AN INVESTIGATION OF HIGH SCHOOL STUDENTS' PHYSICS ACHIEVEMENT IN TERMS OF THEIR ACHIEVEMENT GOAL ORIENTATIONS, SELF EFFICACY BELIEFS AND LEARNING CONCEPTIONS OF PHYSICS

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Dedicated to my mum

for all her love, support and patience

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ABSTRACT

AN INVESTIGATION OF HIGH SCHOOL STUDENTS' PHYSICS ACHIEVEMENT IN TERMS OF THEIR ACHIEVEMENT GOAL ORIENTATIONS, SELF EFFICACY BELIEFS AND LEARNING CONCEPTIONS OF PHYSICS

The aim of this study was to investigate the contributions of high school students' achievement goal orientations, physics learning self efficacy beliefs and physics learning conceptions on their physics performance. In addition, high school students' achievement goal orientations, physics learning self efficacy beliefs, and physics learning conceptions were examined in terms of gender and grade differences. Comparisons between science-mathematics and literature mathematics groups were also made in order to investigate field differences. The sample of this study consisted of 583 students from ninth, tenth and eleventh grades. Quantitative data collection methods were used in this investigation. The instruments that were administrated to students were the Achievement Goal Orientation Questionnaire (AGQ), Physics Learning Self Efficay Questionnaire (PLSEQ) and Physics Learning Conceptions Questionnaire (PLCQ). In order to analyze data multiple regression analysis, two-way ANOVA and one-way MANOVA were used. The results of this study suggested that high school students' achievement goal orientations, physics learning self efficacy beliefs and physics learning conceptions explain 12.4 per cent of variance of their physics performance. Male students obtained higher physics learning self efficacy and qualitative physics learning conception scores compared to female students. In terms of field differences, science-mathematics and literature-mathematics groups had significantly different scores from most of the scales.

ÖZET

ÖĞRENCİLERİN FİZİK BAŞARILARININ BAŞARI YÖNELİMLERİ, FİZİK ÖZ YETERLİK İNANÇLARI VE FİZİK ÖĞRENME ANLAYIŞLARI AÇISINDAN İNCELENMESİ

Bu çalışmanın amacı, lise öğrencilerin fizik dersine karşı başarı yönelimlerinin, öz yeterlik inançlarının ve öğrenme anlayışlarının fizik performansına olan katkısını incelemektir. Ayrıca, lise öğrencilerinin fizik dersine karşı başarı yönelimleri, öz yeterlik inançları ve öğrenme anlayışları, cinsiyet ve sınıf seviyesi bağlamında da karşılaştırılmıştır. Fen-matematik ve edebiyat-matematik alanındaki öğrencilerin aldıkları puanlar alan farkına göre karşılaştırılmıştır. Dokuzuncu, onuncu ve on birinci sınıflardan toplamda 583 öğrenci bu çalışmaya katılmıştır. Araştırmada nicel veri toplama araçları kullanılmıştır. Başarı Yönelimleri Ölçeği, Fizik Öz Yeterlik İnançları Ölçeği ve Fizik Öğrenme Anlayışları Ölçeği bu çalışmada kullanılan veri kaynaklarıdır. Toplanılan veriler, çoklu regrasyon analizi, iki yönlü ANOVA ve tek yönlü MANOVA kullanılarak incelenmiştir. Araştırmanın sonuçlarına göre, fizik dersine karşı başarı yönelimleri, öz yeterlik inançları ve öğrenme anlayışları lise öğrencilerinin fizik performansının yüzde 12.4'ünü yordamaktadır. Erkek öğrenciler ve kız öğrenciler arasında fizik öz yeterlik ve öğrenme anlayışları açısından anlamlı farklar bulunmaktadır. Son olarak, fen-matematik alanında okuyan öğrenciler edebiyat-matematik alanında okuyan öğrencilere göre ölçeklerin bir çoğundan anlamlı olarak farklı puanlar elde etmiştir.

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M	Mean
N	Number
p	Level of Significance
R^2	Variance
η^2	Eta Squared

LIST OF ACRONYMS/ ABBREVIATIONS

AGQ	Achievement Goal Questionnaire
ANOVA	Analysis of Variance
CLSQ	Conceptions of Learning Science Questionnaire
df	Degrees of Freedom
MANOVA	Multivariate Analysis of Variance
SD	Standard Deviation
SE	Standard Error of Estimate
STEM	Science, Technology, Engineering and Mathematics
PISA	Program for International Student Assessment
TIMMS	Trends in International Mathematics and Science Study

1. INTRODUCTION

Education systems all around the world aim to raise scientific literacy levels of their citizens. Students are desired to be scientifically literate and give appropriate decisions when confronted with socio scientific issues in their lives (Osborne, Simon and Collins, 2003). Furthermore, countries strive to have a supply of individuals from science, technology, engineering and mathematics (STEM) fields in order to preserve and enhance their economic well being (Driver, 1996; Osborne *et al*., 2003). For these reasons, continuous educational reforms are made in order to improve science education. Nevertheless, the results of international tests such as the Trends in International Mathematics and Science Study (TIMMS) and the Program for International Student Assessment (PISA) suggest that Turkish students perform under the desired levels in science (OECD, 2016). These low performances of Turkish students resulted in several educational reforms in Turkey. In the current curriculum, science, particularly physics, is viewed from a constructivist view point and the inner processes of students are valued. It was stated that an active science learning process can be initiated by presenting a meaningful context and thereby increasing students' motivation to learn science. If students think that science classes cover relevant topics to their lives, they possess positive affect towards their science courses. So, students' approaches to their classes are ultimately determined by their motivation to learn science (MEB, 2013).

Pintrich and Schrauben (1992) stated that models that explain student performance in terms of only cognitive factors do not take into account the role of students' beliefs, purposes and goals. They indicated that students with adequate cognitive skills may not show an expected performance and this can be explained by the motivational processes they engage in. The researchers also indicated that individuals' motivation influence their choices to engage in a task, cognitive processes they adopt and perseverance in the face of difficulties. So, they emphasized the importance of explaining students' learning in terms of both cognitive and motivational factors. Differently stated, students with higher motivation display a willingness to engage in classroom activities whereas students with lower motivation refrain from performing academic tasks (Bybee and McGrae, 2011).

Students' motivation in learning has been conceptualized in terms of their goals and beliefs (Eccles and Wigfield, 2002). The achievement goal orientation theory posits that students engage in achievement related behaviors because of the goals they set for themselves (Nicholls, 1984). So, students' ultimate learning is determined by whether their aim is to gain mastery or to show their competence to others. Koul *et al.* (2011) indicated that school environments that heavily emphasize giving correct answers and neglect students' deep thinking processes leads students to adopt instrumental and short term goals. So, teaching practices are influential in shaping students' goals which ultimately determine their learning.

Students' engagement in their science classes is also determined by their confidence in themselves to properly learn the presented material (Britner and Pajares, 2006). So, students with higher self efficacy beliefs tend to more eagerly engage in science related activities and thereby obtain more desirable academic outcomes (Bandura, 1993; Britner, 2008). With this regard, the importance of classroom environments that emphasize individual experiences are widely uttered by researchers. These kinds of classroom environments that provide students with free options to engage in scientific activities are also associated with less anxiety towards science (Koul, 2011).

While theories of goal orientation and self efficacy explain individuals' motivated behavior, learning copceptions explain indivduals' understanding of nature of learning. As motivation, learning conceptions may also have an influence on several academic outcomes. Science learning conceptions are associated with how students view the nature of science learning (Lee *et al.*, 2008). So, whether they view science learning as memorization of several facts and formulas or increasing their understanding of the natural world influence their approaches to learning and consequently their achievement (Tsai, 2004; Lee *et al.*, 2008). Having a memorization learning conception leads students to use surface level strategies and not to integrate what they learn with their already existing knowledge. On the other hand, learning biology science in order to view the world from a different view point is associated with use of higher level strategies. So, students' conceptions of learning are influential in their choice of learning strategies.

Students' motivation towards science was found to be different among female and male students (Glynn *et al.*, 2011). Generally, male students possess higher self efficacy and lower anxiety levels compared to female students especially for physical sciences (Britner 2008). The literature also suggests that students' motivation may change according to their grade levels. As students increase in grade levels, they develop skills that are more advanced and this may help them to build higher self efficacy beliefs (Caprara *et al.*, 2008). However, they encounter with more abstract and complex phenomena at the same time that may lead to decreases in self efficacy beliefs. This decrease in self efficacy beliefs was found to be more salient among male students compared to female students (Zimmerman and Martinez-Pons, 1990). This was explained by male students' proneness to engage in more outside shool activities as they increase with age.

Motivation towards science has been investigated across different domains. For example, students were found to possess different levels of self efficacy and anxiety towards earth science, life science and physical science (Britner, 2008). Particularly, female students perceive biology classes more meaningful and display higher anxiety towards physics (Koul, 2011). Students' conceptions of learning were also found to differ across physics, chemistry and biology. Students associate biology with their real lives and learn the subject in order to understand their environment. On the contrary, they state that they learn physics in order to make several calculations and pass their exams (Sadi, 2015). So, students possess negative attitudes towards physics compared to other domains of science. They view physics as incomprehensible, abstract and out of context. This study specifically analyzed students' motivational characteristics towards physics because the findings may provide insight about the sources of these negative attitudes towards physics.

Educational systems and classroom environments are apparently two important factors that shape students' motivation to learn physics. In Turkey, all students have to take the same courses during the first two years of high school. At the end of 10^{th} grade, students make choices for different fields such as science-mathematics, literature-mathematics or social sciences. At the end of 12^{th} grade, Turkish students take a high stakes test in order to be accepted to higher education. Turkish students take different tests on this university entrance exam according to their fields they choose at high school. So, high school students solve both general and domain specific tests at the university entrance exam. Generally, introductory physics topics are covered in the first two years of high schools. In eleventh and twefth grades, students who choose science-mathematics field continue with a curriculum that contains advanced physics topics. Students' motivation towards physics may change as they continue to take more advanced physics courses and acquire several physics knowledge.

This study aims to investigate the contribution of high students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions into their physics performance. In addition, students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions were compared in terms of gender and grade differences. This study also made comparisons of motivational characteristics and learning conceptions between students who had chosen science-mathematics and literature-mathematics fields for their studies. Students' choices of fields can be perceived as their first attempt to select STEM careers and this comparison may give insight about the motivational factors that influence these choices. Additional comparisons were made for 9^{th} and 10^{th} graders according to their intentions to choose a science-mathematics field or not. Finally, students' achievement goal orientations, self efficacy beliefs and learning conceptions were compared between high achievers and low achievers.

2. LITERATURE REVIEW

Students’ motivation towards learning has been a central issue for science educators. Several theories of motivation have been proposed in order to understand the underlying factors that energize people to engage in several actions. These theories have been widely used by science educators in order to explore students’ willingness, confidence and determination to learn science. This study, specifically aims to investigate students’ motivation towards physics and therefore provides a motivation literature about science in general, and physics in particular. Students may adopt different goals and display varying levels of confidence while learning science and physics. They may also possess different conceptions about the nature of science and physics learning. These learnbing conceptions may be related with several academic outcomes. This section provides a general framework of motivational theories and reviews the literature about achievement goal orientation, self efficacy beliefs and learning conceptions. Additionally, findings that relate these motivational characteristics with several important student outcomes such as achievement and career aspirations are presented.

2.1. Theories of Motivation

Motivation can be defined in terms of aspects that lead individuals to engage in several actions. There are a variety of motivational theories that explain the reasons why individuals’ engage in several actions. Eccles and Wigfield (2002) identified four general categories for these motivational theories. According to the researchers, different motivational theories explain the occurrence of motivated behavior as a result of different factors. They distinguished these factors in terms of “expectancy”, “reasons for engagement”, “integrated expectancy and value constructs” and “integrated motivation and cognition”. In this section, several theories of motivation that are classified according to this categorization will be reviewed. The motivational theories that are used in this study will be presented in more detail in the following sections.

The self efficacy theory of motivation posits that individuals engage in several actions only if they have an expectancy of success for their behavior (Bandura, 1997). So, if they believe that they are competent enough to produce a desirable outcome, they eagerly engage in that specific behavior. On the contrary, if they lack this necessary confidence, they refuse to try even if they may have the necessary capabilities.

Self-determination theory explains individuals' motivated behavior in terms of several reasons that stimulate them (Eccles and Wigfield, 2000). According to this theory, individuals are active organisms that try to master both their internal and external environment. During their mastery processes, individuals' actions are guided by several needs such as "competence" and "self determination". Individuals feel intrinsically motivated when they encounter with challenging situations because they have a need to gain competence (Deci and Ryan, 1985). Likewise, individuals are self determined when they engage in behaviors for totally internalized reasons rather than extrinsic factors such as getting good grades or appearing competent.

Another motivational theory is interest theory which posits that individuals engage in motivated behavior because they possess an interest. Hidi and Harackiewicz (2001) differentiated between two types of interest such as personal interest and situational interest. Personal interest is defined in terms of stable traits of individuals and expected to stay constant. Having a personal interest is associated with being knowledgeable and competent about a specific topic. Situational interest, on the other hand, is situation specific and occurs when several features of the environment attracts individuals' attention. Hidi and Harackiewicz (2001) especially emphasized the importance of situational interest because this situation specific interest may create a personal interest if individuals find the situation interesting enough. The researchers also suggested that creating situational interest is essential especially if students have no prior knowledge about the topics. Finally, this situation specific interest may turn into personal interest if students perceive the situation relevant and meaningful. The researchers also added that students who have personal interest enjoy their learning environment, pay increased attention and persist when confronted with difficulties.

Achievement goal orientation theory explains achievement related behavior in terms of individuals' purposes (Ames, 1992). This theory posits that individuals with different type of goals have different notions for success and reasons for engaging in activities. Individuals who aim to master a task view effort as a necessary condition for success. According to them trying hard will eventually result in desirable outcomes. They evaluate their performance in terms of their own standards and compete with themselves. On the other hand, individuals who have performance goals view ability as a necessary condition for success. So, being unsuccessful is extremely destructing for them because they associate this situation with a lack of ability in themselves. They associate success with outperforming others and attaining several performances. Ames (1992) stated that students with mastery goals are more prone to spend effort and persist in the face of difficulties because they believe that effort is the key to success. On the other hand, students with performance goals are reluctant to engage in difficult activities because they associate a possible failure with inability.

Expectancy-value is another motivational theory that integrates expectancy beliefs and values. According to this theory, individuals' performances are predicted both by their expectancy of success and values they give to the task. So, individuals who think that their actions will produce desirable outcomes engage in the specified actions. Secondly, individuals who value the task at hand, also choose to engage in the activities. Eccles and Wigfield (2002) specified three kinds of values that individuals give to tasks: Intrinsic, utility and attainment. Intrinsic value refers to individuals' liking of the task for its inherent characteristics. Utility value is concerned with individuals' reasons to engage in a task for external gains. Finally, attainment value refers to individuals' choices of action to fulfill their self perceptions. The researchers stated that expectancy beliefs predict performance whereas values determine individuals' plans and choices of subjects.

Another motivational theory provided a general framework that integrates motivation and self regulated learning. According to Pintrich (1999), use of self regulated learning strategies is highly related with motivational characteristics. His self regulation learning model consists of cognitive strategies, metacognitive strategies and resource management strategies. Cognitive strategies comprise of surface learning techniques such as rehearsal as well as deep level strategies such as elaboration and organization. Metacognitive learning strategies comprise of individuals' knowledge about their own cognition as well as regulation of their cognition. Planning is a form of metacognitive strategy that consists of setting goals. Monitoring is another metacognitive strategy in which individuals compare their proceedings with their already established goals. Individuals also employ regulative strategies in order to bring their performance closer to the desired levels. Finally, resource management strategies include students' efforts to manage time and set appropriate environments to study. Pintrich (1999) investigated the relationship between these self regulated learning strategies and several motivational constructs such as self efficacy, task value and goal orientation. The results suggested that students with higher self efficacy beliefs tend to use more self regulated learning strategies. Students who value tasks and have mastery goal orientations also used more self regulated strategies. So, the researcher concluded that motivation is a necessary condition for students to become self regulated. Pintrich and De Groot (1990) also found that students' self efficacy beliefs and self regulation were the strongest predictors of their performance.

Zimmerman (1989) drew a self regulated learner view who is an active agent in terms of motivational, metacognitive and behavioral aspects. Students are self regulated to the extent that they use self-regulated learning strategies, have self efficacy beliefs about their capabilities, and struggle to achieve several desired goals. The researcher identified three cyclic phases of self regulated learning as forethought phase, performance phase and self-reflection phase. Forethought phase occurs before engaging in a task and includes planning and setting several goals. It was stated that motivational beliefs such as self efficacy, goal orientation and interest are important determinants of goal setting. In the performance phase, self regulated learners control and observe their proceeding at a task. They focus their attention, choose appropriate task strategies, and monitor their processing by using think aloud procedures. In the self reflection phase, individuals make judgments and reactions about their performances. Individuals evaluate their performances with respect to their already established goals and react with satisfaction or dissatisfaction. Zimmerman (2003) stated that individuals may infer adaptive clues from their accomplishments and struggle to choose more effective problem solving strategies. On the contrary, if individuals experience discouragement, they may become defensive and resist engaging in the task again. So, the researcher indicated that these self reactions influence individuals' subsequent forethought phase during problem solving.

In this study, self efficacy and achievement goal orientation theory were used as a theoretical framework. Self efficacy theory were used because this theory enable the researchers to understand how confidence in abilities result in desired performances. Furthermore, achievement goal orientation theory is associated with reasons that stimulate individuals to engage in actions. So, whether individuals desire to master a task or outperform others is found to be related with their performance. In the context of science education, this study investigated how confidence in students' abilities to learn physics is associated with their achievement. Their physics performance were also investigated in terms of whether their aim is to master at a task or to show a desired performance. In the following sections, achievement goal orientation and self efficacy theories are presented in more detail.

2.2. Achievement Goal Orientation

Several motivational theorists emphasize achievement behavior in order to explain the reasons that stimulate people to engage in several actions. Nicholls (1984) defined achievement behavior as an action people exhibit for the purpose of showing their high instead of low ability. He stated that people with different perceptions of "ability" engage in achievement behavior for different reasons. People with a "static" notion of ability demonstrate their capabilities with respect to other people. They aim to show outperforming outcomes and elicit recognition and praise. Since they view ability as innate, becoming unsuccessful threatens their self-worth (Ames, 1992). Nicholls (1984) defined this orientation that stress outperforming outcomes and ability as *performance-goal*. On the contrary, people with *mastery goal orientations* attribute their success to efforts. They have a dynamic perception of ability that emphasizes effort as a necessary condition to achieve success. Nicholls (1984) stated that people with performance goal orientation view ability as high or low with respect to several normative standards of members of a group. On the contrary, people with mastery-goal orientations judge their performance on a task with respect to inherent necessities of the task or their own previous performance. They feel competent if they increase their own perceived understanding irrespective of judgments of others. Since they believe that desirable outcomes will be produced by exerting effort, they spend more time while learning a task and persist longer in the face of difficulties. In contrast, people with performance goal orientation are concerned with showing their competence and appearing capable. So, they avoid challenging tasks that may harm their competent appearance (Ames, 1992).

Elliot (1999) defined achievement motivation in terms of energizing and directing affect, cognition and behavior that are competence-based. He further expanded mastery and performance orientation by differentiating performance goal orientation as performance-approach and performance-avoidance motivation. This differentiation was made according to several conceptually distinct motives that stimulate behavior such as being successful or avoiding incompetence. So, individuals with performance-approach orientation seek to show their competence and appear successful, whereas individuals with performance-avoidance orientation fear to fail and try to hide their incompetence. Elliot (1999) stated that individuals' fear of obtaining negative outcomes is associated with the quality of their work. Since people with performance-avoidance orientation are too concerned with possible negative outcomes, they are less engaged in tasks, distract while studying, employ superficial information processing, and easily give up in the face of difficulties. On the contrary, performance approach goals are associated with more positive outcomes such as high engagement in tasks, focusing while studying, and persevering in the face of difficulties. However, Elliot (1999) added that performance approach goal orientation is also associated with several negative outcomes such as test anxiety due to the extremely valued evaluation process. Another negative outcome of performance approach goal orientation was stated as avoiding academic support due to the fear of appearing incompetent.

Elliot and McGregor (2001) further differentiated mastery goals in terms of the valence individuals give to the task. So, individuals may engage in competent behavior for the sake of gaining success or refraining failure. People with mastery approach goals were portrayed as engaging in achievement behavior in order to increase their competence and achieve success. Mastery avoidance orientation shares similarities with mastery approach goals except the importance given to the fear of failure. So, individuals with mastery avoidance orientation also desire to gain mastery at a task but fear to be unsuccessful. Perfectionist people were defined as having mastery avoidance orientation since they ultimately fear to make any mistakes although they evaluate their competence in terms of intrapersonal standards.

Pekrun *et al.* (2009) proposed a mediational model that links achievement goals to performance through achievement emotions. They indicated that both goals and emotions were found to be related with performance in numerous studies. They proposed that different achievement goals produce different emotions in achievement setting and these emotions ultimately affect performance of students. The results of their study suggested that mastery goals could produce enjoyment which in turn predicts high performance, or boredom and anger which in turn predicts low performance. Performance approach goals predict achievement emotions such as hope and pride and ultimately performance. Lastly, performance avoidance goals were found to predict anxiety, hopelessness and shame that produce lower levels of performance.

Anderman and Midgley (1997) conducted a study in order to analyze the development pattern of motivation for fifth and sixth grade students. The researchers predicted significant changes in goal orientations of students since this transition occurs from elementary school to middle school and represents a variety of novelties for students. They also explored how students' perceptions of their learning environment changed among this transition. It was found that students perceived their classroom environment more performance oriented after the transition. So, they started to think that showing their competence and saying the right answers are more valued in middle school compared to elementary school. Putting into other words, students perceived their classroom environments more mastery oriented in elementary schools. They handled with tasks in order to gain some proficiency rather than proving their competency to others. The researchers stated that in elementary schools, teachers deal with less number of students and are more flexible in terms of allocating time to activities. This kind of classroom environment may provide students with an opportunity to develop their skills for the sake of gaining mastery. On the other hand, classrooms in middle schools are more crowded and students usually have to deal with a number of tasks within a limited time. So, they may do their tasks for the sake of showing their competence to their teachers or hiding their incompetence.

