)	0(1)	0(2)	0(2)	0(2)	0(2)	X	2
	Çağlar	X 0(2)	0(1) 0(2)	X X	0(1) 0(2)	0(1) X	0(1) 0(2)	0(1) 1(2)	1
	Erkan	X X	0(1) 1(1)	0(1) 0(1)	0(1) 0(1)	0(1) 0(1)	X 1(1)	1(1) 0(1)	3
Future Usefulness	Eda	3(2)	1(2)	0(1)	2(2)	1(2)	1(2)	X	8
	Alper	1(2)	0(1)	0(2)	0(2)	0(2)	1(2)	X	2
	Çağlar	X 0(2)	0(1) 7(2)	X X	2(1) 2(2)	0(1) X	0(1) 0(2)	0(1) 2(2)	13
	Erkan	X X	0(1) 0(1)	0(1) 1(1)	0(1) 0(1)	0(1) 0(1)	X 1(1)	0(1) 0(1)	2
Needs Matching	Eda	1(2)	0(2)	0(1)	0(2)	2(2)	0(2)	X	3
	Alper	1(2)	0(1)	0(2)	0(2)	0(2)	0(2)	X	1
	Çağlar	X 0(2)	0(1) 0(2)	X X	0(1) 0(2)	0(1) X	0(1) 0(2)	0(1) 0(2)	0
	Erkan	X X	0(1) 0(1)	0(1) 0(1)	0(1) 0(1)	0(1) 0(1)	X 0(1)	0(1) 0(1)	0
Modeling	Eda	11(2)	12(2)	9(1)	12(2)	11(2)	12(2)	X	67
	Alper	8(2)	4(1)	7(2)	0(2)	4(2)	8(2)	X	31
	Çağlar	X 6(2)	8(1) 15(2)	X X	4(1) 14(2)	4(1) X	3(1) 12(2)	5(1) 16(2)	87
	Erkan	X X	3(1) 3(1)	0(1) 3(1)	5(1) 5(1)	6(1) 6(1)	X 6(1)	1(1) 3(1)	41
Choice	Eda	2(2)	4(2)	3(1)	3(2)	5(2)	3(2)	X	20
	Alper	0(2)	0(1)	0(2)	0(2)	0(2)	0(2)	X	0
	Çağlar	X 0(2)	1(1) 1(2)	X X	0(1) 1(2)	0(1) X	1(1) 4(2)	0(1) 2(2)	10
	Erkan	X X	0(1) 0(1)	0(1) 0(1)	1(1) 1(1)	1(1) 1(1)	X 1(1)	0(1) 0(1)	5
Total	Eda	70(2)	62(2)	51(1)	38(2)	62(2)	61(2)	X	344
	Alper	60(2)	18(1)	39(2)	3(2)	24(2)	36(2)	X	180
	Çağlar	X 27(2)	14(1) 46(2)	X X	12(1) 27(2)	10(1) X	31(1) 51(2)	13(1) 63(2)	305
	Erkan	X X	11(1) 17(1)	6(1) 14(1)	13(1) 25(1)	22(1) 16(1)	X 20(1)	23(1) 5(1)	170

X: No observation

As can be seen in Table 4.11, the most frequently observed affective teaching practices were related to the following subcategories: relevance, experience, modeling, and choice. Teaching practices in relevance, experience, and modeling subcategories more frequently performed than the other subcategories in relevance category by all teachers observed. However, only Eda performed choice related teaching practices frequently.

Observed frequencies of teaching practices in relevance subscale of the ATPQ for four teachers are presented in Table 4.12. The most frequently observed teaching practices in relevance category are discussed in detail for each case. In order to identify consistencies in four teachers' use of teaching practices related to relevance category; the results are presented separately for each case, and then they are compared.

Table 4.12 Frequencies of affective teaching practices in frequently observed subcategories of Relevance category of the ATPQ for four cases

	Item #	Eda	Alper	Çağlar	Erkan	SUM
Relevance	45	203	87	152	74	516
	TOTAL	203	87	152	74	516
Experience	46	18	3	16	7	44
	47	7	3	13	4	27
	48	1	3	2	6	12
	49	2	22	3	7	34
	50	0	0	0	2	2
	51	6	1	0	0	7
	52	4	25	8	21	58
	TOTAL	38	57	42	47	184
Modeling	58	0	8	0	0	8
	59	0	0	0	0	0
	60	0	0	0	0	0
	61	0	0	0	0	0
	62	0	0	0	0	0
	63	0	0	0	0	0
	65	0	1	0	0	1
	66	0	0	0	0	0
	67	36	14	73	31	154
	68	28	6	13	2	49
	69	3	1	1	7	12
	70	0	0	0	0	0
	71	0	1	0	1	2
	72	0	0	0	0	0
	TOTAL	67	31	87	41	226
Choice	55	20	0	10	5	35

4.2.2.3.1 Eda's case

Eda used the teaching practices related to Items 45, 55, 67, and 68 more frequently than the others as presented in Table 4.12. Eda was the teacher who used students' names more frequently (Item 45). In the interview without being asked about the issue, while talking about another issue, the teacher mentioned that she addressed her students with their names. The following excerpt from the transcripts of audio recording of interview indicates this. The teacher stated that by using the students' names, she was trying to make the students feel that she valued and followed them; and hence, trying to increase their interest in the lesson.

> Eda: "Walking close to them, addressing them with their names, asking questions; all are [to give the students the impression that] 'I care about you, be alerted, be careful, etc., well, participate to the lesson.'"
> R: "I noticed that you were frequently using your students' names."
> Eda: "Yes. I try to learn their names in the first weeks as much as possible, because, when you address with name, he/she feel valuable. But if you describe as saying things like 'The one at the back, hey you.', the student might not feel him/herself much valuable. When you address with name, then he/she thinks 'The teacher knows me, recognizes me, follows me.' I, moreover. When I learn in the first week [students say] things like 'Oh, teacher, you have learnt everybody immediately.' Then, he/she understands that I am seriously concerned with this matter, I seriously follow him/her. Moreover, sometimes we talk about family matters, their mothers, their fathers, about their occupations, etc. After a while, when I remind those, they feel 'Oh, yeah, she didn't forget.' Thus, they are careful, behave interested in the lesson."
> R: "Yeah."
> Eda: "For example, I might say that 'You didn't do your homework several times, you didn't answer my question or you answered my question, or you did your homework very well.' Then he/she thinks that '… my teacher evaluates what I did.' That is, his/her interest in the course increases, maybe he/she is obliged to, 'I am being followed, I need to be careful.'"

Related to the choice subcategory, I have observed the teacher providing options for her students (Item 55). The following excerpt from the transcripts of video recordings of the classroom observations is an example of providing options for different ways to solve questions.

> T: "If it is hard for us to send rays, draw normal or if the figure will be confusing, draw the image of the eye in the mirror, send two rays to the edges of the mirror, the place in between is your sight area, isn't it?"

Moreover, I have observed her trying to change the date of an exam, because the students asked her to change. In the following excerpt from the transcripts of audio recording of the interview, the teacher stated that she was also providing options for term projects and exams, and explained why she provided options to her students. In line with her statements, according to my observations, she was a flexible teacher and was trying to do many things in favor of her students as she stated, hence was trying to provide options whenever possible.

> R: "I have observed you providing options to your students, for example presenting alternative solutions or well. … Do you provide options besides that?"
> Eda: "Sure, for example if my student has taken term project, according to the regulations, it should be related to the current curriculum. But he/she can choose anything he/she wants, only if he/she spends effort, tries, labors. That is necessary for me."
> R: "For example about the exams?"
> Eda: "Sure. For example, if the date is problem for them, and we don't have time constraint. My student. I say that 'I think administering it [the exam] this time." If they have another exam that time, if there is another exam that week, an exam that is important for them or hard for them, I say that 'Shall we do this not this time, but that time? Come to an agreement with the other classes, speak with them, check if they have another exam.' I try to provide options like this. …"
> R: "Is there a reason that you provide options to your students about homeworks and exams?"
> Eda: "If I don't provide them options, they might say that 'Oh, teacher, we said like that, but you did it like this. This is because it happened like this.' But if I provided them options and they have chosen 'You chose it, hence you are going to bear the consequences.' In fact, well, I don't have strict rules, I am open to the flexibilities that are in favor of my student, just my student has good intentions. If it is in favor of him/her, sure, I try to behave as flexible as I can. But sometimes, if time is short, at least I explain like 'I am sorry, but I have to do this that day because of that, that, and that.' Even I cannot provide options, I try to explain the reason to satisfy them, and say 'We weren't able to do because of that.'"

In modeling subcategory, the most frequently observed teaching practice was explaining what she teaches in a step by step approach (Item 67). For example, in the following excerpt from the transcripts of video recordings of observations, she was explaining what she is doing on the board while solving a question.

> T: "In the first case, it [the question] asks me this. How should my mirror be turned that the ray going over 1, goes over 2? What was the rule? If the angle between the reflected [rays] is two alphas, the mirror is turned alpha. First reflected, second reflected." She was explaining on the figure. "I intersect these two." She was continuing drawing while explaining. "The angle here is necessary for me, because it is my 2a angle. Can you find that angle?"
> Ss: "Yes." said several students.
> S: "We can find."
> T: "Is there anyone who says I can't find it?"
> S: "How do we find it?"
> S: "Upper side is trapezoid."
> T: "This and this is parallel to each other. This ray again, therefore this and this is parallel."
> …
> T: "If this is forty, this is also forty. If 2a is forty, a twenty." she said and written the equations below the figure.

In line with my observations, in the interview she confirmed that she explained what she taught in a step by step approach and explained why she used this practice. She mentioned that by performing this teaching practice she was acting as a model for her students and this was helpful for reducing the students' anxiety in physics lessons.

> R: "I have observed you, for example, while solving a question on the board or other times explaining what you teach in a step by step approach. What is the reason that you are using this?"
> Eda: "Well, to show the way, I am the guide there and I have to show the way to my student. 'When you come across a situation like this, you might follow this, this, this ways.' If there are alternatives, 'Moreover, there is also a way like this.' I show the way, well, I can guide them to a certain point; the rest is left to my student. My aim is to show the way, to be a model."
> R: "Okay, how is your student affected?"
> Eda: "It is a topic that he/she learnt recently. So, it is something strange to him/her. Therefore, he/she doesn't know what to do, he/she is novice, naturally he/she has prejudice, anxiety, already has come with a prejudice to physics from the elementary school, thus they should be informed about what they are going to do, for example how to study, how to get ready for the exam, how to get prepared before the lesson, should be guided about these kinds of issues … especially 9th grade students don't know some things, they are not aware, we have to tell them, teach them. Because of this. Reason is to be a model, to be a

guide. Therefore, some things should be explained. We need to explain [by saying] ‘We are going to do this here, later we are going to do this, we have to do this from here.’; the student can overcome his/her prejudice, his/her anxiety. People oppose what they do not know; therefore it is beneficial for him/her to know.”

On the other hand, I have also observed her asking students to explain what they do when they were solving problems or explaining the topic at the board (Item 68). In the following excerpt from the transcripts of video recordings of the classroom observations, one of the students was explaining the number of images formed in mirrors placed at different angles, she asked the student to explain the formula.

T: “We are trying to find how many images of the object will be.”
S: “Yes, n is our number of images, 360, from the circle, by turning…” she was trying to explain on the formula she has written before.
T: “Ah, okay. 360 divided by alpha.”
S: “360 divided by alpha.”
T: “Minus one is our formula. If you explain minus one.” She asked the student to explain minus one in the formula.

Moreover, one student was solving a question on the board. There was some noise in the classroom, she warned the students and then she said “Baha tell us what you are doing… Baha is telling us. There you are Baha. We are listening to you.”

In the following excerpt from the audio transcript of teacher interview, the teacher explained why she was asking her students to explain what they do at the board. She stated that by this way, she was able to see if the student, who is at the board, actually understood what he/she is explaining and the student learns better by explaining to peers, besides the other students might learn better when their friend explained the topic.

R: “Again, when your students are on the board you were expecting them to explain and saying ‘We are listening you.’ etc.”
Eda: “If he/she goes to his/her desk only solving [without explaining], he/she might have memorized it or hasn’t understood why he/she did it, is not aware what he/she knows and doesn’t know, I should also learn this, well, I say I am following my student. I am trying to understand what he/she knows and doesn’t know what he/she is not aware of, what he/she memorized partially, partially. If there are any students among the class, he/she can understand better from the

> other, someone who is at the same age. Because of some of the things might get clearer in his/her mind, from the other's explanation. With many reasons, I try to make them explain."
> R: "Okay, how does this affect the student who explains?"
> Eda: "One of the best learning methods is teaching. How much he/she teaches, he/she learns that much and realizes what he/she doesn't know. While explaining, for example, he met a question, he/she could or couldn't answer that, he/she will understand then 'I know this, I don't know this, oh, I understood this part, but I didn't that part.' Will help learning, his/her own learning."
> R: "The other student."
> Eda: "The student who is listening might, well, someone who is at the same age, who is at the same position will understand him/her better, teaches better, concretizes better, might be more efficient. I think that frankly."

4.2.2.3.2 Alper's case

I have observed Alper using affective teaching practices related to Items 45, 49, and 52 as presented in Table 4.12. Alper was using his students' names frequently in his lessons (Item 45). He was sometimes using students' names to warn them, and sometimes for other reasons. In the following excerpt from the transcripts of audio recording of the interview, teacher stated that he was spending effort for addressing the students with their names from the beginning of the semester to make them feel valuable. However, he stated that he wasn't sure if it affected their motivation or not.

> R: "Again one of the things that I have observed was that you knew your students' names and were using them. Why?"
> Alper: "… I was learning students' names very quickly. At least if I wasn't able to memorize their names, in the first week, second week from the student list, since it is very hard to memorize in the first week, from the student list or by asking a student to prepare a list according to places they sit, addressing the kids with their names from that list, I try to address. This is for, as an individual to feel themselves valuable. 'We are important that the teacher knows our names, the teacher addressed me with my name.' It arouses very different feelings in the kid, I remember, when I was a student. I used to love the teachers who were addressing me with my name. This is a dialogue of two. I haven't observed if this has an effect on learning the lesson. Or I don't know, when I address them with their names, I have observed that students' comprehension of me changes very well. But in the lesson, directly if their motivation increase or decrease, I don't know that very much. In any case, most of the teachers start to address students

with their names after the half of the semester is passed. But addressing them with their names from the first weeks make an effect on them. At least they feel themselves valuable. … As I said, I haven't observed if it has an effect on learning the lesson, increasing their achievement, or motivating them, but I always wanted them feel themselves valuable while addressing them with their names."

In line with my observations and teacher interview, the following excerpt from the transcripts of video recording of the focus group interview, students confirmed that their teacher was using their names.

R: "He usually addresses you with your names?"
K: "Yes."
R: "He knows your names?"
K: "Yes."

Moreover, in experience subcategory, I have observed him using examples from situations that are familiar to the students (Item 49), and relating current learning to real life (Item 52). For example, in the following excerpt from the transcripts of video recordings of the observations; while he was explaining the wavelength of the light and the regions such as visible, ultraviolet, and infrared, he gave example from the films.

T: "For example, for example, you can see infrared in the laser pen. With paper, if you, if you, if you put the laser pen to the paper you can see it in infrared. Like here. That's infrared. Or smoke, paper or smoke. Okay?" He was gesturing like he was holding a laser pen. "Can you. Or in films maybe you see. For example, a thief enters a place and throws a smoke bomb, there is infrared lines passing through everywhere, isn't it? Alarm, alarm, isn't it, in those films."

In the following excerpt from the transcripts of audio recording of the interview, the teacher explained why he was using examples from situations familiar to the students and related current learning to real life. He stated that he used these examples to increase students' interest in the course, and enhance their attitudes toward physics.

R: "I have also observed that the examples you gave to your students were close to them, you were trying to give examples they knew."
Alper: "Yes. This is, I guess, also related to the third or fourth question. I have also explained there. Now, how much faced to the student. In the examples I try to follow an order. Using the examples that are familiar to them first, later, … the questions they can answer easily."

R: "For example there was, don't think it like question all the time. While you were mentioning about the laser, while you were talking about infrared, you mentioned about the alarms."
Alper: "Yes, yes. Like daily life. … We. Some things technologic. We say physics is the base of engineering, is the base of these things, kids don't know these. You see, to place them to somewhere, I have chosen those kinds of examples. This, if the kid perceives that the lessons we learn supports those technological devices, technological materials in daily life, or knows that, he/she will get interested in this lesson; this affects his/her attitude positively. Since there are some kids. I have observed that very well, his/her father is an electronical engineer, this kid's interest, attitude towards physics increases. Why? Since the kid does a robot at home, by him/herself. The achievement score of the kid, who does a robot at home, is 1. It can't be. Why? Since that kid, does a robot at home by him/herself. That is, the teacher can't do the robot. But what do we ask him/her? Two formulas, three equations. You see, there are many predicaments, dilemmas, let's not say predicament, we have a mistake here. Therefore, by supporting every kid's such interests, we should fit them to certain places. When he/she goes home, if the kid notices how some devices work or knows some of the things in them, what he/she can do with them in the future, this will affect his/her attitude. I think so. I must have given these examples because of that."

4.2.2.3.3 Çağlar's case

Çağlar used teaching practices related to Items 45 and 67 more frequently than the other practices in relevance category as presented in Table 4.12. He was using students' names frequently in his lessons (Item 45) during the observations. In the interview, the teacher stated that he cared addressing his students with their names. In the following excerpt from the transcripts of audio recording of interview, the teacher was explaining his views about this teaching practice. He stated that he was spending effort to learn their names in the first weeks of the semester and the students notice this. Furthermore, he was thinking that addressing students with their names was a kind of praise for students.

R: "You were addressing your students with their names."
Çağlar: "This is important, very important. In a week or 15 days, or at most in the first three weeks, I try to learn. Addressing with his/her name honors, praises him/her, that is, it is noticed quickly."

The students also confirmed that their teacher was usually using their names. In line with the teacher's opinions, several students expressed that their teacher knew and used their names and also some other information about them.

Moreover, I have observed him explaining what he taught in a step by step approach (Item 67). For instance, in the following excerpt from the transcripts of video recordings of the observations, he was explaining what he did in a step by step approach while solving an example about convex mirrors.

> T: "Convex mirror, principal axis." He started drawing a figure. "F is placed here, how many centimes is the focal distance of this? Twenty. The object is placed here, object? How many centimes is its height? Ho, ten. How many centimes is this? do?"
> S: "Twenty."
> T: "do is also twenty. … One divided by f, because it is convex mirror, is f real or virtual?" he started writing the formula while speaking.
> S: "Virtual."
> T: "Are we going to write a minus in front of it?"
> Ss: "Yes."
> T: "Yes, because the object is real. Plus one divided by do. Will the image be virtual or real?"
> Ss: "Virtual."
> T: "All the images in convex mirror were virtual. Minus one divided by do, minus one divided by 20 is equal to plus one divided by 20, minus one divided by di. I am taking it to this side, one divided by di is equal to one divided by 20 plus one divided by 20, is equal to two divided by 20, that is." He was writing the solution of the question while he was explaining.
> S: "Ten."
> T: "One divided by 10. That is, di is equal to?"
> S: "Ten."
> T: "Ten, sure, isn't it?"
> S: "Yes."
> T: "That is, we said 10 centimes to where? f divided by two, right? Hmm, then the height of the image, because it is half of it, because while here is 20 here is 10, height of the image is height of object's?"
> S: "Its half."
> T: "Half of it. That is, how many centimes?"
> S: "Five."
> T: "Five centimes. Hmm, it is opposite of the concave mirror, when we put it just between the mirror and F, the height of the image is height of the object's?"
> S: "Twice."

T: “Twice and away as much as the focus. When you put it away as much as the focal distance, the image is?”
S: “Half.”
T: “Half of it.”

In the following excerpt from the transcripts of audio recording of interview the teacher explained how he used step by step approach. According to him, drawing the figures was a crucial step of solving questions, and it was easier for students to solve questions by drawing figures.

R: “You were explaining what you do in a step by step approach, for example you were recommending your students to draw the figures first etc.”
Çağlar: “From time to time, I have witnessed that in physics, when you read the question if you can draw the figure close to the real one, you can draw the figure close to the real one, you can see the accurate result even on the figure. Especially, in the university entrance examination questions etc., if you draw the figure of what is being explained, and interpret it; if you don’t know a thing about physics, if you can do the geometry of the matter, etc. I have seen that the result could be obtained. Hence, drawing the figure, in order to evaluate also if the question is being understood or not. If he/she can draw the figure, he/she has understood the matter. Then, I certainly trust that they reach the result more easily. Therefore, I recommend drawing the figure first, after reading the question. …”
R: “What is the effect of explaining the topic in a step by step approach on student?”
Çağlar: “I don’t like suddenly saying that ‘This was the formula, right? Let’s put [the numbers into the formula].’ That is, I don’t know. It is memorization; it doesn’t fit to his/her logic. Something, what is stated in the question? It was like that, it was accelerating first. I want him/her to see. That is, I want him/her to have something in hand. Therefore, I think he/she finds it more easily. When the topics come one after the other, he/she will be at ease. Therefore, I try to do step by step by step. Otherwise, I have never liked ‘Wasn’t this the formula, let’s write, let’s put in place.’ in my life. Therefore, I would really like doing, I, step by step, drawing the figure, if possible, also by drawing the figure.”

4.2.2.3.4 Erkan’s case

Erkan used teaching practices 45, 52 and 67 more frequently than the other practices in relevance category as presented in Table 4.12. He was using students’ names frequently in his lessons (Item 45). In the interview, the teacher explained that he found it important to address people with their names. By using this teaching practice, he was trying to give students the impression that he valued them; hence, his efficiency was higher. The following excerpt from the transcripts of audio recordings of the teacher interview indicates his ideas about this teaching practice.

> R: “You address your students with their names.”
> Erkan: “This is very important in social life, you know. Even we are physics teachers. When you say teacher, a good communicator, caring human factor. When you address the student with name, you get a different approach. When the student is addressed with his/her name, at least he/she doesn’t distract from the lesson, even he/she doesn’t understand the topic, he/she thinks that he/she is valued. Your chance to get students is more from there, your efficiency is higher. Addressing with name is important for that aspect.”

In experience subcategory, he related current learning to real life (Item 52). Moreover, several times, I have observed him relating what he was explaining to students’ hobbies like soccer and fishing. For instance, in the following excerpt from the transcripts of the audio recordings of the observations; while he was explaining refraction, he gave several examples from real life.

> T: “Let’s continue by giving examples from daily life, by mentioning examples. In fact, you live; you see many refraction phenomena in daily life. You must have various observations about this issue. A very simple example, when you put a pencil or a tea spoon in a tea glass, it seems broken.”
> S: “Yes.”
> T: “Many of you have witnessed this.”
> S: “Yes.”
> T: “You see, while swimming in the sea, err, when you dive into sea you see the outsider in a place different than the actual place, or you are outside you see the insider, swimming person’s body, such as leg, and such like, in a different shape, or if you are looking at the fishes, you see the fishes in a different place than the actual place. When you fill bathtub with some water, you see water less deep. When you look at the water with a slope, you see water less deep than it actually is. That is, you see water shallow even if it is deep.”

Besides, in the interview the teacher mentioned that in order to increase students’ interest in physics and enhance their motivation, he was relating current learning to real life. The following excerpt from the interview transcripts of the audio recordings indicates these.

R: “I have observed you relating real life.”
Erkan: “… it is clear in my mind that it needs to be related to real life. Really why are we covering these, why are we explaining these to the students. These are problems that we are going to face later in life. In order to solve these or to the problems that are present now, we educate our students. Consequently our students, when they take this education, should know that they are going to use this in future. Or these topics are not abstract topics; they are present in our lives, necessary topics. I want to convey them that when we learn, use them, they make our lives easier. Since ninth grade physics topics have two purposes: one is, they are going to choose braches in tenth grade, you know; one is, that they might choose social branch, might choose language branch, might choose mathematics branch, might not choose science; forming the core knowledge for them, one purpose is that. Even if these students work at different areas at least they have information about certain topics, basic topics related to physics. That’s why when you relate to daily life, students get interested. The other purpose is to build the base for students who are going to study science branch. For this reason I find it right to relate to daily life.”
R: “You give examples from real life, for example once you have mentioned about seeing two color uniform of a sportsman as one color, while you were explaining the filters.”
Erkan: “All these are to obtain motivation. That is. When you give example from the uniform of a sportsman, the students’ view is different, but if you mention anything like a blue green object, he/she cannot visualize in his/her head. But when you say a uniform, a sportsman uniform, when you say a soccer player uniform the student can visualize it more easily.”

Moreover, Erkan was explaining what he taught in a step by step approach (Item 67). In line with the observations, in focus group interview students confirmed that their teacher usually explained the topic and the questions in a step by step approach. Usually, most of the students were following him, while he was explaining what he taught in a step by step approach. For example, in the following excerpt of the transcripts of the video recordings of observations, he was explaining refraction of light entering to a different media; he explained the process in a step by step approach.

T: “… Now, sometimes there might be two medium one on the top of the other. For example, this might be glass medium, water medium or a liquid. Refraction indices of these are different. Hence, there might be two reflections. Even there might be three. Three liquids are placed one on the top of the other, how, the object in the bottom of the container, the object different place than the actual place, how different place do we see? Yes, we do about that and then solve

question. Refraction index of that, here is n one, here is n two. Yes, let's assume there are two liquids. But we can use the same formula also for three liquids, for four liquids. Let's say this is air medium." While speaking he was drawing.
S: "Teacher, is n one higher or equal?"
T: "That isn't important. While drawing, I didn't care that. Look at the object at the bottom of the container. You can follow two ways here. First way, you find like you are looking from n one, then n two, after finding its place, sure you found a different place, then you calculate like you are looking from a glass to air. But this is a long process. There is a shorter solution. h prime is equal to h one divided by n one plus h two divided by n two. If we have three media, h three divided by n three. We continue like this for four." He was writing the formula.

4.2.2.3.5 Comparing results of Relevance category for four teachers

Observed frequencies of teaching practices in relevance subscale of the ATPQ for four teachers are presented in Table 4.12. All four teachers were using their students' names frequently. Observed frequencies of teaching practices in experience subscale of the ATPQ for four teachers are also presented in Table 4.12. Teaching practices "relating current learning to prior science and physics topics" (Item 46) and "relating current learning to real life" (Item 52) were performed more than the other teaching practices in this category. Three teachers; Eda, Alper and Çağlar never used "analogies to relate current learning to prior experience" (Item 50), while two (Çağlar and Erkan) did not perform teaching practice "explaining how to use prior knowledge and skills" (Item 51).

Observed frequencies of teaching practices in modeling subscale of the ATPQ for four teachers are also presented in Table 4.12. Three of the teachers; Eda, Çağlar and Erkan frequently were "explaining what he/she teaches in a step by step approach" (Item 67), while only Eda was frequently "asking students to explain what they do when they are solving problems at the board" (Item 68). Any of the four teachers never observed performing actions in Items 59, 60, 61, 62, 63, 66, 70, and 72. Three teachers; Eda, Çağlar and Erkan were never observed performing teaching practices related to Items 58 and 65. Two teachers; Eda and Çağlar were never observed performing teaching practice related to Item 71; while each of the other two; Alper and Erkan were observed performing it only once.

4.2.2.4 Results related to Confidence Category

There were 23 affective teaching practices in six subcategories in confidence category. These subcategories are: provide objectives, difficulty and challenge, expectations, feedback, attributions, and self-confidence. Total frequencies of observed confidence related teaching practices in each week are presented in Table 4.13 for four cases and total frequencies of the subcategories are also presented in the table.

Table 4.13 Total frequencies of observed affective teaching practices in Confidence category and its subcategories for four cases in each week

Category/ Subcategory	Case	Frequency (Class-hour)							Total
		Observation weeks							
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	
Provide Objectives	Eda	6(2)	8(2)	8(1)	3(2)	7(2)	8(2)	X	40
	Alper	3(2)	2(1)	3(2)	3(2)	1(2)	3(2)	X	15
	Çağlar	X 5(2)	4(1) 4(2)	X X	7(1) 6(2)	3(1) X	4(1) 7(2)	5(1) 6(2)	51
	Erkan	X X	1(1) 3(1)	2(1) 3(1)	1(1) 9(1)	4(1) 5(1)	X 1(1)	8(1) 3(1)	40
Difficulty& Challenge	Eda	0(2)	1(1)	1(2)	1(2)	0(2)	0(2)	X	3
	Alper	0(2)	0(1)	0(2)	0(2)	0(2)	0(2)	X	0
	Çağlar	X 0(2)	0(1) 0(2)	X X	0(1) 0(2)	0(1) X	0(1) 0(2)	0(1) 2(2)	2
	Erkan	X X	0(1) 0(1)	0(1) 0(1)	0(1) 0(1)	0(1) 0(1)	X 1(1)	0(1) 1(1)	2
Expectations	Eda	0(2)	2(2)	2(1)	8(2)	3(2)	0(2)	X	15
	Alper	3(2)	5(1)	2(2)	10(2)	5(2)	3(2)	X	28
	Çağlar	X 1(2)	7(1) 0(2)	X X	0(1) 4(2)	2(1) X	4(1) 1(2)	1(1) 5(2)	25
	Erkan	X X	0(1) 0(1)	0(1) 2(1)	0(1) 4(1)	5(1) 3(1)	X 2(1)	1(1) 0(1)	17
Feedback	Eda	131(2)	41(2)	25(1)	46(2)	47(2)	69(2)	X	359
	Alper	48(2)	30(1)	48(2)	21(2)	47(2)	58(2)	X	252
	Çağlar	X 66(2)	62(1) 74(2)	X X	31(1) 68(2)	75(1) X	101(1) 215(2)	55(1) 127(2)	874
	Erkan	X X	10(1) 12(1)	5(1) 2(1)	2(1) 12(1)	9(1) 2(1)	X 11(1)	28(1) 8(1)	101
Attributions	Eda	0(2)	0(2)	0(1)	0(2)	0(2)	0(2)	X	0
	Alper	0(2)	0(1)	1(2)	0(2)	0(2)	0(2)	X	1
	Çağlar	X 0(2)	0(1) 0(2)	X X	0(1) 0(2)	1(1) X	0(1) 0(2)	2(1) 1(2)	4
	Erkan	X X	0(1) 0(1)	0(1) 0(1)	0(1) 0(1)	1(1) 0(1)	X 0(1)	0(1) 0(1)	1
Self-Confidence	Eda	3(2)	1(2)	4(1)	3(2)	5(2)	4(2)	X	20
	Alper	0(2)	0(1)	0(2)	0(2)	2(2)	0(2)	X	2
	Çağlar	X 0(2)	0(1) 0(2)	X X	0(1) 0(2)	0(1) X	0(1) 0(2)	0(1) 0(2)	0
	Erkan	X X	0(1) 0(1)	0(1) 1(1)	0(1) 0(1)	1(1) 0(1)	X 2(1)	0(1) 0(1)	4
Total	Eda	140(2)	53(2)	40(1)	61(2)	62(2)	81(2)	X	437
	Alper	54(2)	37 (1)	54(2)	34(2)	54(2)	64(2)	X	298
	Çağlar	X 80(2)	73(1) 71(2)	X X	38(1) 76(2)	82(1) X	109(1) 227(2)	63(1) 140(2)	956
	Erkan	X X	11(1) 15(1)	7(1) 8(1)	3(1) 25(1)	20(1) 10(1)	X 17(1)	37(1) 12(1)	165

X: No observation

Eda and Alper were observed once a week for six weeks, whereas Çağlar and Erkan were observed twice a week for six weeks. Hence, there were two frequencies for each week in the table for Çağlar and Erkan. Çağlar was observed three hours a week, since there were three hours of physics lessons a week in his school; while the other three teachers were observed two hours a week during the observations, since there were two hours of physics lessons a week in their schools.

As can be seen in Table 4.13, confidence related teaching practices were performed 437 times by Eda, 298 times by Alper, 956 times by Çağlar, and 165 times by Erkan during the observations. Çağlar performed confidence related teaching practices more frequently than the other three teachers observed. The distribution of confidence related teaching practices to the observation weeks are also presented in the table. As can be seen in the table, teaching practices in four subcategories of the ATPQ were more frequently performed than the other subcategories in confidence category. These subcategories are: providing objectives, expectation, feedback, and self-confidence.

Observed frequencies of teaching practices in providing objectives, expectation, feedback, and self-confidence subcategories in confidence category of the ATPQ for four teachers are presented in Table 4.14. All four teachers performed teaching practice 83 more than the other practices in providing objectives category while each of four teachers performed teaching practice 82 only few times as can be seen in Table 4.14. Moreover, all four teachers performed teaching practice 87 more than the other teaching practices in expectations subcategory. They also performed feedback related teaching practices frequently.

Table 4.14 Frequencies of affective teaching practices in frequently observed subcategories of Confidence category of the ATPQ for four cases

Category/ Subcategory	Item #	Eda	Alper	Çağlar	Erkan	SUM
Provide objectives	82	2	1	1	1	5
	83	32	12	49	30	123
	85	6	2	1	9	18
	TOTAL	40	15	51	40	146
Expectations	86	1	1	7	1	10
	87	11	24	10	12	57
	88	3	3	8	4	18
	TOTAL	15	28	25	17	85
Feedback	89	148	122	619	51	940
	90	58	30	57	15	160
	91	105	66	121	18	310
	92	13	13	18	2	46
	93	35	21	59	15	130
	TOTAL	359	252	874	101	1586
Self-confidence	73	0	0	0	0	0
	74	8	0	0	1	9
	80	0	0	0	2	2
	94	5	1	0	0	6
	95	7	0	0	1	8
	96	0	1	0	0	0
	TOTAL	20	1	0	4	25

However, no teaching practices in self-confidence subcategory were frequently observed. In fact, teaching practice 73 in this category was "not giving unexpected negative reactions". Even though it was presented as any of the teachers never it, it was not coded since it was not related to a particular behavior. However, none of the four teachers were giving unexpected negative reactions. More explicitly, I have never observed Erkan giving unexpected negative reactions; Eda and Alper were giving negative reactions that were result of students' behaviors, but not unexpected negative reactions. For example, once Alper gave speech to the students who were late the lesson after the break time and said he might send all of them to the discipline committee of the school, while Eda gave a speech when several students were trying to disrupt the lesson. On the other hand, Çağlar was sometimes getting angry when the students were not able to answer a question after repeating the related topic few times.

The most frequently observed teaching practices are discussed in detail for each case. In order to identify consistencies in four teachers' use of teaching practices related to confidence category; the results are presented separately for each case, and then they are compared.

4.2.2.4.1 Eda's case

Eda used teaching practices related to Items 83, 89, 90, 91, and 93 more frequently than the other teaching practices in confidence category as presented in Table 4.14. In provide objectives category, I have observed Eda mentioning and if needed fulfilling the prerequisite knowledge, skills, or attitudes that were helpful for completing the task (Item 83). For example, while solving a question about "mirrors in motion", she said that "We remind you, if there are people who have forgotten, who did not know." and has written the following equation "x= V t".

In the interview, the teacher explained that she fulfilled student's prerequisite knowledge that were helpful for completing the task in order to help students understand the topic, to overcome students' prejudices and anxieties in physics, and to increase their motivation in physics courses. The following excerpt from the transcripts of audio recording of the interview provides insight about teacher's opinions.

> R: "I have observed that you have fulfilled some knowledge that was helpful for completing the task, at least mentioned. For example, I have observed the topic mirrors; you have mentioned the velocity formula. Is there a particular aim for this?"
> Eda: "Many students know the formula, memorized it. … what is memorized will be forgotten in a while, I want him/her to understand the base of the situation, I think it is missing."
> …
> R: "For example, trigonometry, you mention,"
> Eda: "Okay, I got it. Base, prerequisite knowledge. If it is not good, complete or he/she has forgotten it, it should be reminded so that the base of the building, basis is good, the building is built well. Therefore, reminding is useful. For

> example, the student thinks that he/she knows or some students know while the others don't know. They come from different environments. One might not know what the other knows. Therefore, in order to prepare everybody, I find it useful just to mention. Besides, he/she is already prejudiced. Moreover, trigonometry is added to it for example, they might think 'Oh, it can't be, we can't do this.' However, maybe, what is necessary for me is a little part of it, but the student. Yes, it is useful to inform the student in order to get them to the same level of prerequisite knowledge."
> R: "How does this affect your students?"
> Eda: "If I pass over it saying 'You already know this.' He/she might say 'I wasn't able to learn till now; it is okay that I don't learn anymore. Or I don't know how correct it is to say 'You already know this.' and neglect it, but again [to say] something like 'I value you, even you should have known this, but once again I repeat it. Well, I spent effort, you also spend some effort.' to my student. In fact, it is not my topic, to tell trigonometry, but is it necessary for me this time? Yes, it is necessary. In order my student to form the idea that 'It is necessary for me, I should have known this, I have forgotten it, or I haven't learnt it, but now I can learn it, I can remember it again'. It is useful to explain."