Achievement goal orientation theory explains individuals' behaviors in terms of their achievement goals. According to this theory, individuals may emphasize mastering a task deeply or demonstrating a performance. These goals may in turn influence the efforts they exert and duration they struggle in the face of difficulties. So students' ultimate learning in various topics such as physics may be influenced by their achievement goal orientation.

2.3. Self Efficacy

Self efficacy is a psychological construct that is proposed by Bandura (1997) as a stimulating motive that guides action. This construct emerged from social cognitive theory which posits that behavior, personal factors and environment are all in a reciprocal relationship. According to this theory, individuals are both producers and products of their external environment. They constitute the society in which they live but their actions are also influenced by the norms of society. Bandura (1997) defined self efficacy as one's beliefs in his or her capabilities to produce, organize and perform several actions in order to attain several desired outcomes. According to him, individuals decide to perform several actions if they think that they have the necessary skills to perform those actions. Bandura (1997) further differentiated self efficacy as personal self efficacy and outcome expectations. Personal self efficacy was defined as individuals' beliefs in their own abilities to perform several actions whereas outcome expectancies are the consequences those performances will produce. For example, individuals may believe that finishing a competition in the first place will result in self-satisfaction and social recognition but they may not believe that they are capable enough to finish the competition in the first place.

The first belief corresponds to outcome expectancies whereas the latter one corresponds to personal self efficacy. Bandura (1993) also stated that self efficacy beliefs are major determinants of individuals' choices of action. He pointed out that individuals with same skills may perform differently according to their efficacy beliefs. The one who has confidence in his or her ability to perform successfully achieves desirable accomplishments compared to the person with lower confidence.

Bandura (1993) proposed four sources of self efficacy beliefs as mastery experiences, vicarious experiences, social persuasion and physical states. Mastery experiences -individuals' own performances succeeding at a task- were found to be the most effective source of self efficacy. Individuals succeeding in several tasks and observing the results of their own success develop rapidly beliefs about their efficacy in those tasks. Vicarious experiences are indirect sources of self efficacy beliefs since they comprise of other people that individuals identify with themselves. Individuals enhance their self efficacy beliefs by observing others' success especially when they find the models similar to them. Third source of self efficacy beliefs is social persuasion which posits that encouragements of other people may enhance the efficacy beliefs of individuals. Positive encouragements may strengthen beliefs of individuals to succeed at a task whereas negative judgments may weaken their self efficacy beliefs. The fourth source of self efficacy is physiological states that individuals experience such as stress, anxiety or pleasure. When individuals experience positive physiological states, they interpret this situation as positive and develop self efficacy beliefs. On the other hand, when individuals experience negative states such as stress and anxiety, they fail to believe that they have the necessary skills to succeed (Bandura, 1997).

Bandura (1997) stated that efficacy beliefs influence individuals in their choices of activities, the amount of effort they spend, and the amount of time they persist when confronted with difficulties. Britner and Pajares (2006) investigated self efficacy beliefs of middle school students in the light of self efficacy sources and achievement levels in a science course. They defined science self efficacy as students' beliefs in their own capabilities to succeed in tasks, activities or courses that are science-related. They indicated that self efficacy beliefs strongly predicted science achievement levels of students. Among the self efficacy sources, mastery experiences was the strongest predictor of science self efficacy. So, students who reported higher levels of mastery experiences in science courses tended to have higher levels of science self efficacy beliefs.

Britner (2008) investigated science self efficacy, science anxiety, and goal orientations of high school students in life, physical and earth sciences. He indicated that female students tend to choose life science courses whereas male students are more likely to select physical science courses. It was also found that students' science self efficacy was a better predictor for achievement. Although girls reported higher science grades, they have lower science self efficacy and higher science anxiety. The stereotypically presented science as a male domain is explained as a possible source of female students' lower science self efficacy.

Glynn *et al.* (2011) investigated motivation levels of students who have science majors and non science majors. They developed a questionnaire that measures science motivation under several sub scales such as intrinsic motivation, self-determination, self efficacy, career motivation and grade motivation. Students from science majors significantly scored higher than students from non science majors. In addition, all constructs were found to be related with students' GPA. Students' self efficacy levels were found to be positively and strongly related with achievement but there were gender differences in self efficacy beliefs. Male students had higher self efficacy beliefs and the researchers indicated that parents and teachers who foster natural differences among different genders may be responsible for such discrepancies. Schumm and Bogner (2016) also investigated science motivation levels of high school and college students by using Science Motivation Questionnaire. One result of their study was that the sample of their study has higher grade motivation and lower intrinsic motivation. So, it implies that students are learning science not because they find science inherently interesting but they want to get good grades. The researchers indicated that school environments that foster getting good grades may weaken the pleasure students get from learning science. Another finding of the study was that female students have lower self efficacy levels than boys. The researchers stated that science is traditionally presented as a male domain and this may be a source of self efficacy beliefs of male students.

Neber *et al.* (2008) conducted a study in order to investigate the relationship between students' motivational characteristics as well as their cognitive strategy use. Additionally, students were asked to report their choices of fixed versus open experimentation settings. The results of their study suggested that students with higher self efficacy beliefs use more active learning strategies in their physics classes. These students also prefer open physics experimentations in which they develop the outline of their own investigations. The researcher stated that male students have higher physics self efficacy levels than female students. They also indicated that 10^{th} grade students had lower self efficacy levels and mastery goal orientations. It was stated that at higher classes, getting higher grades are heavily emphasized and this may undermine students' motivation to intrinsically learn physics. The researcher also suggested that the gender gap in self efficacy levels may be reduced by emphasizing the importance of effort on physics success. Thereby, students may believe that success in physics is not inherently determined by being male or female. Tang and Neber (2008) conducted another study in order to investigate students' self regulation and motivational characteristics in science learning among several nations. They indicated that Chinese students use less self regulation strategies compared to their American counterparts. They suggested that the active and regulative role of Chinese teachers may be responsible for this finding. Another interesting result of their study was that German students have more intrinsic motivation in higher grades. Tang and Neber (2008) suggested that German students can freely choose the courses they want to study and this may explain their higher motivation.

Students' science learning self efficacy levels were investigated in relation to their approaches to learning science. Lin and Tsai (2012) developed a multidimensional scale that measures students' science learning self efficacy beliefs under the subscales of *conceptual understanding, higher-order cognitive skills, practical work, everyday application* and *science communication*. The *conceptual understanding* subscale measures students' confidence in their capability to employ cognitive strategies while learning scientific concepts, definitions and laws. The *higher-order cognitive skills* subscale measures students' confidence in their ability to use advanced cognitive skills such as inquiry, critical thinking, and problem solving. The *practical work* subscale assesses students' confidence in their capabilities to use their scientific knowledge and skills in laboratory activities. The *everyday application* subscale evaluates students' confidence of using scientific knowledge and skills in their daily life situations. Finally, *science communication* subscale assesses students' confidence in their capability to discuss scientific concepts and ideas with other people (Lin and Tsai, 2012). The researchers categorized students' approaches to learning science according to their use of deep or surface strategies. Furthermore, their approaches were also analyzed in terms of their intrinsic or extrinsic motivation. The results of their study suggested that students who possess intrinsic motivation and use deep strategies while learning science demonstrated higher self efficacy levels across various self efficacy dimensions. These students had higher confidence to use advanced cognitive strategies, apply their scientific knowledge and skills in real life and communicate their science related ideas with their friends.

Caprara *et al.* (2008) conducted a longitudinal study in order to investigate the development of students' academic self efficacy from middle school to high school. Students' socioeconomic status, achievement and dropout levels were investigated in relation to their self efficacy beliefs. The researchers indicated that over the transition from middle school to high school, students' perceived self efficacy levels significantly decreased. The researchers suggested that as grade level increase, students encounter with complicated and demanding subjects which in turn lowers their self efficacy beliefs. Caprara *et al.* (2008) investigated this change in terms of gender differences and found that male students considerably decrease in their self efficacy beliefs compared to female students. The researchers suggested that male students are traditionally expected to engage in more outside activities than female students. Jessor *et al.* (1991) also stated that peer pressure to engage in non academic activities is more salient among male students (as cited in Caprara *et al.*, 2008). So, male students are more prone to engage in non school activities that may diminish their interaction with course materials and consequently decrease their efficacy beliefs. The researchers suggested that SES mediationally influenced students' efficacy levels in high school through their previous achievement in middle school. So, students from higher SES tend to have higher achievement levels in junior high school and consequently have higher self efficacy beliefs in high school.

Zimmerman and Martinez-Pons (1990) conducted a study about the developmental patterns of students' self efficacy beliefs and indicated contrary results to Caprara's (2008) findings. Additionally, they investigated students' self efficacy levels in relation to their achievement and self regulation strategy use. The researchers indicated that students have higher self efficacy beliefs in higher grades since they gain more mathematical and verbal knowledge and use a variety of self regulation strategies. So, their efficacy beliefs compatibly increase with their grade levels. The researchers also indicated that students' use of various strategies and their self efficacy beliefs are positively correlated. As students progress in school, they tend to adopt various effective strategies and thereby have higher self efficacy beliefs.

Self efficacy beliefs were widely investigated in the literature and was found to be related with numerous student outcomes. Students with higher self efficacy beliefs are more prone to engage in motivated behavior whereas students with lower self efficacy beliefs may refrain from performing academic tasks. This may ultimately determine several student outcomes that are focus of science educators.

2.4. Conceptions of Science Learning

Learning conceptions are defined in terms of individuals' beliefs about nature of learning (Chiou and Liang, 2012). Specifically, science learning conceptions were formulated by analyzing students' views about what science learning is (Lee *et al.*, 2008). It was found that student conceptions of learning influence a variety of outcomes such as learning strategies they use and their achievement. Tsai (2004) conducted a study in order to investigate high school students' conceptions of learning in Taiwan. He conducted a qualitative study and made interviews with 11^{th} and 12^{th} grade students. The data were analyzed by using a phenomenographic approach in which students' responses were coded with several words. Finally, the researcher indicated seven distinct categories that represent students' science learning conceptions such as *memorizing*, *testing*, *calculating*, *knowledge increase*, *applying*, *understanding*, and *seeing in a new way*. Learning science as *memorization* indicates that science consists of several separate pieces of formulas and laws. Students think that they learn science when they successfully memorize these formulas. Learning science for *testing* implies that students acquire scientific knowledge in order to be successful in the exams. Another conception implies that several students view science learning as *making calculations* by manipulating formulas and laws. The last quantitative learning science conception is *increasing knowledge* and implies that students perceive science learning as accumulation of scientific knowledge. The researcher indicated that the first meaningful learning conception is *applying* which indicates the importance of being able to apply scientific knowledge in related real life situations. *Understanding* is another conception and implies that science learning is meaningfully integrating newly acquired and already possessed knowledge structures. So, students learn new materials by linking them to what they already know and thereby engage in deep understanding. The last learning conception implies that students learn science in order to *see their world in a different way*. These students think that they acquire a different view point in exploring the natural world. They understand the method of science that differs from other sources of knowing such as intuition.

The first four dimensions were categorized as quantitative which imply that science learning is the accumulation of distinct and separate knowledge pieces. On the contrary, the last three dimensions constitute the qualitative view in which science learning is perceived as integrating old and new knowledge in a meaningful way. In the study, students viewed science learning as calculating, increasing knowledge and understanding. The researcher stated that the Taiwan education system heavily emphasizes standardized tests in university admissions and this might have an influence on students' quantitative views of science learning. Tsai (2014) stated that students from science and mathematics fields have more qualitative views of science learning compared to students from art majors. Additionally, the researcher suggested several reasons that might be influential on students' learning conceptions such as their motivation. So, students with intrinsic motivation may hold more qualitative views of science learning whereas students with extrinsic motivation may possess quantitative conceptions of science learning.

Students' conceptions of learning science were also investigated in terms of their approaches to learning (Lee *et al.*, 2008). The researchers hypothesized that students with constructivist (qualitative) learning conceptions use deep learning approaches whereas students with reproductive (quantitative) learning conceptions use surface approaches. Using deep learning approaches was associated with having an inherent interest in the course material and using elaborations in order to thoroughly understand the course. On the other hand, students with surface learning approaches were characterized as having an instrumental motivation, handling with the tasks because of obligation and using lower levels of learning strategies such as memorization and rehearsal. The results of the study suggested that students who view science learning as memorization, preparing for tests or making calculations used surface learning approaches. However, students who have learning conceptions such as applying, understanding and perceiving the world in a different way used deeper learning approaches. So, the researchers emphasized the importance of establishing constructivist learning conceptions among students because these conceptions determine their learning strategies and ultimately their achievement levels.

Chiou and Liang (2012) investigated students' conceptions of learning science in relation to their self efficacy beliefs and approaches to learning. The researchers proposed a model that indicates the mediational role of students' learning approaches. So, students with quantitative and qualitative conceptions adopt different learning approaches. Finally, these approaches to learning predict their self efficacy beliefs. Specifically, students with qualitative learning conceptions possess higher motivation and use deep learning strategies. This form of learning approach has a mediational role and ultimately predicts higher self efficacy levels. On the contrary, students with quantitative learning approaches such as memorizing and preparing for tests were found to use superficial strategies as a form of learning approach. Ultimately, these students possess lower levels of self efficacy.

So, the researchers suggested that learning conceptions may be an important source of self efficacy beliefs by influencing the approaches students choose towards science learning.

Sadi and Dagyar (2015) investigated students' conceptions of learning science in relation to their epistemological beliefs and self efficacy levels for biology learning. The researchers proposed a structural model in which students' conceptions of learning mediate the relationship between their epistemological beliefs and self efficacy. Students with sophisticated epistemological beliefs viewed scientific knowledge as complex, evolving and tentative. These students were also found to possess qualitative views of science learning such as "understanding" and "seeing in a new way". The researchers indicated a negative relationship between students' confidence in biology and their epistemological beliefs about the source of knowledge. So, students who think that scientific knowledge is fixed and static had higher self efficacy levels. The researchers explicated that the exam system in Turkey may endorse this understanding of scientific knowledge among students. Hence, students have to find the only single correct answer in the exams in order to enter universities.

Sadi and Lee (2015) investigated students' conceptions of science learning from different domains. They found that students from science-mathematics fields view science learning as calculating, practicing and applying whereas students from mathematics-literature major hold more qualitative views. The researchers stated that students must perform well on the national standardized tests in order to enter universities. This pressure may obligate mathematics-science students to view science learning as calculating, practicing and understanding. Female students were also found to possess more qualitative views of science learning compared to male students. The researchers concluded that female students perceive science more meaningful within a context and consequently possess more sophisticated conceptions of learning science (Sadi and Lee, 2015).

Sadi (2015) conducted another study in order to analyze and compare students' conceptions of learning among different domains such as physics, chemistry and biology.

The results revealed that students have higher levels of learning conceptions for biology compared to physics and chemistry. For, example, more students indicated that they learn biology to see their environment in a new way. The researcher stated that high school physics and chemistry curricula contain a lot of formulas and symbols whereas the biology curriculum contains topics about natural world and living organisms. Presenting physics and chemistry topics as abstract and out of context may lead students to learn them for superficial intentions such as memorizing and calculating. The researcher suggested that classroom practices that present physics and chemistry topics more meaningful may result in sophisticated levels of learning conceptions among students.

Conceptions of science learning can be viewed as indiviuals' understanding of what science learning is. As students' motivation influence their academic outcomes, learning conceptions were also found to impact these outcomes. Different conceptions may influence students to adopt different goals and use different learning strategies. Ultimately, their learning may be influenced by their learning conceptions.

2.5. Studies that Investigate Students' Motivational Characteristics in Relation to Their Scientific Literacy and Achievement

Students' motivational characteristics are found to be related with numerous outcomes such as learning strategies, achievement, scientific literacy and career aspirations. Bybee and McCrae (2011) stated that the fundamental aim of most science curricula are to raise scientifically literate citizens who are capable of giving appropriate decisions when confronted with science related problems in their lives. Individuals are expected to gain several competencies such as identifying scientific issues and using scientific evidence in their daily lives. But it was stated that having scientific knowledge does not necessarily leads people to behave in desired ways. At this point, the researchers emphasize attitudes and interests individuals have with regard to science. So, individuals would gain the desired scientific competencies and apply them in related life situations only if they possess both scientific knowledge and positive attitudes towards science. The researchers also investigated PISA results and indicated that within countries, students' interest toward science and their success was positively related. Students were most interested in real life related scientific issues rather than abstract concepts and explanations. Especially, female students were more interested in scientific issues that are related to health. So, the researchers concluded that classroom practices that present science in a meaningful context would strengthen students' scientific literacy levels.

Lee *et al.* (2016) investigated the relationship between several motivational constructs such as goal orientation, self efficacy and achievement in a science course. They used the general intrinsic-extrinsic motivation framework in their study. According to their model, self efficacy beliefs and mastery orientation was categorized under the heading of intrinsic motivation whereas performance approach and avoidance orientation was categorized under the heading of extrinsic motivation. They hypothesized that students' motivation influence their achievement through their engagement in science courses. They defined engagement as observable learning behaviors that have behavioral, affective and cognitive dimensions. Several examples of engagement were given as attendance, having positive or negative feelings towards the task, and spending mental efforts. They suggested that both self efficacy beliefs and mastery goal orientations predict engagement which in turn predicts science achievement.

Koul *et al.* (2011) investigated high school students' goal orientations in relation to their perceptions of learning environment and their physics and biology classroom anxiety. The results of cluster analysis revealed two distinct profiles of students. The first cluster of students had higher GPA and mastery goal orientations. They also perceived the learning environment more meaningful and cooperative. The second cluster of students had lower GPA and higher performance approach and avoidance goal orientations. They perceive the learning environment competitive and have higher levels of anxiety. The researchers indicated that female students have higher mastery goal orientation whereas male students have higher performance approach goal orientation. The researchers stated that since science is stereotypically presented as a male domain, male students may try to confirm to this belief and avoid looking incompetent. Another result of the study revealed that girls perceived biology classroom environment more meaningful. The researchers stated that health related careers are conventionally accepted appropriate for females because they value helping others rather than competing with others. So, this stereotype may account for girls' perceptions of biology classroom environment.

Gungor *et al.* (2007) investigated students' physics achievement and their affective characteristics. They developed a scale that measures students' affective characteristics on different scales such as interest, achievement motivation, physics anxiety, test anxiety and self efficacy. They indicated that overall, affective characteristics are positively related with achievement. They also stated that achievement motivation explained the highest proportion of variance in physics achievement. So, students who reported that they try hard and spend effort while learning physics had higher achievement levels. Interestingly, the researchers reported a contradictory finding related to self efficacy beliefs. Students' physics self efficacy beliefs were negatively correlated with their physics achievement. This interesting finding was explained by overconfidence which in turn decreases the efforts students spend for learning.

Bryan *et al.* (2010) conducted a study in order to investigate the relationship between students' self efficacy, intrinsic motivation, self determination and achievement. Furthermore, they investigated gender differences as well as students' intent to take advanced science courses in their last two years at high school. The researchers operationalized self determination as students' beliefs about their control on their own learning process. Students' self determination, self efficacy and intrinsic motivation were found to be related both with each other and achievement. Students' science achievement was best predicted by their self efficacy levels. The researchers did not detect any gender differences but there were significant differences in students' motivation in terms of their intention to take advanced science courses. Students who aspire to take advanced science courses had higher intrinsic motivation, self efficacy and self determination. Since these intentions could be viewed as the first milestone towards science careers, the researchers emphasized the importance of classroom practices that foster students' motivation.

The relationship between motivational constructs and students' science achievement was investigated by using the results of TIMMS. This study compared American and Asian students in terms of perceptions of ability and motivation that lead them to study science. One striking finding of this study was that Asian students perceive school science meaningful while explaining real life events. On the contrary, American students find school science boring even if they have high achievement levels. By pointing out the success of East Asian countries in this exam, the researchers emphasized a classroom environment that integrates school science with real life (Yu, 2012).

Sadi and Uyar (2013) conducted a study in order to investigate the relationship between self efficacy, self regulated learning strategies and achievement. They used Pintrich's (1991) Motivated Strategies for Learning Questionnaire and analyzed students' cognitive strategy use, metacognitive strategy use, time and study environment regulation and effort regulation. As much of the findings from literature suggests, they found a positive relationship between students' self efficacy and achievement. In addition, students' cognitive strategy use such as rehearsal and elaboration, their metacognitive strategy use and their management of time and study environment significantly predicted their biology achievement. Sadi and Uyar (2013) also indicated that students with higher self efficacy beliefs tend to use more cognitive and metacognitive strategies. The researchers suggested that since these students believe in their abilities to be successful in biology, they use a variety of deep learning processes in order to fully understand the topics.

Pamuk *et al.* (2014) conducted a study in order to investigate the relationship between student level variables, teacher level variables and students' achievement. They investigated students' self efficacy, goal orientation, metacognitive self regulation, epistemological beliefs and perceptions of constructivist learning environment as student variables. Among the teacher related variables, they analyzed teachers' self efficacy beliefs to teach science, their goal orientations and epistemological beliefs. The results suggested that teachers' self efficacy beliefs were significantly correlated with students' science achievement. Their beliefs about the developing nature of science also positively influenced students' achievement. Pamuk *et al.* (2014) suggested that teachers who are aware of the developing and dynamic nature of science are more aware of students' alternative conceptions and adopt their teaching accordingly. Additionally, teachers with higher self efficacy beliefs use effective teaching strategies and persevere in the face of students' difficulties. Among the student level factors, self efficacy beliefs and performance avoidance goals were significantly associated with achievement. Students with higher beliefs in their capabilities regarding learning science had higher achievement. On the contrary, students who have performance avoidance goals scored significantly lower on the test. Pamuk (2014) stated that students' epistemological beliefs are also related with their achievement. Students with sophisticated beliefs viewed science as dynamic and evolving and scored higher.

Sins *et al.* (2008) conducted a study in order to investigate the relationship between students' motivational characteristics and their level of cognitive processing during a computer modeling activity. They indicated both students' self efficacy levels and their mastery goal orientation predict deep cognitive processing which in turn predicts achievement. On the other hand, students' performance avoidance goal orientation positively predicted surface cognitive processing. It was also indicated that use of surface cognitive processes was significantly and positively related with performance. The researchers suggested that a classroom environment that stresses skill development rather than evaluation may enhance students' mastery goal orientations. Providing students with encouragement and support may also help them to build self efficacy levels.

Lavonen and Laaksonen (2009) investigated the results of PISA exams in terms of student factors and science teaching factors. They indicated that the strongest student level predictors of science success was personal interest, science self efficacy and self concept. In terms of science teaching factors, using demonstrations, engaging students in practical work, and allowing them to draw conclusions were the strongest predictors. Chiu and Xihua (2008) also investigated PISA results in terms of student motivation and family characteristics. Students with higher family resources and fewer family members scored higher on the exam. Among the motivation variables, interest, perseverance and effort, and self efficacy were the strongest predictors of math success.