On the other hand, I have also observed Eda performing the teaching practices related to Items 89, 90, 91, and 93 related to feedback category. Throughout the observations, she was providing feedback for acceptable responses and constructive feedback for responses that did not meet criteria (Item 89), providing feedback when students needed help (Item 90), using verbal praise, personal attention, helpful feedback, and motivating feedback following task performance (Item 91), and giving information about students' mistakes and learning strategies (Item 93). Especially, while the students were solving questions, she was moving around the classroom, paying personal attention to her students, and providing feedback to students' solutions. She was also using verbal praise. When the students made mistakes, she was giving information about their mistakes. For example, she was thanking the students who presented the topic or solved the question on the board, and who answered the question in front of the other students. The following excerpt from the transcripts of video recordings of observations demonstrates how she used these teaching practices. While one of the students was solving questions at the board and explaining what he was doing, the teacher was providing constructive and helpful feedback to him, and giving information about his mistake.

> S: “Image of x in second mirror, like this.” He was drawing the figure at the same time.
> T: “Perpendicular distance.”
> S: “Hı.”
> T: “They aren’t perpendicular.”
> S: “Like thiiis.”
> T: “Yeah.” She said approving “How? Half diagonal.”

The teacher explained why she provided feedback to her students in the interview. She expressed that by providing feedback, using verbal praise and personal attention to her students to increase students’ attention and confidence, and she was trying to make students aware that she cared about them. In the following excerpt from the transcripts of audio recording of the interview, she explained her ideas about these teaching practices.

> R: “I have observed you providing feedback to your students both while you were walking around the desks and solving a question on the board or answering a question. Among these, for the acceptable responses ‘Okay, right, good for you.’ etc.,”
> Eda: “The student expects approval. You are the expert for him/her and he waits for your approval. That’s the reason he tells the answer [saying] ‘I did it.’ He/she is shouting while sitting in his/her desk that ‘The answer is 3’ or ‘The answer is 5’. The student expects your approval in fact, that [saying] ‘I did it.’ As a consequence of it, he/she expects your approval with things like ‘Good for you’ and ‘This part is right, but you should care that part.’, [student] expects interest. I think most of them are trying to say that ‘I am here, pay attention to me.’ In terms of that, yes, you approve with saying ‘Good for you’, you are trying to say that ‘This part is right but you should care that part.’ you say that ‘Okay, good, right, I paid attention to you again’.”
> R: “For example, when your student did something completely irrelevant?”
> Eda: “My student’s personality is also important here, his/her intention. Is his/her aim to do, just [pretend] to do, or he/she tried and fount that. If tried and found that I say things like ‘Okay, this time it is like this, don’t worry, but next time it will be better.’ as much as possible. But completely irrelevant and he/she is doing it just to ridicule, I give negative feedback.”
> R: “For example?”
> Eda: “For example, things like ‘Don’t make fun of it, get back to the topic. pretend as if doing, as if interested. Don’t try to take me in. Consequently, you need these.’ etc. I try to express that I am aware of this. As a result, it comes to

> the same point, I try to say that 'I care about you, I follow you, you also follow the lesson, pay attention to the lesson.' …"

In line with the observations, the students stated that their teacher was providing feedback to them when they needed. In the following excerpt from the transcripts of focus group interview they stated their opinions about teacher's feedbacks.

> R: "While solving problem, doing homework etc., if you need help she guides you, this might be while you are on the board, while you are solving questions in your notebooks or other times, when you need help and go to your teacher guides you, right?"
> Ss: "Yes." said several students.

Moreover, without being asked about the issue, while talking about another teaching practice; one student mentioned that the teacher was providing feedback to them while they are solving questions. The following excerpt from the transcripts of the video recording of the whole class interview includes her ideas.

> M: "…We all make mistakes. She checks all the questions, from the beginning to end, she shows where we made mistakes, like mathematical mistakes one by one."

4.2.2.4.2 Alper's case

Alper used teaching practices related to Items 87, 89, 90, 91, and 93 more frequently than the other teaching practices in confidence category as presented in Table 4.14. Related to expectations subcategory, I have observed him clearly explaining what is expected from the students (Item 87). In the following excerpt from the transcripts of audio recording of the interview, the teacher expressed that stating expectations motivated students, and if the teacher behaves in line with his expectations, he can also sustain students' motivation.

> R: "You were explaining what you expected from your students very clearly in your classroom, as well as related to term projects, also in other situations, for example when you took them to the laboratory what they were going to do there,"
> Alper: "If the students know well what is expected of them, they prepare themselves to that lesson. They should know the rules they should obey in the laboratory, in the class they should know what and how much they should do,

they should know what they should do in that lesson. If we ask why they should know, since it is the student who is going to learn it. We should prepare him/her, we should prepare his/her brain. We are sparkling there. 'Look we are sparkling, the fire is going to start soon.' Sparkle comes before the fire. That sparkle is our expectations. That is, he/she is going to make a room in his/her mind. We should give a name to the room where he/she is going to make in his/her brain. 'The things we are going to learn are these.' If there are rooms in his/her brain made before, these information are going to go there, if there aren't, if we are going to open a new room, we are giving its title. Saying what we expect is important in that aspect. If we come to the laboratory, laboratory is a more troublesome environment, since the number of rules to be obeyed increase in the laboratory because of the safety of the students. Explaining what we expect there maybe might be related to connecting to theoretical part, in addition because of their safety. … That is, students' attention can be distracted very quickly; there are many devices there, different things, things that he/she has never seen in his/her life. We are trying to emphasize that 'We are going to do these, these today, going to use these devices. Don't touch anything else. This is also important for your safety.' Our expectations in the laboratory are somewhat these."
R: "This, explaining your expectations, especially your expectations in the lesson-laboratory is a different aspect as you stated. What is its effect on your students?"
Alper: "As I have mentioned earlier, while separating the 45 minutes, if we think we give 3-5 minutes to this, after that about 10 minutes, students' motivation is at high levels. That is, the kid, when the teacher says what he expects from the students, what he/she is going to teach in this lesson, what kind of way he/she is going to follow, about 10 minutes the student observes. If the teacher goes in the direction of what he/she said, this motivation doesn't decrease anymore. But the teacher relaxes, moves just the opposite direction of what he/she said, the student disrupts the lesson till the end of the lesson."

On the other hand, Items 89, 90, 91, and 93 were related to feedback category. Alper was providing feedback for acceptable responses and constructive feedback for responses that didn't meet criteria (Item 89), providing feedback when students needed help (Item 90), and using verbal praise, personal attention, helpful feedback, and motivating feedback following task performance (Item 91). Moreover, he was giving information about students' mistakes and learning strategies (Item 93). For example, in the following excerpt from the transcripts of video recordings of observations; he was solving a question about the area of umbra. He called one student to the board to continue solving the question, and while the student was solving the question he gave constructive and helpful feedbacks to the student, since the student needed help.

> T: "Selim, what do you think, which triangle can we use here? Draw a triangle for us. That, we can a similar- use similarity. Draw from the middle." he said and gave the chalk to the student.
> …
> T: "Draw from that center, like this."
> …
> T: "Okay. A big triangle is formed here, isn't it? We know the higher dis- distance, because we know where else, Selim?"
> Doğan: "Twenty."
> T: "We also know this place, twenty. We also know this place, twenty." He noted the numbers on the figure. "Right?"
> Selim: "Yes."
> T: "Therefore, let's see mark it, which triangle are we going to use? Mark it, mark it, mark it, largely." He saw that the student marked a larger area, he said. "It's okay, stop, stop, mark the above, mark the above." he said and he deleted the parts that the student marked wrong.

In the following excerpt from the transcripts of audio recording of the interview, the teacher shared his ideas about providing feedback and using verbal praise. He confirmed that he was using verbal praise, when the students completed a task successfully. Moreover, he mentioned that if the students were able to complete tasks successfully by the help of the feedback, their interest increased.

> R: "… I have observed you giving feedback to your students frequently in your classroom. It might be different feedbacks, that you say 'Good for you.', that is, positive that you say 'Okay, this is it.'"
> Alper: "Oh, that, that, I do that, [student] goes to the board and solves the question very well. I say 'Good for you.' for example, I give grades. … But if the student has started the question and got stuck, I help. But if he/she is doing nothing, come to the board and doing nothing, then supporting a little like 'Sit down, look, listen well. You can do better.' I try to make him participate to the lesson, since in my lesson, frankly, if not all the eyes are on me, several people deal with something else, my motivation also decreases and I don't want to continue that lesson in that class. Therefore, each of them should look at me, follow me, do what I say, and learn. If I spend lots of effort to teach that lesson, they should also have some of that responsibility. If the question has connection to another lesson like mathematics, geometry, then I help the students. … the kid has problem with trigonometry, I don't evaluate his/her trigonometry knowledge

in that moment, if I am assessing his/her physics knowledge, I help with trigonometry."
R: "If we continue with the student on the board, if this student listens the lesson, has come to the board and cannot do."
Alper: "Yes. He/she can't do. Then, I support at several points, I support as much as he/she can go on. … I myself give feedbacks like 'Look, if you do this from here, do this like that; you'll probably reach the result.' If I saw that he/she can't go on anymore, 'Sit down, and look, I will do, you'll see then.' Meanwhile, there are many [student] sounds in the classroom saying that 'I do.', I stop them. I solve this question after this. I call another student for another question since there is a competition atmosphere in the classroom, especially among the hardworking students or good doing students. Helping each other might, well, prevent them, decrease their motivation. In this respect, I prefer to do [the question] myself or also give feedback myself."
R: "This student who is on the board, that you helped, has done or couldn't do the question. How does your help affect this student? First did, and then couldn't do."
Alper: "Yes. If as a result he answered the question, this has a positive effect on the student and he/she continues to follow the lesson well. If he/she couldn't do even with my help, for that moment his/her situational motivation might decrease, but if he/she is a hardworking student, I don't think his/her attitude will change much in the future. Maybe for that moment, that day, when he/she goes home, they talk about it at a family conversation, and then he/she forgets. But if that is a student, who doesn't pay much attention, it won't even be an issue at the family talk. He/she already doesn't care the lesson anyhow. But as I said, if it is a hardworking student, in that lesson, in that moment, it might be for a moment, that is, if he/she couldn't solve. But if it is solved his/her interest increase anyway. If he/she solved by help or hearing a voice from back, as a result he/she lives the, well, sitting down after solving a question on the board. It gives them enough, well, that is, positive effect."
….
Alper: "…Giving feedback to the students is important since leaving the student with what he/she couldn't do, he/she couldn't know, is a very wrong event. Unfortunately, solving lots of questions is a reason for pride nowadays in our educational system, especially in the private courses. 'I have solved 10000 questions, I have finished five books etc.' are reasons for pride nowadays, the student comprehends what it is like solving questions by understanding, solving questions by getting feedback. 'Let's say, you solved 10000 questions, with which brain you solved 10000 questions, the same, same brain. The questions you couldn't know, that is, all kinds of questions you couldn't know, you already couldn't know. If someone gave feedback to you, if you added something to your knowledge, continued by getting feedback, then you would have a development in

> your brain.' Therefore, while I, saying this to the student, if don't give feedback to the student myself, I contradict with myself. Getting feedback is important for the development of brain, giving feedback, more appropriately."

Students also confirmed in the interviews that their teacher gave feedback when they needed. Moreover, one of the students expressed that when the teacher gave feedback and helped them while they were solving questions, their self-confidence was increased. In the following excerpt from the transcripts of video recording of student interview, students shared their opinions with me.

> R: "While you are solving questions, doing homeworks, or doing experiments in downstairs [laboratory], did he guide you when you need?
> …
> M: "He paid attention to all groups one by one.
> R: "For example, you showed him your notebook, what did he say?"
> K: "We solved half of the question. He said that 'Your solution is incomplete.' We solved all of it and showed him again."
> R: "Did he guide you that time?"
> K: "Yes."

4.2.2.4.3 Çağlar's case

Çağlar used teaching practices related to Items 83, 89, 90, 91, and 93 more frequently than the other teaching practices in confidence category as presented in Table 4.14. Related to provide objectives subcategory, I have observed him mentioning and if needed fulfilling the prerequisite knowledge that were helpful for completing the task (Item 83). For example, in the following excerpt from the transcripts of audio recording of observation, while he was explaining the formula of the illumination, he noticed that the students lacked the prerequisite knowledge about the cosine. Thus, he explained the trigonometry background necessary for understanding the formula as following.

> T: "Then, if the illumination around O point is something like E zero, if they ask what it is, we assume that it is perpendicular, thus we can say I divided by d square. Okay, then." He asked while he was drawing. "Okay, then we say that the point light source is here, the screen is here, not like the previous one, to the point like thiiis, look, around the point, if the illumination is asked. That is, for example S point, illumination around the S point is asked, then from the definition, kids."

S: “We assume perpendicular.”
T: “Alpha is here, we assume perpendicular, but alpha is not here anymore, I see this.”
S: “Then we make use of the triangles.”
T: “Sure, well done. Of the triangles, that is, we will draw perpendicular to the screen, look; we will call it screen normal, normal. What do we do to make it perpendicular to here, that is, it overlaps? If here is alpha?”
S: “Sine."
T: “Sine or cosine?” asked the teacher and started drawing a triangle.
S: “Err, cosine?”
T: “Which one is cosine, which one is sine?”
Students started to talk altogether answer the question, but it was not clear what they were saying.
…
S: “y divided by z.”
T: “y divided by z.” repeated the teacher. “y is which side of the alpha? Is y at the opposite side of the alpha, or front side?”
Some students said opposite, some said front.
T: “While finding the opposite side, finding the opposite side what do we multiply hypotenuse with? Cosine alpha? Yes?”
S: “Front side divided by opposite.”
Other students were also speaking, but it was not clear what they were saying.
T: “…Front side divided by opposite, yeah? What is cosine alpha? Front side divided by hypotenuse, be careful. Front side divided by hypotenuse. Front side, froo is found, front side is found by multiplying with cosine, front cosine.” He said and then he has written the formula on the board. “Now, look, we came here, that d, this d is multiplied with what to become this? That is, how it becomes perpendicular?”
Students gave different answers.
T: “What should I do this perpendicular side?” He answered himself since he couldn’t get the right answer. “I should multiply with cos, kids. That is? Well, around S point, I multiplied by cos, [after] multiplying it becomes perpendicular to here. Here, we found here. Cos alpha divided by d square, I is the luminous intensity of our source. But here, here alpha, alpha angle is the angle between I and the surface normal.” He was writing the formula, while he was talking.

The teacher confirmed that he fulfilled students’ prerequisite knowledge in the following excerpt from the transcripts of audio recording of interview.

R: “You have mentioned about sines and cosines?”
Çağlar: “We have to, since they don’t learn sines and cosines in mathematics. … Therefore, this is sines, this is cosines, similarity of triangles is like that, obligatorily we have to mention. Even they see in mathematics, ‘You see, you

were doing like this in mathematics, therefore we are going to use this. Our topic is geometrical optics anyhow. Kids, we are using geometry rules explaining light's behavior in optics. … "

On the other hand, items 89, 90, 91, and 93 were related to feedback category. I have observed him providing feedback for acceptable responses and constructive feedback for responses that didn't meet criteria (Item 89), providing feedback when students needed help (Item 90), using verbal praise, personal attention, helpful feedback, and motivating feedback following task performance (Item 91), and giving information about students' mistakes and learning strategies (Item 93). For example, in the following excerpt from the transcripts of video recording of observations, he was explaining the special rays whose paths after reflection from the concave mirror are known.

T: "Fourth. Find a special ray that it is the fourth and the last." He started drawing figure.
There was no answer from the students.
….
T: "What does a ray coming to the surface vertex do, a ray coming to?" asked the teacher to give hint to the students.
S: "Well."
Ss: "From the principal axis." said several students.
T: "With the principal axis." he corrected.
S: "It goes parallel, that is with the same, well..."
S: "Principal axis is normal already."
T: "Say it again."
S: "Goes back with the same angle."
T: "What do they call it, with the same angle? What you say is something different. What, is it correct what you say?"
S: "I don't know, probably correct."
Students laughed.
T: "Say it, my son."
S: "It is correct."
T: "It actually is correct. How, that is, why is it correct? What is this, this ray?" he asked while he was drawing the figure.
S: "Going, reflected."

T: "Reflected ray." repeated the teacher while he was writing "reflected ray" on the figure. "Reflected ray, from here, let's look, you say here is also alpha, right?" he asked while he was drawing.
S: "Yes."
T: "Why?"
S: "Principal axis is the normal."
T: "Why normal?"
S: "Since it is perpendicular to the mirror." said one student with low voice.
….
T: "Since it passes from the center, this is principal axis, since principal axis passes from the center, what?"
S: "It is perpendicular."
T: "Perpendicular to what?"
S: "To the mirror."
T: "To the mirror. That is, it is its normal. Since the principal axis is its normal, friends, sure, the angle of the incident ray with the principal axis, namely with normal is equal to the angle of reflected [ray] with principal axis namely with normal."

In the interview, the teacher also explained how giving feedback affects the students. He stated that he was encouraging them by this way. In the following excerpt from the transcripts of audio recording of interview, he shared his ideas about the effects of these teaching practices.

R: "You guide the students who solve questions on the board. How does this affect your student?"
Çağlar: "There is no meaning that the student comes to the board doing nothing. The student should say that 'Oh, I have done it.' when he/she comes to the board. That is, it's not [right to say that] 'Go to the board, do that.' You'll say something, when the student finds on the board. Even I solve all of it, when he/she goes to the board and write it, he/she will be encouraged saying that 'Oh, I went to the board, I solved a question, I can do this.' It doesn't matter who that is, 'Go the board, solve it.' The kid cannot solve, you are obliged to show the way. You called him/her to the board saying 'Come to the board.', then he/she couldn't solve. 'Sit down.' meaning 'You are shamed.' I didn't want to do that. Certainly by saying something, I don't send any of the students that I called to the board without seeing the result of the question. I have never done 'You sit down, you come.' etc. It is not a pleasant thing also for me, 'You couldn't do, the other you come', isn't it? It is a difficult situation if you are a student. ..."

Moreover, in the following excerpt from the transcripts of audio recording of interview, the teacher also shared his ideas about effects of using verbal praise on the students. He stated that he was using these, to motivate the students and reinforce their positive behaviors.

> R: “Especially, when you see your students’ participation more than the usual days, you were making some kind of appraisals. For example, ‘Özlem, you have studied today.’ or if the students’ participation is more as a class ‘Oh, you have studied today.’”
> Çağlar: “As an encouragement, I might say. As an encouragement, to make clear the students who studied, when you say ‘Oh, you studied.’ by addressing their names, the kids are honored. Therefore, once I have discovered, seen that they try to display the same behavior again. Therefore, from time to time when you say things like ‘Kids’ as you say ‘Özlem, you have studied today. Good for you.”, he/she tries to continue that, ‘Oh, he [the teacher] said this’, the student doesn’t like to hear that ‘You didn’t study today.’ I try to do that.”

4.2.2.4.4 Erkan’s case

Erkan used teaching practices related to Items 83 and 89 more frequently than the others in confidence category as presented in Table 4.14. Related to provide objectives subcategory, I have observed him mentioning and if needed fulfilling the prerequisite knowledge that were helpful for completing the task (Item 83). For example, in the following excerpt of the observation transcripts of the audio recordings, he was explaining the total internal reflection of the prisms and while explaining he mentioned a geometrical rule. Since no students responded his question, he started to explain the geometrical rule.

> T: “… If you have some mathematics, geometry knowledge, for example what kind of relationship is there between delta there and those? What kind of relationship?”
> No answer from the students.
> T: “Do you know this? An exterior angle is equal to the sum of the opposite interior angles.”
> Ss: “Yes.”
> T: “That is delta is equal to delta one plus delta two.” said writing the formula on the board.
> S: “A is equal to.”

T: "Can we write the same thing here? An exterior angle is equal to the sum of the opposite interior angles." said the teacher while the student was talking.
S: "Yes."
T: "A is equal to r one plus i two." Then, the teacher has written the formula on the board.

On the other hand, Item 89 was related to feedback category. More explicitly, he was providing feedback for acceptable responses and constructive feedback for responses that did not meet criteria. Most of the time, he was saying "Yes." or repeating students' responses to provide feedback for acceptable responses. For example, in the following passage from the transcripts of audio recording of observation, the teacher provided constructive feedback for responses that did not meet criteria.

T: "What is the most important difference between reflection and refraction?"
One student raised her hand.
S: "There is also some reflection in refraction, that [light] returns and reflects back also in reflection."
T: "If we see that it is common property. The most important difference one has and the other doesn't have.
S: "My teacher." said one student while the teacher was talking.
Teacher allowed her.
S: "Teacher, in reflection it strikes to a surface and returns back, in refraction it passes from this surface and refracts."
T: "You say. Yes, what else?"
S: "Well, that is, in reflection it strikes to a surface and returns back, in the other that is refraction it changes direction."
T: "More or less, there is a difference similar to this. In reflection the event happens in the same medium, in refraction there is transition from a medium to a different medium, isn't it? There is transition from a medium to a different medium."

In focus group interview, one student also expressed her opinions about the issue without being asked about it. In line with the observations, she confirmed that their teacher was providing feedback to their responses. The following excerpt from the transcripts of video recording of interview presents her ideas.

Ö: "He helps us with the topic or solving the question."
R: "How?"
Ö "For example, he helps about the topic, or how we are going to solve. How is it? For example, he says if you follow that way, you can solve easier."

R: “You have answered the question and said the answer is this, then?”
Ö: “Then, it might change.”

4.2.2.4.5 Comparing results of Confidence category for four teachers

Observed frequencies of teaching practices in providing objectives, expectation, feedback, and self-confidence subcategories in confidence category of the ATPQ for four teachers are presented in Table 4.13. All four teachers were “mentioning and if needed fulfilling the prerequisite knowledge, that help the learner succeed at the task” (Item 83) more than the other practices in the providing objectives subcategory, while each of four teachers performed teaching practice 82 only few times as can be seen in Table 4.13.

All four teachers were “clearly explaining what is expected from the students” (Item 87) more than the other teaching practices in expectations subcategory. However, only Alper used it frequently. In addition, no other teaching practices in this category were frequently observed. The frequencies of each item in this category are presented in Table 4.13.

All five teaching practices in feedback category were frequently performed by four teachers. The frequencies of each item in this category are also presented in Table 4.13. Each of the four teachers was “providing feedback for acceptable responses as well as constructive feedback for those responses that don’t meet criteria” (Item 89) more than the others. Çağlar used this teaching practice more frequently than the other teachers, he used it 619 times. On the other hand, “appreciating students’ positive behaviors in front of other people” (Item 92) was performed less frequently than the other teaching practices in this category. It was performed two times by Erkan and 18 times by Çağlar. Teaching practices in self-confidence category were not frequently used by any of the four teachers observed as presented in Table 4.13.

4.2.2.5 Results related to Satisfaction Category

There were 18 affective teaching practices in six subcategories in satisfaction category. These subcategories are: natural consequences, unexpected rewards, positive outcomes, negative influences, scheduling, and equity. Total frequencies of observed satisfaction related teaching practices in each week of observation are presented in Table 4.15 for four cases. Moreover, total frequencies of the subcategories are also presented in the table.

Table 4.15: Total frequencies of observed affective teaching practices in Satisfaction category and its subcategories for four cases in each week of observation

Category/ Subcategory	Case	Frequency (Class-hour)														Total
		Observation weeks														
		Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Week 7		
Natural consequences	Eda	5(2)		2(2)		0(1)		0(2)		1(2)		4(2)		X		12
	Alper	0(2)		0(1)		2(2)		0(2)		1(2)		0(2)		X		3
	Çağlar	X	0(2)	0(1)	0(2)	X	X	0(1)	0(2)	0(1)	X	0(1)	1(2)	0(1)	0(2)	1
	Erkan	X	X	0(1)	1(1)	0(1)	0(1)	0(1)	0(1)	1(1)	0(1)	X	2(1)	0(1)	0(1)	4
Unexpected Rewards	Eda	0(2)		0(1)		0(2)		0(2)		0(2)		0(2)		X		0
	Alper	0(2)		0(1)		0(2)		0(2)		0(2)		0(2)		X		0
	Çağlar	X	0(2)	0(1)	0(2)	X	X	0(1)	0(2)	0(1)	X	0(1)	0(2)	0(1)	0(2)	0
	Erkan	X	X	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	X	0(1)	0(1)	0(1)	0
Positive Outcomes	Eda	5(2)		1(2)		0(1)		2(2)		3(2)		3(2)		X		14
	Alper	3(2)		0(1)		1(2)		0(2)		4(2)		0(2)		X		8
	Çağlar	X	1(2)	0(1)	2(2)	X	X	0(1)	1(2)	0(1)	X	1(1)	28(2)	1(1)	4(2)	38
	Erkan	X	X	0(1)	0(1)	0(1)	0(1)	0(1)	1(1)	0(1)	0(1)	X	0(1)	0(1)	0(1)	1
Negative influences	Eda	0(2)		0(2)		0(1)		0(2)		1(2)		1(2)		X		1
	Alper	0(2)		0(1)		0(2)		0(2)		1(2)		0(2)		X		1
	Çağlar	X	0(2)	0(1)	0(2)	X	X	0(1)	0(2)	0(1)	X	0(1)	0(2)	0(1)	0(2)	0
	Erkan	X	X	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	X	0(1)	0(1)	0(1)	0
Scheduling	Eda	6(2)		5(2)		3(1)		7(2)		8(2)		14(2)		X		43
	Alper	5(2)		4(1)		6(2)		4(2)		9(2)		5(2)		X		33
	Çağlar	X	5(2)	6(1)	7(2)	X	X	5(1)	7(2)	5(1)	X	0(1)	12(2)	5(1)	10(2)	62
	Erkan	X	X	6(1)	3(1)	4(1)	6(1)	5(1)	6(1)	4(1)	4(1)	X	5(1)	6(1)	2(1)	51
Equity	Eda	1(2)		1(2)		0(1)		0(2)		3(2)		1(2)		X		6
	Alper	0(2)		1(1)		0(2)		0(2)		0(2)		1(2)		X		2
	Çağlar	X	0(2)	0(1)	0(2)	X	X	0(1)	0(2)	0(1)	X	0(1)	0(2)	0(1)	0(2)	0
	Erkan	X	X	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	X	0(1)	0(1)	0(1)	0
Total	Eda	17(2)		9(2)		3(1)		9(2)		15(2)		23(2)		X		76
	Alper	8(2)		5(1)		9(2)		4(2)		15(2)		6(2)		X		47
	Çağlar	X	6(2)	6(1)	9(2)	X	X	5(1)	8(2)	5(1)	X	1(1)	41(2)	6(1)	14(2)	101
	Erkan	X	X	6(1)	4(1)	4(1)	6(1)	5(1)	7(1)	5(1)	4(1)	X	7(1)	6(1)	2(1)	56

X: No observation

Eda and Alper were observed once a week for six weeks, whereas Çağlar and Erkan were observed twice a week for six weeks. Hence, there were two frequencies for each week in the table for Çağlar and Erkan. Çağlar was observed three hours a week, since there were three hours of physics lessons a week in his school; while the other teachers were observed two hours a week during the observations, since there were two hours of physics lessons a week in their schools.

As can be seen in Table 4.15, satisfaction related teaching practices were performed 76 times by Eda, 47 times by Alper, 101 times by Çağlar, and 56 times by Erkan during the observations. Çağlar performed satisfaction related teaching practices more frequently than the other teachers observed. Only the teaching practices related to scheduling subcategory were frequently and consistently performed regularly by all teachers observed. Furthermore, Çağlar also performed teaching practices related to positive outcomes subcategory frequently, however not regularly in his lessons. He performed it few times in each week of observation except in the sixth week of observation. In the sixth week of the observation he performed it 28 times in two class-hours observed on the same day.

Observed frequencies of the teaching practices in positive outcomes, and scheduling subcategories of satisfaction category of the ATPQ for four teachers are presented in Table 4.16. The most frequently observed teaching practices are discussed in detail for each case. In order to identify consistencies in four teachers' use of teaching practices related to satisfaction category; the results are presented separately for each case, and then they are compared.

Table 4.16 Observed frequencies of teaching practices in Satisfaction subscale of the ATPQ for four teachers

Category/ Subcategory	Item #	Eda	Alper	Çağlar	Erkan	SUM
Positive outcomes	100	12	8	24	1	45
	101	0	0	0	0	0
	103	0	0	0	0	0
	104	1	0	14	0	15
	TOTAL	14	8	38	1	61
Scheduling	109	6	5	12	8	31
	110	30	22	40	35	127
	111	7	6	10	8	31
	TOTAL	43	33	62	51	189

4.2.2.5.1 Eda's case

The only satisfaction related teaching practice Eda performed frequently was related to Item 110 in scheduling category as presented in Table 4.16. I have observed the teacher giving enough time to the students to take notes, solve problems, and answer questions.

The teacher explained why she gave time to the students to take notes, solve problems, and answer questions in the interview. She stated that she was trying to give enough time to the students to increase their motivation and sustain their interest. The following excerpt from the transcripts of audio recording of the teacher interview presents her responses to my question related to the issue.

> R: "I have also observed that you were giving time to your students to take notes, especially to solve problems, and to answer questions."
> Eda: "Some solve quickly, immediately says the answer while you are writing the question. But some are slower… As much as possible, one should try to mediate so that any of them doesn't lose interest, all of them, well, spend effort. Anyhow, most of them do this, anyhow the question is solved, I don't need to solve it, I write from the board. Therefore, as much as possible, I try to give time for all of them, so they try to solve. They don't have the same pace. It is beneficial to wait. But the students who solve first should be stopped meantime. Then we do reward-punishment. You remember, we charge the chatting students and students giving the answer [without permission]."

Students also confirmed that their teacher was using the class time efficiently. In the following excerpt from the transcripts of video recording of student interview, students explain that the teacher was using class time effectively by solving many questions.

> R: "Does your teacher use class time efficiently?"
> Ss: "Yes." said several students.
> N: "She does, she solves a lot of questions…"

4.2.2.5.2 Alper's case

The only satisfaction related teaching practice Alper frequently used was related to Item 110 in scheduling category as presented in Table 4.16. I have observed him giving enough time to the students to take notes, solve problems, answer questions, and conduct experiments. Most of the time, he was waiting for the students to take notes by moving around the classroom and he was also giving extra time to the students who were not able to finish the experiments in the laboratory. Moreover, when a student couldn't answer the question immediately, he was saying things like 'Don't you have respect to your friend.' etc. to other students who were raising their fingers to answer question in order to give time for the student.

In the following excerpt from the interview transcripts of audio recording, the teacher shared his ideas about giving enough time to the students for taking notes, solving problems, answering questions, and conducting experiments. He mentioned that by giving extra time to students who were answering or solving questions, students' interests might be increased, if they were able to answer or solve the question in that extra time. He also expressed that by giving extra time, he was trying to encourage students who were not able to solve or answer the question in time; however, there were cut points for the extra time he gave to the students.

> R: "Also doing experiments, besides that, when the students were taking notes, solving questions, answering. Moreover, even sometimes when a student couldn't answer while the other students were raising their hands saying 'We can answer.'

you were saying 'You stop, wait. Don't you have respect to your friend.' etc. to stop them and try to give enough time to your students. I have observed that,"
Alper: "… But if it is a hardworking student, I should give him/her time anyway, I should stop the others anyway that he/she doesn't get offended."
…
Alper: "The purpose of giving time is to be exactly sure about him/her if he/she could answer that question or not. If he/she could answer, his/her interest to the lesson increases extensively anyway. To obtain that."
…
Alper: "Now, the students grow up in a competition environment. But if we want to provide meaningful learning, we need to keep students a little bit away, independent from the time. For this moment, especially 9 and 10th graders don't have much to do with time, they have considerable time to the university entrance examination, about two years, therefore they solve a question in 5 minutes, solve in 10 minutes, it is not very important. What is important is perceiving the questions quickly, and improving ways to solve. That is, there are problem solving strategies, adapting those problem solving strategies to life as soon as possible. Therefore, I give time, 3 minutes, 5 minutes but those 3 minutes, 5 minutes are the minimum times. Therefore, I add additional time to them, that if the kids can handle, they try to deal with the problem in that time. But as I said it doesn't extend to 10 or 20 minutes. It is too much time for a question to give 10 or 20 minutes. This is, sure, we make generalization, but there is difference between questions. If it is a group work, they have 20 minutes to think. The questions there are normal example or problem, small, simple example. They must be distinguished."
R: "How does this affect your student?"
Alper: "Giving extra time always affects positively according to me. At least, when you give extra time, the student who did the question has time to check his/her answer or sometimes this can be; I have observed that when I give extra time, the students who did try to help his/her friend next to him/her. This is also positive in terms of their learning according to me. There might be these kinds of interventions. Therefore, I haven't seen something negative, when I give extra time. People who cannot do anything are also encouraged by this way. There is opportunity to distinguish, find out, recognize people who couldn't think anything about the solution of the questions."

Besides, when he was answering a question related to providing feedback he mentioned about using competitions to condense the time spent for solving questions in the classroom. He mentioned that he was trying to shorten the time spent for some tasks to sustain successful students' attention.

> Alper: “I usually make a competition. … I will give a grade to who solves and brings the answer to me etc. exactly. Now, when there is a competition, since when you say ‘Let’s write this question, solve it.’ the period might extend. When the period extends, successful students lose their attention, since successful students solve the question in 2-3 minutes, that is a normal question. Now, if we give 10 minutes to a question, well, of the lesson vanishes, that is, even the kid is hardworking or lazy, giving 10 minutes to a question is too much. There are many things that can be done in that lesson. Because of that, the aim of the competition there is to speed up the kids, who solve that question in 5 minutes or 10 minutes, and reach the others. That is, they got used to thinking fast, interpreting fast something, to make them acquire that. Those two or three students who come to me, to get that grade, probably they are hardworking; they must have come to get grade. I might have said if they have deficiencies, ‘Look, go and correct it. Let’s wait the time.’ If I have given 3 minutes, I expect them fill that 3 minutes properly. Since there are students who can solve that question at the end of 3 minutes, I sometimes give time and wait till the end of time. Not the one who brings it first but I might do who solved it at the end of three minutes.

Students confirmed that their teacher was giving enough time to them to take notes, solve problems, answer questions, and conduct experiments in the interview.

4.2.2.5.3 Çağlar’s case

The two satisfaction related teaching practices Çağlar frequently used were related to Item 100 in positive outcomes category and Item 110 in scheduling category as presented in Table 4.16. He was frequently using verbal praise like “Well done.” and “That’s it.” for students’ efforts (Item 100).

In the following excerpt from the transcripts of audio recording of interview, the teacher confirmed that he used verbal praise in his lessons and it was something that every physics teacher should do.

> R: “You say ‘Well done, good for you.’”
> Çağlar: “Well, these are the things that every teacher should do, did. … Every colleague does that, you have observed. Really it is, that is. … [One] cannot say ‘Stupid, silly’ etc. to the kid, some flattery, it should be said to a kid that age ‘…, come on, you can do that.’ etc. ...”

Moreover, he was giving enough time to the students to take notes (Item 110). In the interviews the students also confirmed that their teacher was giving enough time to them. In the following excerpt from the transcripts of video recording of interview, only one student stated that she wasn't able to take notes, since the time was not enough for her. Only this student was also observed to be late, while taking notes in the observations.

> R: "Your teacher gives you enough time while taking notes, solving questions?"
> S: "Yes."
> Z: "Yes. He waits us."
> E: "I can't catch up, honestly. I got stressed when I can't catch up."

4.2.2.5.4 Erkan's case

The only satisfaction related teaching practice Erkan used frequently was related to Item 110 in scheduling category as presented in Table 4.16. He was giving enough time to the students to take notes. In the interview, the teacher confirmed that he gave enough time to the students while taking notes, answering questions and in the exams. In the following excerpt from the transcripts of audio recording of the teacher interview, he stated that he was giving extra time to the students in the exams to get good results.

> R: "You usually give enough time to your students while taking notes, answering questions etc."
> Erkan: "Absolutely."
> R: "I haven't observed you in the exam but,"
> Erkan: "I wish you had observed an exam. Sometimes if it is break time or lunchtime, I also give extra time. I do that sacrifice. Just to get a good result."

In the focus group interview, one student also confirmed that their teacher was giving enough time for them to take notes and moreover in the exams, and this was helpful for reducing their anxiety. The following excerpt from the video recording of the interview with the students also indicates this.

> R: "I have observed your teacher giving time for you to take notes. Does your teacher give enough time for you in the exams?"

E: "Yes, he is really one of the best teachers in the exams. When time is not enough for us he even gives the break time.

4.2.2.5.5 Comparing results of Satisfaction category for four teachers

Observed frequencies of teaching practices in positive outcomes, and scheduling subscales in satisfaction category of the ATPQ for four teachers are presented in Table 4.15. The frequencies of each item in positive outcomes category are presented in Table 4.15. The most frequently observed teaching practice was "using verbal praise, real or symbolic rewards, and incentives, or allow students to showcase the results of their effort ("show and tell") to reward their success after instruction" (Item 100) in this category. It was performed 24 times by Çağlar and 12 times by Eda. Moreover, teaching practice "providing motivational feedback when students make mistakes" (Item 104) was performed 14 times by Çağlar. However, teaching practices related to Items 101 and 103 were never performed by any of the four teachers.

All four teachers were "giving enough time to the students while they are solving problems, answering questions, taking notes, conducting experiments, in the exam etc." (Item 110). They performed it more than the other teaching practices in scheduling category as presented in Table 4.15. All four teachers were "using class time effectively" (Item 109) and were "allowing adequate time for exploration of a topic" (Item 111) as much as possible during the observations; even there was only two class hours of physics lessons in a week in three schools and three class hours of physics lessons in a week in private science high school. However, the other practices were only performed few times.

4.2.3 Students' Reactions to Affective Teaching Practices Performed by Physics Teachers

Students' reactions to the affective teaching practices were examined through observations, to answer the fifth research problem, which is "How do students react to teaching practices that four purposefully selected "good" physics teachers frequently use?" Moreover, student interviews were also conducted to support the observations.

Students' behaviors are observed by using the observation scheme used by Guilloteaux (2007), to find out level of their motivation and attitudes. Three class hours of observations in Eda's classroom, Alper's classroom and Çağlar's classroom were analyzed using this scheme. However, only one class hour of observation in Erkan's classroom was analyzed, since only one class hour was video recorded in this school. The checklists for each class hour analyzed are presented in Appendix N. In line with Guilloteaux (2007), classrooms were accepted as highly motivated and having high positive attitude, if at least 2/3 of the students appear to be paying attention, at least 2/3 of the students actively take part in classroom interaction, or work on assigned activity, and at least 1/3 of the students volunteer without the teacher having to force them. Table 4.17 presents students' behaviors related to their affective characteristics.

Table 4.17 Students' behaviors related to their motivation and attitude

Behaviors	Date of observation									
	15.04	14.04	07.04	18.04	04.04	04.04	16.04	09.04	09.04	22.04
	Çağlar	Çağlar	Çağlar	Eda	Eda	Eda	Alper	Alper	Alper	Erkan
Attention	High	High	High	High	High	High	High	High	High	High
Participation	High	Med	Med	High	Med	High	Low	NA	High	Low
Volunteering	Low	Low	NA	Med	High	NA	Med	High	Med	Med

Med: Medium NA: Not Applicable

Results of classroom observations revealed that most of the time students' attention was high in all four classrooms as can be seen in the table. Moreover, when there were opportunities for students to participate, students' participation was varying mostly between medium and high. On the other hand, once Alper's students and most of the time Erkan's students were observed to have low participation to the lessons. Besides, most of the time there was no opportunity for students to volunteer for an activity in the four classrooms observed. Except Çağlar's students, the students were volunteering to the teacher fronted activities highly or medially. Çağlar's students, on the other hand, were displaying low volunteering to the activities. Additionally, which were audio recorded in Erkan's and Çağlar's classrooms were also in line with these results.

It can be concluded that Eda's students had the highest motivation and attitudes compared to the other three classrooms, and Alper's students also had higher motivation and attitudes compared to Çağlar's and Erkan's students. Considering the audio recorded observations and the results presented in Table 4.17 together, it can be concluded that Erkan's students were the students with the lowest motivation and attitudes compared to the other three classrooms observed.

Interviews with the students in four classrooms also provide more information about the effects of teaching practices frequently performed by four teachers. The results of the student interviews are also presented case by case for each category of the ATPQ. The interview results are presented with the observations of the students' behavioral engagements in physics courses whenever possible.

4.2.3.1 Results related to Communication Category

4.2.3.1.1 Eda's case

During the observations, Eda was usually communicating positively (Item 2) and was smiling in class (Item 3). The following excerpt from the whole class interview also confirms that the students were affected by teacher smiling frequently. One student stated that teacher's use of this teaching practice was influential, that she liked physics more.

> R: "When your teacher smiles in the classroom does this affect your liking physics lesson or your desire to study physics?"
> Ss: "Yes, it does." said several students.
> R: "How?"
> S: "It affects me; I like physics more but not my desire to study."

In addition, two of the students stated in the interviews that teacher's positive communication was influential on them by explaining how it affected them. They were thinking that teacher had influence on them, that she could affect their attitudes toward the lesson. The following excerpt from the transcripts of focus group interview enlightens this point.

> N: "If you understand that the teacher feels something, has good feelings for you, you also feel something for the teacher."
> G: "Teacher's behaviors being positive affect the student.
> S: "Teacher is the one who makes students love the lesson."
> G: "Absolutely, teacher has a very big influence, 75 percent is the teacher, 25 percent is the lesson itself."

Eda created an atmosphere for students to ask questions without hesitating (Item 5) and was spending time for speaking to students one by one or as a group (Item 8). She was giving time to students to solve the questions. Meanwhile she was walking around the classroom, checking students' solutions, and speaking to them one by one or as a small group. Most of the time, all of the students were paying attention to the task.

In line with my observations, in the following excerpt from the student interview the students expressed that having a classroom atmosphere, where they can ask their questions without hesitatingly and having opportunity to talk to their teacher one by one, contributed to their affective characteristics. Additionally, two students stated that they like physics courses more since they understand better in such an atmosphere. Conversely, another stated that it did not have any contribution that she did not liked physics course more, but she can focus her attention better and her motivation to study physics is enhanced. One more student clarified the issue saying that even if she hesitated asking questions in the classroom, she had the opportunity to ask the teacher questions one by one in and out of the classroom, and hence both she liked the course more and motivation in the course is increased.

> R: "How does this [asking questions without hesitating] affect you?"
> S: "We can ask anything confusing us, no questions are left behind. Since the teacher being a smiling person affects this."

B: “For example, when we solve tests ourselves, we can ask our questions in the break time. This affects, we learn what we couldn’t do.”
R: “I have observed that any of you were able to ask questions to your teacher without hesitating, and you were able to ask questions after she has written the question on the board and walking around the classroom?”
Ss: “Yes.” said several students.
R: “Does this affect you in terms of your liking physics lesson or your desire to study physics?”
S: “It really affects me.”
R: “How? Why?”
S: “I can understand better if the teacher explains me one by one. I like the course since I understand.”
B: “I agree.”
D: “I have distraction of attention. When the teacher explains on the board I don’t understand, but when she comes close it helps me to focus my attention, but not my liking.”
R: “What about your desire to study?”
D: “As a result of being able, desire to study increases.”
G: “It affects both my liking and my desire to study, affects positively. Because it removes the problem like I don’t understand and hesitate if some people in the classroom laughs at me such like. When the physicist explains one by one I understand better even if I couldn’t understand in the classroom, I can understand better when she explains one by one. So, my desire to study also increases.”

I have also observed that she was frequently repeating parts that were not understood by the students (Item 14). Students stated that since they learn better by this way, they like physics more. In the following excerpt from the transcripts of video recording of the focus group interview, students shared their opinions about this teaching practice with me.

R: “Does this [repeating parts that are not understood] affect you?”
G: “Sure, it affects. If we don’t understand, if there is missing things, we can’t do that question type it in the exam and there is university entrance exam in future, we have an exam. Thus, this, in physics, it affects positively.”
S: “Our knowledge becomes permanent.”
R: “How about your liking or desire to study?”
S: “When I am able to do a topic, I like it.”

Eda has created an atmosphere suitable for learning (Item 7) and was checking if the students followed the lesson or not (Item 17). In the focus group interview, students confirmed that their teacher was checking if they followed the lesson; and that they were following the lesson after they were subject to these practices. The following excerpt from the video recording of the interview enlightens the students' views.

> R: "When she does something like that, does this affect you? Or what does this affect your liking, your desire to study, or something else? Does it affect or not?"
> O: "In case she asks a question again, I leave the book open. In case she asks a question again."
> S: "We come prepared, since it is not known what she is going to ask. She teases us in the classroom; we try to be more careful not to be teased again."

Furthermore, I have observed the teacher teasing the students several times. For example she asked one student to cock a snook at her friend who couldn't solve the question or said 'Dirty' to another. After the lesson I had the opportunity to ask questions to three students who were teased one by one. Each of these students stated that they were not offended by the teacher's teasing, since they were aware that she was joking and trying to encourage them.

Also, in the whole class interview many students commented on this issue and stated that they did not get offended. Besides, I asked if any of the students get offended by their teacher's teasing, only one student raised his hand. He was among the few students who were chatting in the lessons and trying to disrupt the lessons that another student stated that he deserved it. In line with my observations, students were thinking that the teacher was using these teaching practices to get their attention, and to increase their interest and motivation. The students also stated that they were aware that their teacher cared about them. The following excerpt from the video recording of the whole class interview enlightens the students' views.

> A: "I know that she is making joke."
> …
> B: "She is trying to encourage us."
> …
> S: "I know that the teacher is joking. So, I am not offended. She shows us that she cares us, I think."
> D: "I think, by doing things like this the teacher increases the interest in the lesson. … When the teacher explains the topic continuously, everybody gets too

much bored. … I think, teacher's teasing people, it shows that she cares about the class. You get distracted, distracted from the lesson, she tries to get our attention back. I don't know. The people that she teases are generally people who are distracted too much, I think."
M: "She teases us as a joke. Nobody gets offended. If she has a real [another] intention she would tell when she comes to check our notebooks. We all make mistakes. She checks all the questions, from the beginning to end, she shows where we made mistakes, like mathematical mistakes one by one. She cares about us. Maybe, it might be to entertain us. Since sometimes, when we couldn't do we might get demoralized. Everybody does, we might feel bad. I wasn't offended.
C: "I don't afraid to make mistakes. There are some teachers they humiliate you when you make mistakes. Our teacher is not like that."
R: "You don't think that is humiliation."
C: "Yes. Just the opposite."
R: "Why?"
C: "Since we don't get offended. Besides, our teacher's character is that."
M: "Moreover, we see that we are not actually that bad when she laughs us saying 'You can't do.' It is not something too bad. Some of our teachers might react harshly. Our teacher doesn't."

During the observations, she was helping students to take clear notes (Item 16) and all of her students were writing what she was dictating. For example she was dictating the questions by repeating for students to write. She was also emphasizing important parts (Item 18) and most of the students were paying attention to what is being emphasized. In line with the observations, in the interview students stated that when the teacher emphasized something that they paid attention to it, since they thought it would be asked in the exam. Students' views were confirming the observations. In the following excerpt from the video recordings of the focus group interview the students shared their ideas with me.

…
R: "Does this [emphasizing important parts] have any effect?"
S: "[It means that] it is going to be in the exam, [so] we pay attention to it."

I have also observed her solving a lot of questions related to each topic (Item 20). Sometimes she was solving the questions and sometimes she was asking the students to solve the questions on the board. But most of the time, she was giving time to students to solve the questions in their notebooks before solving them on the board. Most of the students were paying attention to the questions.

Moreover, I have observed her explaining the logic behind the topic and the formulas frequently (Item 21). In accordance with my observations, in the interview one student expressed that the lesson is more enjoyable and several others expressed that they loved it more since their teacher explained the logic behind the topic and the formulas. Another student stated that by this way they wanted to participate to the lesson, while two stated that they understand better, and therefore they understood better and found physics easier when they learn in this manner. Hence, it can be concluded that the students think this teaching practice is effective on many aspects of their affective characteristics such as interest and confidence. The following excerpt from the transcripts of video recording of the student interview clarifies their ideas.

> R: "Does this [the teacher explaining the logic behind the topic and the formulas] make any difference in your view of physics? I ask you this, since you are able to compare with last year."
> B: "It is easier."
> S: "Not easier but more enjoyable."
> S: "The desire to participate in the lesson increases."
> M: "I was thinking that physics was a memorization lesson, but now I understand that it is a logic lesson. Therefore, I love it more."
> Ss: "Yes, I also think." said several students.
> O: "It is easier, I understand better. It is easier to solve."

4.2.3.1.2 Alper's case

Alper has created an atmosphere suitable for learning (Item 7) and was checking if the students followed the lesson or not (Item 17). I have observed Alper, using activities, group work, competitions, laboratory work, etc. in the lessons, to increase students' participation and attention. Moreover, almost all of the students were paying attention and participating to the lesson when he used such activities.

I have observed him explaining the logic behind the topic and the formulas (Item 21). In the following excerpt from the transcripts of video recording of interview, his students confirmed that their teacher was explaining the logic behind the topic and the formulas. One of the students also stated that it helped them getting good grades; hence they liked the lesson more. Another student expressed that his motivation increased when he was able understand. Conversely one student stated that his ambition increased when he wasn't able to understand, hence he studied more when he couldn't understand something in the lesson.

> R: "How does understanding affect you?"
> S: "It is very important."
> …
> D: "Understand, I am more successful in the exams, when I am more successful, I love more. When I love more, I become more successful. It goes on successively."
> S: "… When we understand, our desire to study increases. I understand this lesson, oh look we say, and desire arises."
> …
> S: "Ambition might increase when you don't understand, but I don't think anyone will love that lesson when they don't understand. … Not to love, but to understand. …"

4.2.3.1.3 Çağlar's case

Çağlar was using teaching practices Items 7, 14, 15, 16, 17, 18, 20 and 21 frequently in his lessons. However, his students only confirmed that he used several of these teaching practices, but they didn't provide information about how these teaching practices affected them. Moreover, the students' observed behaviors indicating their attitudes and behaviors were presented in Table 4.17. Generally, their behaviors were similar to those behaviors while the teacher was using these teaching practices.

4.2.3.1.4 Erkan's case

I have observed Erkan writing clearly and systematically on the board (Item 15). In the following excerpt from the transcripts of video recording of focus group one student stated that this teaching practice was affecting their motivation and another approved by her gestures that this teaching practice was influential on their affective characteristics.

> R: “Does this have an effect on you or your interest or your desire to study?”
> S approved by her gestures.
> O: “It does our desire to study, but not related to our liking.”

Erkan was also helping students to take clear notes in his lessons (Item 16). Most of the time, all the students were writing what he was dictating. Furthermore, in the focus group interview, five students stated that these notes were useful for them, while one student stated they were not useful.

> R: “I have observed your teacher dictating for you to take notes.”
> H: “I, it is useless, he might give the formula and writes explanation under what he gives. It is enough for us.”
> E: “No, no. Those notes are something for us how to use the formula, that is, something helpful. If those notes are not present we can’t do anything with the formula. What is what, how are we going to use what, without the notes the formula are meaningless.”
> R: “Are there any other opinion?”
> O: “It is useful.”
> Ö: “It is useful, since I can interpret those notes. I can keep them in my mind.”
> H: “I think they are useful.”
> S: “Sure, they are useful for the student.”

I have also observed him emphasizing important parts (Item 18) and most of the students paying attention, when he was emphasizing things. Furthermore, Erkan was explaining the logic behind the topic and the formulas (Item 21) and most of the students were following him usually while he was explaining. For example, while he was explaining the minimum deviation in prisms on a figure he drew on the board, students were following him.

4.2.3.2 Results related to Attention Category

4.2.3.2.1 Eda’s case

Eda was using questions to make students participate to the course (Item 34). Students confirmed that their teacher was asking questions to them in the interviews. In line with my observations, they stated that their teacher was increasing their attention by asking questions to them. Besides, students explained how it increased their motivation and confidence. In the following excerpt from the transcripts of video recording of student interview, they point out several things about this teaching practice.

> …
> R: "Sometimes while explaining the topic or she takes you to the board, or sometimes she comes by you and asks how you did this? … How does this affect you especially while she is explaining the topic and or solving questions in the classroom to make you participate?"
> S: "We listen to her, since she might ask questions."
> G: "We pay more attention to that lesson."
> O: "I am more motivated."
> N: "Our confidence increases. Since we come to the lesson prepared, we can express ourselves more easily."
> S: "Since we are prepared, we can understand when it is explained once."
> N: "It causes us to come prepared; since she does this we come prepared."

4.2.3.2.2 Alper's case

In concreteness category, he was using examples and questions related to daily life (Item 23). Most of the students were listening to him, while he was using examples and questions related to daily life. Moreover, sometimes the students were giving examples from daily life themselves. In other words, they were participating to the lesson. In the focus group interview, students also confirmed that Alper was using daily life examples without being asked about it, while they were answering another question. In the following excerpt from the transcripts of video recording of interview students were sharing their ideas about this teaching practice. The students stated that by using daily life examples and making jokes the teacher sustained their attention.

> R: "Does he use more than one example, story, joke, anecdote, research etc. while explaining the topic?"
> D: "The lesson passes like that."
> S: "It is more useful."
> R: "In what respect?"

S: "In respect of, when a teacher comes and just tells the topic without stopping in 45 minutes. I don't think any students understand anything. In order to divert, both giving examples from daily life and showing practically and by making jokes."

In the interview, students also remembered some of the daily life examples the teacher gave in the classroom. The following excerpt from the video recording of student interview indicates their ideas about using examples from daily life.

R: "Does your teacher use examples from daily life?"
S: "Sure. He just used us."
K: "Glass, expansion, err well, he explained, when the pot are one inside the other, put into hot water to take out. He explained these. He uses in daily life. He continuously says us that physics is part of daily life so you can use it."

Besides, to concretize what he explained, he was drawing diagrams, visual materials and concrete materials (Item 26). He was sometimes drawing the figures and sometimes he was using power point slides to show figures. Most of the students were paying attention to what is being showed. In the following excerpt from the transcripts of video recordings of focus group interview, students stated that their teacher used this teaching practice to help them understand the topic better.

R: "… Does it have any contribution that he uses such things, visual materials, laboratory, or concrete materials? To your liking of the lesson, understanding, desire to participate or desire to study?"
S: "Teacher's aim for doing this is for us to understand better. …"
K: "Some of our friends understand better by visual materials, some better with other. He is trying to address all of us."
S: "Audio."

On the other hand, in inquiry subcategory he was using questions to make students participate to the course (Item 34). In the interview, students also confirmed that their teacher was asking questions to make them participate to the course.

4.2.3.2.3 Çağlar's case

Çağlar was using his gestures, mimics, body movements and tone of his voice in accordance with the importance of the theme (Item 38). For example he was explaining the image formation in concave mirror on the figure of a concave mirror on the board in the following excerpt from the transcripts of video recordings of observations. Most of the students were listening to him.

On the other hand, in inquiry subcategory he was using questions to make students participate to the course (Item 34) and asking questions like “How” and “Why” in order to help them understand the theme deeply (Item 35). He was using questioning as the basic teaching method in his lessons. Students were participating to the lesson, at least paying attention to the lesson when he asked questions.

In line with my observations, in the following excerpt from the transcripts of video recording of whole class interview, students stated that by asking questions the teacher was increasing their participation to the lesson and hence their self-confidence was increased.

> R: “Is it right that your teacher was continuously asking questions in the lesson?”
> S: “Right.”
> R: “Does this have a contribution to you?”
> Students started to talk at the same time.
> O: “It contributes us finding some of the things. He wants us to find.”
> Z: “It provides us to participate to the lesson better.”
> E: “When we find it, our self-confidence increase.”

4.2.3.2.4 Erkan’s case

In inquiry subcategory, Erkan was using questions to make students participate to the course (Item 34). However, usually the same students were participating to the lesson. Even though, more than half of the students in the classroom were paying attention to the lessons most of the time. In focus group interview, one student expressed her ideas about teacher solving many examples without being asked about it. She stated that it helped them understand the topic better if they see different kinds of questions.

E: “Physics and the other lessons, requires us to solve as many examples, since when we see different kinds of examples, it provides us to understand, comprehend this lesson better.”

4.2.3.3 Results related to Relevance Category

4.2.3.3.1 Eda’s case

Eda was the teacher who used her students’ names most frequently (Item 45). In line with my observations, in the following excerpt from the transcripts of video recording of the focus group interview, students told that their teacher knew and used their names, hence they attended and participated more to the lesson, and felt that they were being cared by their teacher.

R: “How does your teacher’s use of your names affect you?”
S: “I feel like that, I am participating to the lesson.”
G: “The teacher noticed my intelligence.”
R: “Does this affect you?”
B: “Since she knows us, we have to behave more carefully.”

In modeling category the most frequently used teaching practices were explaining what she teaches in a step by step approach (Item 67). I have also observed her asking students to explain what they do when they are solving problems at the board. (Item 68). Most of the students were paying attention to what is explained.

4.2.3.3.2 Alper’s case

Alper was using his students’ names frequently in his lessons (Item 45). In the following excerpt from the transcripts of video recording of the focus group interview, students confirmed that their teacher was using their names and it showed them that their teacher cared about them. However, in line with the teacher’s opinions several students stated that it did not affect any of their affective characteristics. Moreover, most of the students stated that it wouldn’t influence them if their teacher did not know their names. One student said that “It is in between, it both influences and not. Not very much.”, while the other said that "It wouldn't affect, but he should know." On the other hand, during the observations most of the students were paying attention to the lesson, when the teacher used their names.

R: "He usually addresses you with your names?"
….
R: "Does this have an effect?"
D: "What would it affect?"
R: "For example he didn't know your names?"
K: "He wouldn't let us notice."
D: "He says 'my son'."
K: "It was the case at the beginning."
S: "It shows that he cares us, we had an influence."
F: "It is in between, it both influences and not. Not very much."
D: "It wouldn't affect, but he should know."

Moreover, in experience subcategory, I have observed him using examples from situations that are familiar to the students (Item 49), and relating current learning to real life (Item 52) and students were paying attention to him.

4.2.3.3.3 Çağlar's case

Çağlar was using students' names frequently in his lessons (Item 45). Students confirmed that their teacher was usually using their names. Several students expressed that their teacher knew and used their names and also some other information about them. They also added that, addressing them with their names made them think that their teacher valued them, it affected the value they give to their teacher and hence the value they give to the physics lesson. Conversely, one student stated that it did not affect his love to physics lessons. The following excerpt from student interview includes these students' ideas.

R: "Your teacher usually addresses you with your names, right?"
S: "Yes."
R: "Does it important for you him addressing you with your names?"
Oz: "It is better that he address with our names. It is not clear if he says 'You in the back."
Z: "Valuing us."

R: "Is there something like he addressed me with my name, he knows me?"
E: "Yes. … He even knows father's job."
R: "Okay, then I ask you like that. He even knows your fathers' job, does this?"
Ss: "It shows that he cares us."
R: "Does these increase things like the value you give to physics lesson?"
B: "Only the value we give to the teacher."
Ss: "Yes." said several students.
R: "Does this influence your liking of the physics lessons?"
H: "Yes."
B: "No, it doesn't affect. I love my teacher but not the lesson."

I have also observed him explaining what he taught in a step by step approach (Item 67). Moreover, in the interviews students explained how explaining what is being taught in a step by step approach helped them. They stated that in this way they were learning the topic better and more easily. The following excerpt from the student interview indicates their views.

R: "Your teacher explains what he teaches in a step by step approach, while solving an example or explaining something he explains them gradually. Does this have an effect?"
S: "Sure."
B: "We comprehend it more easily."
Z: "No point is left ambiguous. He shows the solution one by one, piece by piece. He explains everything."
M: "He helps us to deduce the cause-effect relationship."
…
Ozan: "We understand better."

4.2.3.3.4 Erkan's case

Erkan was using students' names in his lessons (Item 45). In the interview two students stated that teacher addressing them with their names affected their affective characteristics related to physics while another stated it did not. The following excerpt from the transcripts of video recording of the interview reveals students' thoughts.

R: "I have observed your teacher using your names. Does this affect you?"
E: "If the teacher addresses me like "you in the front" or "you in the back", I don't like it. I feel the teacher values me or he is aware that I am interested in the lesson. This affects me really positively.

O: “It doesn’t affect me.”
G: “If the teacher addresses me like “you in the back”, I don’t like it, it also distracts my attention.”

In experience subcategory, he related current learning to real life (Item 52). In the interview the students explained how relating current learning to real life affected them. According to students relating real life to what they were learning was getting their attention, hence increasing their interest in physics, and it also helped understanding the topic, thus it was increasing their confidence. Students also confirmed that relating their hobbies to the topic also grasped their attention and increased their interest in the lesson. Moreover, since it helped learning more easily and remembering what they learned before, hence it increased their confidence. In the following excerpt from the video recordings of the focus group interview, students shared their ideas about relating what they learn to real life.

R: “I have observed you teacher relating what he teaches in the classroom to real life, for example he mentioned rainbow while he was explaining the colors. Moreover, I have observed him using some other examples. Does it affect how much you like this lesson, your interest in this lesson, and desire to study this lesson?
Ss: “Yes.”
R: “Why did it affect you?”
A: “We understand the topic better. … When he uses daily life examples at least something is visualized in our minds and thus it helps us understand this topic better.”
B: “It doesn’t affect me.”
R: “Why?”
B: “The daily life physics affect me. For example the traffic accidents. …” Student was giving examples from mechanics and he told that they were interesting.
R: “You are not interested in optics, right?”
B: “Yes, light.”
A: “The examples given in the classroom are related to things we can face with in our lives.”
C: “These kinds of things take our attention. So I am more interested.”
D: “We get better grades, we understand the topic, we study more and we are more efficient. It gets easier to learn.”
F: “The physics in the documentaries is interesting, but we see topics in classroom which are not useful, …, not the way it is taught.”

R: “If the teacher relates what he teaches to your hobbies, does it affect you? How?”
O: “It [what we learn] is more permanent.”
K: “If he relates my hobbies, it interests me.”
H: “It gets my attention, even if I was not listening to the teacher, and I start to listen what he explains.”
O: “If he gives examples related to us we can remember easily in the exam.”

Moreover, Erkan was explaining what he taught in a step by step approach (Item 67) and most of the students were following him usually while he was explaining. In focus group interview one student stated that they understood better, while another added that they believed they can be successful if they study something they understood. Hence, it increased students’ confidence. The following excerpt from transcripts of video recording of student interview reveals their ideas.

R: “Does your teacher explain what he teaches in a step by step approach?”
H: “Usually.”
R: “Does it affect you? How does this affect you?”
Ö: “It affects positively.”
E: “While solving a question, if he doesn’t explain what he does, we cannot remember what he did, later.”
S: “It helps the student learn more, to understand.”
…
R: “Does this have an effect on your liking of the lesson or your desire to study the lesson?”
S: “Yes, sure.”
…
O: “Since if we study something we understand we believe we can be successful…”
S: “We understand, we like more.”
G: “If a student understands a topic very well, he/she likes it.”

4.2.3.4 Results related to Confidence Category

4.2.3.4.1 Eda’s case

I have observed Eda performing the teaching practices related to Items 89, 90, 91, and 93, which are related to feedback category. I have observed her providing feedback for acceptable responses and constructive feedback for responses that didn't meet criteria (Item 89), providing feedback when students needed help (Item 90), using verbal praise, personal attention, helpful feedback, and motivating feedback following task performance (Item 91), and giving information about students' mistakes and learning strategies (Item 93). In line with the observations, students stated that their teacher was providing feedback to them when they needed. In the following excerpt from the focus group interview, they stated their opinions about teacher's feedbacks. They expressed that by using feedback the teacher helped to increase their confidence and liking of the lesson.

> R: "While solving problem, doing homework etc. if we need help she guides us, this might be while you are on the board, while you are solving questions in your notebooks or other times, when you need help and go to your teacher guides you, right?"
> Ss: "Yes." said several students.
> R: "Does this have an effect on your liking and desire to study, your interest in the lesson?"
> N: "We can show our teacher that we are able to do the questions."
> G: "If we know the method of the question, it is easier to solve those kinds of questions. By being able to solve our confidence increase, when our confidence increases we love the lesson."

One student, without being asked about the issue, mentioned that the teacher was providing feedback and it showed that the teacher cared about them. The following excerpt from the transcripts of video recording of the whole class interview includes her ideas.

> M: "…We all make mistakes. She checks all the questions, from the beginning to end, she shows where we made mistakes, like mathematical mistakes one by one. She cares about us."

4.2.3.4.2 Alper's case

I have observed Alper clearly explaining what is expected from the students (Item 87). One of the students expressed that when the teacher gave feedback and helped while they were solving questions, their self-confidence was increased. The following excerpt from the transcripts of video recording of student interview includes this student's ideas.

> R: "While you are solving questions, doing homeworks, or doing experiments in downstairs [laboratory], did he guide you when you need?
> ….
> R: "Do these kinds of things contribute to you?"
> K: "It does. When we do a question, our self-confidence increase. Sure, it has an effect."

4.2.3.4.3 Çağlar's case

I have observed Çağlar mentioning and if needed fulfilling the prerequisite knowledge that were helpful for completing the task (Item 83). In the following excerpt from the transcripts of video recording of interview, students confirmed that their teacher was fulfilling the prerequisite knowledge they needed to understand the topic and stated that it really helped them understand the topic better.

> R: "If there is a problem related to understanding the topic. For example, your teacher has seen that there is a problem related to sines and cosines. He has explained it again, he needed to cover it again. Does this have a contribution?"
> Z: "Yes. It also helps us comprehend the topic. It is a part of the question."
> C: "Our teacher doesn't enter the topic straightly. He explains what he should explain and he passes. Since, he knows that if he explains all of it, he knows that we are going to understand."
> R: "How does this contribute?"
> G: "It helps us understand better."

On the other hand, Items 89, 90, 91, and 93 were related to feedback category. I have observed Çağlar providing feedback for acceptable responses and constructive feedback for responses that didn't meet criteria (Item 89), providing feedback when students needed help (Item 90), using verbal praise, personal attention, helpful feedback, and motivating feedback following task performance (Item 91), and giving information about students' mistakes and learning strategies (Item 93). In line with the observations, in the interview, students explained how teacher's use of verbal praise and feedback affected them. Students were thinking he was using verbal praise to increase their motivation, and it encouraged them. In the following excerpt from the transcripts of audio recording of interview, the students expressed their opinions about teacher's motivating feedbacks.

> R: "Your teacher says that you can be successful in physics lesson."
> Ss: "He is encouraging us."
> R: "Yes, he is encouraging you. He says that you are perfect students, he sometimes does this when you are not able to solve the question."
> E: "He is stimulating us. His aim is to stimulate us and we get stimulated."
> R: "Does it work?"
> Ss: "It does work."

4.2.3.4.4 Erkan's case

Erkan was using teaching practices Items 83 and 89 frequently in his lessons. However, his students only confirmed that he used these teaching practices, but they didn't provide information about how these teaching practices affected them. Moreover, the students' observed behaviors indicating their attitudes and behaviors were presented in Table 4.17. Generally, their behaviors were similar to those behaviors while the teacher was using these teaching practices.

4.2.3.5 Results related to Satisfaction Category

4.2.3.5.1 Eda's case

I have observed the teacher giving enough time to the students to take notes, solve problems, and answer questions (Item 110) in scheduling subcategory. In the following excerpt from the transcripts of video recording of student interview, students explained that the teacher was using class time effectively by solving many questions. They stated that it did not affect their interest in the lesson but it helped them to understand the topic better. However, one student stated that if they did not understand, their interest decreased; hence, by solving many questions and helping students' understand, the teacher was also sustaining their interest.

R: “Does your teacher uses class time efficiently?”
Ss: “Yes.” said several students.
N: “She does, she solves a lot of questions…”
R: “Using class time effectively, does this have an effect on your interest in the lesson, desire to study, or learning and understanding?”
N: “She solves most kinds of questions; at least we have some familiarity with those kinds of questions.”
S: “Solving a lot of questions-for example, if we don’t understand a question-it causes us not to like. But we understand another question.”

4.2.3.5.2 Alper’s case

Alper was using teaching practice 110 frequently in his lessons. However, his students only confirmed that he used this teaching practice, but they didn’t provide information about how these teaching practices affected them. Moreover, the students’ observed behaviors indicating their attitudes and behaviors were presented in Table 4.17. Generally, their behaviors were similar to those behaviors while the teacher was using this teaching practice.

4.2.3.5.3 Çağlar’s case

The two satisfaction related teaching practices Çağlar frequently used were related to Item 100 in positive outcomes category and Item 110 in scheduling category. He was frequently using verbal praise like “Well done.” and “That’s it.” for students’ efforts (Item 100). In the following excerpt from the transcripts of video recording of interview, the students explained how using verbal praise affected them. In the following excerpt from the transcripts of video recording of interview, students expressed that by this way; he increased their self-confidence and decreased their anxiety in physics courses.

R: “For example when you solve a question your teacher says that ‘You are perfect.’ He says things like this from time to time. How do these affect you?”
S: “We see that we accomplish something, our self-confidence increases.”
D: “We don’t afraid of physics for example. … ”

4.2.3.5.4 Erkan's case

The only satisfaction related teaching practice Erkan used frequently was related to Item 110 in scheduling category. He was giving enough time to the students to take notes. In the focus group interview one student confirmed that their teacher was giving enough time for them to take notes; and moreover, in the exams, and this was helpful for reducing their anxiety. The following excerpt from the video recording of the interview with the students also indicates this.

> R: "I have observed your teacher giving time for you to take notes. Was your teacher giving enough time for you in the exams?"
> E: "Yes, he was really one of the best teachers in the exams. When time was not enough for us, he was even giving the break time.
> R: "Okay, how does this affect you?"
> E: "We are more relaxed in the exams and it affects our grade."

4.3 Summary of the Results

In the quantitative phase of the study, affective teaching practices that are very frequently used by physics teachers, and the most effective affective teaching practices on students' attitude toward physics and motivation in physics were determined by administering the ATPQ to both students and teachers. The main findings and results of the quantitative phase of this study are as follows:

1. According to the students' responses to the ATPQ, four of the most frequently used affective teaching practices were among the most effective teaching practices (i.e. repeating parts that are not understood, explaining logic behind the topic and the formulas, emphasizing important parts, and having self-confidence in physics). On the other hand, no teaching practice rarely used by the physics teachers was among the effective teaching practices.
2. According to the students' responses to the ATPQ, affective teaching practices very frequently used by physics teachers are under the following

subcategories: communication (i.e. emphasizing important parts, repeating parts not understood, explaining the logic behind the topic and formulas) and relevance-modeling (i.e. having self-confidence, giving correct answers to the students' questions). Moreover, one teaching practice was related to attention (i.e. not distracting students' attention by movements). According to teachers, most frequently used affective teaching practices were under communication, confidence-difficulty and challenge; relevance-modeling, relevance-feedback; and satisfaction-positive outcomes. The teachers' results and the students' results were in agreement except that the teachers reported they performed 56 teaching practices in the ATPQ very frequently, while their students reported teachers performed six of the teaching practices very frequently.

3. According to the students' responses to the ATPQ affective teaching practices least frequently used by physics teachers were under the following subcategories: attention-variability (i.e. varying teaching methods and learning environments), relevance-modeling (i.e. inviting guests), attention-participation (i.e. using activities such as group work, brainstorming, role playing, or competition), attention-concreteness (i.e. using materials or media like film, computer, or computer programs), and satisfaction-unexpected rewards. According to the teachers, they did not perform any of the affective teaching practices seldom.
4. According to the students' and the teachers' responses to the ATPQ, most of affective teaching practices influencing students' affective characteristics most strongly are under communication (i.e. repeating parts not understood; explaining the logic behind the formulas and the topic; and emphasizing important parts) and relevance-modeling subcategories (i.e. giving correct answers to the students' questions about physics topics, explaining what is taught in a step by step approach, and behaving enthusiastically and energetically while teaching). Moreover, attention-concreteness, attention-

inquiry; confidence-difficulty and challenge, confidence-attribution; relevance-experience, relevance-expectations, relevance-feedback; satisfaction-positive outcomes and satisfaction-scheduling related teaching practices are also reported to be effective.