Özel *et al.* (2013) also investigated the relationship between affective factors and scientific literacy scores on PISA exam. The results of their study suggested that enjoyment of science were the strongest predictor for science success. Interestingly, they found a negative relationship between motivation to learn science and science scores. They indicated that the centralized exam system may be responsible for this contrary result. Students may have higher motivation since this exam is very important for their future, but several factors such as test anxiety may impede their performance on test taking situations.

Akbaş and Kan (2007) conducted a study in order to investigate the relationship between affective factors and chemistry achievement. They found that motivation and anxiety together explain %18 variance of the chemistry achievement. Kurbanoğlu and Akım (2010) proposed a model in order to explain the relationship between chemistry laboratory anxiety, attitudes and self efficacy beliefs. According to their model, attitudes towards chemistry mediated the relationship between self efficacy and chemistry laboratory anxiety. So, students with higher self efficacy beliefs tend to have positive attitudes towards science and eventually have lower levels of chemistry laboratory anxiety.

Reçber (2011) conducted a study in order to investigate mathematics achievement of students with respect to their attitudes towards mathematics, self efficacy and math anxiety. The best predictor of students' achievement was their math self efficacy following with math anxiety and attitudes. Another finding of the study was that male students have higher self efficacy levels than female students. This may result from the prevalent gender stereotypes that represent science as a male domain. He also found that despite their lower self efficacy beliefs, female students have more positive attitudes towards mathematics. The researcher concluded that high number of female mathematics teachers may be responsible for this finding.

In sum, students' motivational characteristics were found to be related with numerous student outcomes such as achievement and scientific literacy. Generally, students who possess higher levels of motivation tend to demonstrate desiring academic outcomes compared to students with lower levels of motivation. Motivation may influence students' engagement in classes, learning strategies they use, and performance.

2.6. Studies that Investigate Students' Motivational Characteristics and Their Science Technology Engineering and Mathematics (STEM) Career Aspirations

Several studies investigated students' motivational characteristics as well as their STEM career aspirations. Students' self efficacy beliefs, goal orientations and science anxiety levels are all found to be related with their cognitive processing and achievement levels. Researchers further investigated the influence of these psychological constructs on students' choices to take advanced science courses as well as their future career aspirations.

Wang (2013) analyzed first year university students' entrance to several fields in terms of several variables. These students were asked about their high school math achievement, math self efficacy, and number of science and mathematics courses they took. The results of their analyses suggested that students' prior achievement, number of courses they took and their self efficacy levels significantly predicted their choices of STEM majors. With this regard, the researchers emphasized the importance of early exposure to math and science courses that may influence students' STEM career choices.

Koul *et al.* (2011) investigated students' career aspirations in relation to their goal orientations and classroom anxiety. They classified careers in terms of high earning science mathematics engineering (HESME) careers and non-HESME careers. Students aspiring HESME careers had higher mastery orientations and lower anxiety levels. Although female students reported higher mastery orientation, they preferred non-HESME careers because of their high anxiety levels. So, researchers concluded that motivational factors were more important for female students' career choices in spite of their higher GPA.

Skells (2014) analyzed high school freshmen students' STEM career aspirations with respect to their gender, prior achievement, self efficacy, science anxiety and science interest. The results of the study suggested that students' interest in science was the only significant predictor of their STEM career choices. Skells (2014) also stated that students with higher science anxiety levels tend to have lower science self efficacy.

Christensen *et al.* (2014) conducted a mixed method study in order to investigate the relationship between students' perceptions of STEM as disciplines and their career interest in STEM field. Students had positive perceptions in relation to science whereas they possessed negative dispositions towards engineering. The researchers stated that these high school students' interest in STEM careers was influenced by their perceptions of STEM. Students were also asked to openly write what motivates them for a science career. Supportive families, encouraging and qualified teachers, and being intrinsically motivated were the most cited reasons by students to choose a science career.

In this section, the literature about students' motivational characteristics and learning conceptions were presented. Motivation towards science learning is particularly analyzed in terms of achievement goal orientation and self efficacy beliefs. The theoretical framework of these motivational constructs and their relationship with several student outcomes were also discussed. It can be said that students' motivational characteristics were positively related with their achievement levels. Students' learning conceptions imply their understanding of nature of science learning and these conceptions were also found to be related with several academic outcomes such as motivation and use of learning strategies.This study investigated the contribution of students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions into their physics performance. Additionally, students' motivational characteristics were analyzed in terms of gender and grade differences. However, research studies obtained different findings regarding the developmental trajectory of motivation through grades (Caprara, 2008; Zimmerman and Pons,1990). So, this study investigates the development patterns of Turkish students' motivational characteristics as they continue in high school. Since students' decisions to choose STEM careers were found to be influenced by their motivation, their choices of field may also be influenced by their motivation. So, students' physics motivation were compared between science-mathematics and mathematics-literature groups.

3. SIGNIFICANCE OF THE STUDY

Science, particularly physics, is one of the subjects that students perceive difficult and abstract. Turkish students perform below the average scores in international exams in science (OECD, 2016). Furthermore, physics is one of the subjects that students poorly perform in standardized national exams. They view concepts in their physics classes as complex and engage reluctantly in science related activities (Koul *et al.*, 2011). They set short term goals and feel incapable of performing scientific tasks. As Sadi (2015) indicated, they equate physics learning to memorize specific formulae and make several calculations.

Students possess varying motivation levels towards different domains of science (Sadi, 2015; Koul, 2011). For example, they view biology more meaningful whereas physics more abstract and out of context. These perceptions may influence students' goals, confidence and learning conceptions of different domains of science. Physics is one of the subjects that students perceive difficult and perform poorly. In addition, there are gender differences in motivation towards physics, chemistry and biology (Britner, 2008). For these reasons, the aim of this study was to specifically investigate students' achievement goal orientation, physics learning self efficacy beliefs and learning conceptions of physics. Given the importance of motivational characteristics on student outcomes, this study aimed to investigate the contribution of students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions into their physics performance. Their physics performance was operationally defined as their physics exam performance from the previous term. Furthermore, the developmental trajectory of these variables from ninth to eleventh grades were analyzed. Students' achievement goal orientations, physics learning self efficacy beliefs, physics learning conceptions and achievement levels of physics were investigated cross sectionally.

So, this study was aimed to contribute to literature in two ways. Firstly, students' motivation towards physics was investigated on a scale of grades in Turkey. This comparison could enlighten how students' motivation and learning conceptions change as they progress in high school. Students first encounter with basic and introductory physics topics in ninth grade and continue with more advanced topics in higher grades. Their motivation may change both as a result of encountering with more complex physics topics and acquiring physics knowledge.

Secondly, this study investigated students' motivational characteristics in terms of field differences. Field choices may represent the first milestone towards STEM careers and this study compared achievement goal orientations, physics learning self efficacy beliefs and physics learning conceptions of students from science-mathematics and literature-mathematics fields. Given the importance of individuals with STEM majors for a country's economical well being, this analysis may give clues about how motivational characteristics influence students' choices of science related careers in Turkey. Ninth and tenth graders' physics motivation and conceptions of learning physics were also compared in terms of their intentions to choose a science-mathematics or literature-mathematics field. This comparison were made between science-mathematics and literature-mathematics groups among eleventh graders since they have already made a field choice.

The findings of this study is assumed to inform physics educators and science educators about the motivational characteristics of Turkish students. Additionally, the study is expected to help physics teachers and science teachers to establish classroom environments that enhance motivational levels of students and reduce gender differences in motivation.

3.1. Research Questions

1-) What is the total contribution of mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions of high school students to their physics performance scores?

2-) Is there any effect of gender and grade level on high school students' mastery approach goal orientation of physics?

2-a) Is there any main effect of *gender* on high school students' mastery approach goal orientation of physics?

H_0: There is no main effect of *gender* on high school students' mastery approach goal orientation of physics.

2-b) Is there any main effect of *grade level* on high school students' mastery approach goal orientation of physics?

H_0: There is no main effect of *grade level* on high school students' mastery approach goal orientation of physics.

2-c) Is there any interaction effect of *gender and grade level* on high school students' mastery approach goal orientation of physics?

H_0: There is no interaction effect of *gender and grade level* on high school students' mastery approach goal orientation of physics.

3-) Is there any effect of gender and grade level on high school students' mastery avoidance goal orientation of physics?

3-a) Is there any main effect of *gender* on high school students' mastery avoidance goal orientation of physics?

H_0: There is no main effect of *gender* on high school students' mastery avoidance goal orientation of physics.

3-b) Is there any main effect of *grade level* on high school students' mastery avoidance goal orientation of physics?

H_0: There is no main effect of *grade level* on high school students' mastery avoidance goal orientation of physics.

3-c) Is there any interaction effect of *gender and grade level* on high school students' mastery avoidance goal orientation of physics?

H_0: There is no interaction effect of *gender and grade level* on high school students' mastery avoidance goal orientation of physics.

4-) Is there any effect of gender and grade level on high school students' performance approach goal orientation of physics?

4-a) Is there any main effect of *gender* on high school students' performance approach goal orientation of physics?

H_0: There is no main effect of *gender* on high school students' performance approach goal orientation of physics.

4-b) Is there any main effect of *grade level* on high school students' performance approach goal orientation of physics?

H_0: There is no main effect of *grade level* on high school students' performance approach goal orientation of physics.

4-c) Is there any interaction effect of *gender and grade level* on high school students' performance approach goal orientation of physics?

H_0: There is no interaction effect of *gender and grade level* on high school students' performance approach goal orientation of physics.

5-) Is there any effect of gender and grade level on high school students' performance avoidance goal orientation of physics?

5-a) Is there any main effect of *gender* on high school students' performance avoidance goal orientation of physics?

H_0: There is no main effect of *gender* on high school students' performance avoidance goal orientation of physics.

5-b) Is there any main effect of *grade level* on high school students' performance avoidance goal orientation of physics?

H_0: There is no main effect of *grade level* on high school students' performance avoidance goal orientation of physics.

5-c) Is there any interaction effect of *gender and grade level* on high school students' performance avoidance goal orientation of physics?

H_0: There is no interaction effect of *gender and grade level* on high school students' performance avoidance goal orientation of physics.

6-) Is there any effect of gender and grade level on high school students' physics learning self efficacy beliefs?

6-a) Is there any main effect of *gender* on high school students' physics learning self efficacy beliefs?

H_0: There is no main effect of *gender* on high school students' physics learning self efficacy beliefs.

6-b) Is there any main effect of *grade level* on high school students' physics learning self efficacy beliefs?

H_0: There is no main effect of *grade level* on high school students' physics learning self efficacy beliefs.

6-c) Is there any interaction effect of *gender and grade level* on high school students' physics learning self efficacy beliefs?

H_0: There is no interaction effect of *gender and grade level* on high school students' physics learning self efficacy beliefs.

7-) Is there any effect of gender and grade level on high school students' quantitative physics learning conceptions?

7-a) Is there any main effect of *gender* on high school students' quantitative physics learning conceptions?

H_0: There is no main effect of *gender* on high school students' quantitative physics learning conceptions.

7-b) Is there any main effect of *grade level* on high school students' quantitative physics learning conceptions?

H_0: There is no main effect of *grade level* on high school students' quantitative physics learning conceptions.

7-c) Is there any interaction effect of *gender and grade level* on high school students' quantitative physics learning conceptions?

H_0: There is no interaction effect of *gender and grade level* on high school students' quantitative physics learning conceptions.

8-) Is there any effect of gender and grade level on high school students' qualitative physics learning conceptions?

8-a) Is there any main effect of *gender* on high school students' qualitative physics learning conceptions?

H_0: There is no main effect of *gender* on high school students' qualitative physics learning conceptions.

8-b) Is there any main effect of *grade level* on high school students' qualitative physics learning conceptions?

H_0: There is no main effect of *grade level* on high school students' qualitative physics learning conceptions.

8-c) Is there any interaction effect of *gender and grade level* on high school students' qualitative physics learning conceptions?

H_0: There is no interaction effect of *gender and grade level* on high school students' qualitative physics learning conceptions.

9-) Is there any statistically significant difference in mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions of high school students in terms of field differences***?***

9-a) Is there any statistically significant difference in mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions between *science-mathematics groups* and *literature-mathematics groups?*

H_0: There is no statistically difference in mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions between *science-mathematics groups* and *literature-mathematics groups.*

9-b) Is there any statistically significant difference in mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions between high school students *intending to choose science-mathematics field* and *literature-mathematics field*?

$H_{0:}$ There is no statistically difference in mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions between high school students *intending to choose science-mathematics field* and *literature-mathematics field.*

10-) Is there any statistically significant difference in mastery approach goal orientation between high school students who have *high physics performance* and *low physics performance?*

$H_{0:}$ There is no statistically significant difference in mastery approach goal orientation between high school students who have *high physics performance* and *low physics performance.*

11-) Is there any statistically significant difference in mastery avoidance goal orientation between high school students who have *high physics performance* and *low physics performance?*

H_0: There is no statistically significant difference in mastery avoidance goal orientation between high school students who have *high physics performance* and *low physics performance.*

12-) Is there any statistically significant difference in performance approach goal orientation between high school students who have *high physics performance* and *low physics performance?*

H_0: There is no statistically significant difference in performance approach goal orientation between high school students who have *high physics performance* and *low physics performance.*

13-) Is there any statistically significant difference in performance avoidance goal orientation between high school students who have *high physics performance* and *low physics performance?*

H_0: There is no statistically significant difference in performance avoidance goal orientation between high school students who have *high physics performance* and *low physics performance.*

14-) Is there any statistically significant difference in physics learning self efficacy beliefs between high school students who have *high physics performance* and *low physics performance?*

H_0: There is no statistically significant difference in physics learning self efficacy beliefs between high school students who have *high physics performance* and *low physics performance.*

15-) Is there any statistically significant difference in quantitative physics learning conceptions between high school students who have *high physics performance* and *low physics performance?*

H_0: There is no statistically significant difference in quantitative physics learning conceptions between high school students who have *high physics performance* and *low physics performance.*

16-) Is there any statistically significant difference in qualitative physics learning conceptions between high school students who have *high physics performance* and *low physics performance?*

$H_{0:}$ There is no statistically significant difference in qualitative physics learning conceptions between high school students who have *high physics performance* and *low physics performance.*

4. METHODOLOGY

The purpose of this study is to investigate the contribution of high school students' achievement goal orientations towards physics learning, their physics learning self efficacy beliefs, their conceptions of physics learning to their physics performances. These motivational constructs were also analyzed in terms of gender and grade differences. Furthermore, students' motivational levels were compared according to their fields. Lastly, comparisons among these variables in terms of students' physics performance levels were made in order to detect the differences in motivational characteristics between high achievers and low achievers. Three different questionnaires were administrated students at one session in order to investigate their motivational characteristics and learning conceptions. So, quantitative data collection methods were used in this study.

4.1. Variables and Operational Definitions

This study investigated students' achievement goal orientations, physics learning self efficacy beliefs, physics learning conceptions and physics performance as variables. The operational definitions of these variables are defined as following:

- Achievement goal orientation is defined in terms of *individuals' beliefs about their engagement reasons in specific learning tasks* (Elliot and McGregor, 2001). Individuals may have four type of achievement goals that are defined as mastery approach goal orientation, performance approach goal orientation, mastery approach goal orientation and mastery avoidance goal orientation (See Appendix A). In the current study, the Turkish version of the Achievement Goal Questionnaire (AGQ) which was adapted by Arslan and Akın (2014) was used (See Appendix A). Above mentioned types with related original items are shown in Appendix B.

- Science learning self efficacy is defined as students' beliefs in their own capabilities to succeed in tasks, activities or courses that are science-related (Britner and Pajares, 2006). Lin and Tsai (2012) developed Science Learning Self Efficacy Questionnaire that measures sience learning self efficacy on various dimensions, These dimensions consists of conceptual understanding, higher-order cognitive skills, practical work, everyday application and science communication. The Turkish version of this questionnaire that is adapted by Alpaslan and Işık (2016) was used in this study (See Appendix C). Original scale with above mentioned dimensions are shown in Appendix B.

- Science learning conceptions are defined as students' understanding and beliefs about nature of science learning (Chiou and Liang, 2012). Conceptions of Learning Science Questionnaiere (CLSQ) consists of seven dimensions. The *memorization, preparing for exam, calculating and practicing* and *increase of knowledge* dimensions constitute quantitative learning dimensions. The *application, understanding* and *seeing in a new way* dimensions constitute qualitative learning dimensions. A Turkish version of this questionnaire that is adapted by Sadi (2015) for physics was used in this study (See Appendix E). Above mentioned dimensions with original items are shown in Appendix F.

- In this study, physics performance is defined as high school students' achievement levels reflected by their physics course grades from the previous term. These grades are self-reported by students.

4.2. Sample

The sample of this study consists of ninth, tenth and eleventh graders from a public high school in İstanbul. The school is an Anatolian high school for 20 years and located in Kağıthane. A purposive sampling method was used in order to have a large sample and sufficient students for each grade level, gender and study field. So, the results obtained from this study can only be generalized to similar groups of students. This high school is a large and old urban school that has 852 students. The school has 24 classrooms, a cafeteria, a conference room, a separate gym and a laboratory for science classes. Students from twelfth grade did not participate in this study because they were not present in the school for studying university entrance exam. Finally, the sample of this study consisted of 583 students from ninth, tenth, and eleventh grades. The number of subjects was reduced to 518 after eliminating missing data and outliers. Number and percentage of students based on their gender and grade level are presented in the following table.

Table 4.1. Number of students based on gender and grade level.

	9	**10**	**11**	**Total**	**Percentage (%)**
Female	122	120	69	311	59.5
Male	75	76	56	207	40.5
Total	197	196	125	518	100
Percentage (%)	38.0	37.8	24.1	100	

Number of students based on their field is presented in Table 2.2. For ninth and tenth graders, the numbers and percentages of students who intend to choose science-mathematics and literature-mathematics fields are presented since they have not made a field choice yet.

Table 4.2. Number of students based on their fields/intention of fields and grade level.

		Science-Mathematics	**Literature-Mathematics**	**Total**
9	Female	80	42	122
	Male	49	26	75
	n	**129**	**68**	**197**
	Percentage (%)	**65.5**	**34.5**	**100**
10	Female	89	31	120
	Male	61	15	76
	n	**150**	**46**	**196**
	Percentage (%)	**76.5**	**23.5**	**100**
11	Female	51	18	69
	Male	52	4	56
	n	**103**	**22**	**125**
	Percentage (%)	**82.4**	**17.6**	**100**
	N	**382**	**136**	**518**
	Percentage (%)	**73.75**	**26.25**	**100**

4.3. Instruments

Separate self-report instruments were used in this study in order to measure students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions. Students were specifically asked to fill out the instruments by considering their physics course. Students were given a demographic form in which they indicate their gender, grade level, intention of field choice (for 9th and 10th graders), field (for 11th graders) and their physics exam performance from the previous term.

4.3.1. The Achievement Goal Orientation Questionnaire (AGOQ)

The Achievement Goal Orientation Questionnaire (AGOQ) was developed by Elliot and Murayama (2008) in order to measure individuals' goal orientations related to achievement situations. The researchers used mastery and performance goal orientations as a general framework. They further differentiated these achievement goals in terms of their valence such as approach or avoidance goals. The instrument consists of four subscales as *mastery approach goals* with 3 items, *mastery avoidance goals* with 3 items, *performance approach goals* with 3 items and *performance avoidance goals* with 3 items (see Appendix B). The instrument has a five point likert type format in which responses range from 1 (strongly disagree) to 5 (strongly agree). The Cronbach's α reliability for each subscale ranges from .84 to .94 (Elliot and Murayama, 2008).

In the present study, the Turkish form of the AGOQ which was translated to Turkish by Arslan and Akın (2014) was used (see Appendix A). The Cronbach's α reliability coefficient were indicated for mastery approach subscale as .72, mastery avoidance subscale as .68, performance approach subscale as .62 and performance avoidance subscale as .69. The researchers ensured the validity of the adapted scale by consulting expert opinions and making confirmatory factor analysis.

4.3.2. The Science Learning Self Efficacy Questionnaire

The Science Learning Self Efficacy Questionnaire was developed by Lin and Tsai (2013) in order to measure students' science learning self efficacy levels. The questionnaire assesses students' science learning efficacy levels among *conceptual understanding, higher order cognitive skills, practical work, everyday application* and *science communication* dimensions (See Appendix D). The questionnaire consists of 28 items and has an overall Cronbach's α reliability coefficient of .97. The Cronbach's α reliabilities for each subscale range from .83 to .97 (Lin and Tsai, 2013).

A Turkish version of the Science Learning Self Efficacy Questionnaire which was adapted by Alpaslan and Işık (2016) for physics was used in the current study (see Appendix C). The overall Cronbach's α reliability coefficient of the questionnaire was .94. The reliability coefficients for each subscale ranged from .74 to .89. They ensured the construct validity of the study by conducting exploratory and confirmatory factor analysis. Unfortunately, the school principal indicated that students do not use laboratories in their physics classes. Items that are related with physics laboratories were removed from the analysis. So, in the end, *practical work* dimension of the Science Learning Self Efficacy Questionnaire was not included in the analysis.

4.3.3. The Conceptions of Learning Science Questionnaire (CLSQ)

The Conceptions of Learning Science Questionnaire (CLSQ) was developed by Lee *et al.* (2008) in order to measure students' conceptions of learning science. The researchers identified seven categories of conceptions of learning science and broadly categorized them as quantitative and qualitative. Quantitative learning conceptions consist of *memorizing, testing, calculating and practicing, and increasing one's knowledge* whereas qualitative learning conceptions consist of *applying, understanding* and *seeing in a new way* (See Appendix F). The questionnaire consists of 35 items and has a five point Likert type format in which responses range from “strongly disagree” (1) to “strongly agree” (5).

The Cronbach's α reliability coefficients range from .85 to .91 for the subscales of the instrument.

For the present study, the Turkish adaptation of Conceptions of Learning Science Questionnaire for physics course was used. Sadi (2015) adapted the original CLSQ for physics and named it as Conceptions of Learning Physics Questionnaire (see Appendix E). The general Cronbach's α reliability coefficient of the scale is calculated as .89. The Cronbach's α reliability coefficient for each sub scale range from .63 to .85. Factor analysis also sufficiently ensured the construct validity of the scale.