5. According to the teachers' responses to the ATPQ, the most effective teaching practices on their students' affective characteristics are under communication, attention-concreteness, attention-inquiry; relevance-modeling; and satisfaction-positive outcomes. Students reported 31 affective teaching practices as most effective while the teachers reported 84 affective characteristics as most effective. Explicitly, teachers were considered the affective teaching practices as more effective on their students' attitude towards physics and motivation in physics than their students.
6. The bivariate correlations between the categories of the ATPQ and subscales of the ACQ revealed that the relationships were ranging from small (.19) to large (.55). Bivariate correlation coefficients between interest in physics and all categories of ATPQ were large (between .51 and .55), and interest and the total score of the ATPQ was also large (.56). On the other hand, bivariate correlation coefficients between importance of physics courses and categories of the ATPQ were all small (between .19 and .29), and importance of physics and the total score of the ATPQ was also small (.25). All the coefficients between physics related self-concept and categories of the ATPQ were also small (between 25 and .29). However, the correlation coefficient between self-concept and the total score of the ATPQ was medium (.33). The relationship between anxiety in physics and all categories of the ATPQ were medium size (between -.48 and -.35), and all the signs were negative, higher scores indicated higher anxiety. The coefficient between anxiety and the total score of ATPQ was a large (-.51). Correlation coefficients between achievement motivation in physics courses and communication and attention categories

were small (.29, and .25, respectively), while correlation coefficients between achievement motivation in physics courses and relevance, confidence, satisfaction categories were medium (.33, .36, and .35 respectively). The coefficient between achievement motivation in physics courses and the total score of ATPQ was also medium (.35). Correlation coefficients between student motivation in physics courses and communication and attention categories were small (.27, and .29, respectively) whereas correlation coefficients between student motivation in physics courses and relevance, confidence, satisfaction categories were medium (.32, .30, and .34, respectively). The coefficient between student motivation in physics courses and the total score of ATPQ was .34, indicating a medium size relationship. Coefficient between the ACQ and communication category was small, while the relationship with all other categories were medium. The coefficients ranged from .27 to .35.

According to results of the quantitative phase of the study teachers, who use affective teaching practices very frequently, were also determined for the qualitative phase of the study. Four physics teachers from four different school types were selected for the qualitative phase. In order to collect data, classroom observations were conducted for six weeks in these teachers' physics lessons, and interviews with both teachers and their students were conducted to support the observations. Summary of the qualitative results of this study are presented in Table 4.18. The main findings and results of the qualitative phase of this study are as follows:

1. Each of the teachers observed had their own styles, hence their arrangements of affective teaching practices were different; moreover, the teaching practices these four teachers used varied to some degree. However, the following affective teaching practices were observed in all four classrooms frequently: "using more than one example, stories, jokes, anecdotes, researches etc." (Item 25) and " using analogies, diagrams, visual materials or concrete

materials" (Item 26) in concreteness subcategory of attention; "asking questions to make students participate to the course" (Item 34) in inquiry subcategory of attention; providing feedback for acceptable responses and constructive feedback for responses that did not meet criteria (Item 89), providing feedback when students needed help (Item 90), using verbal praise, personal attention, helpful feedback, and motivating feedback following task performance (Item 91), and giving information about students' mistakes and learning strategies (Item 93) in feedback subcategory of confidence; and "using class time effectively" (Item 109), "giving enough time to the students while they are solving problems, answering questions, taking notes, conducting experiments, in the exam etc." (Item 110), and "allowing adequate time for exploration of a topic" (Item 111) in scheduling subcategory of satisfaction.

2. Moreover, all the teachers were organizing what they teach from simple to difficult (Item 78); using clear, understandable, fluent language in their lessons (Item 13); giving the impression that they cared about their jobs (Item 61), self-confident (Item 65), and caring their students; and good at classroom management. The atmosphere in their classrooms was suitable for learning (Item 7), and most of the students were paying attention to what was being explained most of the time.
3. The most frequently observed affective teaching practices were under the following categories: communication, attention, attention-concreteness, attention-inquiry, relevance, relevance-experience, relevance-choice, relevance-modeling, confidence-provide objectives, confidence-expectation, confidence-feedback, satisfaction-positive outcomes, and satisfaction-scheduling.
4. The following affective teaching practices, which were frequently observed, were affecting students' affective characteristics according to both student

interviews and teacher interviews: communicating positively (Item 2), creating an atmosphere for students to ask questions without hesitating (Item 5), repeating parts that were not understood by the students (Item 14), helping students to take clear notes (Item 16), creating an atmosphere suitable for learning (Item 7) and checking if the students follow the lesson or not (Item 17), explaining the logic behind the topic and the formulas (Item 21) in communication category; using examples and questions related to daily life (Item 23) and “using analogies, diagrams, visual materials or concrete materials” (Item 26) in concreteness subcategory of attention, “asking questions to make students participate to the course” (Item 34) in inquiry subcategory of attention, addressing students with their names (Item 45) in relevance subcategory; relating current learning to real life (Item 52) in experience subcategory of relevance, explaining what he/she teaches in a step by step approach (Item 67) in modeling subcategory of relevance; and providing feedback for acceptable responses and constructive feedback for responses that did not meet criteria (Item 89), providing feedback when students needed help (Item 90), using verbal praise, personal attention, helpful feedback, and motivating feedback following task performance (Item 91), and giving information about students’ mistakes and learning strategies (Item 93) in feedback subcategory of confidence.

5. Students in all four classrooms were observed to have high attention in the physics lesson. However, there was not much opportunity for students to participate or volunteer in general. Students’ participation was varying mostly between medium and high, once the private Anatolian high school and most of the time the public high schools students were observed to have low participation to the lessons. Except the private science high school students, the students were volunteering to the teacher fronted activities highly or medially.

As a result, the following affective teaching practices, which were observed frequently in the qualitative phase of the study, were reported as effective by the students and the teachers according to the results of the questionnaire in the quantitative phase of the study and also according to the results of the interviews in the qualitative phase of the study: 2, 5, 7, 14, 16, 17, 21, 23, 34, 67, and 90. Moreover, the following affective teaching practices, which were observed frequently in the qualitative phase of the study, were reported as effective by the teachers according to the results of the questionnaire in the quantitative phase of the study and also by the students and the teachers according to the results of the interviews in the qualitative phase of the study: 26, 45, 89, 91, and 93. Students in the quantitative phase of the study reported that their teachers performed the following affective teaching practices very frequently: 7, 13, 34, 61, 65, 78, 90, 93, 109, 110, and 111. These teaching practices were also observed frequently in qualitative phase of the study.

Table 4.18 Summary of the qualitative results of the study

Subcategory/ Teaching Practice	Teacher Observation	Performed by	Teacher Interview	Student Interview
Communication				
2	Tweak students' cheek Touch shoulders Speak positively	Eda	Increase interest Enhance motivation Increase enjoyment	Love physics more
3	Smile	Eda		Like physics more
5	Answer questions in and out of class	Eda	Decrease anxiety Increase attention Increase participation Increase interest Teacher care students	Like physics more Increase attention Enhance motivation Understand better
	Answer questions in class	Alper	Enhance motivation Learn better	
8	Speak one by one or group	Eda		
14	Ask if students understood Repeat parts not understood	Eda	Sustain attention Increase participation Increase confidence Enhance motivation Teacher care students	Like physics more Understand better
	Ask if students understood	Çağlar		
15	Write clearly on board and power point	Alper		
	Write clearly on board	Çağlar		
		Erkan		Enhance motivation
16	Dictate notes Help taking notes	Eda	Get attention	Get attention
		Çağlar		
		Erkan		

Table 4.18 (continued)

7-17	Warn by name Warn by saying ‘Girls’ etc. Asking questions Tease	Eda	Sustain attention Teacher care students	Enhance motivation Increase interest Get attention Decrease anxiety Teacher care students
	Warn by name Warn by saying ‘Listen to me’ etc. Use gestures	Alper		
	Warn by name Warn by saying ‘Listen to me’ etc.	Çağlar		
18	Change tone of voice Dictate notes Repeat Make someone repeat Practice on the board Say ‘Don’t forget’ etc.	Eda		
	Change tone of voice Repeat Say ‘We say again’ etc.	Çağlar		
	Repeat Say ‘If you pay attention’ etc.	Erkan	Get attention	
20	Solve a lot of questions	Eda	Increase confidence Enhance motivation	
		Çağlar		

Table 4.18 (continued)

21	Explains logic behind topic and formulas	Eda	Increase confidence	Increase enjoyment Love physics more Increase participation Increase confidence Understand better
		Alper		Like physics more Enhance motivation
		Çağlar		
Attention				
36	Not disturb with her movements	Eda		
		Çağlar		
38	Use gestures, mimics, body movements, and tone of voice in line with the importance of the theme	Çağlar		
Concreteness				
23	Daily life examples	Alper	Enhance motivation	Sustain attention
25	More than one example	Eda		
		Alper		Sustain attention
		Çağlar		
		Erkan	Understand better	
26	Draw figures	Eda		
		Çağlar		
		Erkan		
	Draw figures and power point	Alper	Sustain motivation	Understand better

Table 4.18 (continued)

Inquiry				
34	Ask questions	Eda	Increase participation Sustain attention	Enhance motivation Increase confidence Increase attention
		Alper	Sustain motivation Sustain attention	Increase participation
		Çağlar	Increase participation Understand better	Increase participation Increase confidence
		Erkan		Increase participation Sustain attention
35	Ask 'how' and 'why' questions	Çağlar		
Relevance				
45	Use students' name	Eda	Increase interest Teacher care students	Increase participation Increase attention Teacher care students
		Alper	Teacher care students	Teacher care students
		Çağlar	Praise for students	Teacher care students Value of lesson more
		Erkan	Sustain attention Teacher care students	Positive effect Teacher care students
Experience				
49		Alper		
52		Alper	Increase interest Enhance attitude	
		Erkan	Increase interest Enhance motivation Visualize more easily	Get attention Increase interest Increase confidence Understand better

Table 4.18 (continued)

Choice				
55	Provide options for solutions, exams	Eda		
Modeling				
67	Explain step by step	Eda	Present model Decrease anxiety	
		Çağlar		Understand better
		Erkan	Present model	Increase confidence Understand better
68	Ask students to explain what they do on the board	Eda		
Confidence				
Provide Objectives				
83	Fulfill prerequisite knowledge	Eda	Decrease anxiety Enhance motivation	
		Çağlar		Understand better
		Erkan		
Expectations				
87	Explain expectations	Alper	Enhance & sustain motivation	

Table 4.18 (continued)

Feedback				
89-90-91-93	Give feedback Use verbal praise Pay personal attention Give information about mistakes and learning strategies	Eda	Increase attention Increase confidence Teacher care students	Like physics more Increase confidence
		Alper	Increase interest	Increase confidence
		Çağlar	Enhance motivation Reinforce positive behaviors	Enhance motivation
89	Give feedback	Erkan		
Satisfaction				
Positive Outcomes				
100	Use verbal praise like ‘Well done’	Çağlar		Increase confidence Decrease anxiety
Scheduling				
109-110-111	Give enough time solving questions, answering questions, taking notes etc.	Eda	Increase motivation Sustain attention	
		Alper	Increase interest Enhance motivation	
		Çağlar		
		Erkan		Decrease anxiety

CHAPTER 5

DISCUSSION AND CONCLUSIONS

This study was aimed to provide some insight about the affective teaching practices that influence students' attitudes toward physics and motivation in physics lessons using both quantitative and qualitative research methods. The ATPQ was administered to both students and physics teachers to find out their perceptions about the affective teaching practices. Moreover, the ACQ was administered to the students to find out the relationship between students' physics related affective characteristics and their perceptions about the affective teaching practices used by their physics teachers. On the other hand, observations in four "good" physics teachers' classrooms were conducted to find out the teaching practices they use to enhance students' physics related affective characteristics and their effects. Besides, interviews with these teachers and their students were conducted to support the observations.

This chapter is divided into seven sections. In the first section, conclusions of the study are presented. In the second section, discussion of the results are included. Third section discusses strengths and limitations of the study, while fourth section presents implications of the study. In the fifth section internal validity of quantitative phase is discussed, and in the sixth section ethics of quantitative phase included. Last section lists several recommendations for future research.

5.1 Conclusion of the Study

In the quantitative phase of this study, in addition to the teachers and students selected purposefully, there are also teachers and students who were selected by stratified random sampling. Hence, the results of the quantitative phase can be generalized to the accessible population.

The use of quantitative and qualitative methodology together in this study produced a number of findings that complement each other. The most important finding of this study is that teachers' affective teaching practices in physics lessons are related to students' affective characteristics related to physics. In other words, physics teachers can make a difference in their students' affective characteristics by performing affective teaching practices. Even though there might not be specific prescriptions for enhancing students' attitudes toward physics and motivation in physics lessons, the results of this study might provide some insight about the affective teaching practices used by "good" physics teachers with learners who have different characteristics.

According to qualitative and quantitative results of the study; especially, affective teaching practices that help students understanding the topic better in communication category and provide role models to the students in relevance category are effective on students' attitudes toward physics and motivation in physics. Explicitly, providing students concrete materials, arousing inquiry, adjusting difficulty of the topic, relating the topic to students' experience, providing feedback, using positive outcomes and giving enough time to students are effective. In addition, organizing what is taught from simple to difficult; using clear, understandable, fluent language in lessons; caring about job; being self-confident; and providing an atmosphere suitable for learning are also important for influencing students' affective characteristics related to physics.

On the other hand, according to the results of the qualitative and quantitative phases of the study the following affective teaching practices were performed frequently in physics lessons: creating an atmosphere suitable for learning; using clear, understandable, fluent language in the lessons; asking questions to make students participate to the course; caring about job; being self-confident; organizing what is taught from simple to difficult; providing feedback when students need help; using verbal praise, personal attention, helpful feedback, and motivating feedback following task performance; giving information about students' mistakes and learning strategies; using class time effectively; giving enough time to the students while they are solving problems, answering questions, taking notes, conducting experiments, in the exam etc.; and allowing adequate time for exploration of a topic.

5.2 Discussion of the Results

First, the quantitative results of this study and then the qualitative results are compared with the results of the related studies in this section. In spite of the limited number of studies, there are studies that investigated and reported the effect of the affective teaching practices on students' attitudes and motivation in different subject areas. Even the studies were not related to physics or science; several studies were conducted related to affective teaching practices and the ARCS model in various subject areas. Bivariate correlation coefficient between the total score of the ATPQ and the ACQ was .34 according to students' responses. This result was in line with what Guilloteaux found in 2007. The correlation between students' self-reported motivation in English lessons and teacher's motivational practice in English lessons was .31. However, the bivariate correlations between the categories of the ATPQ and the subscales of the ACQ were ranging between .19 and .55. Moreover, the bivariate correlations between the total score of the ATPQ and subscales of the ACQ were between .25 and .56. Especially the coefficients between interest subscale and the ATPQ components were considerable since they all are high, implying that the affective teaching practices were influential on students' interest in physics lessons, regardless of the subcategories. Hence, the bivariate correlation between the total score of the ATPQ and interest was also high.

In the quantitative phase of this study, in line with several studies (e.g., He, 2009; Korur, 2006) from the literature, the teachers reported that they used affective teaching practices more frequently than their students reported and thought the affective teaching practices were more influential on students' affective characteristics than the students' reported. He (2009) investigated importance and frequency of teacher's use of 28 motivational teaching practices in English lessons. He stated that teachers reported that they used motivational teaching practices more frequently than their students reported and found the teaching practices more important than their students reported. Moreover, Korur (2006) also reported similar results in his study about effective physics teacher characteristics on students' motivation.

Corresponding to the quantitative results of this study, Korur (2001) reported that according to students' responses the following teaching practices were effective on students' affective characteristics related to physics: repeating parts that are not understood, creating atmosphere suitable for learning, explaining what is taught in a step by step approach, behaving enthusiastically and energetically while teaching, using questions to make students participate to the course, having self-confidence in physics, caring about his/her job, behaving patiently, using materials, activities, homeworks, exam questions matching students' levels, and using examples, problems, questions related to daily life.

Results of the qualitative phase of this study are also compared with the results of several other studies. Small (1999) and Small et al. (2004) reported that they have observed the librarians using attention related teaching practices the most frequently. Moreover, relevance and confidence practices were performed less frequently, and satisfaction strategies were performed the least frequently. When the distribution of teaching practices into the ARCS categories is analyzed; the results of this study is consistent with Small (1999) and Small at al. (2004) in general. Small (1999) observed that librarians used a total of 2,026 motivation strategies, and 1,136 of the strategies they used were to get and sustain attention and interest. Among these attention strategies, 581 were inquiry arousal strategies; 287 were perceptual arousal, and 268 were variability strategies. On the other hand, 331 relevance, 299 confidence and 260 satisfaction strategies were observed. Similarly, Small et al. (2004) determined 1,423 ARCS strategies. Among these strategies, there were 754 attention strategies, 341 relevance, 278 confidence, and 50 satisfaction strategies.

In this study, 2,184 attention, 999 relevance, 1,856 confidence, and 280 satisfaction related teaching practices were observed in 48 class hours. However, confidence related teaching practices were observed more frequently in this study compared to Small (1999) and Small et al. (2004). This is due to one teacher's use of questioning as the basic teaching method and hence providing feedback frequently. If his teaching practices of feedback subcategory are not involved in the confidence category, the frequency of relevance and confidence related teaching practices become even.

In line with Small (1999) and Small et al. (2004), the most frequently observed affective teaching practices were under the following subcategories in this study: attention-inquiry and relevance-modeling. Affective teaching practices related to attention-concreteness, relevance-experience, relevance-choice, confidence-provide objectives, confidence-expectation, confidence-feedback, satisfaction-positive outcomes, and satisfaction-scheduling subcategories were also frequently observed in this study; while Small (1999) and Small et al., (2004) reported that librarians used few or no teaching practices related to relevance-experience, relevance-choice, confidence-expectation, confidence-feedback, and satisfaction-positive outcomes subcategories.

5.3 Strengths and Limitations of the Study

Strengths of the study mainly are related to qualitative phase of the study. Multiple case study design strengthens the findings of this study, since there are four cases in the qualitative phase of the study. Moreover, longitudinal field work is also strength of the study. Each teacher was observed for six weeks (more than 10 class-hours). Thus, it was possible to collect comprehensive data. Moreover, using multiple sources, recording data mechanically, member checking with teachers and students, and including the field notes and extended transcripts also strengthened this study.

Physics teaching experience strengthened my relations with the teachers, and my physical characteristics (that I am being petite) strengthened my relations with the students. My personal relationship with two of the case teachers was also strength for this study, since they both were very helpful in getting permissions from their principals.

There are also several limitations of the qualitative phase. First, case study protocol was not written for this study. However, processes, procedures, and steps of the study were described in detail. Second, only one hour audio and one hour video data were coded by a second person. However, coding a total of 48 hours of extended transcripts would not be feasible for another person. Moreover, after finishing the initial coding of the whole data, I examined coding two more times.

Limitations of the quantitative phase are related to sampling and data collection. It was planned to include 10% of the students in the population of 9th graders, and 10% of the students in each school type at the beginning of the study. The total number of the students in the sample was 1,138 and it was more than 10% of the population. However, the data were collected from 503 students attending public high schools, being 6% of the population.

5.4 Implications

The results have several practical implications since they provide some evidence that students' affective characteristics are related to the teacher's affective practices. One main implication of the study, which can be derived from the results related to the third research problem, would be to provide teachers training about the affective teaching practices, which were reported as influential in second and fifth research problems, to enhance their students' affective characteristics. However, this would require more than giving them a list of teaching practices, but also embedding these in a more general teaching approach. Still, developing a theoretically sound and empirically tested teacher education module that focuses on the teacher's affective practices might contribute making physics education more effective. However, this is a further step of research about students' physics related affective characteristics.

On the other hand, the results related to the fourth and fifth research problems also provide some evidence about enhancing affective characteristics of the students while teaching the physics curriculum is possible. In other words, some of the affective teaching practices derived from the literature do contribute to students' physics related affective characteristics in the real world. In fact, there wasn't a teacher training related to affective teaching practices in this study. Hence, even the selected "good" teachers do not use some of the affective teaching practices or use them very seldom, as the results of Research Problem 4 and research problem revealed. However, the affective teaching practices performed by these four teachers had some positive influence on their students' affective characteristics and behaviors. Taking all these into consideration, physics teachers paying attention to the following affective teaching practices while planning and implementing the physics curriculum might make a difference in physics lessons since they were obtained both qualitatively and quantitatively from four different learner groups and teachers:

1. Affective teaching practices helping students understand the topic better and providing role models to the students.
2. Providing students concrete materials, arousing inquiry, adjusting difficulty of the topic, attributing students' success to their efforts, relating the topic to students' experience, stating clearly what is expected of the students, providing feedback, using positive outcomes, and giving enough time to students.
3. Organizing what is taught from simple to difficult; using clear, understandable, fluent language in lessons; caring about job; being self-confident; caring about students; and providing an atmosphere suitable for learning.

In addition, activities and materials can be used to enhance students' affective characteristics by taking the previous recommendations into consideration. For example, textbooks might contain motivating features for students such as using a step by step approach explaining a topic or organizing the topic from simple to difficult, and teachers' guides include practical examples of motivating ways to use these materials.

This study provides some information about the interwoven nature of the cognitive and affective components of learning, since the students and also the teachers view affective teaching practices related to the cognitive component. Explicitly, the affective teaching practices enhancing the comprehensibility were reported to be influential on students' attitude and motivation in both quantitative and qualitative results of this study. Hence, these teaching practices might be more influential than they seem to be. So, teachers should especially pay attention to these teaching practices.

5.5 Internal Validity of Quantitative Phase

Mortality, location, instrumentation, and instrument decay are four threats to internal validity in survey research (Fraenkel & Wallen, 1996, p. 383). Mortality threat occurs in longitudinal studies, whereas instrument decay occurs in interviews. These two threats to internal validity are not related to the quantitative phase of this study. Location threat occurs in places that may affect the answers of the respondents. All the questionnaires were administered in the students' own classrooms-a location familiar to them. Moreover, most of the time physics teachers were not in the classroom during the administration of the questionnaires. If the teacher was in the classroom during the administration, he/she was also asked to respond to the teacher questionnaire, which was the parallel format of the ATPQ prepared for the teachers (see Appendix F). Furthermore, among instrumentation threats, data collector characteristics and data collector bias threaten the quantitative phase of this study. To overcome both of these threats, whenever possible I administered the questionnaires myself. However, some of the schools did not allow me to enter their classrooms. Thus, I prepared a guideline for administration of the questionnaires (see Appendix G) to overcome the threats related to data collector characteristics and bias.

5.6 Ethics of the Quantitative Phase

In the quantitative phase, the aim of the questionnaires was to collect the students' and teachers' opinions. Even though the teachers were not expected to be in the classroom while questionnaires were administered, still they might walk into the classroom or ask students about the questionnaires. Thus, students were explicitly assured that their answers would be confidential that their teachers would not see the questionnaires. A parallel version of the ATPQ was administered to the teachers, thus it is assumed that the wording did not offend the teachers. Moreover, the teachers were busy with responding the questionnaires even if they were present in the classrooms. Besides, during data collection, an environment where participants could respond the questionnaires honestly was created with the presence of the researcher in the classrooms whenever possible. This was also helpful for eliminating peer and teacher influences. Furthermore, students' names were not demanded in order to provide them secrecy and confidence in their responses. In order to avoid deception of the participants the aim of the study was presented to the participants both written on the front-page of the questionnaires and orally before the administration of the questionnaires. Additionally, the instruments used in the study were examined by my advisor, human subjects' research ethics committee at the university, and Evaluation Committee of Ankara Provincial Directorate of National Education.

5.7 Suggestions for Further Research

1. Experimental studies, designed according to the results of this study and including several affective teaching practices, might provide more information about their effects on students' attitudes toward physics and motivation in physics. The teaching practices might be selected according to the results of this study.

2. In depth investigations dealing with the learner groups (in different school types), which were involved in this study, separately might provide more information about the effects of affective teaching practices on students' attitudes toward physics and motivation in physics. Since, affective teaching practices should change according to learner characteristics. Accordingly, since the affective teaching practices that should be used to enhance students' motivation in physics and attitude towards physics might change according to learner characteristics, the study might be repeated with different grade levels. Moreover, most effective teaching practices for other student characteristics such as learning styles might be determined.
3. Studies aimed to change students' attitude toward physics should be designed specifically; since attitudes are more stable constructs, and attitude change require special treatments based on attitude change theories.
4. In depth investigations with the new physics curriculum might also provide insight about the effects of affective teaching practices, since the new curriculum comply with the affective teaching practices better.

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APPENDIX A

NAME OF THE SCHOOLS THAT THE QUESTIONNAIRES WERE ADMINISTERED

1. 50. Yıl Lisesi
2. Ankara Anıttepe Lisesi
3. Bahçelievler Deneme Lisesi
4. Cumhuriyet Lisesi
5. Dikmen Lisesi
6. İbni Sina Lisesi (Sincan) (Purposeful)
7. Kalaba Lisesi (Keçiören) (Purposeful)2
8. Kılıçarslan Lisesi (Purposeful)
9. Kocatepe Mimar Kemal Lisesi
10. Mustafa Kemal Lisesi (Yenimahalle) (Purposeful)
11. Öğretmen Necla Kızılbağ Lisesi
12. Ömer Seyfettin Lisesi
13. Sancak Lisesi
14. Tınaztepe Lisesi
15. Aydınlikevler Anadolu Lisesi (Purposeful)
16. Ayrancı Anadolu Lisesi (Random and purposeful)
17. Çankaya Anadolu Lisesi
18. Dikmen Anadolu Lisesi
19. Hacı Ömer Tarman Anadolu Lisesi
20. Kırkkonaklar (İncesu) Anadolu Lisesi (Purposeful)
21. Reha Alemdaroğlu Anadolu Lisesi
22. Yıldırım Beyazıt Anadolu Lisesi (Altındağ) (Purposeful)
23. Başkent Üniversitesi Özel Ayşe Abla Lisesi
24. Gazi Koleji
25. Jale Tezer Koleji
26. Özel Bilim Koleji
27. Özel Büyük Lise *
28. Özel Evrensel Lisesi
29. Özel Gürçağ Lisesi*
30. Özel ODTÜ Geliştirme Vakfı Lisesi
31. Özel Tevfik Fikret Lisesi
32. Özel Yüce Koleji (Purposeful)
33. Gazi Üniversitesi Vakfı Özel Fen Lisesi
34. Başkent Üniversitesi Özel Ayşeabla Fen Lisesi
35. Özel Arı Fen Lisesi * (Purposeful)
36. Özel Gürçağ Fen Lisesi*
37. Özel Yüce Fen Lisesi
38. Özel Evrensel Fen Lisesi
39. Özel Jale Tezer Fen Lisesi

* The questionnaire was not administered because the school administration did not allowed the researcher or the data collected was not used because of reliability issues.

APPENDIX B

REFERENCES OF THE ITEMS IN THE AFFECTIVE TEACHING PRACTICES QUESTIONNAIRE

ITEM #	REFERENCES
1	Original
2	Original
3	Original
4	Pintrich & Schunk
5	Wlodkowski
6	Korur revised
7	Korur
8	Korur
9	Original
10	Korur
11	Original
12	Original
13	Korur + Wlodkowski
14	Wlodkowski
15	Korur revised
16	Original
17	Wlodkowski
18	Original
19	NEGATIVE of Item 11
20	Original
21	Original
22	Small+Shellnut
23	Korur
24	Smith &Ragan revised
25	Korur
26	Korur revised
27	Korur revised
28	Smith & Ragan + Clark
29	Korur
30	Small revised

ITEM #	REFERENCES
31	Smith &Ragan revised
32	Clark revised
33	Smith &Ragan revised
34	Korur revised+Smith &Ragan
35	Korur revised
36	Original
37	Small + Arnone
38	Korur revised
39	Korur revised
40	Small revised
41	Korur revised
42	Original
43	Small revised
44	NEGATIVE of Item 36
45	Korur revised
46	Korur revised
47	Korur revised
48	Smith &Ragan revised
49	Keller
50	Smith &Ragan
51	Smith &Ragan
52	Smith &Ragan revised
53	Smith &Ragan revised
54	Newbill revised
55	Zvacek + Wang&Han revised
56	Original
57	Smith &Ragan revised
58	Korur

ITEM #	REFERENCES
59	Korur revised
60	Korur revised
61	Wlodkowski
62	Wlodkowski
63	Korur + Wlodkowski
64	NEGATIVE of Item 49
65	Korur
66	Original
67	Feng&Tuan revised
68	Wang
69	Original
70	Original
71	Korur revised
72	Original
73	Keller
74	Keller
75	Wongwiwatthananukit & Popovich revised
76	Wongwiwatthananukit & Popovich revised
77	Zwacek revised
78	Korur revised + Wongwiwatthananukit & Popovich
79	Smith&Ragan revised
80	Smith&Ragan revised
81	Smith & Ragan
82	Wongwiwatthananukit & Popovich revised
83	Keller revised
84	NEGATIVE of Item 94
85	Wongwiwatthananukit & Popovich+Clark revised
86	Zhang

ITEM #	REFERENCES
87	Original
88	Small
89	Keller
90	Keller
91	Pintrich & Schunk
92	Original
93	Keller
94	Original
95	Shellnutt revised
96	Shellnutt revised
97	Original
98	Smith&Ragan revised
99	Smith&Ragan revised
100	Original
101	Wongwiwatthananukit & Popovich revised
102	Small revised
103	Original
104	Smith&Ragan revised
105	Korur
106	Korur
107	Korur revised
108	Korur
109	Korur
110	Arnone revised
111	Arnone revised
112	Wongwiwatthananukit & Popovich revised
113	Wongwiwatthananukit & Popovich revised
114	NEGATIVE of Item 106
115	Wongwiwatthananukit & Popovich revised

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APPENDIX C

OPEN-ENDED SURVEY QUESTIONS

Aşağıda fizik dersleri ile ilgili çeşitli sorular yer almaktadır. Bu soruları yanıtlarken bu yıl boyunca fizik dersleri ile ilgili sınıfta, okulda veya okul dışında fizik öğretmeniniz tarafından yapılan her şeyi belirtiniz. Yanıtlarınız ileriki yıllarda fizik derslerinin, görüşleriniz doğrultusunda şekillenmesine katkıda bulunabileceğinden dolayı önem taşımaktadır. Bu araştırmada toplanılan tüm bilgiler kesinlikle gizli tutulacaktır ve ders notlarına etki etmeyecektir. Yardımlarınız için teşekkür ederiz.

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1. Fizikte başarılı olabilmek amacıyla daha çok çaba sarf etmenizi sağlamak için neler yapıldı?
   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

   Nasıl daha etkili olabilirdi?

2. Fizik derslerine çalışmak için gerekli motivasyonu sağlamak için neler yapıldı?

   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

   Nasıl daha etkili olabilirdi?

3. Fiziğe ilginizi çekmek için neler yapıldı?

   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

   Nasıl daha etkili olabilirdi?

4. Fiziğe ilginizi ders süresince tutmak için neler yapıldı?

   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

Nasıl daha etkili olabilirdi?

5. Fizik derslerinde motive olmanız için neler yapıldı?

   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

   Nasıl daha etkili olabilirdi?

6. Fizik derslerindeki kaygılarınızı (stresinizi) azaltmak için neler yapıldı?

   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

   Nasıl daha etkili olabilirdi?

7. Fizik derslerinde kendinizi rahat hissetmeniz için neler yapıldı?

   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

   Nasıl daha etkili olabilirdi?

8. Fizik sınavlarındaki kaygılarınızı (stresinizi) azaltmak için neler yapıldı?

   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

   Nasıl daha etkili olabilirdi?

9. Fizik sınavlarında kendinizi rahat hissetmeniz için neler yapıldı?

   Hangileri daha etkili oldu?

   Bunlardan başka neler yapılabilirdi?

   Nasıl daha etkili olabilirdi?

10. Fizikte kendinize olan güveninizi artırmak için neler yapıldı?

    Hangileri daha etkili oldu?

    Bunlardan başka neler yapılabilirdi?

    Nasıl daha etkili olabilirdi?

11. Fizik derslerinizi sevmeniz için neler yapıldı?

Hangileri daha etkili oldu?

Bunlardan başka neler yapılabilirdi?

Nasıl daha etkili olabilirdi?

12. Fizik derslerinde derse önem vermeniz için neler yapıldı?

    Hangileri daha etkili oldu?

    Bunlardan başka neler yapılabilirdi?

    Nasıl daha etkili olabilirdi?

13. Fizik dersleri ile ilgili yaptığınız ekstra aktiviteleri artırmak için neler yapıldı?

    Hangileri daha etkili oldu?

    Bunlardan başka neler yapılabilirdi?

    Nasıl daha etkili olabilirdi?

14. Fizik derslerinden memnun (tatmin) olmanızı sağlamak için neler yapıldı?

    Hangileri daha etkili oldu?

    Bunlardan başka neler yapılabilirdi?

    Nasıl daha etkili olabilirdi?

15. Fizik derslerini sizinle (hayatınızla veya gündelik hayatınızla) ilişkilendirmek için neler yapıldı?

    Hangileri daha etkili oldu?

    Bunlardan başka neler yapılabilirdi?

    Nasıl daha etkili olabilirdi?

APPENDIX D

THE AFFECTIVE TEACHING PRACTICES QUESTIONNAIRE AND THE AFFECTIVE CHARACTERISTICS QUESTIONNAIRE

Sevgili Öğrenciler;

Bu çalışma; lise öğrencilerinin bir fizik öğretmeninin derste hangi davranışlarda bulunduğu ve bu davranışlardan hangilerinin, öğrencilerin tutum ve motivasyonunu etkilediği konusunda görüşlerini belirlemeyi amaçlamaktadır. Ankette **tutum** fizik derslerini sevme, fizik dersine duyulan ilgi ve verilen önem anlamında kullanılmaktadır. **Motivasyon** ise fizik derslerinde kişinin kendisine duyduğu güven; fizik derslerine devam etme, katılma ve çalışma isteği anlamında kullanılmaktadır.

Araştırma sonuçları, fizik derslerinin daha verimli hale getirilmesinde kullanılacaktır. Araştırmada <u>kesinlikle</u> öğretmenler <u>değerlendirilmeyecek</u>, toplanılan tüm bilgiler <u>gizli tutulacak</u> ve <u>ders notlarına etki etmeyecektir</u>. Ankette olumsuz ifadeler, yanlış anlaşılmamaları için altı çizili olarak belirtilmiştir. Anket üç bölümden oluşmaktadır. Birinci bölümde kişisel bilgilerinizle ilgili sorular yer almaktadır. İkinci bölümde fizik öğretmeninizin davranışları ile ilgili sorular yer almaktadır. Bu bölümde her davranış için hem "**Öğretmeniniz hangi sıklıkta kullanıyor?**" hem de "**Tutum ve motivasyonunuzu ne kadar etkiliyor?**"sütunlarına <u>**birer işaretleme**</u> yapınız. Üçüncü bölümde ise sizin fizik derslerine yönelik tutum ve motivasyonunuzu belirlemeye yönelik sorular yer almaktadır. Yardımlarınız için teşekkür ederim.

I. BÖLÜM: KİŞİSEL BİLGİLER

Cinsiyetiniz: ( ) Kız ( ) Erkek **Doğum yılınız:** ___________

İlk fizik sınavı notunuz: _______ **İkinci fizik sınavı notunuz:** _______

Fizik öğretmeninizi seviyor musunuz? ( ) Oldukça çok ( ) Çok ( ) Az ( ) Hiç

Lisede hangi alanı seçmeye karar verdiniz? ( ) Kararsızım ( ) Sayısal ( ) Eşit ağırlık ( ) Sözel ( ) Dil

II. BÖLÜM: ÖĞRETMEN DAVRANIŞLARI ANKETİ

	Fizik öğretmenimiz	**Öğretmeniniz hangi sıklıkta kullanıyor?**					**Tutum ve motivasyonunuzu ne kadar etkiliyor?**				
		Her zaman	**Sık sık**	**Bazen**	**Nadiren**	**Hiç**	**Çok Artırır**	**Artırır**	**Etkilemez**	**Azaltır**	**Çok Azaltır**
1	bize karşı sabırlı davranır.										
2	bizimle iyi iletişim kurar.										
3	derste ve ders dışında güler yüzlüdür.										
4	dersi öğrenmemizi etkileyebilecek bizimle ilgili olaylardan haberdardır.										
5	sorularımızı çekinmeden sorabileceğimiz bir sınıf ortamı sağlar.										
6	ders anlatırken notlarına veya ders kitabına çok fazla bağlı kalır.										
7	sınıfta öğrenme için elverişli bir ortam sağlar.										
8	bizimle tek tek veya grup olarak konuşmaya zaman ayırır.										
9	öğrencilerin dersle ilgili veya ilgisiz sorunlarıyla ilgilenir.										
10	bize ders dışında da zaman ayırır.										
11	sınıf veya okul dışında bizi gördüğünde bizimle konuşur.										
12	bizimle ilgilendiği için bizimle ve ailemizle (telefonla veya yüz yüze) görüşür.										
13	ders anlatırken açık, anlaşılır, akıcı ve yalın bir dil kullanır.										
14	ders anlatırken <u>anlaşılmayan</u> kısımları tekrar anlatır.										
15	tahtaya veya saydama (asetata) yazdıkları düzenli ve okunaklıdır.										
16	derste anlaşılır notlar tutturur veya dağıtır.										
17	dersi takip edip etmediğimizi kontrol eder.										
18	bir konuyu anlatırken önemli kısımları vurgular.										
19	sınıf veya okul dışında bizi gördüğünde bizimle <u>konuşmaz.</u>										
20	derste çok sayıda soru çözer.										
21	ders anlatırken konunun ve formüllerin mantığını anlatır.										

	Fizik öğretmenimiz <u>dikkatimizi çekmek veya bizi meraklandırmak için</u>	Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
		Her zaman	Sık sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
22	ders anlatırken bilmece, bulmaca gibi gizemli şeyler kullanır.										
23	günlük hayattan örnekler, problemler, sorular vb. kullanır.										
24	şaka, sözcük oyunu, espri, fıkra, komik benzetmeler vb. kullanır.										
25	konuyla ilgili birden fazla örnek, hikâye, fıkra, anı, araştırma vb. kullanır.										
26	ders anlatırken benzetmeler, şemalar, görsel materyaller ve/veya somut araç-gereçler kullanır.										
27	tepegöz, slâyt göstericisi, film, video, bilgisayar ve bilgisayar programı gibi materyallerden veya ortamlardan yararlanır.										
28	grup çalışması, beyin fırtınası, oyun, simülasyon, rol oynama, canlandırma, drama, yarışma vb. etkinlikler yaptırarak derse aktif olarak katılmamızı sağlar.										
29	derste deney (veya gösteri deneyi) yapar veya bize yaptırır.										
30	<u>alışılmadık</u> ve ilginç etkinlikler kullanır.										
31	ilginç sorular, çelişkili ifadeler vb. ile tuhaf ve <u>alışılmamış</u> noktalara dikkatimizi çeker.										
32	dersi takip edip etmediğimizi görmek için bir şeyleri bilerek yanlış yapar; örneğin soruyu yanlış çözer.										
33	konuyu işlemeden önce sorular sorarak bizim görüşlerimizi savunmamızı ister.										
34	bize soru sorarak derse katılmamızı sağlar.										
35	konuları daha derinlemesine anlamamızı sağlayan "Nasıl?", "Niçin?" vb. sorular sorar veya bizi bu tür sorular sormaya özendirir.										
36	sınıfta dikkatimizi dağıtacak şekilde hareket <u>etmez</u>.										
37	kafa karıştırıcı bilgiler vererek dikkatimizi çektikten sonra bu bilgileri konuyla ilişkilendirerek kafa karışıklığımızı giderir.										
38	jest, mimik, el, kol, vücut hareketlerini ve ses tonunu konuların önemine uygun olarak kullanır.										
39	bir konuyu farklı yollarla anlatır.										
40	ders işleyiş yöntemini düzenli olarak değiştirir.										
41	dersleri sınıf dışında (laboratuarda, dışarıda vb.) işler.										
42	bizi dersle ilgili gezilere, sergilere, başka okullardaki etkinliklere vb. götürür.										
43	yarışma ile arkadaşlarımızdan daha iyi olma isteğimizi tetikleyerek konuları öğrenmemizi sağlar.										
44	sınıfta dikkatimizi dağıtacak şekilde hareket eder.										

	Fizik öğretmenimiz dersi, kişisel amaçlarımızla ilişkilendirmek veya ihtiyaçlarımızı karşılamak için	Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
		Her zaman	Sık sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
45	bize adımızla hitap eder.										
46	önceki fen ve fizik konuları ile bağlantı kurar.										
47	diğer derslerle bağlantı kurar.										
48	öğrendiklerimizi; önbilgi, tecrübe, ilgi ve ihtiyaçlarımızla ilişkilendirir.										
49	verdiği örnekleri bildiğimiz durumlardan seçer.										
50	bilmediğimiz bir konuyu anlatırken bildiğimiz konulara benzetmeler yapar.										
51	yeni bir konuyu öğrenirken sahip olduğumuz bilgi ve becerileri, nasıl kullanacağımızı açıklar.										
52	öğrendiklerimizi, gerçek hayatla ilişkilendirir.										
53	öğrendiklerimizin neden önemli olduğunu görmemizi sağlar.										
54	dersin gidişine bakarak dersin işlenişi ile ilgili bazı değişiklikler yapar.										
55	öğreneceklerimiz, sınavlar, yapılacak ödevler vb. ile ilgili bazı hususlarda bize seçme hakkı verir; örneğin sınavın test mi, klasik mi olacağını bizim belirlememize izin verir.										
56	fizik dersinin ileriki konulardaki, üniversite sınavındaki, üniversitedeki, meslek hayatımızdaki vb. yararlarını görmemizi sağlar.										
57	gelecekteki hedeflerimizle öğrendiklerimizi ilişkilendirmemize yardımcı olur.										
58	fizik konularıyla ilgili sorularımıza doğru cevap verir.										
59	cevabını bilmediği soruları araştırıp bize açıklar.										
60	kendini geliştirerek öğrendiklerini bizimle paylaşır.										
61	işini ciddiye aldığını gösterir.										
62	işini yapmaktan keyif alır.										
63	ders anlatırken dinamik ve enerjiktir.										
64	verdiği örnekleri bilmediğimiz durumlardan seçer.										
65	fizik dersinde kendine güvenir.										
66	davranışları ile bize örnek olur.										
67	ders anlatırken yaptıklarını adım adım açıklar.										
68	tahtada soruları açıklayarak çözmemizi ister.										
69	başarılı olabilmek için nasıl çalışmamız gerektiğini öğrenmemize yardım eder.										
70	bizimle deneyimlerini paylaşmaları için sınıfa; üst sınıftan öğrenciler, fizikle ilgili alanlarda çalışan kişiler vb. misafirler getirir.										
71	derste konunun tarihsel gelişimi veya ünlü fizikçilerin yaşamları ile ilgili şeyler anlatır.										
72	sınıftaki öğrencilerin birbirine destek olmasını sağlayarak grup ruhu aşılamaya çalışır.										

	Fizik öğretmenimiz derste kendimize güvenmemiz ve başarılı olmanın bizim kontrolümüzde olduğunu göstermek için	Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
		Her zaman	Sık sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
73	beklenmedik olumsuz tepkiler vermez.										
74	bir kural koyduğunda bu kuralı sürekli olarak uygular.										
75	seviyemize uygun ders anlatır.										
76	derste, bizim düzeyimize uygun materyaller, etkinlikler, ödevler, sınav soruları, vb. kullanır.										
77	başarabileceğimiz; ama bizi biraz uğraştıran etkinlikler, sorular, deneyler, ödevler vb. kullanır.										
78	konuyu, örnekleri ve çözeceği soruları basitten karmaşığa doğru sıralar.										
79	neden başarılı ya da başarısız olduğumuzla ilgili yerinde değerlendirmelerde bulunur.										
80	yeterince çaba harcayan herkesin derste başarılı olabileceğini gösterir.										
81	neden başarılı ya da başarısız olduğumuzla ilgili değerlendirmelerimizi sınıfla paylaşmamızı ister.										
82	dersin başında işlenecek konunun başlıklarını listeleyerek o derste ne öğreneceğimizi açıklar.										
83	dersi anlamamızı engelleyen, dersle ilgili eksikliklerimizi giderir.										
84	yanlış yaptığımızda bize kızar.										
85	başarılarımızın nasıl değerlendirileceğini önceden açıklar.										
86	bizden yüksek beklentileri olduğunu belirtir.										
87	derste bizden beklediklerini açık bir şekilde ifade eder.										
88	fizik dersinde başarılı olabileceğimizi söyleyerek cesaretlendirir.										
89	dersteki gelişimimizle ilgili olumlu ve yerinde eleştirilerde bulunur.										
90	soru çözerken, ödev yaparken vb. ihtiyaç duyduğumuzda bize yol gösterir.										
91	deney, soru vb. yaptıktan hemen sonra bizi değerlendirir.										
92	olumlu davranışlarımızı, başkalarının önünde takdir eder.										
93	notlarımızı açıklarken eksiklerimizi ve nasıl başarılı olabileceğimizi söyleyerek bize yol gösterir.										
94	yanlış yaptığımızda bize kızmaz.										
95	fizik dersinde başarılı olabileceğimizi bize gösterir.										
96	yazılı veya sözlü sınavlarda yüksek not verir.										

	Fizik öğretmenimiz <u>fizik derslerinde tatmin olmamız ve başarılı olmamıza yardım etmek için</u>	Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
		Her zaman	Sık sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
97	fizikle ilgili bilgi ve becerilerimizin arttığını gösterir.										
98	öğrendiklerimizi gerçek veya gerçeğe yakın koşullarda uygulamamıza olanak tanır.										
99	bir işi (soru çözmeyi, deneyi vb.) önce bitirenlerin arkadaşlarına yardım etmesini ister.										
100	çabalayıp bir şeyler başardığımızda, (örneğin notumuzu 10'dan 50'ye çıkardığımızda) bizi takdir eder.										
101	başarılarımızı takdir sözcükleriyle, gerçek veya sembolik ödüllerle uygun bir şekilde ödüllendirir.										
102	derste sürpriz ödüller verir.										
103	çalışmalarımızı (sınıftakilerle, okuldakilerle veya okul dışından kişilerle) sunu yaparak, sergi düzenleyerek vb. paylaşmamızı sağlar.										
104	yanlış yaptığımızda bize yardımcı olacak ve bizi motive edecek değerlendirmeler yapar.										
105	ceza olarak derste öğrencileri, arkadaşlarının önünde küçük <u>düşürmez</u>.										
106	derslerde bize yerli yersiz <u>bağırmaz</u>.										
107	disiplin anlayışı olarak düşük not <u>vermez</u> veya notla <u>korkutmaz</u>.										
108	bir öğrencinin yaptığı hatadan dolayı bütün sınıfı <u>cezalandırmaz</u>.										
109	ders süresini etkili bir biçimde kullanır.										
110	soru çözerken, cevap verirken, not tutarken, deney yaparken, sınavda vb. bize yeterince zaman verir.										
111	konunun anlaşılması ve anlamadığımız noktaları sormamız için bize yeterince zaman verir.										
112	bize daha önce bildirdiği beklentileri ile derste ve sınavda yapmamız gerekenler uyumludur.										
113	bir kural koyduğunda bu kuralı adil bir şekilde uygular.										
114	derslerde bize yerli yersiz bağırır.										
115	bazı öğrencileri veya grupları (örneğin kızları veya erkekleri) <u>kayırmaz.</u>										

III. BÖLÜM: TUTUM VE MOTİVASYON ANKETİ

#	Cümleler	Kesinlikle Katılırım	Katılırım	Kararsızım	Katılmam	Kesinlikle Katılmam
1	Fizik derslerimiz eğlencelidir.					
2	Fizik dersini ilgi çekici buluyorum.					
3	Fizik derslerine gitmek için can atıyorum.					
4	Fizik derslerimiz sıkıcıdır.					
5	Fizik dersinin, ilerideki çalışmalarımda bana yararlı olacağını düşünüyorum.					
6	Fizik derslerinde öğrendiklerimin, gündelik hayatta işime yarayacağını düşünüyorum.					
7	Fizik dersinde öğrendiğimiz şeylerin gerçek hayatta <u>kullanılmayacağını</u> düşünüyorum.					
8	Fizik derslerinde öğrendiklerimin, hayatımı kolaylaştıracağını düşünüyorum.					
9	Bu dönemki fizik dersinde öğrendiklerimi bir daha <u>kullanmayacağım</u> için bu derse ihtiyacım <u>olmadığını</u> düşünüyorum.					
10	Fizik dersinde kendimi gergin hissederim.					
11	Fizik dersine gitmek beni kaygılandırır.					
12	Fizik dersi, kendimi <u>rahatsız</u> ve sinirli hissetmeme neden olur.					
13	Fizik dersi, kendimi tedirgin ve şaşkın hissetmeme neden olur.					
14	Fizik dersinde başarılı olmak için elimden geleni yaparım.					
15	Fizik dersinde yapılacak iş ne kadar zor olursa olsun, elimden geleni yaparım.					
16	Fizik derslerinde <u>başarısız</u> olduğumda daha çok çabalarım.					
17	Fizik derslerinde elimden gelenin en iyisini yapmaya çalışırım.					
18	Fizik derslerindeki yeteneğimle gurur duyarım.					
19	Fizik dersiyle başa çıkabilecek kadar zekiyim.					
20	Fizik derslerindeki başarılarımla gurur duyarım.					
21	Fizik dersinde iyi notlar alma yeteneğine sahibim.					
22	Zorunlu olmasam da fizik dersi almak isterim.					
23	Fizikle ilgili daha çok şey öğrenmek isterim.					
24	Fizik becerilerimi geliştirmek isterim.					
25	Eğitim hayatım boyunca alabildiğim kadar fazla fizik dersi almak isterim.					

APPENDIX E

EXPERT CHECKLIST FOR DEVELOPING THE ATPQ

Bu çalışma; lise öğrencilerinin bir fizik öğretmeninin derste hangi davranışlarda bulunduğu ve davranışlardan hangilerinin, öğrencilerin tutum ve motivasyonunu etkilediği konusunda görüşlerini belirlemeyi amaçlamaktadır. **Tutum** ile öğrencilerin fizik derslerini ne kadar sevdiği, fizik dersine duydukları ilgi ve verdikleri önem kastedilmektedir. **Motivasyon** ile fizik derslerinde kendilerine duydukları güven; fizik derslerine devam etme, katılma ve çalışma istekleri kastedilmektedir.

Araştırmada Keller'in ARCS (Attention-Dikkat Çekme, Relevance-İlgi, Confidence-Güven, Satisfaction-Tatmin) temel alınmış, öğrenci motivasyon ve tutumunun nasıl değiştirilebileceği ile ilgili farklı çalışmalar gözden geçirildikten sonra tüm maddeler ARCS alt boyutlarına yedirilmeye çalışılmıştır. Ancak üç farklı boyutla ilgili maddeler ARCS'ın 4 alt boyutuna yedirilemeyince kendi başlıkları ile ankete eklenmiştir. Bu alt boyutlar Sınıf Ortamı, Ders Dışı ve Anlaşılırlık olarak adlandırılmıştır. Öğretmen Davranışları Anketindeki ve Tutum ve Motivasyon Anketindeki maddelerin ARCS modelinin alt boyutlarına göre dağılımı bir sonraki sayfada verilmiştir.

Anket maddeleri ile ilgili görüşlerinizi bildirirken:

1. Anlaşılmadığını düşündüğünüz maddeler varsa bunları anket üzerinde veya anketin arkasındaki boş sayfalarda numaralarını yazarak belirtiniz. Varsa nasıl daha anlaşılır hale getirilebilecekleri ile ilgili görüşlerinizi ekleyiniz.
2. Maddeleri daha kısa ve öz bir şekilde düzenlemek için önerileriniz varsa bunları anket üzerinde veya anketin arkasındaki boş sayfalarda numaralarını yazarak belirtiniz.
3. Anketten çıkmasını önerdiğiniz soruları anket üzerinde belirtiniz.
4. Ankete eklenmesini önerdiğiniz soruları anketin arkasındaki boş sayfalarda belirtiniz.
5. Maddelerin alt boyutlara dağılımını değerlendiriniz. Alt boyutlara uygun olmadığını düşündüğünüz maddeleri anket üzerinde veya anketin arkasındaki boş sayfalarda numaralarını yazarak belirtiniz.
6. Sizce bu alt boyutlar tutum ve motivasyonu etkileyen öğretmen davranışları için yeterli midir? Varsa eklenmesini uygun gördüğünüz alt boyutlar nelerdir?

Öğretmen Davranışları Anketindeki maddelerin Keller'in ARCS modeline göre alt boyutlara dağılımı

ATTENTION-DİKKAT	17, 18
A.1 Concreteness –Somutluk	19, 20, 21, ,23, 25, 22=**41***
A.2 Incongruity & Conflict-Uyumsuzluk & Çelişki	24, 26, 27, 28
A.3 Humor-Mizah	29, 30
A.4. Variability-Değişkenlik	31, 32, 33, 34, 35, 36, 37, 38
A.5-6 Participation & Inquiry-Katılım & Sorgulama	39, 40, 42, 43
RELEVANCE-İLGİ	44, 45, 53
R.1 Experience-Deneyim	46, 47, 48, 49, 50, 51, 52
R.2 Present Worth-Önem	54, 55
R.3 Future Usefulness- Gelecekteki Önem	61, 62
R.4 Needs Matching-İhtiyaç Karşılama	56=**80***
R.5 Modeling-Örnek Olma	63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79
R.6 Choice & Control- Seçenek & Kontrol	57, 58, 59, 60
CONFIDENCE-GÜVEN	81, 82, 83, 84, 85
C.1 Provide Objectives & Prerequisites Clearly-Hedefleri & Gereklilikleri Açıkça Bildirmek	95, 96, 97
C.2 Difficulty & Challenge- Güçlük	86, 87, 88, 89, 91, 90=**98***
C.3 Feedback & Expectations-Eleştiri & Beklenti	99, 100, 101, 102, 103, 104, 105, 106
C.4 Attributions- Atıf	92, 93, 94
C.5 Self-confidence- Özgüven	107, 108, 109, 110
SATISFACTION-TATMİN	111, 112, 113, 119, 120
S.1 Natural consequences-Doğal Sonuçlar	114, 115
S.2 Unexpected Rewards- Beklenmeyen Ödüller	116, 117
S.3 Positive Outcomes- Olumlu Çıktılar	118
S.4 Negative Influences- Olumsuz Etkiler	121, 122, 123, 124=**131***
S.5 Scheduling- Zamanlama	125, 126, 127, 128
S.6 Equity-Adalet	129, 130, 132
CLARITY-ANLAŞILIRLIK-AÇIKLIK	133, 135, 136, 137, 138, 139, 134=**140***
CLASSROOM ATMOSPHERE-SINIF ORTAMI	1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 2=**10***
OUT OF CLASS-DERS DIŞI	14, 15, 13=**16***

* koyu renkle yazılmış maddeler alt boyutlarda yer alan ve "=" işareti ile belirtilen maddelerin birebir tersi olarak yazılmışlardır.

Tutum ve Motivasyon Anketindeki maddelerin Keller'in ARCS modeline göre alt boyutlara dağılımı

Attention	1-5
Relevance	6-10
Confidence	11-15
Satisfaction	16-20
Motivation	21-22
Achievement Motivation	23-24-25

Anlaşılmayan maddeler

Madde no	Önerileriniz

Altboyutlara uymayan maddeler

Madde no	Önerileriniz

Anketten çıkmasını önerdiğiniz maddeler

Ankete eklenmesini önerdiğiniz maddeler

Diğer öneri ve görüşleriniz

APPENDIX F

TEACHER VERSION OF THE AFFECTIVE TEACHING PRACTICES QUESTIONNAIRE

Sayın Öğretmenim;

Bu çalışma; bir fizik öğretmeninin derste hangi davranışlarda bulunduğu ve bu davranışlardan hangilerinin, öğrencilerin tutum ve motivasyonunu etkilediği konusunda görüşlerini belirlemeyi amaçlamaktadır. Ankette **tutum** fizik derslerini sevme, fizik dersine duyulan ilgi ve verilen önem anlamında kullanılmaktadır. **Motivasyon** ise fizik derslerinde kişinin kendisine duyduğu güven; fizik derslerine devam etme, katılma ve çalışma isteği anlamında kullanılmaktadır.

Araştırma sonuçları, fizik derslerinin daha verimli hale getirilmesinde kullanılacaktır. Araştırmada kesinlikle öğretmenler değerlendirilmeyecek, toplanılan tüm bilgiler gizli tutulacaktır. Ankette olumsuz ifadeler, yanlış anlaşılmamaları için altı çizili olarak belirtilmiştir. Anket iki bölümden oluşmaktadır. Birinci bölümde kişisel bilgilerinizle ilgili sorular yer almaktadır. İkinci bölümde fizik derslerindeki davranışlarınızla ile ilgili sorular yer almaktadır. Bu bölümde her davranış için hem **"Hangi sıklıkta kullanıyorsunuz?"** hem de **"Öğrencilerinizin tutum ve motivasyonunuzu ne kadar etkiliyor?"** sütunlarına **birer işaretleme** yapınız. Yardımlarınız için teşekkür ederim.

I. BÖLÜM: KİŞİSEL BİLGİLER

Cinsiyetiniz:	( ) Kadın ( ) Erkek
Yaşınız:	( ) 21-30 ( ) 31-40 ( ) 41-50 ( ) 51-60 ( ) 61-üzeri
Öğretmenlikte kaçıncı yılınız?	( ) 1-5 ( ) 6-10 ( ) 11-20 ( ) 21-30 ( ) 31-üzeri
Mezun olduğunuz üniversite/bölüm:	____________________ / ____________________
Mezun olduğunuz fakülte:	( ) Eğitim ( ) Fen-Edebiyat ( ) Mühendislik
Öğrenim durumunuz:	( ) Üniversite ( ) Yüksek lisans ( ) Doktora

II. BÖLÜM: ÖĞRETMEN DAVRANIŞLARI ANKETİ

		Hangi sıklıkta kullanıyorsunuz?					Öğrencilerinizin tutum ve motivasyonunu ne kadar etkiliyor?				
		Her zaman	Sık sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
1	öğrencilere karşı sabırlı davranırım.										
2	öğrencilerle iyi iletişim kurarım.										
3	derste ve ders dışında güler yüzlüyüm.										
4	dersi öğrenmelerini etkileyebilecek, öğrencilerle ilgili olaylardan haberim olur.										
5	öğrencilerin sorularını çekinmeden sorabilecekleri bir sınıf ortamı sağlarım.										
6	ders anlatırken notlarıma veya ders kitabına bağlı kalırım.										
7	sınıfta öğrenme için elverişli bir ortam sağlarım.										
8	öğrencilerle tek tek veya grup olarak konuşmaya zaman ayırırım.										
9	öğrencilerin dersle ilgili veya ilgisiz sorunlarıyla ilgilenirim.										
10	öğrencilere ders dışında da zaman ayırırım.										
11	sınıf veya okul dışında öğrencileri gördüğümde, onlarla konuşurum.										
12	öğrencilerle ilgilendiğim için onlarla ve aileleriyle (telefonla veya yüz yüze) görüşürüm.										
13	ders anlatırken açık, anlaşılır, akıcı ve yalın bir dil kullanırım.										
14	ders anlatırken anlaşılmayan kısımları tekrar anlatırım.										
15	tahtaya veya saydama (asetata) yazdıklarım düzenli ve okunaklıdır.										
16	derste anlaşılır notlar tutturur veya dağıtırım.										
17	öğrencilerin dersi takip edip etmediğini kontrol ederim.										
18	bir konuyu anlatırken önemli kısımları vurgularım.										
19	sınıf veya okul dışında öğrencileri gördüğümde onlarla konuşmam.										
20	derste çok sayıda soru çözerim.										
21	ders anlatırken konunun ve formüllerin mantığını anlatırım.										

	Öğrencilerin <u>dikkatini çekmek veya onları meraklandırmak için</u>	Hangi sıklıkta kullanıyorsunuz?					Öğrencilerinizin tutum ve motivasyonunu ne kadar etkiliyor?				
		Her zaman	Sık sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
22	ders anlatırken bilmece, bulmaca gibi gizemli şeyler kullanırım.										
23	günlük hayattan örnekler, problemler, sorular vb. kullanırım.										
24	şaka, sözcük oyunu, espri, fıkra, komik benzetmeler vb. kullanırım.										
25	konuyla ilgili birden fazla örnek, hikâye, fıkra, anı, araştırma vb. kullanırım.										
26	ders anlatırken benzetmeler, şemalar, görsel materyaller ve/veya somut araç-gereçler kullanırım.										
27	tepegöz, slâyt göstericisi, film, video, bilgisayar ve bilgisayar programı gibi materyallerden veya ortamlardan yararlanırım.										
28	grup çalışması, beyin fırtınası, oyun, simülasyon, rol oynama, canlandırma, drama, yarışma vb. etkinlikler yaptırarak öğrencilerin derse aktif olarak katılmalarını sağlarım.										
29	derste deney (veya gösteri deneyi) yaparım veya öğrencilere yaptırırım.										
30	<u>alışılmadık</u> ve ilginç etkinlikler kullanırım.										
31	ilginç sorular, çelişkili ifadeler vb. ile öğrencilerin tuhaf ve <u>alışılmamış</u> noktalara dikkatlerini çekerim.										
32	dersi takip edip etmediklerini görmek için bir şeyleri bilerek yanlış yaparım; örneğin soruyu yanlış çözerim.										
33	konuyu işlemeden önce sorular sorarak öğrencilerin görüşlerini savunmalarını isterim.										
34	öğrencilere soru sorarak derse katılmalarını sağlarım.										
35	öğrencilerin konuları daha derinlemesine anlamalarını sağlayan "Nasıl?", "Niçin?" vb. sorular sorarım veya öğrencileri bu tür sorular sormaya özendiririm.										
36	sınıfta öğrencilerin dikkatini dağıtacak şekilde hareket <u>etmem</u>.										
37	kafa karıştırıcı bilgiler vererek öğrencilerin dikkatini çektikten sonra bu bilgileri konuyla ilişkilendirerek öğrencilerin kafa karışıklıklarını gideririm.										
38	jest, mimik, el, kol, vücut hareketlerimi ve ses tonumu konuların önemine uygun olarak kullanırım.										
39	bir konuyu farklı yollarla anlatırım.										
40	ders işleyiş yöntemimi düzenli olarak değiştiririm.										
41	dersleri sınıf dışında (laboratuarda, dışarıda vb.) işlerim.										
42	öğrencileri dersle ilgili gezilere, sergilere, başka okullardaki etkinliklere vb. götürürüm.										
43	yarışma ile öğrencilerin arkadaşlarından daha iyi olma isteğini tetikleyerek konuları öğrenmelerini sağlarım.										
44	sınıfta öğrencilerin dikkatini dağıtacak şekilde hareket ederim.										

	Dersi, öğrencilerin kişisel amaçlarıyla ilişkilendirmek veya ihtiyaçlarını karşılamak için	Hangi sıklıkta kullanıyorsunuz?					Öğrencilerinizin tutum ve motivasyonunu ne kadar etkiliyor?				
		Her zaman	Sık sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
45	öğrencilere adlarıyla hitap ederim.										
46	önceki fen ve fizik konuları ile bağlantı kurarım.										
47	diğer derslerle bağlantı kurarım.										
48	öğrendikleriyle; öğrencilerin önbilgi, tecrübe, ilgi ve ihtiyaçların ilişkilendiririm.										
49	verdiğim örnekleri öğrencilerin bildiği durumlardan seçerim.										
50	<u>bilmedikleri</u> bir konuyu anlatırken öğrencilerin bildiği konulara benzetmeler yaparım.										
51	yeni bir konuyu öğrenirken öğrencilerin sahip olduğu bilgi ve becerileri, nasıl kullanacaklarını açıklarım.										
52	öğrendiklerini, gerçek hayatla ilişkilendiririm.										
53	öğrendiklerinin neden önemli olduğunu görmelerini sağlarım.										
54	dersin gidişine bakarak dersin işlenişi ile ilgili bazı değişiklikler yaparım.										
55	öğrenecekleri, sınavlar, yapılacak ödevler vb. ile ilgili bazı hususlarda öğrencilere seçme hakkı veririm; örneğin sınavın test mi, klasik mi olacağını belirlemelerine izin veririm.										
56	fizik dersinin ileriki konulardaki, üniversite sınavındaki, üniversitedeki, meslek hayatlarındaki vb. yararlarını görmelerini sağlarım.										
57	öğrencilerin gelecekteki hedefleriyle öğrendiklerini ilişkilendirmelerine yardımcı olurum.										
58	öğrencilerin fizik konularıyla ilgili sorularına doğru cevap veririm.										
59	cevabını <u>bilmediğim</u> soruları araştırıp öğrencilere açıklarım.										
60	kendimi geliştirerek öğrendiklerimi öğrencilerle paylaşırım.										
61	öğrencilere işimi ciddiye aldığımı gösteririm.										
62	işimi yapmaktan keyif alırım.										
63	ders anlatırken dinamik ve enerjiğim.										
64	verdiğim örnekleri öğrencilerin <u>bilmediği</u> durumlardan seçerim.										
65	fizik dersinde kendime güvenirim.										
66	davranışlarımla öğrencilere örnek olurum.										
67	ders anlatırken yaptıklarımı adım adım açıklarım.										
68	öğrencilerin tahtada soruları açıklayarak çözmelerini isterim.										
69	öğrencilerin başarılı olabilmek için nasıl çalışmaları gerektiğini öğrenmelerine yardım ederim.										
70	öğrencilerle deneyimlerini paylaşmaları için sınıfa; üst sınıftan öğrenciler, fizikle ilgili alanlarda çalışan kişiler vb. misafirler getiririm.										
71	derste konunun tarihsel gelişimi veya ünlü fizikçilerin yaşamları ile ilgili şeyler anlatırım.										
72	sınıftaki öğrencilerin birbirine destek olmasını sağlayarak grup ruhu aşılamaya çalışırım.										

	Öğrencilerin fizik dersinde kendilerine güvenmeleri ve başarılı olmanın kendi kontrollerinde olduğunu göstermek için	Hangi sıklıkta kullanıyorsunuz?					Öğrencilerinizin tutum ve motivasyonunu ne kadar etkiliyor?				
		Her zaman	Sık sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
73	beklenmedik olumsuz tepkiler vermem.										
74	bir kural koyduğumda bu kuralı sürekli olarak uygularım.										
75	öğrencilerin seviyesine uygun ders anlatırım.										
76	derste, öğrencilerin düzeyine uygun materyaller, etkinlikler, ödevler, sınav soruları vb. kullanırım.										
77	öğrencilerin başarabilecekleri; ama onları biraz uğraştıran etkinlikler, sorular, deneyler, ödevler vb. kullanırım.										
78	konuyu, örnekleri ve çözeceğim soruları basitten karmaşığa doğru sıralarım.										
79	öğrencilerin neden başarılı ya da başarısız olduklarıyla ilgili yerinde değerlendirmelerde bulunurum.										
80	yeterince çaba harcayan herkesin derste başarılı olabileceğini gösteririm.										
81	öğrencilerin neden başarılı ya da başarısız olduklarıyla ilgili değerlendirmelerini sınıfla paylaşmalarını isterim.										
82	dersin başında işlenecek konunun başlıklarını listeleyerek o derste ne öğreneceklerini açıklarım.										
83	öğrencilerin dersi anlamalarını engelleyen, dersle ilgili eksikliklerini gideririm.										
84	yanlış yaptıklarında öğrencilere kızarım.										
85	öğrencilerin başarılarının nasıl değerlendirileceğini önceden açıklarım.										
86	öğrencilerden yüksek beklentilerim olduğunu belirtirim.										
87	derste öğrencilerden beklediklerimi açık bir şekilde ifade ederim.										
88	öğrencileri, fizik dersinde başarılı olabileceklerini söyleyerek cesaretlendiririm.										
89	öğrencilerin dersteki gelişimleriyle ilgili olumlu ve yerinde eleştirilerde bulunurum.										
90	soru çözerken, ödev yaparken vb. ihtiyaç duyduklarında öğrencilere yol gösteririm.										
91	deney, soru vb. yaptıktan hemen sonra öğrencileri değerlendiririm.										
92	öğrencilerin olumlu davranışlarını, başkalarının önünde takdir ederim.										
93	öğrencilerin notlarını açıklarken eksiklerini ve nasıl başarılı olabileceklerini söyleyerek onlara yol gösteririm.										
94	yanlış yaptıklarında öğrencilere kızmam.										
95	öğrencilere fizik dersinde başarılı olabileceklerini gösteririm.										
96	yazılı veya sözlü sınavlarda öğrencilere yüksek not veririm.										

	Öğrencilerin fizik derslerinde tatmin olmaları ve başarılı olmalarına yardım etmek için	Hangi sıklıkta kullanıyorsunuz? Her zaman	Sık sık	Bazen	Nadiren	Hiç	Öğrencilerinizin tutum ve motivasyonunu ne kadar etkiliyor? Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
97	öğrencilerin fizikle ilgili bilgi ve becerilerinin arttığını gösteririm.										
98	öğrencilerin, öğrendiklerini gerçek veya gerçeğe yakın koşullarda uygulamalarına olanak tanırım.										
99	bir işi (soru çözmeyi, deneyi vb.) önce bitirenlerin arkadaşlarına yardım etmesini isterim.										
100	çabalayıp bir şeyler başardıklarında, (örneğin notunu 10'dan 50'ye çıkardığında) öğrencileri takdir ederim.										
101	öğrencilerin başarılarını takdir sözcükleriyle, gerçek veya sembolik ödüllerle uygun bir şekilde ödüllendiririm.										
102	derste sürpriz ödüller veririm.										
103	öğrencilerin çalışmalarını (sınıftakilerle, okuldakilerle veya okul dışından kişilerle) sunu yaparak, sergi düzenleyerek vb. paylaşmalarını sağlarım.										
104	öğrenciler yanlış yaptığında onlara yardımcı olacak ve onları motive edecek değerlendirmeler yaparım.										
105	ceza olarak derste öğrencileri, arkadaşlarının önünde küçük düşürmem.										
106	derste öğrencilere yerli yersiz bağırmam.										
107	disiplin anlayışı olarak öğrencilere düşük not vermem veya onları notla korkutmam.										
108	bir öğrencinin yaptığı hatadan dolayı bütün sınıfı cezalandırmam.										
109	ders süresini etkili bir biçimde kullanırım.										
110	soru çözerken, cevap verirken, not tutarken, deney yaparken, sınavda vb. öğrencilere yeterince zaman veririm.										
111	konunun anlaşılması ve anlamadıkları noktaları sormaları için öğrencilere yeterince zaman veririm.										
112	öğrencilere daha önce bildirdiğim beklentilerimle, derste ve sınavda yapmaları gerekenler uyumludur.										
113	bir kural koyduğumda bu kuralı adil bir şekilde uygularım.										
114	derste öğrencilere yerli yersiz bağırırım.										
115	bazı öğrencileri veya grupları (örneğin kızları veya erkekleri) kayırmam.										