4.3.4. Students' physics performance

In the present study, students' physics course grades/exam performances from the previous term were used as their physics performances. Students were requested to report their physics exam performance on the demographic form.

4.4. Procedure

In order to investigate students' achievement goal orientation, physics learning self efficacy beliefs, physics learning conceptions and physics performance, above memtioned likert type instruments were implemented to high school students.Quantitative data collection methods were used in this study.

For the purpose of determining the sufficient time for completely filling out the instruments, a pilot study was made with 25 high school students from different schools. It was observed that a maximum of 30 minutes was sufficient for every single student of the group to complete the questionnaires, as well as they did not After consulting to the principal of the school, the instruments were cross sectionally administered in a one class period to the participants. Twelfth graders were not included in the sample since they were not present in the school during the administration process. They were going to take university entrance exam and conventionally get permission from school administration to study for this exam during this period of year. So, a total of 518 students from ninth, tenth and eleventh grades participated in this study. Before starting the data collection process, the necessary permissions form the national education directorate and the Ethics Committee of Boğaziçi University and were taken (see Appendix H).

4.5. Data analysis

In order to analyze the data, descriptive statistics for students' demographic characteristics as well as scores from the instruments were examined. After conducting the initial assumption tests, the following analysis were carried out.

A *multiple regression analyses* was conducted in order to examine the contributions of students' achievement goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions, qualitative physics learning conceptions and grade level into their physics performance. This analysis enables researchers to evaluate the predictive power of each independent variable relative to other independent variables (Pallant, 2011, p.148). A standard multiple regression was conducted in order to indicate how much unique variance in the dependent variable can be explained by each of the independent variables.

A *Two-Way Analysis of Variance (ANOVA*) was conducted in order to compare students' achievement goal orientations, physics learning self efficacy levels and physics learning conceptions in terms of gender and grade level. This analysis enables researchers to investigate the effects of several independent variables on a dependent variable as well as an interaction effect among the independent variables. An interaction effect is defined in terms of the effects of the levels of independent variables (Hinkle, 2003, p.417). So, when the effects of first independent variable is not same across the levels of the other independent variable, an interaction may exist. Since the developmental trajectory of motivational characteristics through grades could be significantly different for female and male students, an interaction effect was analyzed in this study (Caprara *et al.*, 2008).

A *One-Way Multivariate Analysis of Variance (MANOVA)* was conducted in order to compare students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions between science-mathamatics and literature mathematics groups. By using this analysis, researchers can compare multiple dependent variables between several groups (Pallant, 2011, p.283). A two different one-way MANOVA was conducted because ninth and tenth graders haven't made a field choice yet. So, the comparisons for ninth and tenth graders were made in terms of their intent of field choices whereas for eleventh graders were made in terms of their already chosen fields.

Independent samples t-tests were conducted in order to compare students' achievement goal orientations (*mastery approach, performance approach, mastery avoidance*, and *performance avoidance*), physics learning self efficacy ***(****conceptual understanding*, *higher order cognitive skills*, *practical work*, *everyday application* and *science communication)*, and physics learning conceptions ***(****memorizing, testing, calculating and practicing, increasing one's knowledge, applying, understanding* and *seeing in a new way*) between high and low achievers. This analysis enables researchers to indicate whether two groups are statistically significantly different on a dependent variable (Hinkle, 2003, p.236).

5. RESULTS

In this section, the results of various descriptive and inferential statistics are presented. Firstly, descriptive statistics of the scores from the instruments are introduced. Secondly, results of the multiple regression analysis that predicts physics performance are presented. Thirdly, the differences in students' motivation in terms of gender and grade levels are discussed. Student's motivational variables are differentiated in terms of field differences. Lastly, each sub dimension of the scales were compared between students who have high physics performance and low physics performance. Before proceeding with analysis, assumptions of all the statistical tests were checked. In the end, the number of sample size reduced to 518 from 536 because of the required assumptions (univariate and multivariate outliers).

5.1. Descriptive Statistics for the Data

Students' physics performance levels as well as the scores they obtained from each instrument are presented in this section. All of the students reported their physics course grade from the previous term except eleventh graders from literature-mathematics field. Since these students did not take a physics course in the previous term, they reported the physics course grade from the last term they had a physics course. Students' physics exam performance from the previous term are presented in Table 5.1. The mean for physics course grade is 77.69 *(SD* = 10.16*)* for ninth graders and 72.20 for tenth graders *(SD* = 11.69*).* Since eleventh graders from literature-mathematics field did not take a physics course in previous term, their physics course grade from one year before was used in the analysis. Eleventh graders' from science-mathematics field had a mean score of 70.80 *(SD* = 15.35*)* and students from mathematics-literature field had a mean score of 64.23 *(SD* = 11.24*).*

Table 5.1. Students' physics exam performance from the previous term.

	M			SD		
	Female	Male	Total	Female	Male	Total
9	76.89	79.00	77.69	9.95	10.43	10.16
10	71.28	73.67	72.20	10.86	12.83	11.69
11 (SM)	77.29	67.21	70.80	10.61	18.34	15.35
11 (LM)	63.78	66.25	64.23	11.28	12.50	11.24

The mean and standard deviation values for each dimension of the scales for the total sample are presented in Table 5.2. Students' scores for their achievement goal orientation, physics learning self efficacy and physics learning conceptions are illustrated. For the Physics Learning Self Efficacy Scale, descriptive characteristics of each sub dimension as well as the total scale are demonstrated. The same procedure is held for Physics Learning Conceptions Questionnaire. Tsai (2014) characterized the *memorizing*, *preparing for the exam*, *calculating and practicing* and *increasing one's knowledge* conceptions as quantitative. On the other hand, he categorized *application*, *understanding* and *seeing in a new way* dimensions as qualitative. So, a mean value for quantitative learning conceptions as well as qualitative learning conceptions is included in Table 5.2. The results revealed that the total sample had a mean score of 3.33 from the total Physics Learning Self Efficacy Scale *(SD* = .75*)*. Students had a mean score of 3.29 for quantitative learning conceptions *(SD* = .62*)*, and 3.66 for qualitative learning conceptions. *(SD* = .84*).*

Table 5.2. Descriptive statistics of the measures for the total sample.

N = 518	M	SD
Mastery approach goals	4.10	.78
Mastery avoidance goals	4.05	.78
Performance approach goals	3.97	.96
Performance avoidance goals	4.05	.92
Conceptual understanding	3.47	.80
Higher order cognitive skills	3.29	.82
Everyday application	3.24	.81
Science communication	3.51	.95
Mean self efficacy	3.33	.75
Memorizing	2.82	1.09
Preparing for the exam	3.03	.88
Calculating and practicing	3.77	.81
Increasing one's knowledge	3.62	.89
Mean quantitative learning conceptions	3.29	.62
Application	3.56	.85
Understanding	3.79	.93
Seeing in a new way	3.66	1.00
Mean qualitative learning conceptions	3.66	.84

Descriptive characteristics of the measures are separately presented for ninth, tenth and eleventh graders in Appendix G.

5.2. Multiple regression analysis for predicting physics performance

A multiple regression analysis was conducted in order to analyze the unique contributions of several independent variables (predictor variables) to a dependent variable. In the current study, the dependent variable was physics performance whereas the independent variables were mean mastery approach goal orientation, mean mastery avoidance goal orientation, mean performance approach goal orientation, mean performance avoidance goal orientation, mean physics learning self-efficacy beliefs, mean quantitative physics learning conceptions and mean qualitative physics learning conceptions. Students from ninth, tenth and eleventh grades took different exams throughout the semester. So, standardized T scores were used in order to eliminate the influence of different exams and grade level was not included in the model. Since there were no significant differences in physics performance, gender was also not included in the model (t (362.57) = .16, p = .87). This analysis was conducted in order to gain insight about the relative contribution of each independent variable to physics performance. In this section the research question 1 was investigated. Before conducting the multiple regression analysis, assumptions of this analysis were checked.

5.2.1. Assumptions of multiple regression analysis

In order to conduct multiple regression analysis, several assumption tests were conducted. Sample size, multicollinearity, outliers, normality, linearity and homoscedasticity (constant variance of the error terms) are the assumptions that are tested for conducting multiple regression analysis in this study (Pallant, 2011, p.177; Hair *et al.*, 2014, p.285). Below are presented the results of these assumption tests.

Sample size: Pallant (2011) indicated that the generalization of the results obtained from a study is dependent on the sample size (p.286). It was stated that as the number of variables increase, the sample sizes should also increase. He recommended a formula (N > 50 + 8m) in order to determine the necessary sample size where m represents the number of variables. For this study, the number of participants (N=518) exceed the recommended sample size (N=114).

Multicollinearity: Another assumption of multiple regression analysis is that independent variables predicting the dependent variable should not highly correlate with each other (Hair *et al.*, 2014, p.290). So, the correlation coefficients among the variables should be less than .90. A correlation matrix that shows the correlation coefficients between the independent and dependent variables is presented in Table 5.3. None of the correlations exceed .90.

Table 5.3. Correlation coefficients between the variables.

	Physics Perf.	Mast. App.	Mast. Avoi.	Perf. App.	Perf. Avoi.	P. L. Self-Efficacy	Quan. P.L. Concept.	Qual. P.L. Concept.
Physics Perf.	1.00							
Mast. App.	.28**	1.00						
Mast. Avoi.	.20**	.72**	1.00					
Perf. App.	.25**	.50**	.45**	1.00				
Perf. Avoi.	.14**	.42**	.47**	.66**	1.00			
P. L. Self-Efficacy	.23**	.46**	.35**	.41**	.32**	1.00		
Quan. P.L. Concept.	-.08	.17**	.19**	.20**	.13**	.15**	1.00	
Qual. P.L. Concept.	.21**	.44**	.37**	.32**	.25**	.58**	.24**	1.00

Multicollinearity can be also assessed by interpreting the tolerance and VIF values. Tolerance is defined as the variance of a specific independent variable that is not explained by the other independent variables (Hair *et al.*, 2014, 291). Generally, high tolerance values indicate low multicollinearity. Tolerance values should be higher than .10. Variance Inflation Factor (VIF) is another measure of multicollinearity and is calculated by inversing the tolerance value. The acceptable range for VIF values are 1 to 10. Table 5.4 indicates the tolerance and VIF values for independent variables. All tolerance values are higher than .10, and none of the VIF values exceed 10.

Table 5.4. Tolerance and VIF values for independent variables.

	Tolerance	VIF
Mastery approach goal orientation	.41	2.46
Mastery avoidance goal orientation	.44	2.25
Performance approach goal orientation	.48	2.07
Performance avoidance goal orientation	.53	1.90
Physics learning self-efficacy beliefs	.58	1.72
Quantitative physics learning conceptions	.92	1.09
Qualitative physics learning conceptions	.59	1.70

Outliers: Pallant (2011) indicated that multiple regression analysis is very sensitive to outliers (p.286). So, standardized residual values that are beyond the -3.29/+3.29 can be regarded as outliers. In order to check whether outliers have any influence on the model, Cook's distance can be analyzed. Tabachnik and Fidell (2007) suggest that cases that have a Cook's distance more than 1 can be problematic (p.195). For this study, the maximum Cook's distance value was .032. So, none of the outliers had a significant influence on the results.

Normality: The first assumption of conducting multiple regression is that all independent and dependent variables should have a normal distribution. In order to check for this assumption, Kolmogorov-Smirnov and Shapiro-Wilk tests were conducted. The results of both tests indicated that all the variables had non-normal distributions ($p < .05$). Since Kolmogorov-Smirnov and Shapiro-Wilk tests are sensitive to sample size, larger samples may result in significant findings that indicate non-normal distributions. According to George and Mallary (2010), an alternative way to check for normality assumption is considering the skewness and kurtosis values. Distributions that have skewness and kurtosis values ranging from -2 to +2 can be considered as normal. For this study, normality assumption was tested by skewness and kurtosis values since the sample size of this study can be considered as large (N=534). According to results, it can be said that all the independent and dependent variables have normal distributions since their skewness and kurtosis values did not exceed -2/+2 threshold (Table 5.5).

Table 5.5. Skewness and kurtosis values for independent and dependent variables.

	Skewness	Kurtosis
Mastery approach goal orientation score	-.84	.33
Mastery avoidance goal orientation score	-.71	.28
Performance approach goal orientation score	-.98	.67
Performance avoidance goal orientation score	-1.11	1.11
Physics learning self-efficacy score	-.18	.05
Quantitative physics learning conception score	.19	.47
Qualitative physics learning conception score	-.72	.66
Physics performance score	-.40	-.04

Another way to check for normality assumption is to visually analyze the Normal Probability-Probability of Regression Standard Residual plot. If the values approximately represent a linear pattern, it can be assumed that the normality assumption was met (Figure 5.1).

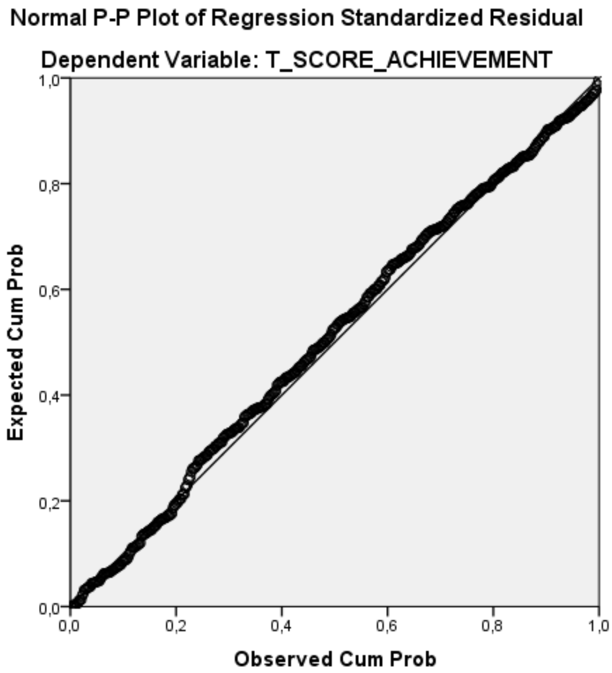

Figure 5.1. Normal plot of regression standardized residual.

Linearity: Another assumption of multiple regression analysis is that dependent and independent variables should have a linear relationship. This assumption can be visually tested with a scatterplot of standardized residuals (Figure 5.2). In order to meet the linearity assumption, standardized residual values should have a random distribution around the standard residual zero line and they should demonstrate a linear pattern rather than a curvilinear pattern (Hair *et al.*, 2014, p.179; Pallant, 2011, p.151). So, no distinct relationship between the residuals and predicted values should be inferred from the scatterplot. As it is seen from Figure 5.2, no distinct relationship exists between the residuals and predicted values exist for the dataset of this study.

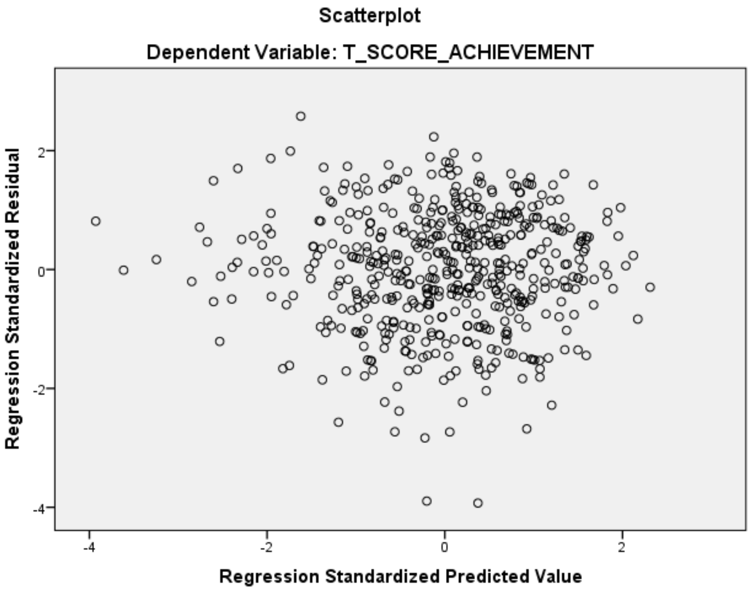

Figure 5.0-1.Distribution of standardized residual values.

Homoscedasticity (constant variance of the error terms): Another assumption of multiple linear regression is homoscedasticity which indicates that all the variables should have homogeneous variances. This assumption is tested by a visual diagram of standardized residuals (Hair *et al.*, 2014, p.181; Pallant 2011, p.153). It can be assumed that if the standardized residuals display a random pattern around the standard residual zero line, the homoscedasticity assumption is met. The Figure 5.2 shows that most of the values lie between the -2/ +2 range which can be interpreted as a sign of homogeneous variances.

5.2.2. Results of multiple regression analysis

After conducting the assumption tests, a multiple regression analysis was conducted in order to indicate the contribution of each independent variable to predict physics performance. The following table indicates the significance of the contribution of the independent variables into the dependent variable. So, the linear combination of mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions, qualitative physics learning conceptions and grade level into physics performance was significant (*F* (9,508) = 9.12, $p < .001$).

Table 5.6. ANOVA results.

Model	Sum of squares	df	Mean squares	F	p
Regression	7160.14	9	795.57	9.12	.000
Residual	44339.86	508	87.28		
Total	51500.00	517			

Table 5.7 indicates how much variance in physics performance could be explained by the linear combination of the independent variables. According to Cohen and Cohen (1983), the R squared values ranging from .09 to .25 have a medium effect size. So it can be said that the R squared value found in this analysis has a medium effect size (*F* (9,508) = 9.12, $p < .001$, R^2=.124). A variance of 12.4 % in physics performance can be explained by the linear combination of the independent variables.

Table 5.7. Model Summary.

Model	R	R^2	Adjusted R^2	SE
1	.37	.139	.127	9.34

In order to indicate the relative contributions of independent variables to physics performance, unstandardized coefficients, standardized coefficients, significance values and partial correlations of each independent variable are presented in the following table. The beta weights represent the relative contribution of each independent variable to the dependent variable.

Table 5.8. Summary of coefficients.

Model	B	SE	Beta	t	p	Part R
Constant	38.44	3.10		12.38	.00	
Mastery Approach G.O.	2.26	.82	.18	2.75	.01	.11
Mastery Avoidance G. O.	.05	.79	.00	.07	.95	.00
Performance Approach G.O.	2.06	.62	.20	3.33	.00	.14
Performance Avoidance G.O.	-1.01	.62	-.09	-1.65	.10	-.07
Physics Learning Self-Efficacy Beliefs	.90	.71	.07	1.26	.21	.05
Quantitative Physics Learning Conceptions	-2.81	.69	-.16	-4.09	.00	-.17
Qualitative Physics Learning Conceptions	1.17	.63	.10	1.86	.06	.08

The standradized beta values indicate that mastery approach goal orientation (Beta=.18, p < .001), performance approach goal orientation (Beta=.20, p < .05), and quantitative physics learning conceptions (Beta = -.16, p < .001) significantly contributed to physics performance. As expected, mastery approach goal orientation and performance approach goal orientation are positively correlated with physics performance. On the other hand, quantitative physics learning conceptions made the strongest unique contribution to the dependent variable. Quantitative physics learning conceptions significantly and negatively predicts physics performance. The regression equation that predicts physics performance is as following: Physics performance = $2.26_{M.approach} + 2.06_{P.appraoch} - 2.81_{quantitative}$

Part-R values which are referred as semipartial correlation coefficients are also presented for each independent variable in Table 5.8. The squared of this value represents the unique contribution of each independent variable to the total R squared value (Pallant, 2011, p.161). According to table, quantitative learning conceptions were recorded as having the highest Part-R value, indicating that 3% of the total variance can be explained by this variable (Table 5.8).

5.3. Comparisons in terms of Gender and Grade Differences

Students' achievement goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions are analyzed in terms of gender and grade differences. First, the necessary assumption tests were performed. Then, Two-Way ANOVA was conducted for mean values of each dimension of Achievement Goal Orientation Questionnaire, the total Physics Learning Self Efficacy Scale, quantitative dimensions and qualitative dimensions of the Physics Learning Conceptions Questionnaire.

5.3.1. Differences in Mean Achievement Goal Orientation Scores in terms of Gender and Grade Level

In order to analyze the differences in achievement goal orientation (mastery approach, mastery avoidance, performance approach and performance avoidance) scores of students in terms of gender and grade level, Two-Way ANOVA test was conducted. Since Achievement Goal Orientation Questionnaire (AGQ) consists of four dimensions, separate Two-Way ANOVA tests were conducted for each of the dimension. Before conducting the analysis, preliminary assumption tests were carried out. The results of these tests are presented in the following sections.

5.3.1.1. Differences in Mean Mastery Approach Goal Orientation Scores in terms of Gender and Grade Level. In this section the null hypotheses for research questions 2-a, 2-b and 2-c was tested. So, student's mastery approach goal orientation scores were analyzed in terms of gender and grade level. Initial analysis was conducted in order to test whether the mastery approach goal orientation scores meet the required assumptions. Afterwards the Two-Way ANOVA test was conducted.

The assumptions of Two-Way ANOVA test are independence of observations, normality, and homogeneity of variances (Hinkle *et al.*, 2003, p.238). The results of these assumption tests are presented below.

Independence of observations: This assumption necessitates that scores of different samples in an analysis should not influence each other (Hinkle *et al.*, 2003, p.239). So, it was assumed that separate groups in this study had no interaction while the tests were applied to them.

Normality: The normality assumption indicates that the scores of students demonstrate a normal distribution. The normal distribution was defined as “the distribution of normally distributed standard scores with a mean equal to 0 and a standard deviation equal to1” (Hinkle *et al.*, 2003). It was indicated that scores that have skewness and kurtosis values ranging from -2 to +2 can be accepted as normally distributed (Pallant, 2005). In the following table the skewness and kurtosis values for mastery approach goal orientation scores are presented. According to results, only the kurtosis value of mastery approach goal orientation score exceeds the threshold of 2.

Table 5.9. Skewness and kurtosis values for mean mastery approach goal orientation score.

	Skewness	Kurtosis
Females	-.86	.61
Males	-.87	.04
Ninth graders	-.96	.81
Tenth graders	-.69	.19
Eleventh graders	-.83	-.19

In the following figures the distribution of mastery approach goal orientation for each group are represented by histograms.