APPENDIX G

GUIDELINES FOR ADMINISTRATION OF THE QUESTIONNAIRES

ANKET UYGULAMA YÖNERGESİ

1. Araştırma sonuçları, fizik derslerinin daha verimli hale getirilmesinde kullanılacaktır.
2. Araştırmada **kesinlikle** toplanılan tüm bilgiler gizli tutulacak ve ders notlarına etki etmeyecektir. Araştırma Çankaya ilçesindeki fizik öğretmenlerinin kullandığı davranışları ve bu davranışların öğrencilerin tutum ve motivasyonu üzerindeki etkilerini bulmayı amaçlamaktadır. Tek tek **öğretmenler değerlendirilmeyecek**, genel olarak kullanılan ve etkili olan davranışlar belirlenecektir. Bir öğretmenin tüm davranışları kullanıyor olması mümkün değildir, bunun için bazı sorulara "hiç" yanıtı vermeniz öğretmeninizin kötü bir öğretmen olduğu anlamına gelmemektedir.
3. Ankette **tutum** fizik derslerini sevme, fizik dersine duyulan ilgi ve verilen önem anlamında kullanılmaktadır. **Motivasyon** ise fizik derslerinde kişinin kendisine duyduğu güven; fizik derslerine devam etme, katılma ve çalışma isteği anlamında kullanılmaktadır.
4. Anket üç bölümden oluşmaktadır. Birinci bölümde kişisel bilgilerinizle ilgili sorular yer almaktadır. İkinci sınav notunuz açıklanmamışsa bu bölüme "açıklanmadı" yazabilirsiniz veya bu bölümü boş bırakabilirsiniz.
5. İkinci bölümde fizik öğretmeninizin davranışları ile ilgili sorular yer almaktadır. Bu bölümde her davranış için hem "**Öğretmeniniz hangi sıklıkta kullanıyor?**" hem de "**Tutum ve motivasyonunuzu ne kadar etkiliyor?**"sütunlarına **birer işaretleme** yapınız. Bu iki sütuna işaretleme yaparken ikinci sütunu ilk sütundan **bağımsız** olarak değerlendiriniz. İlk sütuna "bize karşı sabırlı davranır" ifadesi için "her zaman, sık sık, bazen, nadiren, hiç" seçenekleri arasından birini işaretledikten sonra ikinci sütuna "**öğretmeniniz bu davranışı yapmıyorsa bile yapsaydı ne olurdu?**" diye düşünerek işaretleme yapınız. Öğretmeniniz bu davranışı yapıyorsa da yine ikinci sütunu "**bu davranışı yapması sizi nasıl etkiliyor?**" sorusunu düşünerek işaretleme yapınız. [Bir başka deyişle öğretmeniniz derslerde size karşı sabırlı davranmıyorsa ve siz "bize karşı sabırlı davranır" ifadesi için ilk sütunda "hiç" seçeneğini işaretlemiş olsanız bile ikinci sütuna "bize karşı sabırlı davransaydı bu tutum ve motivasyonumu nasıl etkilerdi?" sorusunu düşünerek işaretleme yapınız.] *Parantez içindeki bölüm açıklama anlaşılmazsa okunabilir.*
6. İkinci bölümdeki anketin her sayfasındaki soru kökü farklıdır örneğin ikinci sayfada soruların tamamı "**Fizik öğretmenimiz dikkatimizi çekmek veya bizi meraklandırmak için" şeklinde başlarken üçüncü bölümde sorular "Fizik öğretmenimiz dersi, kişisel amaçlarımızla ilişkilendirmek veya ihtiyaçlarımızı karşılamak için"** şeklinde başlamaktadır.
7. Üçüncü bölümde ise sizin fizik derslerine yönelik tutum ve motivasyonunuzu belirlemeye yönelik sorular yer almaktadır.
8. Ankette olumsuz ifadeler, yanlış anlaşılmamaları için altı çizili olarak belirtilmiştir.

Yardımlarınız için teşekkür ederim.

Almer Abak Güngör
Ankara Üniversitesi
Eğitim Bilimleri Fakültesi
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APPENDIX H

MINISTRY OF NATIONAL EDUCATION OFFICIAL PERMISSION PAPER

1956

Orta Doğu Teknik Üniversitesi
Middle East Technical University

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GÖNDEREN : Prof.Dr.R.Sezer Aygün
Fen Bilimleri Enstitüsü Müdür Yardımcısı

KONU : Almer Abak Güngör hk.

Anabilim Dalınız doktora programı öğrencilerinden Almer Abak Güngör'e ilişkin T.C. Ankara Valiliği Milli Eğitim Müdürlüğü tarafından gönderilen ve Öğrenci İşleri Dairesi Başkanlığı tarafından Enstitümüz'e iletilen yazılar ekte verilmektedir.

Gereği için bilgilerinizi saygılarımla rica ederim.

Ek:19

1956

Orta Doğu Teknik Üniversitesi
Middle East Technical University

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B.30.2.ODT.0.70.72.00/400 – 136 – 31 8.1.2008

FEN BİLİMLERİ ENSTİTÜSÜ MÜDÜRLÜĞÜ'NE

İLGİ: 10.12.2007 tarih ve B.30.2.ODT.0.C1.00.00/126/2949-13332 sayılı yazınız.

İlgi yazınız T.C. Ankara Valiliği Milli Eğitim Müdürlüğü'ne iletilmiş olup, alınan yazı ve ekleri ilgisi nedeni ile ilişikte sunulmuştur.

Gereğini bilgilerinize arz ederim.

Saygılarımla.

Nesrin ÜNSAL
Öğrenci İşleri
Dairesi Başkanı

ODTÜ
Fen. Bil. Enst. Müdürlüğü

Evrakın		
	GELİŞ TARİHİ	08 OCA 2008
	SIRA NO :	45

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

ÖĞRENCİ İŞLERİ
DAİRESİ BAŞKANLIĞI

BÖLÜM : Strateji Geliştirme
SAYI : B B.08.4.MEM.4.06.00.04-312/523
KONU : Araştırma İzni (Almer Ablak GÜNGÖR)

03/01/2008

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
(Öğrenci İşleri Dairesi)

İLGİ : a) 17.12.2007 tarih ve 18357 sayılı yazınız
b) 27.12.2007 tarih ve 312/1263 sayılı Valilik Oluru.

Üniversiteniz, Orta Öğretim Fen ve Matematik Alanları Anabilim Dalı Doktora Programı öğrencisi Almer Ablak GÜNGÖR'ün, ilgi (a) yazınız ekinde alınan tez çalışması ilgi (b) Valilik Oluru ile uygun görülmüş olup, konu hakkında araştırmanın yapılacağı Müdürlüğümüz İlçe Milli Eğitim Müdürlüklerine bilgi verilmiştir.

Mühürlü anket örneği'nin (16 Sayfadan oluşan) uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitiminde iki örneğinin (CD/disket) Müdürlüğümüz Strateji Geliştirme Bölümüne gönderilmesi hususunda bilgilerinizi ve gereğini rica ederim.

Murat Bey BALTA
Vali a.
Milli Eğitim Müdürü

EKLER :
EK-1 : Anket Formu (16 Sayfa)
EK-2 : Valilik Oluru (1 Adet)
EK-3 : Okul Listesi.

07.01.08 000415

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

BÖLÜM : Strateji Geliştirme
SAYI : B B.08.4.MEM.4.06.00.04-312/1263 27/12/2007
KONU : Araştırma İzni (Almer Ablak GÜNGÖR)

VALİLİK MAKAMINA
ANKARA

İLGİ : a) M.E.B. Bağlı Okul ve Kurumlarda Yapılacak Araştırma ve Araştırma Desteğine Yönelik İzin ve Uygulama Yönergesi.
b) ODTÜ Öğrenci İşleri Dai. Bşk.'nın 17.12.2007 tarih ve 18357 sayılı yazısı.

Orta Doğu Teknik Üniversitesi Ortaöğretim Fen ve Matematik Alanları Anabilim Dalı, Doktora Programı öğrencisi Almer Ablak GÜNGÖR'ün "Lise Öğrencilerinin Fiziğe Karşı Tutumlarının Değiştirilmesi" konulu tez çalışması ilgi (a) yönerge doğrultusunda Müdürlüğümüz Değerlendirme Komisyonu tarafından incelenmiş olup, (16 Sayfadan oluşan) çalışmanın, ekli listede belirlenen okullarda, gönüllülük esasına dayalı olarak uygulanması Müdürlüğümüzce uygun görülmüştür.

Makamlarınızca da uygun görüldüğü takdirde Olurlarınıza arz ederim.

Murat Bey BALTA
Milli Eğitim Müdürü

O L U R
27/12/2007

Mehmet KURDOĞLU
Vali a.
Vali Yardımcısı

EKLER :
1. Anket (6 Sayfa)
2. Gözlem Formu (6 Sayfa)
3. Öğretmen ve Öğrenci Görüşme Formu (4 Sayfa)

EK 3

Sevgili Öğrenciler;

Bu çalışma; lise öğrencilerinin bir fizik öğretmeninin derste hangi davranışlarda bulunduğu ve davranışlardan hangilerinin, öğrencilerin tutum ve motivasyonunu etkilediği konusunda görüşlerini belirlemeyi amaçlamaktadır. Araştırma sonuçları, fizik derslerinin daha verimli hale getirilmesinde kullanılacaktır. **Tutum** ile fizik derslerini ne kadar sevdiğiniz, fizik dersine duyduğunuz ilgi ve verdiğiniz önem kastedilmektedir. **Motivasyon** ile fizik derslerinde kendinize duyduğunuz güven; fizik derslerine devam etme, katılma ve çalışma isteğiniz kastedilmektedir.

Araştırmada kesinlikle öğretmenler değerlendirilmeyecek, toplanılan tüm bilgiler gizli tutulacak ve ders notlarına etki etmeyecektir. Anket üç bölümden oluşmaktadır. Birinci bölümde kişisel bilgilerinizle ilgili sorular yer almaktadır. İkinci bölümde fizik öğretmeninizin davranışları ile ilgili sorular yer almaktadır. Bu bölümde her davranış için hem **"Öğretmeniniz hangi sıklıkta kullanıyor?"** hem de **"Tutum ve motivasyonunuzu ne kadar etkiliyor?"** sütunlarına birer işaretleme yapınız. Üçüncü bölümde ise sizin fizik derslerine yönelik tutum ve motivasyonunuzu belirlemeye yönelik sorular yer almaktadır.

Yardımlarınız için teşekkür ederim.

1. BÖLÜM: KİŞİSEL BİLGİLER

1. **Cinsiyetiniz:** ( ) Kız ( ) Erkek
2. **Doğum yılınız:** ____________
3. **Okulunuzun adı:** __________________________
4. **Fizik öğretmeninizi seviyor musunuz?** ( ) Oldukça çok ( ) Çok ( ) Az ( ) Hiç
5. **İlk fizik yazılısı notunuz:** ( ) 0-Sıfır ( ) 1-Bir ( ) 2-İki ( ) 3-Üç ( ) 4-Dört ( ) 5-Beş
6. **İkinci fizik yazılısı notunuz:** ( ) 0-Sıfır ( ) 1-Bir ( ) 2-İki ( ) 3-Üç ( ) 4-Dört ( ) 5-Beş
7. **Lisede hangi alanı seçmeye karar verdiniz?** ( ) Kararsızım ( ) Sayısal ( ) Eşit ağırlık ( ) Sözel

2. BÖLÜM: ÖĞRETMEN DAVRANIŞLARI ANKETİ

		Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
	Fizik öğretmenimiz(in)	Oldukça sık	Sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
SINIF ORTAMI											
1	sakin bir insandır.										
2	öğrencilerle iletişimi iyidir.										
3	derste ve ders dışında güler yüzlüdür.										
4	sınıfta olan biten her şeyden haberdardır.										
5	ders anlatırken konunun ve formüllerin mantığını anlatır.										
6	sorularımızı çekinmeden sorabileceğimiz bir sınıf ortamı sağlar.										
7	ders anlatırken notlarına ve ders kitabına çok fazla bağlı kalır.										
8	dikkatimizin dağıldığını fark edip çeşitli şekillerde dikkatimizi toplar.										
9	sınıfta öğrenme için elverişli bir ortam sağlar.										
10	öğrencilerle iletişimi iyi değildir.										
11	öğrencilerle tek tek veya grup olarak konuşma ve tartışmaya zaman ayırır.										
12	öğrencilerin dersle ilgili veya ilgisiz sorunlarıyla ilgilenir ve çözmelerine yardımcı olur.										
DERS DIŞI											
13	öğrencilere ders dışında da zaman ayırır.										
14	sınıf veya okul dışında bizi gördüğünde selam verir ve bizimle konuşur.										
15	olumsuz bir durum olmadan yalnızca bizimle ilgilendiği için bizimle ve ailemizle telefonla görüşür veya evlerimize bizi ziyarete gelir.										
16	öğrencilere ders dışında zaman ayırmaz.										

	Fizik öğretmenimiz(in)	Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
		Oldukça sık	Sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
DİKKAT ÇEKME											
17	ders anlatırken bizim konuya merakımızı uyandırır.										
18	ders süresince derse ilgimizi canlı tutar.										
19	ders anlatırken gizemli şeyler veya bulmacalar kullanır.										
20	gösteri deneyi yapar veya bize yaptırır.										
21	dersi günlük hayattan örneklerle ilginç ve eğlenceli hale getirir.										
22	gerçek hayattan örnekler, problemler, sorular vb. kullanır.										
23	ders anlatırken benzetmeler, örnekler, şemalar, görsel materyaller ve somut araç-gereçler kullanır.										
24	ilginç sorular sorarak, çelişkili ifadeler kullanarak vb. tuhaf ve alışılmamış noktalara dikkatimizi çeker.										
25	konuyla ilgili birden fazla örnek, hikâye, fıkra, anı, araştırma, vb. kullanır.										
26	dersi takip edip etmediğimizi görmek için bir şeyleri yanlış şekilde yapar; örneğin bir soruyu yanlış şekilde çözer.										
27	görüşlerini doğrudan açıklamaz, bize sorular yönelterek öncelikle bizim görüşlerimizi savunmamızı ister.										
28	kafa karıştırıcı bilgiler vererek dikkatimizi çektikten sonra bu bilgileri konuyla ilişkilendirerek kafa karışıklığımızı giderir.										
29	şaka, sözcük oyunu, espri, fıkra vb. kullanır.										
30	komik benzetmeler yapar.										
31	jest, mimik, el, kol, vücut hareketlerini ve ses tonunu konuların önemine uygun olarak kullanır.										
32	tepegöz, slâyt göstericisi, film, video, eğitim programı ve bilgisayar gibi materyallerden ve ortamlardan yararlanır.										
33	bir konuyu farklı yollarla anlatır.										
34	alışılmadık ve ilginç etkinlikler kullanır.										
35	ders işleyiş şeklini düzenli olarak değiştirir.										
36	sınıfta hep aynı şekilde hareket eder.										
37	dersleri sınıf dışında (laboratuarda, dışarıda vb.) işler.										
38	bizi dersle ilgili gezilere, sergilere, başka okullardaki etkinliklere vb. götürür.										
39	bize soru sorarak zihinsel ve fiziksel olarak derse katılmamızı sağlar.										
40	deney, grup çalışması, beyin fırtınası, oyun, simülasyon, canlandırma, drama, yarışma vb. etkinlikler yaptırarak derse aktif olarak katılmamızı sağlar.										
41	gerçek hayattan örnekler, problemler, sorular vb. kullanmaz.										
42	yarışma ile arkadaşlarımızdan daha iyi olma isteğimizi tetikleyerek konuları öğrenmemizi sağlar.										
43	bizi, "Nasıl?, Niçin?,...ise ne olacak?" tipinde sorular sormaya teşvik eder.										

		Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
	Fizik öğretmenimiz(in)	Oldukça sık	Sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
İLGİ											
44	bizi tanır ve bize ismimizle hitap eder.										
45	fizik dersini kendimizle ilişkilendirmemize yardımcı olur.										
46	dersin sonunda o derste öğrendiklerimizi özetler.										
47	dersin başında bir önceki derste öğrendiklerimizi özetler.										
48	önceki fen veya fizik konuları ve diğer derslerle bağlantı kurar.										
49	ön bilgi, tecrübe, ilgi ve sorunlarımızla öğrendiklerimizi ilişkilendirir.										
50	verdiği örnekleri bizim bildiğimiz durumlardan seçer.										
51	bilmediğimiz bir şeyi anlatırken anlamamızı kolaylaştırmak için bildiğimiz şeylere benzetmeler yapar.										
52	sahip olduğumuz becerileri, yeni şeyler öğrenirken nasıl kullanacağımızı açıklar.										
53	bizi ezber bilgiye yönlendirir.										
54	öğrendiklerimizi, gerçek hayatla ilişkilendirir ve nasıl kullanabileceğimizi gösterir.										
55	fizik dersinde yaptıklarımızın ve öğrendiklerimizin neden önemli olduğunu görmemizi sağlar.										
56	ders işlerken bizim ihtiyaçlarımızı göz önünde bulundurur.										
57	bizim düşüncelerimizi dikkate alarak ve dersin gidişine bakarak dersin işlenişi dersle ilgili bazı değişiklikler yapar.										
58	öğreneceklerimiz, sınavlar veya yapılacak ödevler vb. ile ilgili bazı hususlarda bize seçme hakkı tanır.										
59	İşlenecek konunun ana hatlarını belirlememize izin verir.										
60	başarılarımızın nasıl değerlendirileceğine dair bize söz hakkı verir.										
61	fizik dersinin ileriki konulardaki, üniversite sınavındaki, üniversitedeki, meslek hayatımızdaki vb. yararlarını görmemizi sağlar.										
62	gelecekteki hedeflerimizle öğrendiklerimizi ilişkilendirmemize yardımcı olur.										
63	fizik konularıyla ilgili sorularımıza doğru cevap verir.										
64	sorularımıza mantıklı yaklaşıp cevabını <u>bilmediği</u> soruları araştırıp bize açıklar.										
65	kendini geliştirmek için çaba gösterir ve öğrendiklerini bizimle paylaşır.										
66	işini ciddiye aldığını gösterir.										
67	işini yapmaktan keyif alır.										
68	ders anlatırken dinamik ve enerjiktir.										
69	dersi içten <u>gelmeyerek</u> (isteksiz) anlatır.										
70	fizik dersinde kendine güvenir.										
71	sınav sonuçlarımızı en kısa zamanda bize duyurur.										
72	bize verdiği öğütleri önce kendisi yerine getirir.										
73	hatalarını kabul eder ve bunlardan kısa zamanda vazgeçer.										
74	ders anlatırken düzenlidir, her şeyi adım adım açıklar.										
75	öğrencilerin, tahtada soruları açıklayarak çözmelerini ister.										
76	derste başarılı olmamız için nasıl çalışmamız gerektiğini öğretir.										
77	bizimle tecrübelerini paylaşmaları için sınıfa dersle ilgili misafirler (üst sınıftan öğrenciler, fizikle ilgili alanlarda çalışan kişiler vb.) getirir.										
78	derste konunun tarihsel gelişimi ve ünlü fizikçilerin hayatları ile ilgili şeyler anlatır.										
79	sınıftaki öğrencilerin birbirine destek olmasını sağlayarak grup ruhu aşılamaya çalışır.										
80	ders işlerken bizim ihtiyaçlarımızı göz önünde <u>bulundurmaz</u>.										

	Fizik öğretmenimiz(in)	Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
		Oldukça sık	Sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
GÜVEN											
81	derste kendimize güvenmemize yardımcı olur.										
82	derste kaygı duymamamızı sağlar.										
83	derste rahat hissetmemizi sağlar.										
84	ne zaman ne yapacağı belli olmaz.										
85	bir kural koyduğunda bu kuralı sürekli olarak uygular.										
86	bizim önbilgi, yetenek, ilgi ve ihtiyaçlarımıza göre konuları ayarlar.										
87	seviyemize uygun ders anlatır.										
88	başarabileceğimiz ama bizi biraz uğraştıran etkinlikler, sorular, deneyler, ödevler vb. kullanır.										
89	derste kullanılan materyaller, yapılan etkinlikler, ödevler, tartışmalar, sınav soruları vb. bizim düzeyimize uygundur.										
90	dersin işleniş hızı bizim seviyemize uygundur.										
91	konuyu, örnekleri ve çözeceği soruları basitten karmaşığa doğru sıralar.										
92	neden başarılı ya da başarısız olduğumuzla ilgili değerlendirmeleri yerindedir.										
93	yeterince çaba harcayan herkesin derste başarılı olabileceğini gösterir.										
94	neden başarılı ya da başarısız olduğumuzla ilgili değerlendirmelerimizi sınıfla paylaşmamızı ister.										
95	dersin başında işlenecek konunun başlıklarını listeleyerek o derste ne öğreneceğimizi açıklar.										
96	dersi anlamamız engelleyen eksikliklerimiz olduğunda bunları belirleyerek eksiklerimizi giderir.										
97	başarılarımızın ne şekilde değerlendirileceğini önceden açıklar.										
98	dersin işleniş hızı bizim seviyemize uygun değildir.										
99	erişemeyeceğimiz hedefler koyup beklentilerinin yüksek olduğunu bildirir.										
100	derste bizden beklediklerini açık bir şekilde ifade eder.										
101	bizi, fizik dersinde başarılı olabileceğimizi söyleyerek cesaretlendirir.										
102	dersteki gelişimimizle ilgili olumlu ve yerinde eleştirilerde bulunur.										
103	ödev yaparken, proje yaparken, soru çözerken vb. ihtiyaç duyduğumuzda bize yol gösterir.										
104	bir etkinlik, deney, soru vb. yaptıktan hemen sonra bizi değerlendirir.										
105	olumlu davranışlarımızı, arkadaşlarımızın önünde över.										
106	notlarımızı açıklarken eksiklerimizi ve nasıl başarılı olabileceğimizi söyleyerek bize yol gösterir.										
107	yanlış yaptığımızda bize kızmaz.										
108	fizik dersinde başarılı olabileceğimizi bize gösterir.										
109	yazılı ve sözlü sınavlarda yüksek not verir.										
110	iyi bir şeyler yaptığımızda bizi başkalarının önünde takdir eder.										

	Fizik öğretmenimiz(in);	Öğretmeniniz hangi sıklıkta kullanıyor?					Tutum ve motivasyonunuzu ne kadar etkiliyor?				
		Oldukça sık	Sık	Bazen	Nadiren	Hiç	Çok Artırır	Artırır	Etkilemez	Azaltır	Çok Azaltır
TATMİN											
111	fizik öğrendiğimiz için iyi hissetmemizi sağlar.										
112	fizik dersinden memnun olmamızı sağlar.										
113	fizik dersinde bilgi ve becerilerimizin arttığını gösterir.										
114	öğrendiklerimizi gerçek koşullarda uygulamamıza olanak tanır.										
115	bir işi (soru çözmeyi, deneyi, vb.) önce bitirenlere sorumluluk vererek arkadaşlarına yardım etmesini ister.										
116	çabalayıp bir şeyler başaran öğrencilerini (örneğin notunu 1'den 3'e çıkaranları) takdir eder.										
117	başarılarımızı takdir sözcükleriyle, gerçek veya sembolik ödüllerle uygun bir şekilde ödüllendirir.										
118	çalışmalarımızın sonuçlarını sınıftakilerle, okuldakilerle veya okul dışından kişilerle sunu yaparak, poster hazırlayarak, sergi düzenleyerek vb. paylaşmamızı sağlar.										
119	yanlışlarımızı doğruları öğrenmek için fırsat olarak görmemizi ister.										
120	yanlış yaptığımızda bize yardımcı olacak ve bizi motive edecek değerlendirmeler yapar.										
121	derste ceza olarak öğrencileri arkadaşlarının önünde küçük düşürür.										
122	derslerde bize yerli-yersiz bağırır.										
123	disiplin anlayışı olarak düşük not verir veya notla korkutur.										
124	bir öğrencinin yaptığı bir hatadan dolayı bütün sınıfı cezalandırır.										
125	derste sürpriz ödüller verir.										
126	ders süresini etkili bir biçimde kullanır.										
127	soru çözerken, cevap verirken, not tutarken, deney yaparken, sınavda vb. bize yeterince zaman verir.										
128	konunun anlaşılması ve anlamadığımız noktaları sormamız için bize yeterince zaman verir.										
129	bize söylediği beklentileri ile derste ve sınavda yapmamız gerekenler uyumludur.										
130	bir kural koyduğunda bu kuralı adil bir şekilde uygular.										
131	bir öğrencinin yaptığı bir hatadan dolayı bütün sınıfı <u>cezalandırmaz.</u>										
132	bazı öğrencileri veya grupları (örneğin kızları veya erkekleri) kayırır.										
ANLAŞILIRLIK											
133	ders anlatırken açık, anlaşılır, akıcı ve yalın bir dil kullanır.										
134	ders anlatırken anlaşılmayan kısımları tekrar anlatır.										
135	tahtaya veya tepegöze yazdıkları düzenli ve okunaklıdır.										
136	derste anlaşılır notlar tutturur veya dağıtır.										
137	dersi takip edip etmediğimizi sürekli kontrol eder.										
138	bir konuyu anlatırken önemli kısımları vurgular.										
139	dersi daha iyi anlamamız için bol soru çözer.										
140	ders anlatırken anlaşılmayan kısımları tekrar <u>anlatmaz.</u>										

3. BÖLÜM: TUTUM VE MOTİVASYON ANKETİ

#	Cümleler	Kesinlikle Katılırım	Katılırım	Kararsızım	Katılmam	Kesinlikle Katılmam
1	Fizik derslerimiz eğlencelidir.					
2	Fizik dersini severim.					
3	Fizik dersinde ilgimi çeken çok az şey var.					
4	Fizik dersine çalışmak hoşuma gidiyor.					
5	Fizik derslerine gitmek için can atıyorum.					
6	Fizik dersinin içeriği ile hali hazırda bildiğim şeyler arasında bir alaka göremiyorum.					
7	Fizik dersinin, ilerideki çalışmalarımda bana yararlı olacağını düşünüyorum.					
8	Fizik dersinde öğrendiğim şeylerin benim için yararlı olacağını düşünüyorum.					
9	Fiziğin, ileriki meslek hayatımda önemli bir yeri olacağını düşünüyorum.					
10	Fizik derslerinde öğrendiklerimin, hayatımı kolaylaştıracağını düşünüyorum.					
11	Fizik derslerinde rahatımdır.					
12	Fizik sınavlarında rahatımdır.					
13	Fizik dersinde başarılı olmak için elimden geleni yaparım.					
14	Fizik dersinde başarılı olabileceğimden eminim.					
15	Fizik dersinde başarılı olacağım konusunda kendime güveniyorum.					
16	Fizik dersindeki çalışmalarım beni tatmin eder.					
17	Fizik dersinin beni çok tatmin ettiğini hissediyorum.					
18	Fizik dersinde kazandığım şeylerle tatmin olduğumu hissediyorum.					
19	Fizik derslerindeki başarılarımla gurur duyarım.					
20	Fizik dersinde aldığım notlardan memnunum.					
21	Zorunlu derslerimin dışında da fizik dersi almak isterim.					
22	Fizikle ilgili daha çok şey öğrenmek istiyorum.					
23	Fizik dersinde çok çalışmak için gerekli motivasyona sahibim.					
24	Fizik derslerinde başarılı olmak için elimden geleni yaparım.					
25	Fizik dersinde yapılacak iş ne kadar zor olursa olsun, elimden geleni yaparım.					

EK-4

Gözlem Formu

	SIKLIK	UYGUNLUK
DİKKAT ÇEKME		
Somutluk		
Gösteri deneyi yapmak		
Gizem		
Bulmaca		
Hikaye ve biyografi gibi örnekler kullanmak		
Tanıdık veya kişisel örnekler ve anektodlar kullanmak		
Sorgulama yapmak		
Soru sorma, paradoks oluşturma, araştırma üretme ve düşünmeyi sağlamak		
Çözülmesi gereken bir problem sunmak		
İlginç bir senaryo		
Gündelik hayattan örnekler		
Teknoloji ile ilgili sorular sormak		
Somut analojiler (benzetmeler) kullanmak		
Tuhaflık ve Kargaşa		
Sıra dışı ve tuhaf içerik kullanmak		
Bir şeyi yanlış yoldan yapmak (öğretim içinde doğrusunu göstermek)		
Öğrencilerin daha önceki deneyimleri ile çelişkili gerçekleri veya ifadeleri kullanmak		
Konuyu anlatırken şeytanın avukatını oynamak		
Paradoks oluşturmak		
Kavramsal kargaşa oluşturmak		
Yenilikleri, karmaşayı ve belirsizliği kullanmak, (öğrenciler yeni, karmaşık ve belirsiz şeyleri keşfetmek isteyecektir)		
Mizah		
Konuya başlarken veya dersi bitirirken şaka kullanmak		
Örtüşen veya aşırı gibi görünen içeriği aktarırken sözcük oyunu veya tekrarlayan espri kullanmak		
Komik analojiler (benzetmeler) kullanmak		
Değişiklik		
Beklenmedik olayları kullanmak		
Ses tonunda, hareketlerde, öğretim formatında, öğretim ortamında veya basılı materyallerin tasarımında veya diziminde değişiklik yapmak		
Etkileşimin seyrinde örneğin öğrenci-öğretmen etkileşiminden öğrenci-öğrenci etkileşimine geçerek değişiklik yapmak		
Kullanılan görsellerde değişiklik yapmak (diyagram, çizim, zaman çizelgesi, harita, sergi vb.)		
Görsel işitsel ortamda değişiklik yapmak (tepegöz, bildiri, projeksiyon cihazı vb.)		
Gruplamayı değiştirmek		
Öğretim metotlarını (anlatım, tartışma, beyin		

fırtınası, panel vb) veya sunuş stilini değiştirmek		
Aktarım (konuşma) hızını değiştirmek		
Aktif Katılım		
Bireysel katılımı, interaktiviteyi veya basit araçlarla yaparak öğrenmeyi teşvik etmek		
Rol oynamayı kullanmak		
Laboratuar çalışması yaptırmak		
Oyun ve simülasyon kullanmak		
Yarışma veya rekabeti kullanmak		
Aktif düşünme gerektiren soru-cevap-dönüt etkileşimini kullanmak		
Öğrencilerin ilgilerini artırabilecek konu, proje veya ödevleri seçmelerine olanak tanımak		
Takım çalışmasına olanak tanımak		
Soruşturma		
Öğrencilerin çözebilecekleri problemler veya sorular kullanmak		
Beyin fırtınası yaptırmak		
Öğrencilerin hayal gücünü kullanmalarını teşvik etmek		
Sık sık problem çözme etkinlikleri kullanmak		
İLGİ		
Deneyim		
Öğrencilerin sahip oldukları becerileri kullanmak		
Öğreneceklerinin sahip odluları becerilerle ilişkisini açıklamak		
Öğrenilecekleri öğrencilerin önbilgilerinin üzerine inşa etmek		
Yeni bilgi veya beceri edinirken öğrencilerin önbilgi ya da becerilerini kullanmalarına fırsat vermek		
Öğrencilerin deneyimlerini veya düşüncelerini paylaşmalarını istemek		
Öğrencilere aşina olan durumlardan örnekler kullanmak		
Öğrenileceklerle öğrencilerin önceki deneyimlerini ilişkilendirmek için analojileri (benzetmeleri) kullanmak		
Metafor kullanmak		
Şu Andaki Değer		
Öğretimin öğrenciler için o andaki önemini ifade etmek		
Gelecekteki Yarar		
Kazanımları, açık bir şekilde öğrencilerin gelecekteki etkinlikleri ile ilişkilendirmek böylece öğrenciler öğretimi kendi gelecek hedefleri ile ilişkilendirebilecektir		
İhtiyaç Eşleşmesi		
Öğrencilerin ihtiyaçları ile ilişkili argümanlar kullanmak		
Öğrencilerin motivasyon profillerine uyan öğretim stratejileri kullanmak		
Bireysel başarı veya kendi kendine çalışma, grup		

çalışması, liderlik sorumluluğu ve fırsatı vererek ve olumlu rol modelleri ile karşılaşmalarını sağlayarak öğretimi, öğrencilerin güdü ve değerlerine duyarlı hale getirmek		
Bireysel rehberlik/destek vermek		
Öğrencilerin özelliklerine benzer örnek veya görsel kullanmak		
Model Olma		
Öğrencilerin yapmalarını istediği şeyleri yapmak		
Eski öğrencileri misafir konuşmacı veya öğretici olarak kullanmak		
Bireysel hızda yapılan çalışmalarda önce bitiren öğrencilerin öğretmenlik yapmalarına izin vermek (akran modeli)		
Öğretme isteğiyle örnek olmak		
Model olması için video kullanmak		
Öğrencilere özel yaklaşım ve beceri gerektiren problemleri çözen uzmanları gözlemleme imkanı vermek		
Güçlü modeller kullanmak		
Aynı şeyi yapan farklı modeller kullanmak		
İşbirlikli etkinlikler kullanmak (akran modeli)		
Öğrencilerin gözünde güvenilirliği yüksek olan kaynaklar kullanmak		
Öğrencilerin güvenilirliği yüksek olan kaynağın uzmanlığı hakkında bilgi sahibi olmasını sağlamak		
Öğrencilere çekici gelen modeller kullanmak		
İkna mesajındaki kullanılan argümanların kalitesi ve yapısı, güvenilir kaynaklar çekici kaynaklardan daha kritiktir		
Kaynağın çekiciliğini artırmak için öğrencilerle onların tarafını tutacak şekilde fikir birliğine varmak		
Öğrenciler istenilen davranışı sergileyen modeli gözlemlemenin yanı sıra modelin bu davranışa teşvik edildiğini de gözlemlemelidir.		
Seçenek		
Öğrencilere içeriği, kazanımları, etkinlikleri, grup üyelerini seçme imkanı vererek öğrenme üzerinde kişisel kontrol olanağı vermek		
Öğrencilerin çalışmalarını sürdürürken çeşitli metotlar kullanmalarına izin vermek		
Öğrencilerin çalışmalarını ne şekilde organize edeceklerini seçmelerine izin vermek		
Değerlendirme için seçenek vermek		
Çalışma metotları için seçenek vermek		
Kazanımlar için seçenek vermek		
Ödevler için seçenek vermek		
GÜVEN		
Kazanımları ve Gereklilikleri Bildirmek		
Kazanımları veya öğretilenlerin yararını açıkça belirten cümleler veya örnekler vermek ve kazanımların başarıyla edinilmeleri için hedefleri belirtmek veya öğrencilerin açıklamalarını		

sağlamak		
Başarmak için neler yapmak gerektiğini ve değerlendirme ölçütlerini açıklayarak olumlu beklentiler ve güven oluşturmak		
Dönüt vererek alıştırma yapma imkanı vermek		
Başarılı olmak için gerekli ön bilgi, beceri ve tutumlardan bahsetmek		
Testte veya alıştırmada kaç soru olacağını ve zamanlı olup olmayacağını belirtmek		
Aşırı zorlanmadan veya sıkılmadan korunmak için öğrenme için gerekli şeyleri önbilgi ve becerilerle eşleştirmek		
Öğretimin hedeflerini, kazanımları, genel olarak dersin yapısını açıkça belirtmek		
Örnek olabilecek ve kabul edilebilir çalışmalara örnek vermek		
Performans gerekliliklerini açıklamak		
Öz değerlendirme, akran değerlendirme araçları sağlamak		
Zorluk		
Ders ilerledikçe öğrenme başarısının artmasını sağlayan çeşitli ve uğraştırıcı deneyimler sunmak		
Ders süresince materyalleri ve alıştırmaları zorluğu artacak şekilde organize etmek yani öğrencilerin üstesinden gelebilecekleri uğraştırıcı materyaller oluşturmak		
Öğrenme gereksinimleri ile ön bilgi ve becerileri eşleştirerek seviyesi düşük öğrenciler için aşırı zorlanma ve kaygıyı azaltırken daha yüksek seviyeli öğrencilerin sıkılmalarını önlemek		
Dersin başında ön test uygulamak. Öğrencilerin dersin başındaki bilgi seviyeleri birbirlerinden çok farklı olabilir.		
Adım adım ilerleme yaklaşımını kullanmak		
İçeriği büyük parçalar halinde gruplamak		
Öğrencilerin yapabilecekleri ancak bir miktar çaba harcamalarını gerektirecek etkinlikler tasarlamak (çok zor değil fakat çok kolay değil)		
Beklentiler		
Öğrencilerin gerçekçi hedefler koymalarına yardımcı olmak		
Harcanan çaba ve sahip olunan yetenekle başarılı olma ihtimalini belirten cümleler kullanmak		
Hedeflerin gerçekleştirilmesi için çalışma planının nasıl yapılacağını öğretmek.		
Makul ve elde edilebilir hedefler koymak		
Öğrencilere yüksek beklentiler bildirmek		
Öğrenci cevaplarını düzelterek yeniden ifade etmek		
Kontrol Odağı		
Öğrencilerin, başarılarının şans veya diğer dış etkenlerin sonucu olmadığı, kendi çabalarının sonucu olduğunu bilmelerini sağlamak		
Öğrencilerin başarıları ve başarısızlıkları için		

uygun atıflar yapmaları için cesaretlendirmek		
Öğrencilerin başarılarının şans veya diğer dış etkenlerin sonucu olmadığı, kendi çabalarının sonucu olduğuna ilişkin dönüt vermek (örneğin bu ödev için kadar çok çalıştığınız anlaşılıyor veya bu cevap sizin okurken ne kadar dikkatli olduğunuzu gösteriyor)		
Özgüven		
Bir beceri edinirken öğrencilerin gittikçe daha serbest deneyimler edinmelerine izin vermek		
Daha korunaklı ve düşük riskli koşulları takiben öğrencilerin gerçekçi koşullarda beceri alıştırmaları yapmalarını sağlamak		
Öğrencilerin kendi yeteneklerine güvenmelerini sağlayacak sıklıkta ve erkenden başarı fırsatı sağlamak		
Hata yapmanın kabul edilebilir olduğu bir öğrenme ortamı sağlamak		
İşbirlikli testler yapmak		
Motive edici dönütler vermek (yalnızca yapabilirsin demek bile yeterli olabilir)		
Dönüt		
Kabul edilebilir cevaplara dönüt vermenin yanında kriterlere uymayan cevaplara da yapıcı dönütler vermek		
Detaylı ve bilgilendirici dönütler vermek		
Stratejiler hakkında bilgi vermek		
Dönütün motive edici yararlarının azalmasını engellemek (örneğin çok basit bir iş için çok fazla övgü), özellikle öğrenciler yeni bir beceriedinmeye çalışırken daha sık kullanılabilir		
Akran dönütü		
TATMİN		
Doğal Sonuçlar		
Öğrencilerin becerilerini, gerçekçi ortamlarda olabildiğince erken kullanmalarını sağlamak		
Öğrencilerin "gerçek dünya" problemlerini çözebileceklerini fark etmelerini sağlayacak problem, simülasyon ve çalışma denemeleri yapmalarını sağlamak		
Bir görevi tamamlayan öğrencilerin henüz tamamlamayanlara yardım etmelerine izin vermek		
Başarı için gerekli olan öğrenci etkinliklerini ve özelliklerini ifade etmek, herhangi bir risk veya karşılaşılan güçlükte bu açıklamaları sürdürmek		
Öğrencileri ilişkili ilgi alanları ve kavramların uygulamaları hakkında bilgilendirmek		
Beklenmeyen Ödüller (doğal sonuçların yokluğunda kullanılmalıdır.)		
İşin tamamlanmasının hemen ardından sözlü övgü, kişisel dikkat, yardımcı dönüt, motive edici dönüt, gerçek veya sembolik ödüller vermek		
Olumlu Çıktılar		
Dışsal ödülleri kullanırken ödülün dersten daha ilgi		

çekici olmamasına dikkat etmek		
Dışsal ödülleri doğru cevaplar için kullanmak ve yanlış cevaplar için öğrencileri cezalandırmamak, öğrencilerin yanlışları öğrenme fırsatları olarak görmelerine yardımcı olmak		
Öğrenciler bir görevde daha yetkin hale geldiklerinde ve öğretimle birlikte geliştiklerinde yaptırımı aralıklı olarak kullanmak		
Öğrencilerin çabaları ve başarıları için dönüt ve olumlu duygularını geliştirecek diğer bilgileri kullanmak		
Olumsuz Etkiler		
Tehdit etmekten kaçınmak		
Öğrencilerin kendilerini değerlendirme fırsatları varsa dış performans değerlendirmesinden kaçınmak		
Basit davranışları çok fazla ödüllendirerek öğrencileri rahatsız etmemek		
Olumsuz sonuçlar eğlenceli olduğunda öğrenciler kasıtlı olarak yanlış cevabı seçebilirler		
Dışsal ödülleri çok fazla kullanmamak, öğretimi gölgede bırakabilirler		
Zamanlama		
Aralık ve sayı olarak yaptırımların zamanlamasını değiştirmek		
Konunun incelenmesi için yeterince zaman vermek		
Ders ilerledikçe ödüller rutin veya tahmin edilebilir hale gelmemelidir, bir miktar sürpriz etkisi yaratmalıdır		
Eşitlik		
Performans gerekliliklerini ifade edilen beklentilerle, kazanımlarla ve standartlarla tutarlı hale getirmek		
Tüm öğrencilerin ödevlerini, testlerini ve başarılarını ölçecek standartların tutarlı olması		
Öğretimle tutarlı alıştırma ve etkinlikler kullanmak		
Eşitsizliğe engel olmak (kişisel durumlara tüm öğrencilerin erişmesine izin vermek veya hiçbir öğrencinin erişmesine izin vermemek)		

EK-5

Öğretmen Görüşme Formu

Amaç: Öğrencilerin fizik derslerine karşı olumlu duyuşsal özelliklerini geliştirerek dolaylı yoldan fizik dersindeki başarılarını artırmak. Duyuşsal özellikleri ile öğrencilerin tutumları yani derse ilgileri, dersi önemsemeleri ve motivasyonları yani dersteki kaygıları, özyeterlik algıları, benlik kavramları gibi özellikler kastedilmektedir.