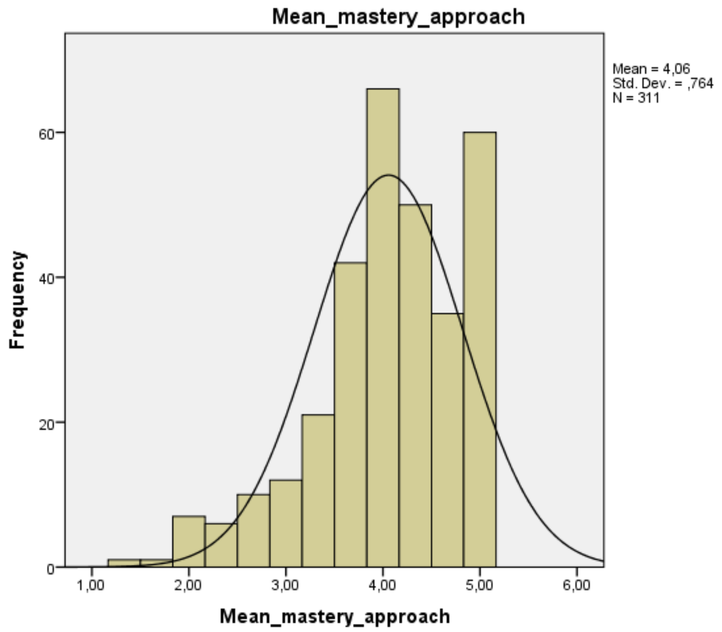

Figure 5.3. Histogram of mean mastery approach goal orientation scores for female students.

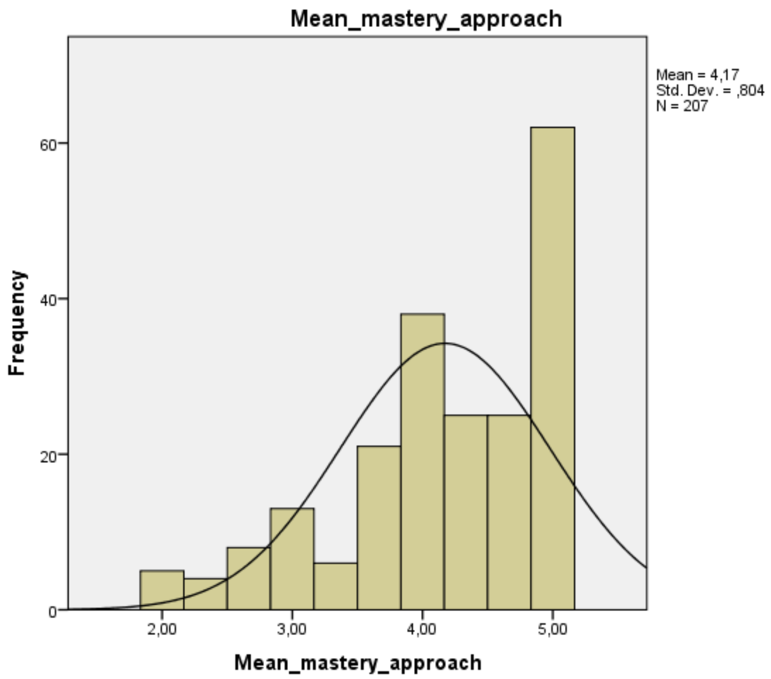

Figure 5.4. Histogram of mean mastery approach goal orientation scores for male students.

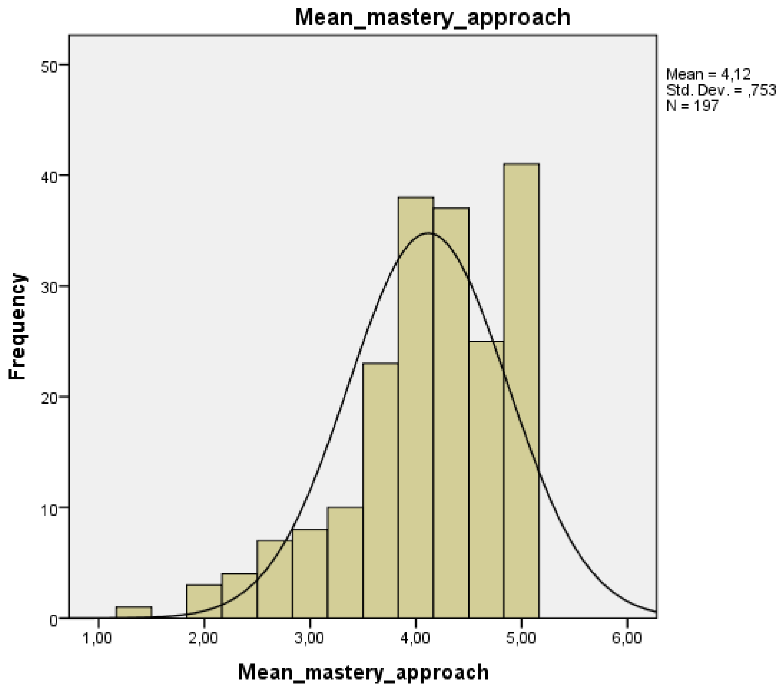

Figure 5.5. Histogram of mean mastery approach goal orientation scores for ninth graders.

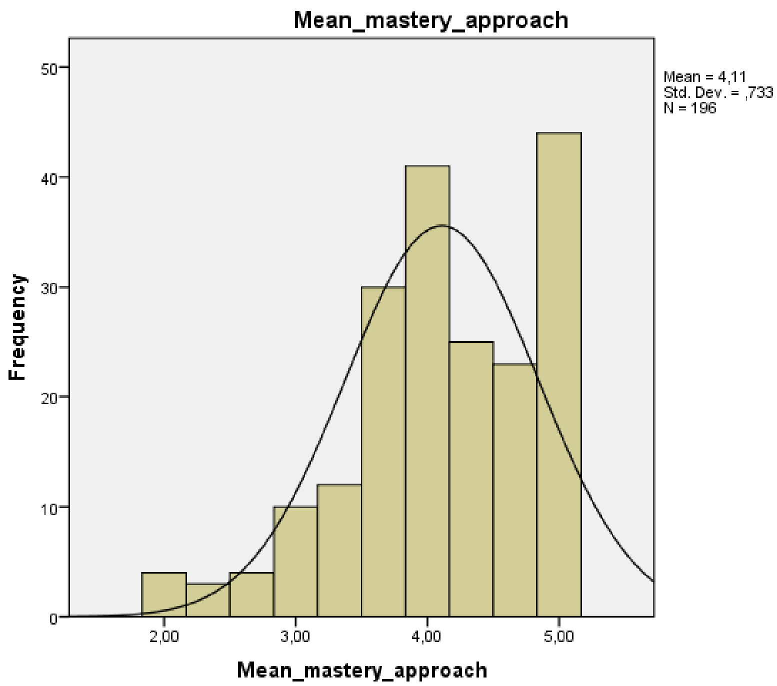

Figure 5.6. Histogram of mean mastery approach goal orientation scores for tenth graders.

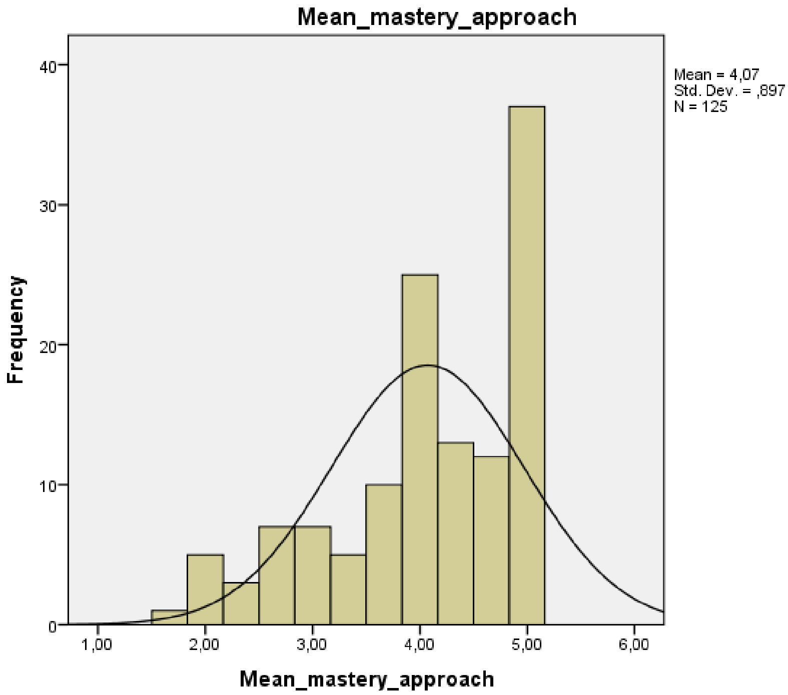

Figure 5.7. Histogram of mean mastery approach goal orientation scores for eleventh graders.

Homogeneity of variance: Another assumption of Two-Way ANOVA test indicates the variances of each population should be equal (Hinkle *et al.*, 2003). This assumption was tested by Levene's Test of Homogeneity. According to this test, significant results indicate unequal variances among groups. In the following table the results of homogeneity test is presented.

Table 5.10. Levene's test results for mean mastery approach goal orientation scores.

	F	df1	df2	p
Mastery approach goal orientation	2.22	5	512	.05

According to Levene's test results, students' mean mastery approach goal orientation scores satisfied the homogeneity of variance assumption. So the variances of scores for each group are not statistically significantly different from each other (F(5, 512) = 2.22, p = .05).

The mean mastery approach goal orientation scores satisfied the independence of observations and normality assumptions. However, the homogeneity of variance assumption was violated so the results should be interpreted with caution. The following table represents the results of Two-Way ANOVA test for mean mastery approach goal orientation scores.

Table 5.11. Two-way analysis of variance results for mean mastery approach goal orientation as a function of gender and grade level.

	df	MS	F	p	Partial η^2
Gender	1	1.94	3.17	.08	.01
Grade	2	.08	.13	.88	.00
Gender*Grade	2	.38	.62	.54	.00

The results of the analysis indicated that there was no interaction effect among gender and grade level on students' mastery approach goal orientation scores (F (2, 512) = .62, p = .54). Furthermore, the analysis for gender (F (1, 512) = 3.17, p = .08) and grade level (F (1, 512) = .13, p = .88) suggest no main effect for these variables. So, the null hypothesis for research questions 2-a, 2-b and 2-c were confirmed.

5.3.1.2. Differences in Mean Mastery Avoidance Goal Orientation Scores in terms of Gender and Grade Level. In this section, students' mean mastery avoidance goal orientation scores were analyzed in terms of gender and grade differences. So, the hypotheses for research questions 3-a, 3-b, and 3-c were tested. First, preliminary analysis was conducted in order to check whether the variable satisfies the required assumptions. Then Two-Way ANOVA test was conducted in order to indicate any interaction or main effect of the independent variables on mean mastery avoidance goal orientation score.

Independence of observations, normality and homogeneity of variances assumptions were checked for mean mastery avoidance goal orientation score. The results of these tests are presented below.

Independence of observations: It was assumed that the scores of each group was unrelated to each other.

Normality: In order to check the normality of mean mastery avoidance goal orientation scores, skewness and kurtosis values were presented in the following table. Kurtosis and skewness values for mastery avoidance goal orientation are between the +2 and -2 threshold.

Table 5.12. Skewness and kurtosis values for mean mastery avoidance goal orientation scores.

	Skewness	Kurtosis
Females	-.73	.41
Males	-.67	.05
Ninth graders	-.77	.61
Tenth graders	-.62	.02
Eleventh graders	-.75	.33

In the following figures the distribution of mean mastery avoidance scores of students are represented by histograms.

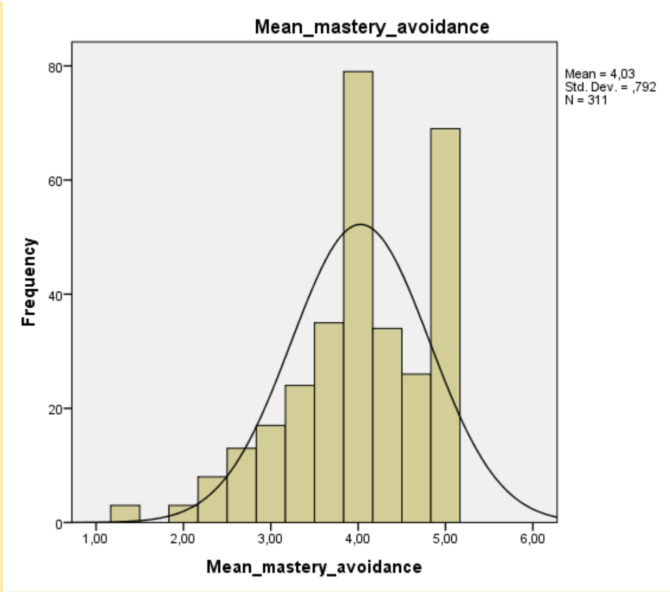

Figure 5.8. Histogram of mean mastery avoidance goal orientation scores for female students.

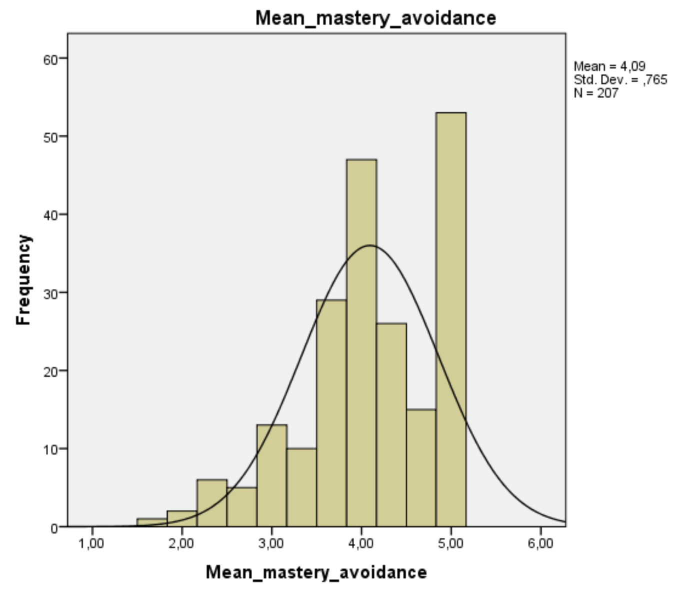

Figure 5.9. Histogram of mean mastery avoidance goal orientation scores for male students.

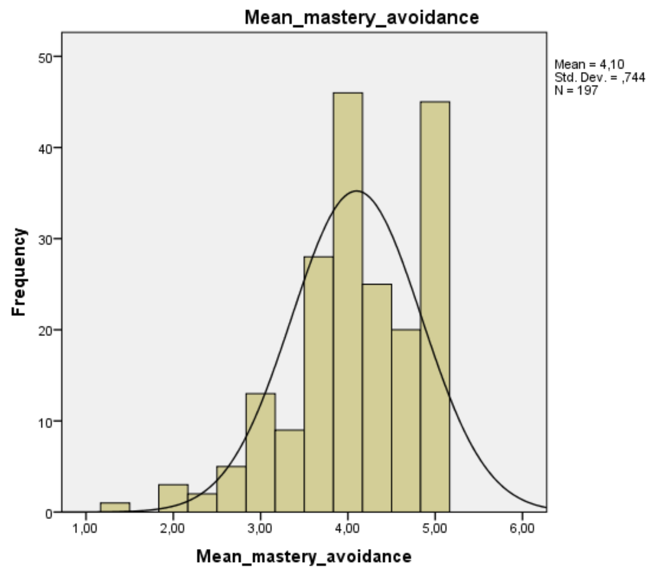

Figure 5.10. Histogram of mean mastery avoidance goal orientation scores for ninth graders.

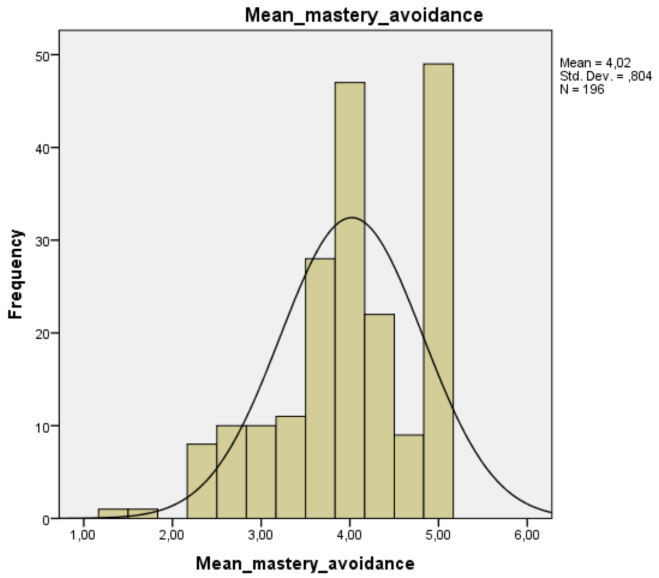

Figure 5.11. Histogram of mean mastery avoidance goal orientation scores for tenth graders.

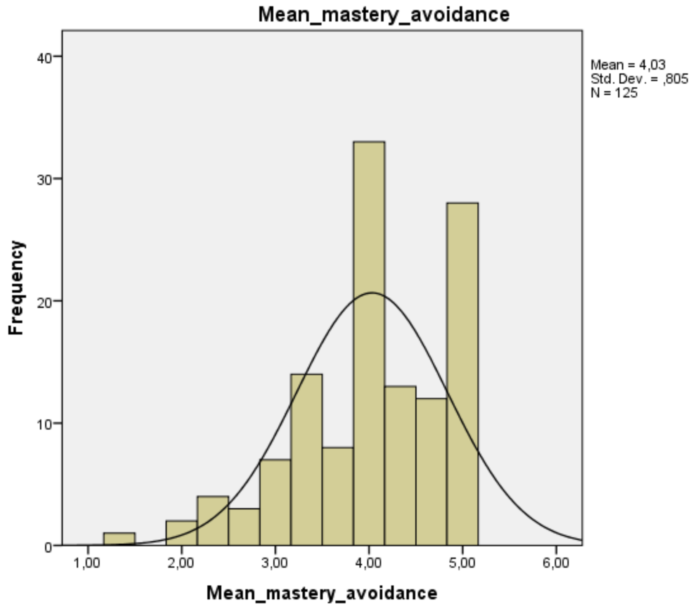

Figure 5.12. Histogram of mean mastery avoidance goal orientation scores for eleventh graders.

Homogeneity of variance: Table 5.13 represents the results of Levene's homogeneity of variances test. According to results, homogeneity of variances assumption was met for mean mastery avoidance goal orientation scores (F (5, 512) = .37, p=.87).

Table 5.13. Levene's test results for mean mastery avoidance goal orientation scores.

	F	df1	df2	p
Mastery avoidance goal orientation	.37	5	512	.87

The mean mastery avoidance goal orientation scores satisfied the independence of variances, normality and homogeneity of variances assumptions. In the next step, two-way ANOVA was conducted in order to examine the main and interaction effects of gender and grade level on students' mean mastery avoidance goal orientation scores. Table 5.14 represents the results of two-way ANOVA.

Table 5.14. Two-way analysis of variance results for mean mastery avoidance goal orientation as a function of gender and grade level.

	df	MS	F	p	Partial η^2
Gender	1	.57	.93	.34	.00
Grade	2	.41	.67	.51	.00
Gender*Grade	2	.06	.10	.90	.00

The results of two-way ANOVA indicated that there was no interaction among gender and grade level (F (2, 512) = .10, p = .90). In addition, gender (F (1, 512) = .93, p = .34) and grade level (F (1, 512) = .67, p = .51) had no main effects on mean mastery avoidance goal orientation scores. So, the null hypotheses for research questions 3-a, 3-b and 3-c were confirmed.

5.3.1.3. Differences in Mean Performance Approach Goal Orientation Scores in terms of Gender and Grade Level. In order to analyze the differences in mean performance approach goal orientation scores in terms of gender and grade level, two-way ANOVA was conducted. So, in this section the null hypothesis for research questions 4-a, 4-b and 4-c were tested. Before conducting the analysis, the preliminary analysis was held to check whether the mean performance approach orientation scores meet the necessary assumptions.

Independence of observations, normality and homogeneity of variances assumptions were checked for mean performance approach goal orientation scores in this section. The results of these tests are presented below.

Independence of observations: Mean performance approach goal orientation scores for each group was assumed to be unrelated with each other.

Normality: The normality assumption for mean performance approach goal orientation scores was checked by analyzing the skewness and kurtosis values (Table 5.15). None of the skewness and kurtosis value exceed +2/-2.

Table 5.15. Skewness and kurtosis values for mean performance approach goal orientation score.

	Skewness	Kurtosis
Females	-.96	.59
Males	-.97	.73
Ninth graders	-.91	.72
Tenth graders	-.81	.06
Eleventh graders	-1.20	1.12

In the following figures, histograms of mean performance approach goal orientation scores for females, males, ninth graders, tenth graders, and eleventh graders were presented.

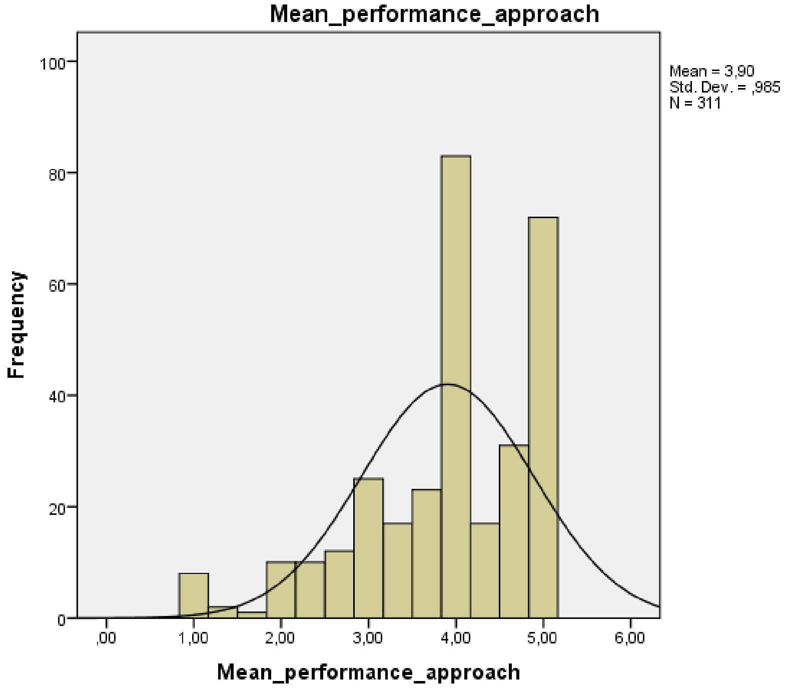

Figure 5.13. Histogram of mean performance approach goal orientation scores for female students.