Bize yardımcı olmak için tez, makale, kitap gibi kaynaklar önerebilirsiniz veya bu konuda çalışan/çalışmış kişilere bizi yönlendirebilirsiniz ya da konuyla ilgili kendi çıkarımlarınızı belirtebilirsiniz.

Bunun için, bir fizik öğretmeninin derste ve ders dışında neler yapabileceği ile ilgili olarak çeşitli stratejiler belirlemek istiyoruz. Örneğin öğretmenin dersini işlerken günlük yaşamdan örnekler kullanması, öğrencilerin önbilgilerini dikkate alması vb.

Sorular:

1. Öğrencilerin fizik derslerine ilgilerini artırmak için neler yapılabilir?
    - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
2. Öğrencilerin fizik derslerine verdikleri önemi artırmak için neler yapılabilir?
    - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
3. Öğrencilerin fizik dersleri ile ilgili yaptıkları ekstra aktiviteleri artırmak için neler yapılabilir?
    - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
4. Öğrencilerin fizik derslerindeki kaygılarını azaltmak için neler yapılabilir?
    - ders kaygısı
    - sınav kaygısı
    - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
5. Öğrencilerin fizik derslerindeki motivasyonlarını artırmak için neler yapılabilir?
    - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?

6. Öğrencilerin fizik derslerindeki başarı motivasyonlarını artırmak için neler yapılabilir?

   ALTERNATİF 6: Fizik dersinde başarılı olabilmek için daha çok çabalamanız için neler yapılabilir?

   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?

7. Öğrencilerin fizik dersleri ile ilgili özyeterlik algılarını artırmak için neler yapılabilir?

   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?

8. Öğrencilerin fizik derslerindeki benlik kavramlarını artırmak için neler yapılabilir?

   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?

9. Öğrencilerin fizik derslerinde kendilerine olan güvenini artırmak için neler yapılabilir?

   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?

Öğrenci Görüşme Formu

Fizik dersleri ile ilgili bazı öğrenci özelliklerini geliştirmek için bir fizik öğretmeninin derste ve ders dışında neler yapabileceği ile ilgili olarak;

1. Fizik derslerine olan ilginizi artırmak için neler yapılabilir?
   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
2. Fizik derslerine verdiğiniz önemi artırmak için neler yapılabilir?
   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
3. Fizik dersleri ile ilgili yaptığınız ekstra aktiviteleri artırmak için neler yapılabilir?
   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
4. Fizik derslerindeki kaygılarınızı (stresinizi) azaltmak için neler yapılabilir?
   a. dersteki kaygınızı (stresinizi) azaltmak için
      - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
   b. sınavdaki kaygınızı (stresinizi) azaltmak için
      - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
5. Fizik derslerindeki motivasyonunuzu artırmak için neler yapılabilir?
   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
6. Fizik derslerindeki başarı motivasyonunuzu artırmak için neler yapılabilir?
   ALTERNATİF 6: Fizik dersinde başarılı olabilmek için daha çok çabalamanız için neler yapılabilir?
   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?
7. Fizik derslerinde kendinize olan güveninizi artırmak için neler yapılabilir?
   - Bu stratejiler ne şekilde kullanılırsa daha etkili olur?

EK-1

Araştırmanın Ankara'da, aşağıda belirtilen okullarda yürütülmesi için izin istenilmektedir:

1. Çankaya ilçesindeki bütün resmi ve özel liseler
2. Kalaba Lisesi (Keçiören)
3. Genç Osman Lisesi (Keçiören)
4. Mustafa Kemal Lisesi (Yenimahalle)
5. Batıkent Endüstri Meslek Lisesi (Yenimahalle)
6. Ankara Üniversitesi Geliştirme Vakfı Özel Okulları (Gölbaşı)
7. Yıldırım Beyazıt Anadolu Lisesi (Altındağ)
8. İbni Sina Lisesi (Sincan)

APPENDIX I

THE AFFECTIVE TEACHING PRACTICES CHECKLIST

	COMMUNICATION
1	Behaves patiently.
2	Communicates positively.
3	Smiles in and out of class.
4	Knows about events about the students that may influence learning.
5	Creates an atmosphere for students to ask questions without hesitating.
6	Counts on his/her notes or the book too much.
7	Creates an atmosphere suitable for learning.
8	Spends time for speaking to the students one by one or as a group.
9	Cares about students' problems related to the course or not related to the course.
10	Spends time for students out of the class time.
11	Speaks to the students when he/she sees them out of the class or out of the school.
12	Speaks or calls students or their families since he/she cares about them.
13	Uses a clear, understandable, fluent and simple language in courses.
14	Repeats the parts that are not understood.
15	Writes clearly and systematically on the board or transparency.
16	Distributes or helps students to take clear notes.
17	Checks if the students follow the lesson/class/lecture or not.
18	Emphasizes important parts.
20	Solves a lot of questions.
21	Explains the logic behind the topic and the formulas.
ATTENTION	
36	Doesn't disturb students' attention with his/her movements.
38	Uses his/her gestures, mimics, body movements and tone of voice in accordance with the importance of the theme.
	A.1. CONCRETENESS
22	Uses sense of mystery
23	Uses examples, problems, questions related to daily life.
25	Uses more than one examples, stories, jokes, anecdotes, researches etc.

26	Uses analogies, diagrams, visual materials or concrete materials.
27	Uses materials and media like over head projector, film, video, computer or computer programs. Uses distinct visual or audial stimuli related to topic (Using graphic, animation, inverse, flash, sound and other audio and/or visual capabilities of the audiovisual instruments)
	A.3. HUMOR
24	Uses humor, joke, gag, pun, humorous analogies etc. an introduction to the topic or in the conclusion or while delivering the material that may overlap or become redundant
	A.5. PARTICIPATION
28	Uses activities like group work, brainstorming, games, simulations, role playing, drama, competition to actively involve students.
29	Conducts experiments or has the students conduct experiments. Uses experiments or demonstrations.
43	Uses competitions to trigger students' feeling of being better than their friends to teach topics.
	A.2. INCONGRUITY AND CONFLICT
31	Directs students' attention to unusual points by using interesting questions, incongruous statements etc.
32	Does something in a wrong way to get students attention.
33	Asks students to defend their ideas before starting the theme/subject/lesson
37	Plays devils advocate, introduce a cognitive conflict etc.
	A.6. INQUIRY
34	Uses questions to make students participate the course.
35	Asks questions like "How" and "Why" or supports students asking these kinds of questions in order to help them understand the theme deeply.
	A.4. VARIABILITY
39	Varies teaching methods teaching a topic.
40	Varies teaching methods.
41	Varies the learning environment.
42	Conducts trips, exhibitions, activities in other schools etc./Takes students to trips, exhibitions, activities in other schools etc. Varies the learning environment.
30	Uses unusual and interesting activities.
RELEVANCE	
45	Uses students' names.
	R.1. EXPERIENCE
46	Relates current learning to prior science and physics topics.
47	Relates current learning to other courses.
48	Relates current learning to students' prior knowledge, experience, interest and needs.
49	Uses examples from situations that are familiar to the students.

50	Uses analogies to relate current learning to prior experience.
51	Explains how to use prior knowledge and skills.
52	Relates current learning to real life.
	R.2. PRESENT WORTH
53	Helps students see the value of what they learn.
	R.4. NEEDS MATCHING
54	Makes some alterations according to the flow of the course.
	R.6. CHOICE
55	Provide options for objectives, examinations, homeworks, etc.
	R.3. FUTURE USEFULNESS
56	Tie the instructional goals explicitly to the students' future activities in which the students relate he instruction to their own future goals.
57	Tie the instructional goals explicitly to the students' future activities in which the students relate he instruction to their own future goals.
	R.5. MODELING
58	Gives correct answers to the students' questions about physics topics. Provides role model with his/her behaviors for the students.
59	Finds answer to the questions he/she could not answer and explains it to the students. Provides role model with his/her behaviors for the students.
60	Improves him/herself and shares what he/she learns with the students. Provides role model with his/her behaviors for the students.
61	Cares about his/her job. Provides role model with his/her behaviors for the students.
62	Models through teacher enthusiasm.
63	Behaves enthusiastically and energetically while teaching. Models through teacher enthusiasm.
65	Has self-confidence in physics. Provides role model with his/her behaviors for the students.
66	Provides role model with his/her behaviors for the students.
67	Explains what he/she teaches in a step by step approach. Provides opportunities to the students to observe expert models solving problems. Provides multiple models doing the same thing.
68	Asks students to explain what they do when they are solving problems at the board. Provides opportunities to the students to observe expert models solving problems. Provides multiple models doing the same thing. Provides powerful model.
69	Helps students learn how to study to be successful.
70	Invites guests like students from the higher grades, people having a physics-related job to share their experiences.
71	Tells about the historical development of the topic or famous physicists lives.
72	Creates a group spirit by guiding students to support their friends in the class.

CONFIDENCE	
	C.5. SELF-CONFIDENCE
73	Doesn't give unexpected negative reactions.
74	Consistent in applying the rules.
80	Provide opportunity for students to see everyone who spends effort can be successful.
94	Provide an environment where it's okay to make mistakes.
95	Provide success opportunities early and often enough to establish the learner's belief in his or her ability to achieve.
96	Give high grades in written or oral examinations.
	C.2. DIFFICULTY & CHALLENGE
75	Lectures according to the students' level.
76	Designs materials, activities, homeworks, exam questions matching students' levels.
77	Designs activities at which students are likely to succeed, but that require some effort (not difficult but not too simple)
78	Organize materials and practice exercises on an increasing level of difficulty- that is structure the materials to provide a conquerable challenge, over the course life.
	C.4. ATTRIBUTIONS
79	Communicates students that their successes were the product of their effort rather than luck or other external factors (when that is the case)
81	Encourages students to "verbalize appropriate attributions for both successes and failures"
	C.1. PROVIDE OBJECTIVES
82	Clearly presents the objectives and the overall structure of the lesson.
83	Mentions and if needed fulfils the prerequisite knowledge, skills, or attitudes that will help the learner succeed at the task.
85	Explains the evaluative criteria.
	C.3. EXPECTATIONS & FEEDBACK
86	Communicates high expectations to the students.
87	Clearly explains what is expected from the students. Explain the performance requirements.
88	Encourages the students even by simply telling you can do it.
89	Provides feedback for acceptable responses as well as constructive feedback for those responses that don't meet criteria.
90	Provides feedback when students need help.
91	Uses verbal praise, personal attention, helpful feedback, and motivating feedback (praise) immediately following task performance.
92	Appreciates students' positive behaviors in front of other people.
93	Gives information about students' mistakes and learning strategies.

	SATISFACTION
	S.1. NATURAL CONSEQUENCES (intrinsic reinforcement)
97	Makes students realize that their knowledge and skills increased.
98	Allows students use their skills in realistic settings as soon as possible.
99	Allows students who have mastered a task to help students who have not yet finished. Provides opportunity for students earn peer respect.
	S.2. UNEXPECTED REWARDS (uses when natural consequences are missing)
102	Uses unexpected tangible reward.
	S.3. POSITIVE OUTCOMES (extrinsic reinforcement)
100	Uses verbal praise, real or symbolic rewards, and incentives, or allow students to showcase the results of their effort ("show and tell") to reward their success after instruction
101	Uses verbal praise, real or symbolic rewards, and incentives, or allow students to showcase the results of their effort ("show and tell") to reward their success after instruction
103	Uses verbal praise, real or symbolic rewards, and incentives, or allow students to showcase the results of their effort ("show and tell") to reward their success after instruction
104	Provides motivational feedback when students make mistakes.
	S.4. NEGATIVE INFLUENCES (Doesn't use too many extrinsic rewards)
105	Avoid the use of threats, the use of surveillance practices (as opposed to positive attention)
106	Avoid the use of threats, the use of surveillance practices (as opposed to positive attention)
107	Avoid the use of threats, the use of surveillance practices (as opposed to positive attention)
108	Avoid the use of threats, the use of surveillance practices (as opposed to positive attention)
	S.5. SCHEDULING (vary the overall schedule of reinforcement, in terms of both interval and quantitiy.)
109	Uses class time effectively.
110	Gives enough time to the students while they are solving problems, answering questions, taking notes, conducting experiments, in the exam etc.
111	Allows adequate time for exploration of a topic.
	S.6. EQUITY
112	Makes performance requirements consistent with stated expectations.
113	Avoids unequal.
115	Avoids unequal.

APPENDIX J

EXTENDED TRANSCRIPTS (CODED) AND FIELDNOTES

(PROVIDED IN THE FORM OF CD INSIDE THE BACK COVER OF THESIS BOND)

APPENDIX K

TIME TABLE OF OBSERVATIONS

		High School			
Week	Date	Private Science	Private Anatolian	Public Anatolian	Public
I	11 March 2008	2 (audio)			
	12 March 2008				
	13March 2008		2 (video)		
	14 March 2008			2 (video)	
II	17 March 2008	1 (audio)			
	18 March 2008	2 (audio)			1 (audio)
	19 March 2008		1 (video)		
	20 March 2008				1 (audio)
	21 March 2008			2 (video)	
III	24 March 2008				
	25 March 2008				1 (audio)
	26 March 2008		2 (video)		
	27 March 2008				1 (audio)
	28 March 2008			1 (video)	
IV	31 March 2008	1 (audio)			
	1 April 2008	2 (audio)			1 (audio)
	2 April 2008		2 (video)		
	3 April 2008				1 (audio)
	4 April 2008			2 (video)	
V	7 April 2008	1 (video)			
	8 April 2008				1 (audio)
	9 April 2008		2 (video)		
	10 April 2008				1 (audio)
	11 April 2008			2 (video)	
VI	14 April 2008	1 (video)			
	15 April 2008	2 (video)			
	16 April 2008		2 (video)		
	17 April 2008				1 audio
	18 April 2008			2 (video)	
VII	21 April 2008	1 (video)			
	22 April 2008	2 (video)			1 (video)
	23 April 2008				
	24 April 2008				1 (audio)
	25 April 2008				
	TOTAL	8 audio+7 video	11 video	11 video	10 audio+1 video

APPENDIX L

PHYSICAL SETTINGS OF THE CLASSROOMS OBSERVED

PUBLIC ANATOLIAN HIGH SCHOOL: EDA'S CLASSROOM

PRIVATE ANATOLIAN HIGH SCHOOL: ALPER'S CLASSROOM

PRIVATE SCIENCE HIGH SCHOOL: ÇAĞLAR'S CLASSROOM

PUBLIC HIGH SCHOOL: ERKAN'S CLASSROOM

APPENDIX M

SAMPLE CODING OF QUALITATIVE DATA

07 April 2008 Sixth Observation **20 students + 2 absent**

Video Tape + Field Notes

First hour Sınıfa öğretmenle birlikte girdik. T: "Halen başlayamadık arkadaşlar." Öğretmen tahtanın önünde durdu, sınıfa göz gezdirdi. S: "Nee!" S: "Özgür nerede?"" S: "Kanki yok." T: "Kim yok?" Defteri imzalamak için kürsüye geçti. S: "Can." S: "Can yok." S: "Can'ın ne işi var burada?" S: "Abi Can'ın ne işi var burada?" T: "Can'la kim yok? Bir kişi daha yok." S: "Evet, bir kişi daha yok!" S: "Erkan yok." T: "Kim?" S: "Erkan." T: "Başladık mı tanımlamaya?" diye sordu öğrencilere defteri	

imzalarken. Öğrenciler kendi aralarında konuşuyorlardı. S: "Abi çekmeye başlamışlar." S: "Kamera çekiyor." Öğretmen öğrencilere doğru ilerledi. T: "Şu kalemin yazıyor mu?" diye sordu bir öğrenciye. S: "Defter için mi?" dedi öğrenci. Öğretmen kalemi aldı, kürsüye geri döndü. Öğrenciler kendi aralarında konuşmaya devam ediyorlardı. Sınıf defterini kapattı.	
T: "Evet, çocuklar, var mı sormak istediğiniz bir soru? Var mı sormak istediğiniz?" diyerek kalem aldığı öğrenciye doğru yöneldi ve kalemini geri verdi. S: "Yok." T: "Peki, sizin yüzünüzden hocam, sizin sayenizde aynaları yapabilir hale geldik hocam diyor. Küresel aynalara geçelim. Herkes. Kaç kişi çukur aynayı, şey düzlem aynayı yapabilir? Düzlem aynayı anladık diyenler?" Tüm öğrenciler parmaklarını kaldırdılar.	Commun5
T: "Peki, tartışmada açacağız, zaman zaman döneriz ama isterseniz bugün küresel aynalar diyelim." dedi ve tahtaya küresel aynalar yazdı. "<u>Küresel aynalar. Şimdi çocuklar, küresel ayna bi küreden keseceğiz. Küreden kesilerek sırlanmış aynalar, küre parçası olacak.</u>" diyerek **tahtaya bir küre çizdi**. "<u>r yarıçaplı bir küreden, r yarıçaplı bir küreden bi şöyle bir parça kesiyoruz, kesip alıyoruz, çocuklar.</u>" derken **küre üzerinde kürenin yarıçapını çizdi**. "<u>Dış tarafını sırlarsak çukur ayna.</u>" derken **kürenin bir parçasının dış tarafını taradı**. "<u>Şöyle bir parça kesip iç tarafını sırlarsak tümsek ayna. Tümsek tarafı yansıtır. Yani yansıtıcı tarafı ne taraf olan,</u>"	Commun15 <u>Commun21Model67</u> **Concrete26**

şöyle diyelim isterseniz; yansıtıcı tarafı, yansıtıcı yüzeyi, çukur tarafı, çukur tarafı olan ayna. Ne deniliyormuş buna gençler?" derken tahtaya şeklin kenarına şekildeki gibi "**yansıtıcı yüzeyi çukur tarafı olan ayna (Çukur ayna)" yazdı.**	
S: "Çukur ayna."	
T: "**Çukur ayna**. Daha tanımını yapacağız tabi ama biraz aklınızda kalsın diye söylüyorum. Burada ne tarafı, ya şey, yansıtıcı?	**ExpFee89**
Yansıtıcı yüzeyi, yansıtıcı yüzeyi, tümsek tarafı, siz de yazın, yazın bakın, tümsek tarafı olan ayna." derken tahtaya şeklin kenarına **"yansıtıcı yüzeyi tümsek tarafı olan ayna" yazdı.**	Commun16
Bir öğrenci sınıfa girdi.	
S: "Erkan, yanlış geliyorsun." dedi bir öğrenci sınıfa giren öğrenciye.	
S: "Kurtarıcımız."	
S: "Kameraya çekiliyosun."	
S: "Kameraya el salla."	
Birkaç öğrenci sınıfa giren öğrenci ile dağıldılar ve kendi aralarında konuşmaya başladılar.	
T: "Beni dinleyin. Şimdi gençler!" diyerek uyardı öğretmen. "Evet, bir küreden kesip alacağız." dedi ve kalemle kürsüye vurdu öğrencileri uyarmak için. "Küresel ayna diyebilmek için, küreden parça kesip alcağız ama istediğimiz büyüklükte kesip alamıyoruz. İstediğimiz büyüklükte küresel parçayı kesip alırken çocuklar,	Commun7, 17
bilmeniz gereken 1-2 şey vardı." derken tahtaya ikinci bir daire	Concrete26
çizdi. "**Bu önemli, dikkat etmeniz lazım,** 8-10 derece civarında alabilirsiniz en fazla, yani şu gördüğün merkez açı, alfa açısı yaklaşık 8-10 derece civarında olur." diyerek şekil üzerinde çizerek gösterdi. "Yaklaşık 10 derece. Çok daha büyük parça alıp da	**AttentionCommun18**

küresel aynanın gösterdiği özellikleri göstersin diye bekleyemezsiniz. Mesela şu aynanın yarısını alıp da kürenin yarısını alıp da gençlerim; şu küre, kürenin yarısını alayım efendim şöyle, şurası merkezidir, şurası çukur aynadır diyemezsiniz." derken şekil çizerek ve üzerinde anlatmaya devam etti. "Neden? Hepimiz biraz sonra üzerinde de tartışacağız, bunun nedenlerini, niçinlerini açıklayacaz. Yani, bu nedenle mesela şurası 8-10 derece olacak. Iıı, şey, küçükcükse bile çocuklar, kürenizin yarıçapı küçük, küçükse şayet, küre 8-10 derecelik şöyle açı alırsanız o zaman aynayı cımbızla falan tutmanız gerekecektir." derken diğerlerinden daha küçük bir daire çizdi tahtaya. Şekli çizdikten sonra konuşmaya devam ederken öğrencilere döndü ve **eliyle küçüklüğünü belirtmek amacıyla küçük bir cisim tutuyormuş gibi bir hareket yaptı**. Öğrencilere bakarak konuşmaya devam etti. "Yani çok küçük kalacaktır. Bu nedenle küresel ayna dediğimiz çukur ya da tümsek aynaların eğrilik yarıçapları ne olmalıdır? Çoook , çook neredeyse fark edemeyeceksiniz eğri olduğunu, çook büyük olmalıdır. Yani eğrilik yarıçapları çok, çook büyük olursa 10 derecelik aldığınızda bile kayda değer bir büyüklükte aynayı elde edebilirsiniz, çocuklar. Yani düşünün şöyle, bir ayna alıyorsunuz." Konuşurken tahtayı sildi. Tahtaya diğerlerinden çok daha büyük bir daire çizdi. Şekil üzerinde göstererek konuşmaya devam etti. "Şu yarıçapı kocaman, şöyle bir küre alıyorsunuz. Bu küre de yarıçapı 10 derece olmalı bir parça kopardığınız zaman bile büyüklüğü kayda değer bir büyüklükte ayna olabilir. Öyle ise küresel ayna dediğimiz, tamam, bir küre parçası ama, kürenin parçasını alırken istediğiniz büyüklükte alamıyorsunuz. Gördüğü merkez açı ne kadar olabiliyo?"	Concrete26 **Attention38** Inq34

öğrencilere dönerek sordu. S: "On." T: "**Sekiz, on derece civarında oluyor.** O zaman küresel aynaları oluşturan küresel aynaların eğrilik yarıçapları, yarıçapları nedir ki ne? Çok büyüktür." Konuşurken bir yandan da tahtaya **"*Küresel aynaların eğrilik yarıçapları çok büyük" yazdı.** Bir öğrenci öğretmen konuşurken kapıyı çaldı, sınıfa girdi ve yerine oturdu. Öğretmen öğrencilere dönerek konuşmaya devam etti. T: "Neredeyse siz şeyi anlayamayacaksınız. Yani şöyle elinizle falan dokununca ancak anlayabilirsiniz." diyerek eliyle bir cisme dokunuyor gibi yaptı. "**Belki şöyle bakınca arabaların dikiz aynaları falan böyle küresel aynadır.** Tümsek ayna normalde bakınca düz gibi durur, değil mi çocuklar? Eğrilik yarıçapının çok büyük olmasındandır." dedikten sonra tahtaya döndü anlatmaya devam ederken **şekil çizdi**. "İşte biz bu aynalardan mesela çukur aynayı şöyle alacağız. Yansıtıcı tarafi tam ortasından geçen, yani merkezinden geçen diyelim ona, çizginin adına aynayı ikiye bölen, şart değil aslında da tanımını biraz sonra yaparız. Merkezinden geçerek aynaya giden doğrulara ne diyeceğiz çocuklar? **Bunları daha önceden biliyorsunuz.**" Bir öğrenci bir şeyler söyledi. Ama ne söylediği net olarak duyulmadı. **Bu arada öğretmen şeklin üzerine "asal eksen" yazdı.** T: "Mesela ne deniliyormuş?" diye sorusunu yineledi öğrencilere dönerek. S: "Asal eksen." T: "Şimdi, asal ekseni tanımlayın deseler; aynanın merkezinden	**ExpFee89** **Commun15** **Concrete23 Exp52** **Concrete26** Inq34 **ProObj83** Commun21

geçerek, eğrilik merkezinden geçerek aynaya giden her doğruya asal eksen denilebilir. Ama biz çoğunlukla aynayı ikiye bölen, iki eşit parçaya bölenini kullanacağız. Ama kaç tane asal ekseni vardır derlerse; mesela bir küresel aynanın, bir çukur aynanın, bir tümsek aynanın sonsuz tane asal ekseni vardır diyebilirsiniz. Çünkü merkezden geçerek aynaya giden kaç çizgi çizebilirim?" Yüzü öğrencilere dönük olarak şekil üzerinde anlattı.	Inq34
S: "Sonsuz."	
T: "Sonsuz tane çizgi çizebiliriz. Anlatabiliyo muyum? Sonsuz tane çizgi çizebilirim demek sonsuz tane asal ekseni vardır. Şuraya ne denilir?"	Inq34
S: "T."	
T: "T'nin adı ne o zaman? T?"	Inq34
S: "Asal ekseni, ayna."	
T: "Tepe noktası, evet. Asal eksenin aynayı kestiği nokta. Tepe noktası deriz fizikte. M neydi? Bir daha söyleyin."	Inq34
Ss: "Merkez." dedi birkaç öğrenci.	
T: "Evet. Eğrilik merkezi dedik aynı zamanda. Lütfen kamera var, bilmem ne var falan diye çocuklar. Her zamanki gibi davranın. Eğrilik merkezi. Tam T ile M'nin tam ortası?" Konuşurken **tahtaya şeklin altına bir yandan da kısaltmaların neye karşılık geldiğini yazdı.**	Inq34
S: "Hocam, r'yi unuttunuz."	
T: "Eğrilik merkezi. Tam ikisinin tam ortasına ne denilir çocuklar? F deniliyor. Onu zaten biliyorsunuz odak, odak. Büyük F ne? Odak noktası. Küçük f ne? Küçük f."	Inq34
S: "Odak noktası."	
T: "Odak uzaklığı. **Hatırlıyor musunuz, nerede çocuklar şey,**	**Inq34**

odak noktası? Odak noktası nerede oluyor?" diye öğrencilere dönerek sordu.	
S: "Hocam, merkezle şeyin ortası."	
T: "Tabi, aferin. Merkezle tepe noktasının tam ortası, arkadaşlar, şura, odak noktası budur." diye şekil üzerinde göstererek anlatmaya devam etti. "Merkez deyince, merkezle, şuraya merkez dedik. Aynaya olan uzaklığı, şurası, ne kadar çocuklar?"	ExpFee91 Inq34
Ss: "f, f ." dedi birkaç öğrenci	
T: "**r kadar. De mi? r kadar**. O zaman şurası ne kadar? F ile M'nin arası ne kadar ya da F ile T'nin arası ne kadar?"	**ExpFee89** Inq34
S: "r bölü iki kadar."	
T: "**r bölü iki kadar.** İşte, oraya biz arkadaşlar odak uzaklığı diyoruz. r bölü iki, r bölü ikidir ya? Buralar f bölü iki, f bölü ikidir işte, odak uzaklığı. Ya affedersiniz." diyerek şekil üzerinde düzeltti. f yazacağı yere f bölü iki yazmıştı. "Buralar küçük f, küçük f buralar. Dolayısıyla bir aynadaki aynanın odak uzaklığı, küresel aynanın odak uzaklığı nedir?" **diyerek şekil üzerinde yazarak gösterdi.**	**ExpFee89** Inq34
S: "İki r."	
T: "Yaklaşık olarak eğrilik yarıçapının." Konuşurken bir yandan da **tahtaya f yaklaşık eşittir r bölü iki yazdı.**	
S: "r bölü iki."	
T: "Yarısıdır. Yani odak noktası dediğim, **bir kere daha söylüyorum çocuklar,** odak noktası dediğimiz T ile M'nin tam ortası olduğuna göre, r'yi, eğrilik yarıçapını kaç eşit parçaya bölüyo odak noktası?" diye şekil üzerinde göstererek sordu.	**AttentionCommun18** Inq34
S: "İki."	
T: "**İki eşit parçaya.** O parçalardan her birine ne diyor muşuz?"	**ExpFee89** Inq34

S: "Odak uzaklığı."	
T: "**Odak uzaklığı.** Odak uzaklığı yaklaşık olarak eğrilik yarıçapının yarısıdır dedik. **Şimdi dikkat etmeniz lazım, burada bilinmesi gereken bi durum var çocuklar.** Çukur ayna. Kaç tane asal ekseni vardır dedik biraz önce?"	**ExpFee89** **AttentionCommun18** Inq34
S: "Sonsuz."	
T: "**İsterseniz yazalım onu da arkadaşlar." dedi ve konuşurken söylediklerini tahtaya yazdı.** "Bir çukur ayna, hatta bir küresel aynanın, bir küresel aynanın, tümsek de öyle, bir küresel aynanın, aynanın kaç tane asal ekseni vardı?"	**Commun16**
10:00	
S: "Sonsuz."	
T: "Sonsuz tane asal ekseni, asal ekseni. **Peki, kaç tane odağı vardır? Dolayısıyla, dolayısıyla sonsuz tane de odak noktası vardır, odak noktası vardır. Yani bunu çizerek de göstermeye çalışalım çocuklar.**" dedi ve şekil çizdi, şekil üzerinde göstererek anlatmaya devam etti."Şu asal eksen di mi? Biz buna asal eksen diyeceğiz, merkezden geçen bu doğru asal eksendir. Peki, başka asal eksen çizelim. Merkezden geçen tüm doğrulara ne denilir dedik?"	ExpFee89 Concrete26 Commun21Model67 Inq34
S: "Asal eksen."	
T: "**Asal**. **O zaman şu da asal eksen mi?**" dedi ve şekil üzerinde kırmızı kalemle ikinci bir asal eksen çizdi.	**ExpFee89 Inq34**
S: "Evet."	
T: "Buna da çoğunlukla biz yardımcı asal eksen diyeceğiz, yardımcı asal eksen diyeceğiz. Şu asal eksenin üzerindeki odak noktası nere? Şu siyahla çizdiğim asal eksenin üzerindeki odak noktası nere?"	Inq34