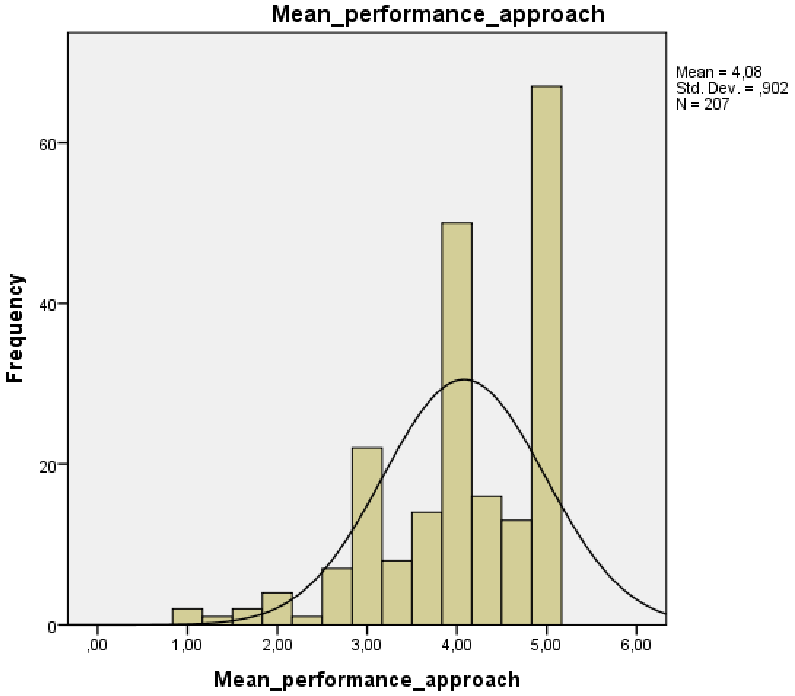

Figure 5.14. Histogram of mean performance approach goal orientation scores for male students.

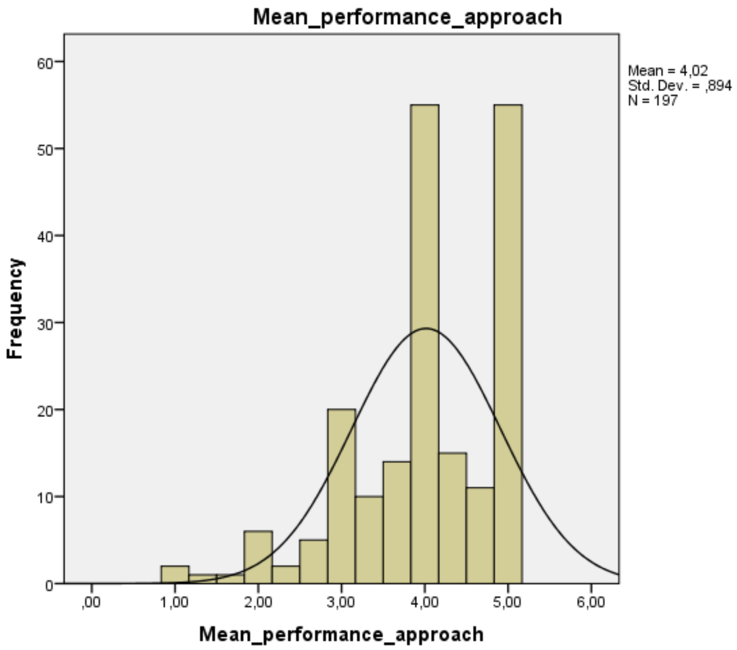

Figure 5.15. Histogram of mean performance approach goal orientation scores for ninth graders.

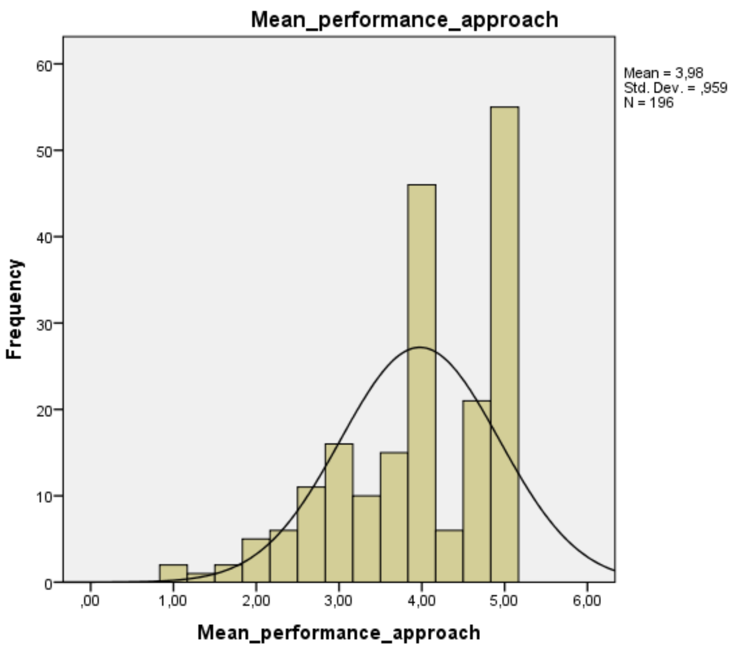

Figure 5.16. Histogram of mean performance approach goal orientation scores for tenth graders.

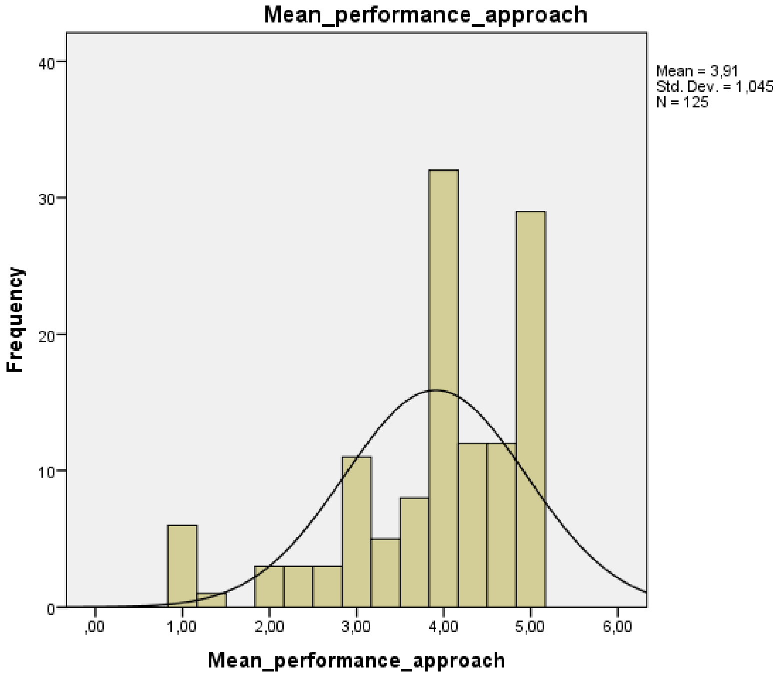

Figure 5.17. Histogram of mean performance approach goal orientation scores for eleventh graders.

Homogeneity of variance: Levene's test for homogeneity of variances revealed that mean performance approach goal orientation scores did not satisfy this assumption (Table 5.16).

Table 5.16. Levene's test results for mean performance approach goal orientation scores.

	F	df1	df2	p
Performance approach goal orientation	2.38	5	512	.04

In order to analyze the main effects of gender and grade level as well as the interaction effect between these variables, a two-way ANOVA was conducted (Table 5.17). The results indicated no interaction between gender and grade level (F (2, 512) = 1.14, p = .32). Only, gender (F (1, 512) = 5.13, p = .02) was found to have a main effect on mean performance approach goal orientation score but this result should be interpreted with caution since homogeneity of variances assumption was not met. In addition, the effect size was small for gender (Partial η^2 = .010).

Table 5.17. Two-way analysis of variance results for mean performance approach goal orientation as a function of gender and grade level.

	df	MS	F	p	Partial η^2
Gender	1	4.66	5.13	.02	.01
Grade	2	.37	.40	.67	.00
Gender*Grade	2	1.04	1.14	.32	.00

Table 5.18 represents the pairwise comparisons of mean performance approach goal orientation scores between female and male students. Male students had significantly higher scores compared to female students ($p < .001$).

Table 5.18. Pairwise comparisons of performance approach goal orientation scores between female and male students.

	M		Mean difference	p
	Female	Male	Female-Male	
Mean performance approach goal orientation	3.88	4.08	-.20	.00

According to results, the null hypothesis for research question 4-a was rejected whereas 4-b and 4-c were supported.

5.3.1.4. Differences in Mean Performance Avoidance Goal Orientation Scores in terms of Gender and Grade Level. Students' mean performance avoidance goal orientation scores were analyzed in terms of gender and grade differences. So, the hypotheses for research questions for 5-a, 5-b and 5-c were tested in this section. First tests for necessary assumptions were held then two-way ANOVA was conducted.

The necessary assumptions for conducting two-way ANOVA were independence of observations, normality and homogeneity of variances. The results of these tests are presented below.

Independence of observations: The mean performance avoidance goal orientation scores for each group was obtained in a way that assures no influences among groups.

Normality: The normality of mean performance avoidance goal orientation scores for each group were checked by analyzing the kurtosis and skewness values (Table 5.19). Since none of the values exceed +2 or -2, it can be said that scores for each group are normally distributed.

Table 5.19. Skewness and kurtosis values for mean performance avoidance goal orientation score.

	Skewness	Kurtosis
Females	-.97	.73
Males	-1.33	1.86
Ninth graders	-1.22	1.42
Tenth graders	-.94	.63
Eleventh graders	-1.26	1.62

Homogeneity of variance: According to Levene's test, homogeneity of variances assumption was met for mean performance avoidance goal orientation scores (Table 5.20).

Table 5.20. Levene's test results for mean performance avoidance goal orientation scores.

	F	df1	df2	p
Performance avoidance goal orientation	1.38	5	512	.23

In the following figures, histograms of mean performance avoidance goal orientation scores for females, males, ninth graders, tenth graders, and eleventh graders were presented.

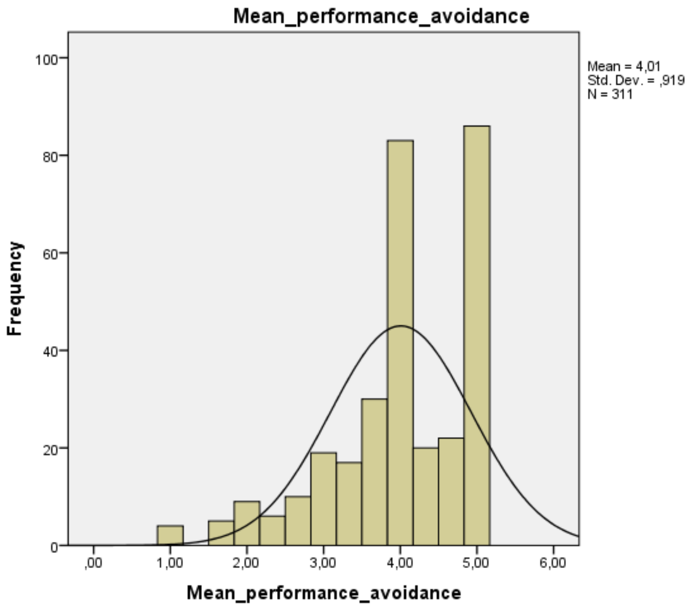

Figure 5.18. Histogram of mean performance avoidance goal orientation scores for female students.

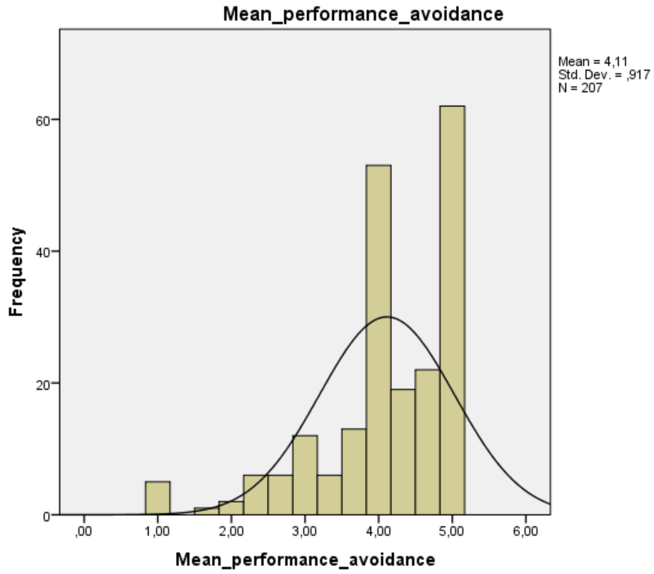

Figure 5.19. Histogram of mean performance avoidance goal orientation scores for male students.

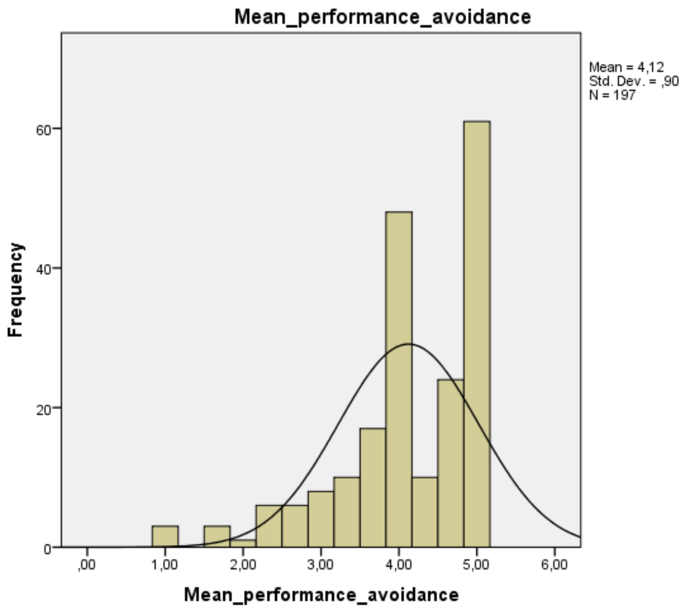

Figure 5.20. Histogram of mean performance avoidance goal orientation scores for ninth graders.

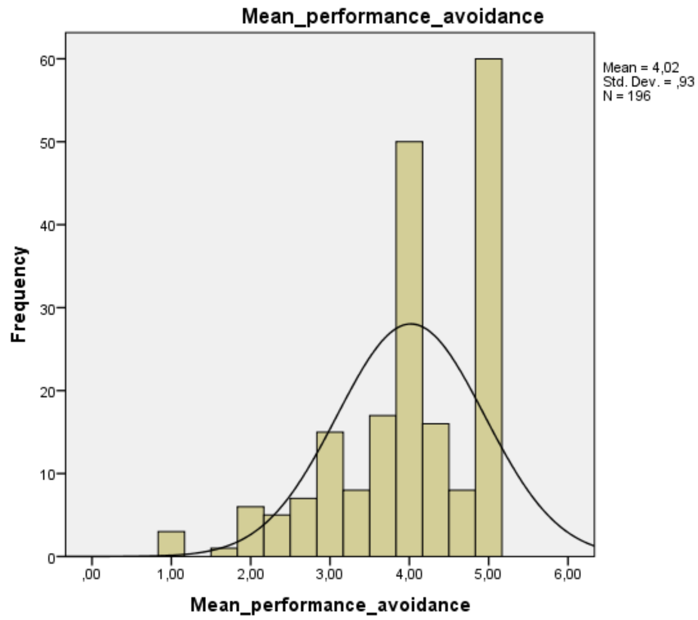

Figure 5.21. Histogram of mean performance avoidance goal orientation scores for tenth graders.

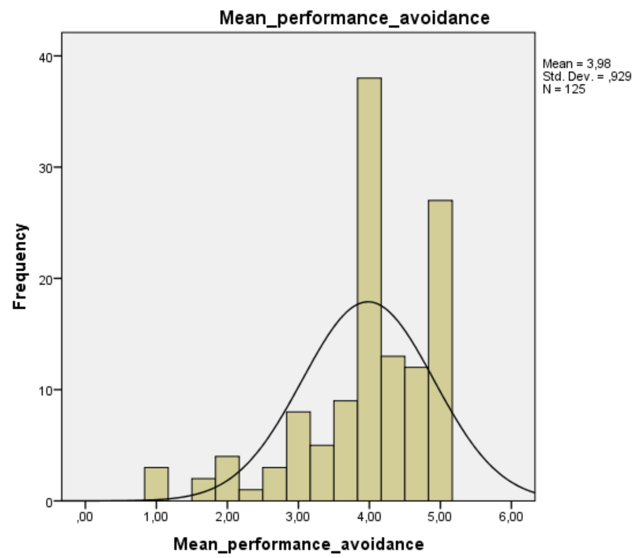

Figure 5.22. Histogram of mean performance avoidance goal orientation scores for eleventh graders.

Since all of the assumption tests were satisfied, Two-Way ANOVA was conducted. Table 5.21 shows that there was no interaction between the effects of gender and grade level on mean performance avoidance goal orientation (F (2, 512) = .84, p = .44). Gender (F (1, 512) = 2.46, p = .12) and grade level (F (2, 512) = 1.01, p = .37) had also no main effects on mean performance avoidance goal orientation scores.So, the hypotheses for research questions 5-a, 5-b and 5-c were confirmed.

Table 5.21. Two-way analysis of variance results for mean performance avoidance goal orientation as a function of gender and grade level.

	df	MS	F	p	Partial η^2
Gender	1	2.07	2.46	.12	.01
Grade	2	.85	1.01	.37	.00
Gender*Grade	2	.70	.84	.44	.00

5.3.2. Differences in Mean Physics Learning Self-Efficacy Scores in terms of Gender and Grade Level

Students' mean physics learning self-efficacy scores were analyzed by using Two-Way ANOVA. The interaction effect among gender and grade level as well as main effects of each variable on mean physics learning self-efficacy scores were analyzed. So, the null hypotheses for research question 6-a, 6-b and 6-c were tested. In the following section, the results of several assumption tests were provided. Then results of Two-Way ANOVA test was presented.

Independence of observations, normality and homogeneity of variances assumptions were checked for mean physics learning self-efficacy scores. The results of these tests were presented below.

Independence of observations: It was assumed that mean physics learning self-efficacy scores of each group were not influenced from each other.

Normality: The normality of mean physics learning self-efficacy scores were checked by skewness and kurtosis values (Table 5.22). The results suggested that no values exceed the critical +2/-2 threshold.

Table 5.22. Skewness and kurtosis values for mean physics learning self-efficacy score.

	Skewness	Kurtosis
Females	-.08	.14
Males	-.31	.16
Ninth graders	-.29	-.01
Tenth graders	.03	.26
Eleventh graders	-.38	-.17

In the following figures, distribution of mean physics learning self-efficacy scores for female and male students, and ninth, tenth and eleventh graders are presented with histograms.

Figure 5.23. Histogram of mean physics learning self-efficacy scores for female students.

Figure 5.24. Histogram of mean physics learning self-efficacy scores for male students.

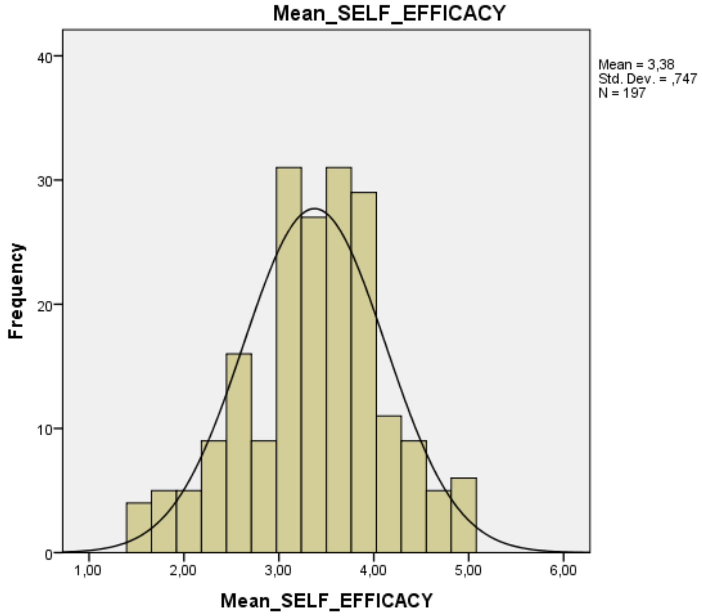

Figure 5.25. Histogram of mean physics learning self-efficacy scores for ninth graders.

Figure 5.26. Histogram of mean physics learning self-efficacy scores for tenth graders.

Figure 5.27. Histogram of mean physics learning self-efficacy scores for eleventh graders.

Homogeneity of variance: Levene's test of homogeneity of variances was conducted in order to analyze the variances of groups (Table 5.23). The results suggested that mean physics learning self-efficacy scores of each group has homogeneous variances (F(5, 512) = .32, p=.90).

Table 5.23. Levene's test results for mean physics learning self-efficacy scores.

	F	df1	df2	p
Physics learning self-efficacy	.32	5	512	.90

The mean physics learning self-efficacy scores satisfied the required assumptions of independence of observations, normality and homogeneity of variances. So, further tests were conducted in order to analyze the mean physic learning self efficacy scores in terms of gender and grade level differences (Table 5.24). The results of Two-Way ANOVA suggested there was no interaction between the effects of gender and grade level (F (2, 512) = 1.74, p = .18). The main effect of gender (F (1, 512) = 37.32, p < .001). was significant whereas the main effect of grade level was insignificant (*F* (2, 512) = .60, *p* = .55). In addition, the effect size for gender was moderate (Partial η^2 = .07).

Table 5.24. Two-way analysis of variance results for mean physics learning self efficacy scores as a function of gender and grade level.

	df	MS	F	p	Partial η^2
Gender	1	19.75	37.32	.00	.07
Grade	2	.32	.60	.55	.00
Gender*Grade	2	.92	1.74	.18	.01

Since gender had a main effect on mean physics learning self efficacy, female and male students had significantly different scores (Table 5.25). Male students had significantly higher physics learning self efficacy scores compared to female students ($p < .001$).

Table 5.25. Pairwise comparisons of physics learning self efficacy scores between female and male students.

	M		Mean difference	
	Female	Male	Female-Male	p
Mean physics learning self efficacy	3.16	3.56	-.41	.00

According to results, the null hypothesis for research question 6-a was rejected whereas 6-b and 6-c were confirmed.