Ss: "Tam tepe noktası, T ile M'nin orta noktası." dedi birkaç öğrenci ancak söyledikleri birbirine karışıyordu.	
T: "**T ile M'nin tam ortası.** Bakın, şurası, T ile M'nin tam ortasına F diyorum, F. Peki, bu yardımcı asal eksen üzerindeki odak noktası nerede derlerse?"	**ExpFee89** Inq34
S: "F."	
T: "**Neresi biliyor musunuz? Şu gerçek, o tam aynayı iki eşit parçaya bölen odaktan indirilen dikmenin üzerindeki noktadır, çocuklar. F üssü burası.**" dedi **ve şekil üzerine yazarak gösterdi.** "Yani F odak, F üssü ne o zaman?" bir yandan da **tahtaya "F: odak F': yrd. odak" yazdı.**	**ExpFee89** Inq34 **Commun15**
S: "Yardımcı odak."	
T: "Yardımcı odak diyelim buna da mesela. Niye yardımcı odak dedik?"	Inq35
S: "Çünkü yardımcı asal eksenin."	
T: "**Yardımcı asal eksenin üzerindeki odak noktası arkadaşlar. Adı yardımcı odak diyelim.**" dedi ve öğrencilere dönerek konuşmaya devam etti. "Dolayısıyla bir küreyi düşünün. Bak şöyle, üç boyutlu düşünün, bunu çocuklar. Bunu şöyle çizgi gibi duruyor ya küresel ayna, bir küreden kestiğinizi, küre parçasından kestiğini düşünün. Şey aslında. **Çanak anten gibi, böyle bir yemek tabağı gibi parça kalıyor. Küreden kestiğinizde öyle olmaz mı çocuklar? Bir küre, küreden bir parça kestiniz, şurayı aldınız, şöööyledir bunun görüntüsü. Şurayı silerseniz çocuklar çanak anten gibi bir parça kalıyor elimizde**. Şöyle, şunu belirgin çizeyim biraz daha isterseniz." dedi ve şekil çizerek üzerinde göstererek anlattı. "**De mi, küre, şöyle bir parça kalıyor, şöyle çanak anten gibi bir parça.** Odak noktası da, işte, bunun asal	**ExpFee89** **Concrete26** Commun26

eksen, baya büyük bi nokta, arkadaşlar, şöööle bi nokta, baya büyük bir nokta. Dolayısıyla çok büyük parça alamamamızın, 10 derece civarında almamızın nedeni de bu. Yani şunu biraz daha büyütelim. Odak noktası şöyle bir şey aslında. Şöyle. **Merkezi de buraysa, dikkatinizi çekerim şimdi merkezi bura.** Burası odak noktası, şu asal eksen. Şöyle gidemiyosunuz mesela, şöyle bir çizgi çizemiyorsunuz çocuklar, şöyle bir asal eksen yok, niye?”	**AttentionCommun18** Inq35
S: “Aynadan geçmez ki hocam.”	
T: “**Aynadan geçmiyor ama bir de 10 dereceden fazla olmayacaktı. Kestiğimiz parça en fazla 10 derece civarında olacaktı.**” Tahtada daha önce yazdığı yazıyı aradı konuşurken. “Nerde? Ya, silmişim herhalde. **En fazla 10 derece olacaktı, 10 derece civarında olacaktı.**” diye anlatırken şekil üzerinde çizerek göstermeye devam etti. “O zaman merkez açı, gördüğü merkez açı 10 derece civarında olacak şekilde çizgiler çizebiliyorsunuz. Şööööyle, bunu birazcık daha küçülteyim isterseniz, şuradan, şöyle, 10 derece civarında olmasının amacı bu işte, nedeni bu. Dolayısıyla çizdiğimiz bütün, bütün yardımcı asal eksenler nerden gitmek zorunda çocuklar. Şöyle bir noktadan gitmek zorunda. **Bak, bi başka odak daha çizelim mesela. Şöyle bi başkasını daha çizelim.** Dolayısıyla burda üç boyutlu bir bilye koyduğumuzu düşünün çocuklar. Yani şöyle diyelim bak, canlandırma yapalım şöyle.”	**ExpFee89** **Concrete25** Concrete26
S: “Aynaya gelen ışıkların hepsini kapsıyor yani.”	
T: “**Haa!** Hepsini tutacak şekilde büyükçe bir nokta aslında o. Yani şurasına, şuraya, küresel aynaya, şu tam odak dediğimiz asal eksenin üstünde, T ile M’nin tam ortasına bir bilye, mesela pin-pon topu koyduğunuzu düşünün. **Pinpon topunun merkezi tam**	**ExpFee89** **Inq34**

nereye gelecek ama?" Eliyle bir pinpon topu tutuyor gibi şekil üzerinde gösterdi. S: "Odağa." T: "Tam odağa gelecek şekilde. Dolayısıyla onun etrafında büyükçe bir odak, sonsuz tane odak dediğimiz, sonsuz tane nokta birleşince, şöyle pinpon topu gibi bir bölüm oluşturuyor. Onların hepsine odak deniliyor. Tek değil, dolayısıyla, dolayısıyla siz burada çizince, öyle doğru çizdiğinizde tahtaya tek boyutluymuş gibi tahtaya, tahtanın üzerine çizilince, bütün odaklar sanki şöyle, F'nin üssünden asal eksene çizilen dikmenin üzerindeymiş gibi gözükür. Ama öbür tarafa doğru da var, aslında şöyle bir topu düşünsenize, topu, pinpon topunu sadece yukarıdan aşağıya doğru değil, odak noktaları şöyle de var, bu tarafa doğru var, her tarafa doğru var. O zaman sonsuz tane noktayı birleştirerek bir bilye oluşturuyorsunuz sanki. O bilyenin üzerine denk gelen bütün noktalara ne deniliyor?"	Attention38 Inq34
S: "Odak noktası."	
T: "**Odak noktası.** Ama onlardan birisi, odak diye kullandığımız asıl, pin-pon topunun neresi?"	**ExpFee89** Inq34
S: "Merkezi."	
T: "**Tam merkezi.** Ama üstlerinde, kenarlarında bulunan ne var? Yardımcı odak dediğimiz yardımcı odaklar var. Dolayısıyla çok net bir şekilde görülüyor ki, ayna eğri olduğuna göre gençler, ayna eğri olduğuna göre şu uzaklık, şu uzaklığa tam olarak eşit?" diyerek şekil üzerinde göstererek anlatmaya devam etti.	**ExpFee89** Inq34
S: "Değildir."	
T: "**Değildir.** Ama bu uzaklık, şurası çok küçük olduğu için, eğrilik yarıçapı da çok büyük olduğu için yaklaşık olarak düz	**ExpFee89** Inq34

sayarsanız burayı, yaklaşık olarak buraya?" diye şekil üzerinde gösterererek anlattı. S: "Eşit." T: "Onun için de ben odak uzaklığı r bölü ikidir diyemedim. Neden r bölü ikidir, yaklaşık r bölü ikidir dediğimi anlatmaya çalışıyorum. Bak şurasıyla şurada, tam asal eksende şurayla şura eşit ama burayla bura bura eşit değil. Yani kısa böyle diyebilirim, çocuklar. Şöyle, siz şöyle anlayabilirsiniz. Bütün şekiller size sorulacak, sorulacak sorular üzerinde, sayfa düzleminde, kâğıt düzleminde, tahta düzleminde geleceğine göre tahta düzleminde çizdiğiniz şu çukur ayna ya da tümsek ayna da olabilir, biraz sonra bakacağız, asal eksen, şurası merkez, şurası tepe noktası, şurada bir odak noktamız var. F. Herhangi bir yerden, as merkezden geçerek aynanın herhangi bir yerine gelen, diyelim ki, bu sefer de şuradan çizelim, şööööyle. Bu çizginin adı ne?"	Inq34
Ss: "Yardımcı." T: "Yardımcı asal eksen. Doğru mu?" S: "Evet."	
T: "**O zaman, peki.** Bu yardımcı asal eksen üzerindeki odağı okuderlerse; gerçek asal eksenden dikme çıkarıyorsunuz şöyle.	**ExpFee89**
Yukarıya ve aşağıya doğru uzatıyorsunuz. Bunu kesen her yerde ne vardır?" diye sordu şekil üzerinde göstererek. S: "Odak noktası."	Inq34
T: "**Yardımcı odak noktası.** Mesela bir başkası için şöyle bi daha çizebilirsiniz. Mesela bu asal eksenin üzerindeki odak noktası nerededir deseler, şurası. Mesela bu yardımcı asal eksenin üstündeki odak noktası neresidir diye sorsalar size. Neresidir? Şurasıdır. Bir tane daha çizseler burasıdır. Dolayısıyla bunlar tek	**ExpFee89**

boyut üzerinde, böyle çizgiymiş gibi görünüyor ama küresel aynada şöyle şöyle, şöyle düşünürseniz, bunu tam üç boyutlu çizmesi zor. Canlandırabildiniz mi bilmiyorum. Bunların hepsi birer odak. Kaç tane odağı vardır o zaman?"	Inq34
S: "Sonsuz."	
T: "**Sonsuz tane odağı vardır, şööööyle.** Bir tane nokta değil, böyle bir şey yani. Gençler, odak noktaları bazıları aynaya yakın, bazıları aynadan daha?"	**ExpFee89**
S: "Uzak."	
T: "Ortalama olarak eğrilik yarıçapının?"	Inq34
S: "Yarısıdır."	
T: "Yarısıdır diyoruz. **Yazmak istediğiniz bir şey var mıdır burada?"**	ExpFee89 **Commun16, Sch110**
S: "Evet."	
T: "**Pekâlâ not alın." dedi ve sıralar arasında gezinmeye başladı**. Gezinirken "Erkan, yazdın mı oğlum?" diye sordu.	Relev, Commun17
E: "Yazıyorum, hocam."	
T: "Gökhan yazılıda ne olduğunu biliyorsun?"	Relev
Ç: "Tehdit etmiştiniz."	
T: "Yazılıda neler yaşadığımızı biliyorsunuz. En yüksek notlardan birini alan adam, en düşük notlardan birini alıyor. En yukarılardaydın. Demek ki ikinci döneme iyi başlamadın. Biraz lütfen ders çalış. Siliyorum."	Attribution79
Ss: "Hayır."	
T: "Sol tarafı sileyim."	
S: "Hayır."	
20:00	
Beş, altı saniye daha bekledikten sonra tahtanın sol tarafını	

sildi.	
T: "Bi dakika bakar mısınız, bir dakka bakar mısınız? **Yazmak için süre vereceğim.** Tekrar düşünün; yarım küre şeklinde bir aynamız var, yarım küre şeklinde." dedi ve **şekil çizerken** anlatmaya devam etti. "Böyle bir şey olduğunu düşünün. Şurası ne çocuklar? Böyle bir şey alsak mesela. Bu asal eksen. Doğru mu? Şura ne?"	AttentionCommun18 Commun14 **Concrete26** Inq34
S: "Merkez."	
T: "**Merkez.** Şura?"	**ExpFee89** Inq34
S: "Odak."	
S: "Odak."	
T: "Şimdi, böyle bir ayna hayatta çukur ayna özelliği göstermez de. Nedenini söyleyeyim şimdi. Bakın, şuradan geçen şu çizginin adı ne?" diye şekil üzerine yazarken anlatmaya devam etti.	Inq34
S: "Yardımcı asal eksen."	
T: "**Yardımcı asal eksen. Ne güzel. Yardımcı asal eksen.** Peki, odak noktasını bulun."	**ExpFee89** Inq34
S: "Ayna, merkezin üstünde bir şey mi?"	
T: "Nasıl oluyor? Şuradan dikme indirsem odak buraya mı geldi yani şimdi. Ne olacak bu? Odak aynanın üstüne mi geldi yani? Nasıl, nasıl bir şey?" diyerek **çizerek şekil üzerinde gösterdi**.	Inq35 **Concrete26**
S: "Yani şu şekilde olabilir mi?"	
T: "İşte, böyle küresel ayna olmaz. Yani ben, yardımcı asal eksen olarak bunu çizemeyeceğim. Öyle bir imkânım olmayacak. Niye? Küresel aynada böyle bir çizgiyi çizme ihtimali olmayacak, küresel aynanın özelliğini taşıyabilmesi için bir aynada. Niye?" dedi öğrencilere dönerek.	
S: "Çünkü odak."	
S: "Çünkü odak."	

Birkaç öğrenci birden konuştu.	
T: "Bunun anlamını bulun."	
S: "Yardımcı odağı çizemediğimiz için."	
T: "**Ama başta, en başta onu söyledim.**"	**ExpFee90,91**
S: "Yani hocam gösterebilir miyim tahtada?"	
S: "Ortası, ortasında merkez."	
T: "**En başta onu söyledim.** O şartımız ne?	Inq34
S: "Merkezle tepe noktası."	
S: "Merkezle tepe noktası şeyi eşit."	
S: "Küre."	
T: "**Ne olması lazım?"**	**ExpFee90,91**
S: "Küre olması lazım."	
T: "**Küre, burada yarım, evladım."**	**ExpFee90,91**
S: "Hocam, o tepelerde kalan 8-10 derece."	
T: "**Ne olması lazım?**"	
S: "Sekiz, on derece."	
T: "Burda gördüğü merkez açıyı kaç derece olacak şekilde çizmişim?"	Inq34
S: "180."	
T: "**180 derece.** <u>Hatta şöyle yaparsanız, işte 90 dereceden falan bile fazla olabilir. Yani o zaman buraya kadar, buralara kadar olmadığı gibi şuraya kadar da olmayacak, buraya kadar da olmayacak, buralara kadar da olmayacak. Dolayısıyla da ben böyle bir asal eksen çizemeyeceğim çukur aynada. Ancak çizebilsem çizebilsem, gördüğü merkez açı şu kadar olduğu için arkadaşlar, çizebilsem, çizebilsem en fazla yardımcı asal ekseni olan aynaya varacak şekilde bunu çizebileceğim. O zaman da gerçekten de, gerçek odaktan dikme çıkarınca yardımcı odak olarak burayı</u>	**ExpFee89**

alabileceğim arkadaşlar. Çok büyük olduğu zaman görüyorsunuz küresel ayna, küresel ayna özelliğin." derken şekil üzerinde çizerek gösterdi anlatırken. S: "Kaybediyor." Öğretmen öğrencilere dönerek konuşmaya devam etti. T: "Kaybediyor. Küresel ayna olmuyor, olamaz. Biraz sonra öğreneceğimiz özelliklerin hiç birisine sahip olmaz. En başta söylediğimiz, odak uzaklığı yaklaşık olarak r bölü ikidir. Yani T ile M'nin arasının, merkez ile tepe noktasının, aynanın arasını yaklaşık iki eşit parçaya bölerler, bir kere hemen başta onu çürütüyorsunuz çok büyük açı aldığınız zaman onun için. Sekiz, on dereceden fazla merkez açı, gördüğü merkez açı 8-10 dereceden fazla olamaz. Dolayısıyla da bunu çizemediğiniz için de şöyle bir durumu çizebilirsiniz en fazla. O da yaklaşık olarak gerçekten iki eşit parçaya böler. Nereyi iki eşit parçaya böler? Eğrilik yarıçapını, onun da yarısı yaklaşık olarak yarısı, odak uzaklığına eşittir deriz. **Buralar önemli, başta nasıl sağlam temel atarsanız öyle gidiyor, lütfen dikkat edin!** Tamam mıyız?" S: "Hayır." T: "Uykum geliyor yalnız susmayın öyle. Ben bile heyecanlanıyorum gelirken hep, kamera var diye. Elim ayağım dolaşıyo, Serra. Hoca, oturuyor diye mi hıı?" Sr: "Efendim!" T: "Sanki hocadan şey ediyormuş gibi tek başına." S: "Yaa!" S: "Hıı!" S: "Kameraya çıkmamak için." T: "Kameraya gülümse"	Concrete26 **AttentionCommun18** Sch110 Relev

S: "Hayır."	
S: "Gülümse."	
S: "Hocam, bi dakika lütfen."	
T: "O zaman özetle arkadaşlar, özetle ne diyebiliriz? İki çeşit küresel ayna var. Söyleyin. İki çeşit küresel ayna var."	AttentionCommun18
S: "Biri tümsek, biri de çukur."	
T: "Evet. Birincisi çukur ayna, ikincisi?" **diyerek bir yandan da tahtaya not etti konuştuklarını.**	Inq34 **Commun15, 16**
Ss: "Tümsek ayna." dedi iki öğrenci.	
T: "**Tümsek ayna**. Her ikisinin de kaç tane asal ekseni var?"	**ExpFee89** Inq34
S: "Sonsuz."	
T: "Sonsuz tane asal ekseni."	ExpFee89
S: "Sonsuz tane odak noktası"	
T: "**Evet, virgül, sonsuz tane odak noktası var.** Şimdi, bir düzlem aynada cismi aynanın önüne koyunca görüntü nerede çıkıyordu?"	Inq34
S: "Arkada, arka tarafında."	
T: "Arka tarafında. Cisim ne, nasıl oluyordu?"	ExpFee89 Inq34
S: "Sanal."	
T: "Kim sanal?"	Inq34
S: "Uzantısı sanal"	
S: "Görüntüsü."	
T: "Ne sanal?"	
S: "Uzantısı sanal."	
S: "Görüntüsü."	
S: "Uzantısı"	
T: "Oğlum, Fırat, ne sanal?"	
S: "Uzantısı sanal."	

S: "Görüntüsü sanal."	
T: "<u>Görüntüsü sanal</u>. Niye sanal sen onu demek istiyorsun."	<u>ExpFee89</u> Inq35
S: "Çünkü."	
T: "<u>Uzantıları kesişerek oluştu falan diyorsun, değil mi?</u>"	ProObj83
S: "Doğrudur."	
T: "<u>O zaman aynanın önündekilere ne deniliyor? Aynanın önündeki gerçek deniliyo</u>, arkasında olanlar?"	<u>ExpFee89</u> Inq34
S: "Sanaldır."	
T: "<u>Sanaldır</u>. Peki, soru soruyorum size. Sorumuzu dinler misiniz? Çukur aynanın odak noktası gerçek midir, sanal mıdır?"	<u>ExpFee89</u> Inq34
S: "Gerçek." dedi birkaç öğrenci.	
T: "Niye?"	Inq35
S: "Aynanın önünde."	
T: "Aferin size, işte bu. <u>Peki, tümsek aynayı düşünün. Çizin hatta arkadaşlar tümsek aynayı.</u>"	ExpFee91 <u>Commun21Model67</u>
S: "Sanal."	
T: "<u>Şöyle, tümsek ayna. Şu tümsek ayna</u>. Ne tarafı yansıtıcı?" derken bir yandan da tahtaya şekil çizdi.	Inq34
S: "Tümsek tarafı."	
T: "**<u>Tümsek tarafı.</u>** Ne tarafı sırlı tarafı yani?"	**<u>ExpFee89</u>** Inq34
S: "Çukur."	
T: "**<u>Çukur tarafını sırladık, şöyle</u>**. <u>Şuranın adı tepe noktası, şura merkezi,</u> merkezle tepe noktasının tam ortasına ne deniliyor?"	**<u>ExpFee89</u>** Inq34
S: "Odak."	
T: "**<u>Odak noktası deniliyor.</u>** Peki, bu tümsek aynanın odak noktasının neresinde kalıyor?"	**<u>ExpFee89</u>** Inq34
S: "Arkasında."	
T: "**<u>Evet, arkasında.</u>** Yani tümsek aynanın odak noktası, ne o	**<u>ExpFee89</u>** Inq34

zaman?”	
S: “Sanal.”	
T: “**Sanaldır diyeceğiz**. Yani sanalı da biraz ileride göreceğimiz formüllerde önüne eksi yazarak ifade edeceğiz. Yani, f eksidir diyeceğiz. **O zaman şöyle diyelim isterseniz.**”	**ExpFee89** Inq35 **Commun16**
S: “Hocam.”	
T: “**Başlığımız, başlık, ayrı ayrı atalım. Çukur aynayı inceleyelim, çukur ayna.**”	
S: “Hocam.”	
S: “Şu sondakini bi yazalım mı?”	
T: “Buyur, canım.” Dedi ve sıralar arasında gezinerek bekledi öğrencilerin yazmasını. “**Var mı sıkıntısı olan?** **Çukur ayna yazalım, yalnız çukur aynayı açıklıyoruz arkadaşlar. Yansıtıcı yüzeyi çukur tarafı olan, yansıtıcı yüzeyi çukur tarafı olan küresel aynadır, küresel aynadır. Yansıtıcı yüzeyi çukur olan küresel aynadır. Satır başından bir başka madde. Üzerine düşürülen, üzerine düşürülen, üzerine düşürülen paralel ışık demetlerini, paralel ışık demetlerini, üzerine düşürülen paralel ışık demetlerini bir noktada toplar, bir noktada toplar.**”	Sch110 **Commun5**
diyerek sınıfta gezinerek yazdırdı. “Hangi noktadır topladığı?”	Inq34
S: “Odak.”	
T: “**Odak noktasıdır.** **Topladığı her nokta aynanın odaklarından birisidir. Işığın toplandığı noktalar öyle diyelim ışığın toplandığı noktalar, ışığın toplandığı noktalar aynanın odaklarından birisidir.**”	**ExpFee89**
S: “Işığın toplandığı?”	
T: “**Noktalar**, kaç tane odağı vardı?”	Inq34
S: “Sonsuz.”	

T: "**O sonsuz tane odaktan birisidir**. **Işığın toplandığı noktalar, aynanın odaklarından birisidir. Satır başından, bir başka madde, çukur aynanın odağı gerçektir. Çukur aynanın odağı gerçektir. Çukur aynanın odağı, odak noktası ya da gerçektir, o da olur.** Yani."	**ExpFee89**
S: "Aynanın önü."	
30:00	
T: "**Evet. Aynanın önündedir.** Peki. Yani f artıdır. Öyle dicez, f formüllerde, f'nin önüne ne yazacağız? Bir formül çıkaracağız ilerde, gerçek olanların önüne?"	**ExpFee89** Inq34
S: "Artı"	
T: "**Artı**. Sanalsa?"	**ExpFee89**
S: "Eksi"	
T: "Eksi yazacağız, arkadaşlar. **Şimdi, bakalım, çocuklar bakar mısınız?** Hepiniz biliyor-, mesela, ben eminim, biliyorsunuzdur. Asal eksene paralel gelen ışın, çukur aynada yansıdıktan sonra?"	**Attention Commun18** ProObj83
S: "Odaktan geçer."	
T: "**Odaktan geçer**. Ortaokulda, OKS' de herkes biliyor bunu. Ama biraz önce bi laf etti. Tam-noksan belki şuydu, bi tane odak varmış gibi falan hatırlıyor olabilirsiniz. Halbuki çukur aynanın ya da tümsek aynanın da öyle sonsuz tane odağı vardır. O zaman bir laf ettik orda. Ne dedik? Hangi doğrultudan gelirse gelsin, iddiamız bu, hangi doğrultudan, ne taraftan gelirse gelsin, üzerine düşürülen paralel ışık demetlerini?"	**ExpFee89** Commun14 Inq34
S: "Odak."	
T: "Bir noktada toplar. O nokta?"	Inq34
S: "Odak."	
T: "**Aynanın odağıdır**. Mesela şöyle düşünelim. Şu çukur ayna,	**ExpFee89**

bu asal eksen. Şurda işte merkezi var, bunun tam yarısı şurası ne?"	Commun21Model67
diye anlatırken bir yandan şekil çizmeye başladı.	Inq34
S: "Odağı"	
T: "**Odağı.** Asal eksene paralel gelen ışınlar demeti olsun. Bu asal eksene paralel geliyor. Asal eksene paralel geliyor bunlar.	**ExpFee89**
Yansıdıktan sonra nereye giderler?"	Inq34
S: "Odağa."	
T: "İşte, asal. Bir paralel demetini bir noktada topladı, nerede topladı gördüğünüz gibi?"	Inq34
S: "Odak."	
T: "**Odakta topladı.** Odakta topluyor. Aşağıdan da gelebilir bu, buradan topluyor arkadaşlar. Ama nereden gelirse gelsin arkadaşlar, mesela şuradan gelse, şuraya yazıyım şöyle, paralel ışık demetleri geliyor şöyle. Peki, bunlara ne olur derlerse size, nolur	**ExpFee89**
biliyor musunuz, bakın şöyle olur, merkezden geçen bu çizgi neyi bunun?"	Inq34
S: "Yardımcı odağı."	
T: "**Yardımcı odağı**. O zaman bu ışınlar nasıl geliyorlar?"	**ExpFee89** Inq34
S: "Yardımcı."	
T: "Yardımcı asal eksene paralel. O zaman yardımcı asal eksene paralel ışınlar?"	Inq34
S: "Yardımcı odaktan geçer."	
T: "**Bitti o zaman**, o zaman madem sonsuz tane asal eksenimiz var, doğru mu? Işın hangi doğrultudan gelirse gelsin, şu asal eksen benim işime yaramıyor mu? Şu kırmızıyla çizdiğim ışınlar için işime yaramıyo mu? İşime yarayan asal ekseni çiziyorum. Bir şey	**ExpFee89**
biliyorum, nasıl olsa bir kural biliyorum. Ne o bildiğim kural? Asal eksene paralel gelen bu ışınlar yansıdıktan sonra?"	Inq34ProObj83

S: "Odak noktasından."	
T: "**Odaktan geçeri biliyorsanız.** O zaman aynaya bir ışın geliyorsa, onun yansıyanının nereye gittiğini bulabilmek için?"	**ExpFee89** Inq34
S: "Paralel."	
T: "**O gelen ışına paralel olan asal ekseni, çizerim**, yardımcı asal ekseni çizerim. Sonra onun üstündeki yardımcı odağı bulurum, yardımcı asal eksene paralel gelen ışın napar? Yardımcı odaktan geçer derim. İşte şurası gerçek odak noktasıydı. O zaman şöyle dikme indiriyorum şuradan, şöyle dikme indiriyorum. Şura ne?" diye şekil üzerinde yazarak anlatmaya devam etti.	**ExpFee89** Inq34
S: "Yardımcı odak."	
T: "**Yardımcı odak noktasında**. O zaman bu kırmızılar, yazdığımız, asal eksene paralel gelen ışınlar olduğuna göre yardımcı odaktan geçerler derim arkadaşlar. Hangi doğru bakın toplamda da yine bir nokta, ne bu noktamın adı?"	**ExpFee89** Inq34
S: "Yardımcı odak."	
T: "**Yardımcı odak.** İstediğim taraftan gelebilir. Bunun adı yardımcı asal eksen. İstediğim taraftan gelebilir. Yardımcı asal ekseni çizerim, ondan sonra eksenin üzerinde odaktan geçecek şekilde yansıtabilirim. Birileri size diyebilir ki, arkadaşım, kardeşim, gel bakiyim buraya, öğretmeniniz, kimse o, kızım-oğlum gel bakiyim buraya dedi. Soruyosun. Diyor ki, şurası merkez, şurası odak noktası, şurası tepe, şurdan gelen ışın yansıdıktan sonra nasıl gider? Şu ışının yansıyanını çiz dedi. Bu gelen ışın, gelen ışın adını öyle koyduk, gelen ışın. Gelen ışının yansıyanını çiz. Yansıyanını çiz. Napacaksınız?" diye anlatırken **şekil çizdi.**	**ExpFee89** Inq35 **Concrete26**
S: "Yardımcı asal eksenden."	
T: "En kolay yöntemlerden birisi bu. Yardımcı."	ExpFee88, 89

S: "Asal eksen."	
T: "Gelen ışına paralel mi, aşağı yukarı?"	Inq34
S: "Evet."	
T: "O zaman bunun adı ne?"	Inq34
S: "Yardımcı asal eksen."	
Zil çaldı.	
T: "Yardımcı asal eksen. Bu ışık nasıl geldi, o zaman bu gelen ışık yardımcı asal eksene?"	ExpFee89 Inq34
S: "Paralel geldi."	
T: "Paralel geldi. O zaman yardımcı asal eksen üzerindeki neyi bulacağım?"	ExpFee89 Inq34
S: "Odak."	
T: "Odağı. Dikme indirdim, şura ne?"	ExpFee89 Inq34
S: "Yardımcı odak."	
T: "Yardımcı odak. Yardımcı asal eksene paralel gelen ışın."	ExpFee89
Ss: "Yardımcı"	AttentionCommun18
T: "Yardımcı odaktan geçer. Yansıyanı budur, evet. Yani bu asal eksenin nereden kesti bu ışının yansıyanı? Aynanın, arkasında kesti, **yani mesela şurası A cismi ise burası onun neyi?**"	**Inq34**
S: "Görüntüsü."	
T: "İyi. İşte şuradan gelecek ışın, uzantısı oradaki, mesela öyle yapacağız. **Anladınız mı?** Anladım bu konuyu diyen kaç kişi var?"	**Commun5**

S: “Hocam, bu ışının yansıyanı olabilir mi?” T: “Bu yardımcı asal eksen şu zaten, Ali. Şuradan dikme indirirsen, şurası yardımcı odak, o zaman yardımcı eksene paralel gelen yardımcı nokta geçer. Hadi kolay gelsin.” Sınıftan birlikte çıktık.	Relev Commun14

APPENDIX N

CHECKLIST OF INDICATORS OF STUDENTS' AFFECTIVE CHARACTERISTICS

Case (Date)	**Açıklama**	**Dakika**								
Çağlar (15.04.08)		**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
İlgilenme	• Öğrenciler öğretmene bakıyor,	22	22	20	22	22	22		21	
	• Öğrenciler öğretmenin hareketlerini takip ediyor,	22	22	20	22	22	22		21	
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,	22	22	22	22	22	22	22	22	
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,		22			22				
	• Öğrenciler okunan yazıyı takip ediyor,	22		20	22				22	
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.	22	22	22	22	22	22		22	
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor						12			
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor	X	X	X	X	X		X	X	
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmen veya arkadaşları ile konuşuyor).				22	20	12			
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.		8					22		
• Düşük katılım	• Birkaç öğrenci derse katılıyor.									
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.					X	X			
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.	X	X	X	X			X		
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma									
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.	X								
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.									
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.									

Çağlar (14.04.08)	Açıklama	Dakika								
		5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
İlgilenme	• Öğrenciler öğretmene bakıyor,	19	19	17	16	17	19			
	• Öğrenciler öğretmenin hareketlerini takip ediyor,	19	19	17	16	17	19			
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,	19	19	17	16	17	19			
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,									
	• Öğrenciler okunan yazıyı takip ediyor,									
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.	19	19	19	19	19	19			
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor									
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor	X	X	X	X	X	X			
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).									
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.									
• Düşük katılım	• Birkaç öğrenci derse katılıyor.									
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.	X	X							
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.				X	X				
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma									
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.									
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.	X			X	X				
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.									

Case (Date)	Açıklama	Dakika								
Çağlar (07.04.08)		**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
İlgilenme	• Öğrenciler öğretmene bakıyor,	20	22	22	22	22	22	22		
	• Öğrenciler öğretmenin hareketlerini takip ediyor,	20	22	22	22	22	22	22		
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,	20	22	22	22	22	22	22		
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,									
	• Öğrenciler okunan yazıyı takip ediyor,									
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.	20	22	22	22	22	22	22		
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor									
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor	X	X	X	X	X	X	X		
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).									
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.									
• Düşük katılım	• Birkaç öğrenci derse katılıyor.									
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.		X		X			X		
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.			X		X	X			
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma									
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.									
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.									
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.									

Case (Date)	Açıklama	Dakika								
Eda (18.04.08)		**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
İlgilenme	• Öğrenciler öğretmene bakıyor,	30		30	25	30	30	30	30	
	• Öğrenciler öğretmenin hareketlerini takip ediyor,	30		30	25	30	30	30	30	
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,		30			30	30	30	30	
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,	5		5	29	30				
	• Öğrenciler okunan yazıyı takip ediyor,	30	30	28	30		30	30	30	
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)	5								
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.	30	30	29	30	30	30	30	30	
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor									
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor	X	X	X	X	X	X	X	X	
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).	30	30	30	30	30	30	30		
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.	30	30	30	30	30	30	30		
• Düşük katılım	• Birkaç öğrenci derse katılıyor.									
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.									
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.	X	X	X	X	X	X	X	X	
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma	30	30	30	30	30	30	30	30	
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.	X				X				
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.									
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.		8			X	X			

Case (Date)	**Açıklama**	**Dakika**								
Eda (04.04.08_1)		**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
İlgilenme	• Öğrenciler öğretmene bakıyor,	30	29	30	30	30	27	29		
	• Öğrenciler öğretmenin hareketlerini takip ediyor,	30	29	30	30	30	27	29		
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,	30	30	30		30	30	30		
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,	28			4			28		
	• Öğrenciler okunan yazıyı takip ediyor,						30			
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.	30	5	30		30	27	30		
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor									
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor	X	X	X	X	X	X	X		
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).	30				2	30	30		
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.							17		
• Düşük katılım	• Birkaç öğrenci derse katılıyor.	X	X							
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.									
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.				X	X	X	X		
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma	1				30				
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.	X								
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.									
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.					X		X		

Case (Date)	Açıklama	Dakika								
Eda (04.04.08_2)		**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
İlgilenme	• Öğrenciler öğretmene bakıyor,	30	27	26	30	29	27	27		
	• Öğrenciler öğretmenin hareketlerini takip ediyor,	30	27	26	30	29	27	27		
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,	30	27		30	29	27	27		
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,	30		12	30					
	• Öğrenciler okunan yazıyı takip ediyor,	30		30		29				
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.	30	27	26	30	29	27	27		
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor									
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor	X	X	X	X	X	X	X		
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).	30	28	26	30	30	23	25		
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.	30	28	26	30	30	23	25		
• Düşük katılım	• Birkaç öğrenci derse katılıyor.									
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.									
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.	X	X	X	X	X	X	X		
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma									
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.									
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.									
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.									

Case (Date)	Açıklama	Dakika								
Alper (16.04.08_1)		**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
İlgilenme	• Öğrenciler öğretmene bakıyor,	20	20	20	22	22				
	• Öğrenciler öğretmenin hareketlerini takip ediyor,	20	20	20	22	22				
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,	20	22	20	22	22				
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,		5							
	• Öğrenciler okunan yazıyı takip ediyor,	20								
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.									
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor	X								
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor									
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor		X	X	X	X				
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).		3		22					
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.									
• Düşük katılım	• Birkaç öğrenci derse katılıyor.	X		X	X	X				
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.		X							
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.									
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma	6	10	7	5	7				
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.									
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.	X		X	X	X				
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.		X							

Case (Date)	Açıklama	Dakika								
Alper (09.04.08_1)		5	10	15	20	25	30	35	40	45
İlgilenme	• Öğrenciler öğretmene bakıyor,		21	21						
	• Öğrenciler öğretmenin hareketlerini takip ediyor,		21	21						
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,		21	21						
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,		21	21						
	• Öğrenciler okunan yazıyı takip ediyor,									
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.									
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor									
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor		X	X						
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).									
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.									
• Düşük katılım	• Birkaç öğrenci derse katılıyor.									
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.									
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.									
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma									
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.									
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.									
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.		X							

Case (Date)	Açıklama	Dakika								
Alper (09.04.08_2)		5	10	15	20	25	30	35	40	45
İlgilenme	• Öğrenciler öğretmene bakıyor,		22		22		22	16		22
	• Öğrenciler öğretmenin hareketlerini takip ediyor,		22		22		22	16		22
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,		22		22	22		16		22
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,									
	• Öğrenciler okunan yazıyı takip ediyor,									
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.				21		17	16	20	22
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor									
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor		X		X		X	X	X	X
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).					5				
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.		20		22	22		16		22
• Düşük katılım	• Birkaç öğrenci derse katılıyor.						X			
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.									
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.		X		X	X		X		X
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma									
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.									
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.									
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.					3	7		3	

Case (Date)	Açıklama	Dakika								
Erkan (22.04.08)		**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
İlgilenme	• Öğrenciler öğretmene bakıyor,	25	23	23	25	25	20	23	15	17
	• Öğrenciler öğretmenin hareketlerini takip ediyor,	25	23	23	25	25	20	23	15	17
	• Öğrenciler görsel materyalleri (resim, çizim, video vb.) izliyor,	25	25	25	25	25	25	25	20	20
	• Öğrenciler dersle ilgili birşeyler söyleyen bir öğrenciye dönüyor,	18								
	• Öğrenciler okunan yazıyı takip ediyor,							25		
	• Öğrenciler uygun sözel olmayan tepkiler veriyor (başlarını sallıyor vs.)									
	• Öğrenciler ders düzenini bozan hareketler yapmıyor.	25	25	25	25	25	23	20	15	17
• Düşük ilgi	• Birkaç öğrenci dersle ilgileniyor									
• Orta ilgi	• Öğrencilerin 1/3 ile 2/3 dersle ilgileniyor								X	
• Yüksek ilgi	• Öğrencilerin 2/3'ünden fazlası dersle ilgileniyor	X	X	X	X	X	X	X		X
Katılım	• Öğrenciler dersle ilgili sınıf içi etkileşimde bulunuyor (dersle ilgili öğretmenle veya arkadaşları ile konuşuyor).	4		5	10		3			
	• Kendilerine verilen dersle ilgili bir görevi yerine getiriyor.									
• Düşük katılım	• Birkaç öğrenci derse katılıyor.	X		X			X			
• Orta katılım	• Öğrencilerin 1/3 ile 2/3 derse katılıyor.				X					
• Yüksek katılım	• Öğrencilerin 2/3'ünden fazlası derse katılıyor.									
Gönüllü olma	• Öğretmen zorlamadan öğretmenin yönettiği etkinliğe katılmaya hazır olma									
• Gönüllü yok	• Öğrenciler gönüllü değil, öğretmen öğrencileri katılmaları için davet ediyor.									
• Az gönüllü	• Birkaç öğrenci katılmaya gönüllü olmak için öncelikle 'Hadi, siz iyi öğrencilersiniz' vb diyerek cesaretlendirilmeyi bekliyor.									
• Gönüllü katılım	• Öğrencilerin üçte birinden fazlası öğretmen onlara bir şey söylemeden gönüllü oluyor.	4						2	7	4

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EDUCATION

Degree	Institution
MS	METU, SSME, Physics Education
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WORK EXPERIENCE

Year	Institution	Enrollment
2003-	Ankara University, Elementary Education Dept.	Research Assistant
2001-2003	MEB, Karahamzali Elementary School	English Teacher

FOREIGN LANGUAGES

English (Fluent), German (Basic)

PUBLICATIONS

Güngör, A. A., Eryılmaz, A. & Fakıoğlu, T. (2007). The relationship of freshmen's physics achievement and their related affective characteristics. Journal of Research in Science Teaching, 44(8), 1036-1056.

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