5.3.3. Differences in Mean Physics Learning Conceptions Scores in terms of Gender and Grade Level

Students' physics learning conceptions were analyzed in terms of gender and grade differences. According to Tsai (2014), students could have seven distinct learning conceptions: Memorizing, preparing for the exam, calculating and practicing, increasing one's knowledge, application, understanding, and seeing in a new way. Nevertheless, he categorized the first three dimensions as quantitative learning conceptions and the remaining four dimensions as qualitative learning conceptions. For practical reasons, two separate analysis were held for students' mean quantitative physics learning conception scores and mean qualitative physics learning conception scores. The required assumptions were checked for both scores separately.

5.3.3.1. Differences in Mean Quantitative Physics Learning Conception Scores in terms of Gender and Grade Level. Students' mean quantitative physics learning conception scores were analyzed in terms of gender and grade differences by using Two-Way ANOVA. So, the null hypothesis for research questions 7-a, 7-b and 7-c were tested in this section.First the necessary assumptions were checked and then the analysis was held.

Independence of observations, normality and homogeneity of variances assumptions were checked by several tests for mean quantitative physics learning conception scores. The results of these assumption tests are presented below.

Independence of observations: It was assumed that mean quantitative physics learning conceptions scores of each group did not influence each other.

Normality: The normality of mean quantitative physics learning conception scores was analyzed with skewness and kurtosis values (Table 5.26). All the skewness and kurtosis values for each group lie between the critical range of +2/-2.

Table 5.26. Skewness and kurtosis values for mean quantitative physics learning conception score.

	Skewness	Kurtosis
Females	.17	.39
Males	.22	.39
Ninth graders	.52	.32
Tenth graders	.58	.46
Eleventh graders	.00	.64

The distribution of mean quantitative physics learning conception scores of female and male students, and ninth, tenth and eleventh graders were presented by histograms in the following figures.

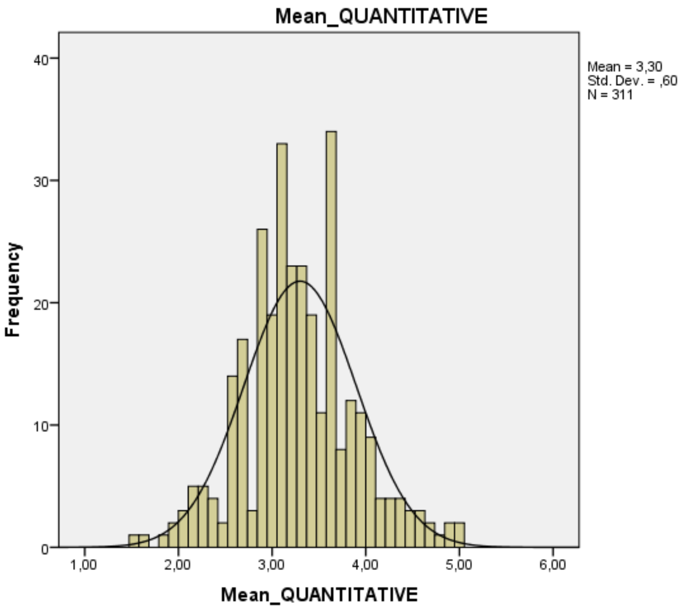

Figure 5.28. Histogram of mean quantitative physics learning conception scores for female students.

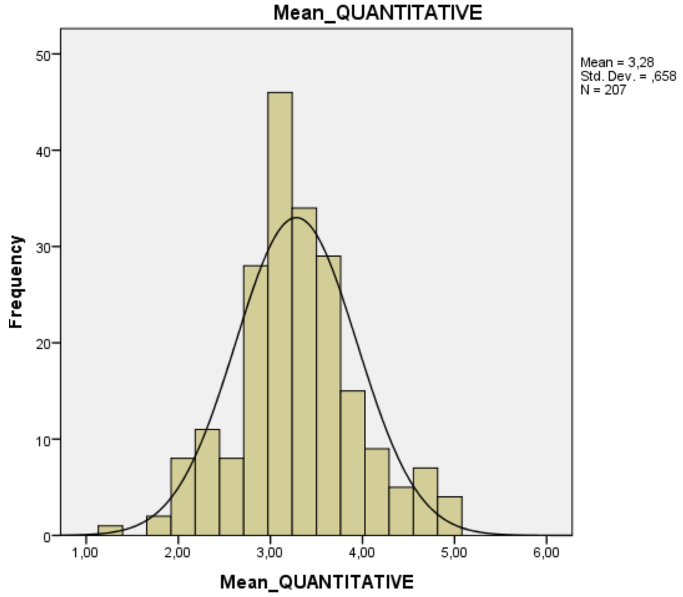

Figure 5.29. Histogram of mean quantitative physics learning conception scores for male students.

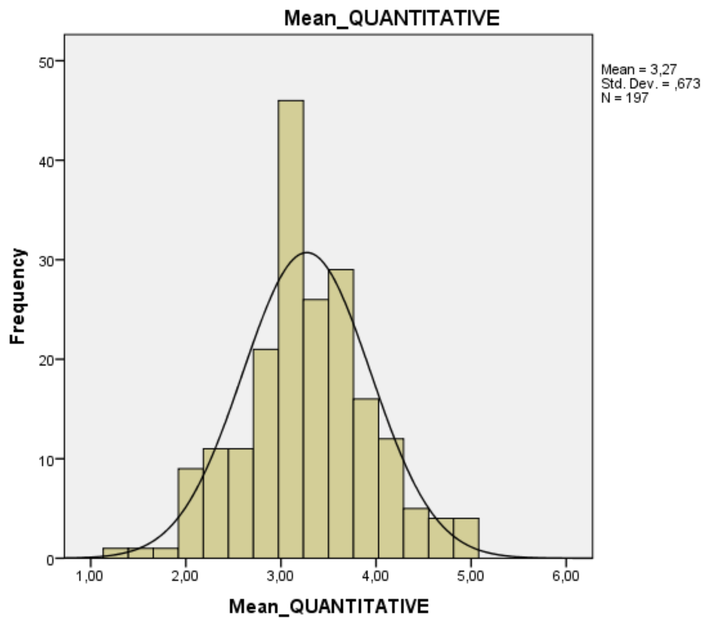

Figure 5.30. Histogram of mean quantitative physics learning conception scores for ninth graders.

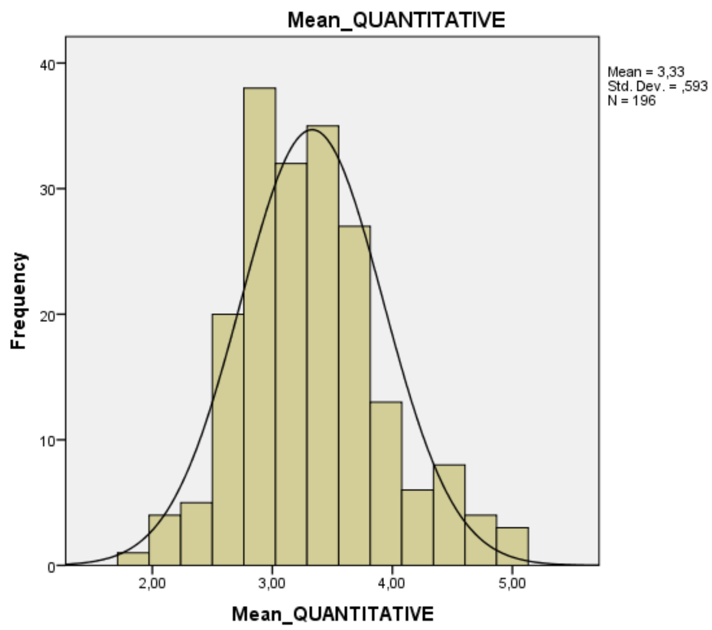

Figure 5.31. Histogram of mean quantitative physics learning conception scores for tenth graders.

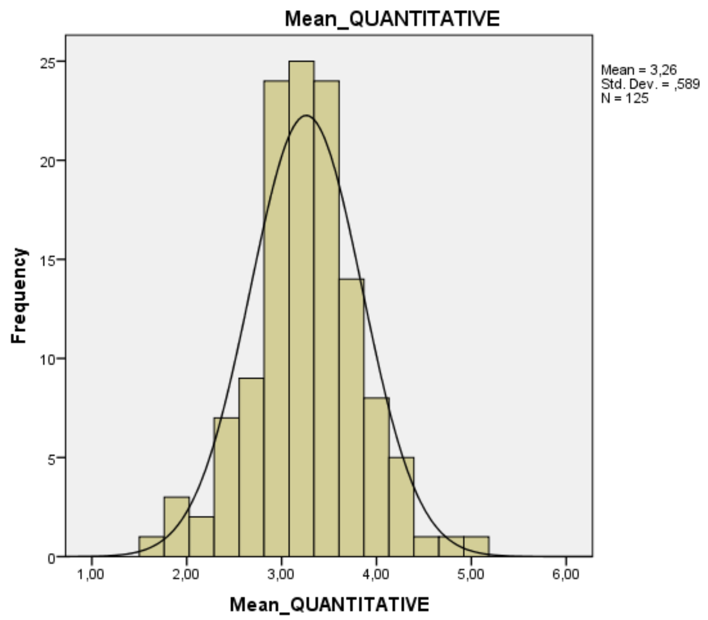

Figure 5.32. Histogram of mean quantitative physics learning conception scores for eleventh graders.

Homogeneity of variance: The assumption of homogeneity of variances was met for physics learning conception scores (Table 5.27).

Table 5.27. Levene's test results for mean quantitative physics learning conception scores.

	F	df1	df2	p
Quantitative physics learning conceptions	1.00	5	512	.42

Since independence of observations, normality and homogeneity of variances assumptions for quantitative physics learning conceptions scores was met, Two-Way ANOVA was conducted in order to detect gender and group differences (Table 5.28). The results suggested that there was no interaction between the effects of gender and grade level on mean quantitative physics learning conception scores (F (2, 512) = 1.17, p = .31). Gender (F (1, 512) = .01, p = .92). and grade level (F (2, 512) = .87, p = .42) also had no main effects on mean quantitative physics learning conception sores. So, the null hypotheses for research questions 7-a, 7-b and 7-c were confirmed.

Table 5.28. Two-way analysis of variance results for mean quantitative physics learning conception scores as a function of gender and grade level.

	df	MS	F	p	Partial η^2
Gender	1	.00	.01	.92	.00
Grade	2	.34	.87	.42	.00
Gender*Grade	2	.46	1.17	.31	.01

5.4.3.2. Differences in Mean Qualitative Physics Learning Conception Scores in terms of Gender and Grade Level. Students' mean qualitative physics learning conception scores were analyzed in terms of gender and grade differences. The null hypotheses for research questions 8-a, 8-b and 8-c were tested in this section. The required assumption tests and Two-Way ANOVA results are presented in the following sections.

Independence of observations, normality and homogeneity of variances assumptions were checked for mean qualitative physics learning conception scores. The results of these tests are presented below.

Independence of observations: Mean qualitative physics learning conceptions scores of each group was assumed not influential on each other.

Normality: The normality of mean qualitative physics learning conception scores was analyzed with skewness and kurtosis values (Table 5.29). No value exceeded the critical threshold of +2/-2.

Table 5.29. Skewness and kurtosis values for mean qualitative physics learning conception score.

	Skewness	Kurtosis
Females	-.41	-.06
Males	-.75	.77
Ninth graders	-.90	.83
Tenth graders	-.50	.27
Eleventh graders	-.58	.36

The distribution of mean qualitative physics learning conception scores of each group are presented by histograms in the following figures.

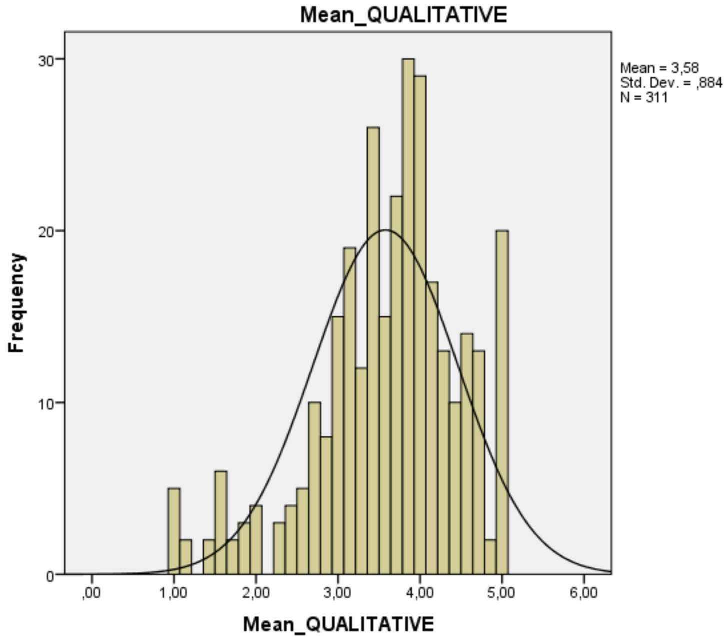

Figure 5.33. Histogram of mean qualitative physics learning conception scores for female students.

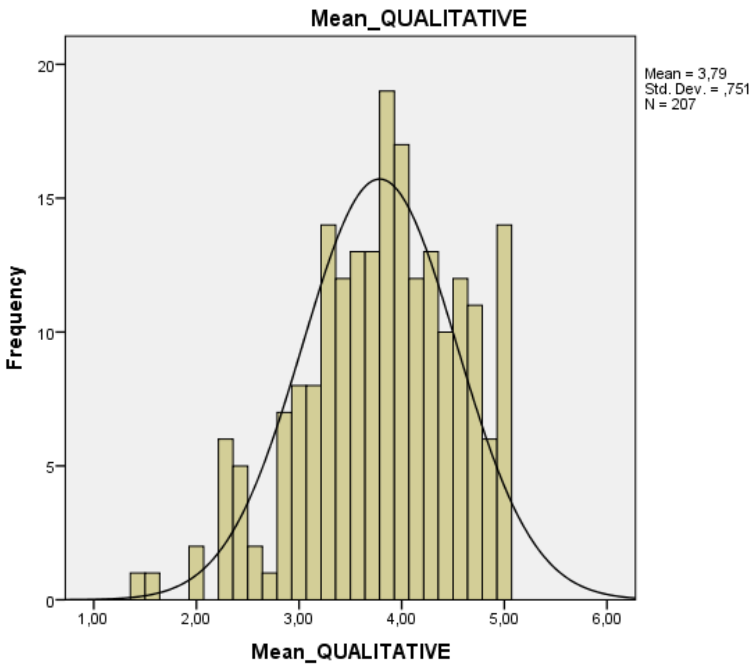

Figure 5.34. Histogram of mean qualitative physics learning conception scores for male students.

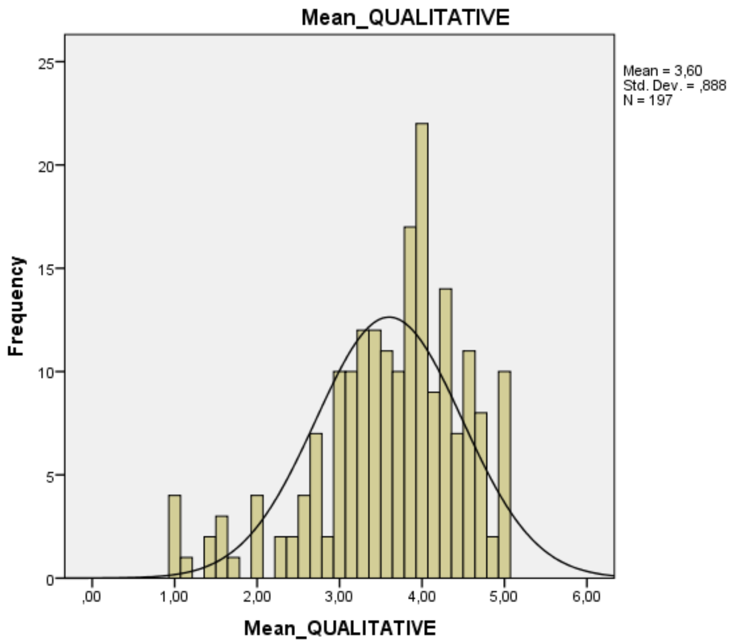

Figure 5.35. Histogram of mean qualitative physics learning conception scores for ninth graders.

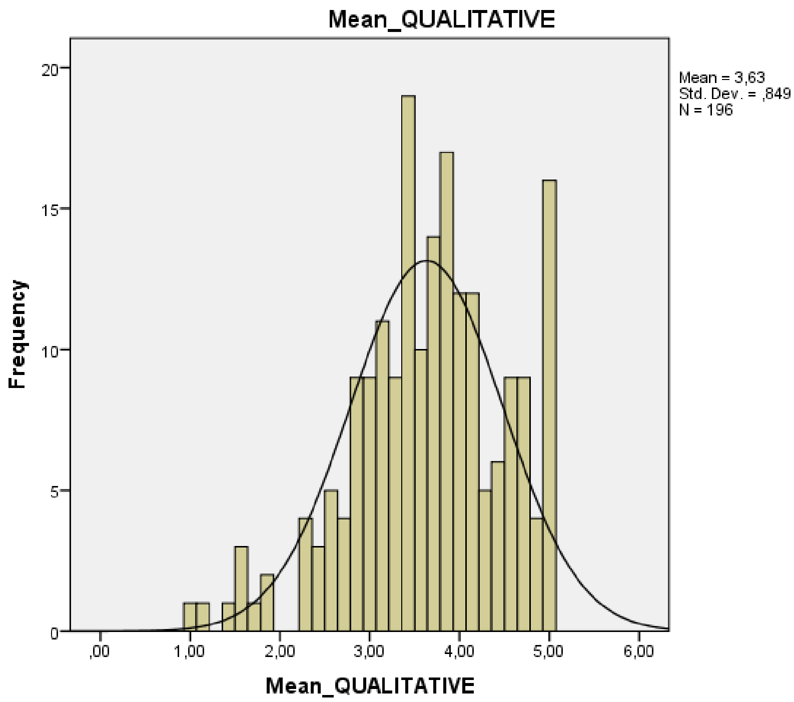

Figure 5.36. Histogram of mean qualitative physics learning conception scores for tenth graders.

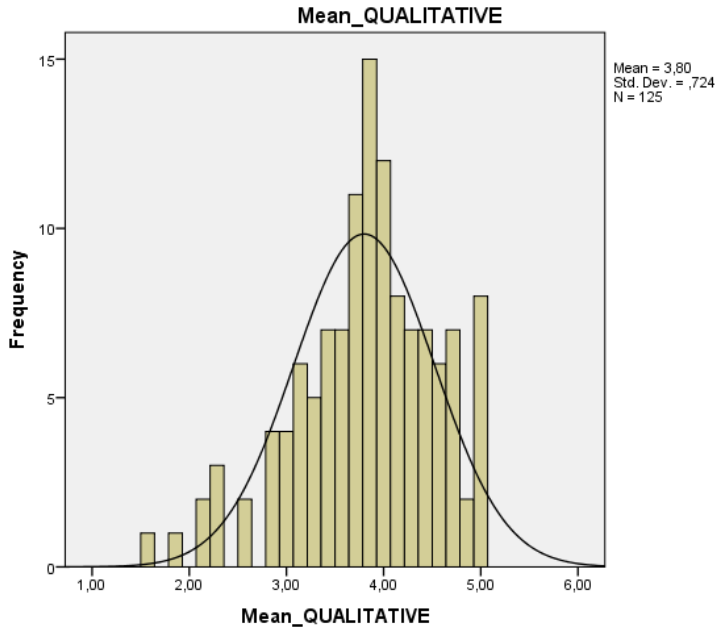

Figure 5.37. Histogram of mean qualitative physics learning conception scores for eleventh graders.

Homogeneity of variance: In order to check the homogeneity of variances assumption, the Levene's test was conducted (Table 5.30). The test result suggested that all of the groups have statistically equal variances.

Table 5.30. Levene's test results for mean qualitative physics learning conception scores.

	F	df1	df2	p
Qualitative physics learning conceptions	1.54	5	512	.17

Since mean qualitative learning conception scores met all the required assumptions, Two-Way ANOVA test was conducted (Table 5.31). There was no interaction among the effects of gender and grade level on mean qualitative physics learning conception scores (F (2, 12) = .62, p = .54). Only gender had a main effect on mean qualitative physics learning conception scores (F (1, 512) = 5.78, p = .02) with small effect size as partial η^2 = .01.

Table 5.31. Two-way analysis of variance results for mean qualitative physics learning conception scores as a function of gender and grade level.

	df	MS	F	p	Partial η^2
Gender	1	4.01	5.78	.02	.01
Grade	2	1.19	1.72	.18	.01
Gender*Grade	2	.43	.62	.54	.00

In the following table, pair wise comparisons of qualitative physics learning conceptions between female and male students were presented. As it is seen in Table 5.32, male students had higher qualitative physics learning conception scores compared to female students.

Table 5.32. Pairwise comparisons of qualitative physics learning conception scores between female and male students.

	M		Mean difference	
	Female	Male	Female-Male	p
Mean qualitative physics learning conceptions	3.61	3.79	-.18	.00

According to results, null hypothesis for research question 8-a was confirmed whereas 8-b and 8-c were rejected.

5.4. Comparisons in terms of Field Differences

In order to analyze students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions in terms of field differences, a one-way MANOVA was conducted. This analysis enables researchers to examine group differences in terms of combination of multiple dependent variables. In this analysis, the dependent variables were students' mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions. Since ninth and tenth graders have not made a field choice yet, a comparison in terms of intentions to choose science-mathematics or literature-mathematics field was made for these students. For eleventh graders, a separate one-way MANOVA was conducted in order to compare the combination of dependent variables for field differences. So, two separate one-way MANOVA was conducted for ninth and tenth graders together and eleventh graders. Before proceeding with the analysis, several assumption tests was conducted.

5.4.1. Comparisons in terms of Intentions to Choose Science-Mathematics and Literature-Mathematics Fields

This comparison was conducted for ninth and tenth graders since they have not made a field choice yet. So, the null hypotheses for research questions 9-a was tested in this section. The following assumptions were tested before proceeding with the analysis. The normality and outliers assumption was tested for the whole sample including eleventh graders.

5.4.1.1. Assumptions of One-Way MANOVA. According to Pallant (2011), MANOVA has the following assumptions: Normality, outliers, linearity, multicollinearity, and homogeneity of variance-covariance matrices. Below are the results of these assumption tests.

Normality: In order to conduct MANOVA, the variables should both have univariate and multivariate normality. The univariate normality of the variables were analyzed by Kolmogorov-Smirnov and Shapiro Wilk tests as well as skewness and kurtosis values. According to results of Kolmogorov-Smirnov and Shapiro Wilk tests, the dependent variables had no normal distribution ($p < .05$). Since these tests are sensitive to large sample sizes, skewness and kurtosis values were analyzed in order to check univariate normality (Tabachnick and Fidell, 2007). All skewness and kurtosis values were within the acceptable range of +2/-2 values. Multivariate normality were analyzed by Mahalanobis distance, which should have a maximum value of 24.32 for seven dependent variables in MANOVA. Nine cases were found to have Mahalanobis distance values larger than 24.32, so they were deleted from the data set.

Outliers: Outliers were defined as values that are well above or below than other scores (Pallant, 2011). Standardized residual values that do not fall within the -3.29/+3.29 interval, can be regarded as outliers (Tabachnick and Fidell, 2007). Since there were 13 cases that do not have the indicated values, they were deleted from the data set.

Linearity: This assumption asserts that there should be a linear relationship between each dependent variables. A visual analysis of a matrix scatter plot indicated that all the dependent variables have a linear relationship with each other.

Multicollinearity: In order to conduct MANOVA, dependent variables should not highly correlate with each other. The following table illustrates bivariate correlations among dependent variables. According to Pallant (2011), correlation coefficients that exceed .9 may be problematic. None of the correlations between dependent variables exceed .9.

Table 5.33. Correlation coefficients between the variables for ninth and tenth graders.

	Mast. App. score	Mast. Avoi. Score	Perf. App. score	Perf. Avoi. score	P. L. Self-Efficacy	Quan. P.L. Concept.	Qual. P.L. Concept.
Mast. App. Score	1.00						
Mast. Avoi. Score	.72**	1.00					
Perf. App. Score	.50**	.45**	1.00				
Perf. Avoi. Score	.42**	.47**	.66**	1.00			
P. L. Self-Efficacy	.46**	.35**	.41**	.32**	1.00		
Quan. P.L. Concept.	.17**	.19**	.20**	.13**	.15**	1.00	
Qual. P.L. Concept.	.44**	.37**	.32**	.25**	.58**	.24**	1.00

Homogeneity of variance-covariance matrices: This assumption asserts that all dependent variables for each group should have homogenous variance-covariance matrices. Significance values for Box's test of equality of variances that are less than .001 indicates that the assumption of homogenous variance-covariance matrices was not met. For this analysis, the homogeneity of variance-covariance matrices assumption was met ($p = .06$).

Levene's test of homogeneity of variances were also analyzed for each dependent variable. Unfortunately, values for mean performance approach goal orientation ($p = .01$), physics learning self efficacy beliefs ($p = .03$) and qualitative physics learning conceptions ($p = .02$), two groups' scores were not homogeneous. Tabachnick and Fidell (2007) suggested to use a more strict α level (.025 or .001) when the homogeneity of variances assumption was not met. So, α level of .001 was used for this analysis.

5.4.1.2. Results of One-Way MANOVA for Ninth and Tenth Graders. In the following table, the descriptive statistics for mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions of two groups are presented. The values represented below are for ninth and tenth graders since this comparison was made in terms of intentions to choose science-mathematics field or literature-mathematics field (Table 5.34).

Table 5.34. Mean scores of students who intend to choose science-mathematics (SM) and literature-mathematics (LM) field.

	Intended area	N	M	SD	SE
Mastery Approach	SM	279	4.21	.71	.04
	LM	114	3,87	.78	.07
Mastery Avoidance	SM	279	4.13	.78	.05
	LM	114	3.89	.74	.07
Performance Approach	SM	279	4.12	.86	.05
	LM	114	3.70	1.02	.09
Performance Avoidance	SM	279	4.12	.88	.06
	LM	114	3.94	.99	.09
Self Efficacy	SM	279	3.44	.71	.04
	LM	114	3.12	.82	.07
Quantitative conceptions	SM	279	3.27	.61	.04
	LM	114	3.37	.68	.06
Qualitative conceptions	SM	279	3.74	.79	.05
	LM	114	3.32	.97	.08

According to results, there was a statistically significant difference in students' scores between who intend to choose science-mathematics field and literature-mathematics field (Wilks' Λ = .89, $F(7,385) = 6.50$, $p < .001$, multivariate $\eta^2 = .11$).

Follow-up univariate tests for each dependent variable indicated that students' mastery approach goal orientation ($F(1,391) = 17.72$, $p < .001$, multivariate $\eta^2 = .04$), performance approach goal orientation ($F(1,391) = 16.86$, $p < .001$, multivariate $\eta^2 = .04$), physics learning self efficacy beliefs ($F(1,391) = 15.03$, $p < .001$, multivariate $\eta^2 = .04$) and qualitative physics learning conceptions ($F(1,391) = 19.83$, $p < .001$, multivariate $\eta^2 = .05$) were statistically significantly different between two groups. For all of the mentioned variables, students who intend to choose science-mathematics field obtained higher results than students who intend to choose literature-mathematics field. Effect size for all of the variables were moderate. So, the null hypothesis for research question 9-a was rejected for this analysis.

5.4.2. Comparisons in terms of Science-Mathematics and Literature-Mathematics Groups

Eleventh graders have either science-mathematics or literature-mathematics field and the following variables were compared between these two groups: Mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions. So, the null hypothesis for research question 9-b was tested in this section. Since the normality and outliers assumptions in order to conduct a one-way MANOVA test was met for the whole sample, only the following assumption tests were conducted separately for eleventh graders.

5.4.2.1. Assumptions of One-Way MANOVA. The normality, multicollinearity and homogeneity of variance-covariance matrices assumptions were checked for this part of the analysis. Below are the results of these assumption tests.

Linearity: A visual analysis of a matrix scatter plot indicated that there exists a linear relationship between all the variables for science-mathematics and literature-mathematics groups.

Multicollinearity: This assumption was tested for eleventh graders separately and the bivariate correlations are presented in the following table. None of the correlations exceeds the suggested critical value of .9.

Table 5.35. Correlation coefficients between the variables for eleventh graders.

	Mast. App. score	Mast. Avoi. Score	Perf. App. score	Perf. Avoi. score	P. L. Self-Efficacy	Quan. P.L. Concept.	Qual. P.L. Concept.
Mast. App. Score	1.00						
Mast. Avoi. Score	.80**	1.00					
Perf. App. Score	.53**	.46**	1.00				
Perf. Avoi. Score	.45**	.41**	.72**	1.00			
P. L. Self-Efficacy	.47**	.39**	.40**	.31**	1.00		
Quan. P.L. Concept.	.03**	.12**	.07**	.03**	-.14**	1.00	
Qual. P.L. Concept.	.43**	.34**	.24**	.19**	.367**	.12**	1.00

Homogeneity of variance-covariance matrices: The significance value for Box's test of equality of covariance matrices was .453 which met this assumption for eleventh graders.

In addition, Levene’s test of homogeneity of variances for each dependent variables were analyzed separately. Only the mean value for performance approach goal orientation violated this assumption (*p* = .03). So the α level was set to .001 as Tabachnick and Fidell (2007) suggested in cases of the violation of this assumption.

<u>5.4.2.2. Results of One-Way MANOVA for Eleventh Graders.</u> Descriptive statistics for mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions for science-mathematics groups and literature-mathematics groups are presented in Table 5.36.

Table 5.36. Mean scores of science-mathematics (SM) and literature-mathematics (LM) groups.

	Intended area	N	M	SD	SE
Mastery Approach	SM	101	4.25	.08	.08
	LM	22	3.23	.17	.17
Mastery Avoidance	SM	279	4.18	.07	.07
	LM	114	3.36	.16	.16
Performance Approach	SM	279	4.03	.10	.10
	LM	114	3.35	.22	.22
Performance Avoidance	SM	279	4.07	.09	.09
	LM	114	3.56	.19	.19
Self Efficacy	SM	279	3.45	.06	.06
	LM	114	2.51	.14	.14
Quantitative conceptions	SM	279	3.27	.06	.06
	LM	114	3.21	.13	.13
Qualitative conceptions	SM	279	3.95	.07	.07
	LM	114	3.12	.14	.14

The results of one-way MANOVA test indicated that there was a statistically significant difference between science-mathematics and literature-mathematics groups (Wilks' Λ = .66, $F(7,117) = 8.69$, $p < .001$, multivariate $\eta^2 = .34$). When the results for each dependent variables were analyzed separately, it was found that values of mastery approach goal orientation($F(1,123) = 29.06$, $p < .001$, multivariate $\eta^2 = .19$), mastery avoidance goal orientation($F(1,123) = 21.45$, $p < .001$, multivariate $\eta^2 = .15$), physics learning self efficacy beliefs ($F(1,123) = 37.71$, $p < .001$, multivariate $\eta^2 = .24$), and qualitative physics learning conceptions ($F(1,123) = 28.45$, $p < .001$, multivariate $\eta^2 = .19$) were statistically significantly different between science-mathematics and literature-mathematics groups.

For all the specified variables, students from science-mathematics groups obtained higher scores and the effect size were large. So, the null hypothesis for research question 9-b was rejected for this analysis.

5.5. Comparisons between High Achievers and Low Achievers

In this section, students' achievement goal orientations, physics learning self efficacy beliefs and physics learning conceptions are differentiated between high achievers and low achievers. Independent sample t-test was used in order to compare each construct and their sub dimensions in terms of achievement levels. So, the null hypotheses for research questions 10, 11, 12, 13, 14, 14-a, 14-b, 14-c, 14-d, 15, 15-a, 15-b, 15-c,15-d, 16, 16-a, 16-b and 16-c were tested in this section. In order to carry out this analysis, a categorization was made according to the physics performance of students. The histogram of students' T scores for physics performance are presented in the following figure.

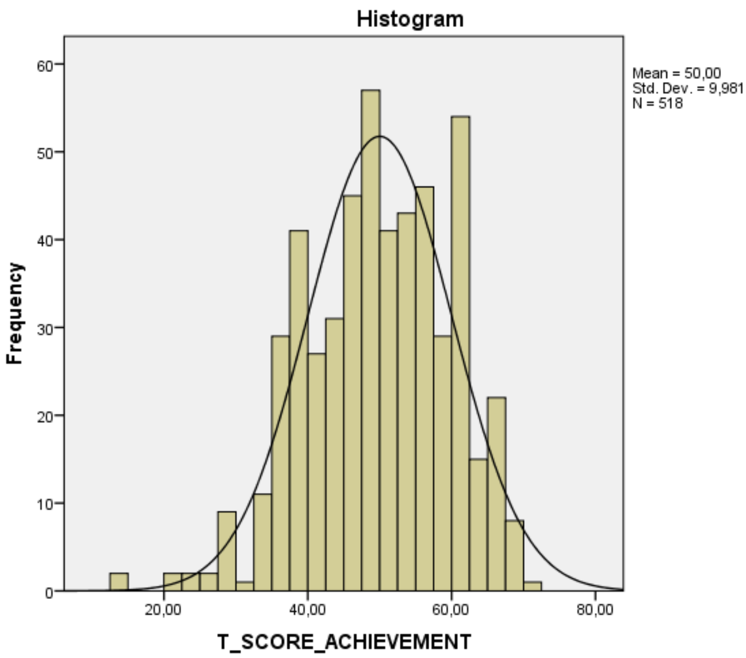

Figure 5.38. Distribution of students' physics performance scores.

The mean, standard deviation, minimum, maximum, skewness and kurtosis values for physics aperformance was presented in the following table. It can be said that the distribution of physics performance scores is normal since skewness and kurtosis values do not exceed the 2/-2 threshold.

Table 5.37. Descriptive statistics of students' physics performance.

	Mean	SD	Min	Max	Skewness	Kurtosis
Physics performance	50	9.98	12.92	70.36	-.40	-.04

Since only high achievers and low achievers were compared, not all of the performance scores were included in the analysis. The categorization of students as high achievers or low achievers was made according to mean and standard deviation values. So, students who have from minimum to a standard deviation less than the mean score were categorized as low achievers. Similarly students who have from maximum to a standard deviation more than the mean score were categorized as high achievers. This categorization is illustrated in the following table.

Table 5.38. The range of scores for high achievers and low achievers.

	Maximum	Minimum
High achievers	70.36	59.98
Low achievers	40.02	12.92

Students' physics performance scores were also compared in terms of gender differences. The results indicated that there were no significant differences in physics performance scores in terms of gender ($t(362.57) = .16$, $p = .87$). For all grade levels, standardized T scores were used and consequently the above mentioned analyses were conducted for the whole sample.

Table 5.39. Number of high and low achievers from different grades.

	High achievers	Low achievers
Ninth graders	36	33
Tenth graders	36	41
Eleventh graders	30	23

5.5.1. Comparisons of High School Students' Motivational Characteristics in terms of Their Physics Performance

Before proceeding with the independent samples t-test, the normality assumption for physics performance scores for each group was tested. Physics performance scores of both high achievers and low achievers had a normal distribution since skewness and kurtosis values are within the acceptable -2/+2 range.

Table 5.40. Skewness and kurtosis values of physics performance scores for the whole sample.

	Skewness	Kurtosis
High achievers	-1.93	-1.36
Low achievers	.76	-.53

Descriptive statistics that high school students obtained from each dimension of the scales are presented in the following table.

Table 5.41. Mean scores of high achievers and low achievers for the whole sample.

	Achievement groups	n	Mean
Mastery approach goals	Low achievers	99	3.84
	High achievers	100	4.50
Mastery avoidance goals	Low achievers	99	3.85
	High achievers	100	4.32

Table 5.41. Mean scores of high achievers and low achievers for the whole sample cont.

	Achievement groups	n	Mean
Performance approach goals	Low achievers	99	3.66
	High achievers	100	4.32
Performance avoidance goal	Low achievers	99	3.91
	High achievers	100	4.25
Conceptual Understanding	Low achievers	99	3.24
	High achievers	100	3.91
Higher order cognitive skills	Low achievers	99	3.09
	High achievers	100	3.60
Science communication	Low achievers	99	3.29
	High achievers	100	3.87
Mean self efficacy	Low achievers	99	3.14
	High achievers	100	3.68
Memorizing	Low achievers	99	3.07
	High achievers	100	2.65
Preparing for the exam	Low achievers	99	3.22
	High achievers	100	2.90
Calculating and practicing	Low achievers	99	3.73
	High achievers	100	3.94
Increasing one's knowledge	Low achievers	99	3.55
	High achievers	100	3.95
Mean quantitative conceptions	Low achievers	99	3.38
	High achievers	100	3.33
Application	Low achievers	99	3.42
	High achievers	100	3.83
Understanding	Low achievers	99	3.57
	High achievers	100	4.19
Seeing in a new way	Low achievers	99	3.40
	High achievers	100	4.10
Mean qualitative conceptions	Low achievers	99	3.46
	High achievers	100	4.03
Everyday application	Low achievers	99	3.08
	High achievers	100	3.55

In order to compare students' scores for each dimension of the scales, an independent sample t-test was conducted. The results of this analysis as well as Levene's test for equality of variances are presented in the following table. For all of the students, high achievers and low achievers obtained significantly different scores from most of the sub dimensions of the questionnaires. Students from different achievement groups scored similarly only on mean quantitative physics learning conceptions.The effect size for mastery approach goal orientation ($\eta^2 = .37$), mastery avoidance goal orientation($\eta^2 = .21$), performance approach goal orientation($\eta^2 = .26$), performance avoidance goal orientation ($\eta^2 = .09$), conceptual understanding ($\eta^2 = .22$), higher order cognitive skills ($\eta^2 = .21$), everyday application ($\eta^2 = .18$), science communication ($\eta^2 = .22$), mean physics learning self efficacy ($\eta^2 = .26$), memorizing ($\eta^2 = .09$), preparing for the exam ($\eta^2 = .08$), increasing one's knowledge ($\eta^2 = .12$), application ($\eta^2 = .13$), understanding ($\eta^2 = .09$), seeing in a new way ($\eta^2 = .10$) and mean qualitative conceptions ($\eta^2 = .10$) were large. The magnitude of the differences were moderate only for calculating and practicing ($\eta^2 = .04$). So, the null hypotheses for research questions 10, 11, 12, 13, 14, 14-a, 14-b, 14-c, 14-d, 15-a, 15-b, 15-c,15-d, 16, 16-a, 16-b and 16-c were rejected for high school students.

Table 5.42. Independent Samples t-test result in terms of achievement groups.

	Levene's Test for Equality of Variances			t	df	p	η^2
		F	p				
Mastery approach goal orientation	E. v.a.	8.15	.01	-6.47	197	.00	.38
	E.v.n.a.			-6.46	181.12	.00	.37
Mastery avoidance goal orientation	E. v.a.	1.60	.21	-4.33	197	.00	.21
	E.v.n.a.			-4.33	191.70	.00	.21
Performance approach goal orientation	E. v.a.	6.97	.01	-5.00	197	.00	.26
	E.v.n.a.			-4.99	184.36	.00	.26
Performance avoidance goal orientation	E. v.a.	2.03	.16	-2.68	197	.01	.09
	E.v.n.a.			-2.67	193.60	.01	.09
Conceptual Understanding	E. v.a.	.10	.75	-6.34	197	.00	.36
	E.v.n.a.			-6.34	196.82	.00	.36
Higher order cognitive skills	E. v.a.	.19	.66	-4.37	197	.00	.21
	E.v.n.a.			-4.37	196.98	.00	.21

Table 5.42. Independent Samples t-test result in terms of achievement groups cont.

	Levene's Test for Equality of Variances			t	df	P	η^2
		F	p				
Everyday application	E. v.a.	.00	.99	-3.95	197	.00	.18
	E.v.n.a.			-3.95	196.98	.00	.18
Science communication	E. v.a.	.43	.51	-4.48	197	.00	.22
	E.v.n.a.			-4.48	195.93	.00	.22
Mean self efficacy	E. v.a.	.03	.85	-5.04	197	.00	.26
	E.v.n.a.			-5.04	196.99	.00	.26
Memorizing	E. v.a.	.00	1.00	2.75	197	.01	.09
	E.v.n.a.			2.75	196.98	.01	.09
Preparing for the exam	E. v.a.	.56	.46	2.49	197	.01	.08
	E.v.n.a.			2.49	196.37	.01	.08
Calculating and practicing	E. v.a.	.11	.74	-1.82	197	.07	.04
	E.v.n.a.			-1.82	197.00	.07	.04
Increasing one's knowledge	E. v.a.	.01	.94	-3.13	197	.00	.12
	E.v.n.a.			-3.13	196.98	.00	.12
Mean quantitative conceptions	E. v.a.	1.45	.23	.57	197	.57	.00
	E.v.n.a.			.57	193.11	.57	.00
Application	E. v.a.	1.40	.24	-3.30	197	.00	.13
	E.v.n.a.			-3.30	194.36	.00	.13
Understanding	E.v.a.	.54	.47	-3.82	152	.00	.09
	E.v.n.a.			-3.85	77.85	.00	.09
Seeing in a new way	E.v.a.	1.77	.19	-4.17	152	.00	.10
	E.v.n.a.			-4.37	84.17	.00	.11
Mean qualitative conceptions	E.v.a.	.84	.36	-4.13	152	.00	.10
	E.v.n.a.			-4.25	81.05	.00	.11

*E.v.a.: Equal variances assumed
**E.v.n.a.: Equal variances not assumed

In this section, contribution of high students' achievement goal orientations, physics learning self efficacy beliefs and physics learning coınceptions on their physics performance were analyzed by using multiple regression analysis. These motivational characteristics and learning conceptions were compared in terms of gender and grade level differences by using two-way ANOVA. In order to investigate field differences, separate one-way MANOVA tests were conducted for ninth and tenth graders together as well as eleventh graders. Finally, separate independent samples t-tests were conducted in order to compare high achievers and low achievers in terms of their achievement goal orientation, physics learning self efficacy beliefs and learning conceptions.

6. DISCUSSION AND CONCLUSION

The aim of this research study is to investigate the contribution of students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions into their physics performance. In addition, students' achievement goal orientation, physics learning self efficacy beliefs, and physics learning conceptions were analyzed in terms of gender and grade differences. A comparison in terms of field differences were conducted in order to gain insight about motivation levels of students from science-mathematics and literature-mathematics fields. Lastly, motivational characteristics of students who have high physics performance and low physics performance were also compared.

In the first part of this study, contributions of students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions into their physics performance were analyzed. Since there were no significant differences in physics performance between female and male students, gender was not included in the model. Students' physics performance were significantly and positively predicted by their mastery approach goal orientation and performance approach goal orientation. The most important positive contribution to physics performance was made by students' performance approach goal orientation. Although most of the time performance approach goal orientation is associated with surface cognitive processes and mastery approach goal orientation is associated with deep cognitive processes, both goal orientations may predict performance (Sins, 2008; Elliott, 1999; Koul *et al.*, 2011). Students' mastery approach goal orientation may lead them to study in order to increase their mastery and their performance approach goal orientation may lead them to struggle for getting good grades. In short term, both goal orientations may predict performance although mastery approach goal orientation was accepted to be effective for long term (Elliott, 1999).

Another finding of this study was that quantitative physics learning conceptions negatively predicted physics performance. So, students who have higher quantitative learning conceptions tend to have lower physics performance levels. Tsai (2014) conceptualized quantitative learning conceptions as *memorizing, preparing for tests, calculating and practicing,* and *increasing one's knowledge*. These conceptions were associated with viewing science as separate pieces of knowledge. So, physics is learnt for more external reasons and no coherent view of physics is adopted by the learners. As Lee *et al.* (2007) suggested students with quantitative views of learning tend to have extrinsic motivation and use surface learning strategies. Chiou and Liang (2012) also indicated that using these kind of surface learning strategies might ultimately lead to lower self efficacy beliefs. These findings may explain the negative relationship between quantitative learning conceptions and physics performance that is found in this study. Performance is conventionally found to be positively related with using deep learning strategies and self efficacy beliefs. As quantitative learning conceptions were negatively related with using deep learning strategies and self efficacy beliefs, they may be also negatively related with physics performance. As Tsai (2014) suggested, educational systems that heavily emphasize standardized national exams may lead students to adopt quantitative learning conceptions. In Turkey, standardized national exams play an important role in students' lives. In these exams, making calculations and finding the correct answer is highly valued. So, students may conceptualize physics learning as preparing for exams and making several calculations. Having a view of physics as separate pieces of knowledge may eliminate students to form a coherent understanding of the subject and ultimately decrease their performance.

Students' achievement goal orientation, physics learning self efficacy beliefs, and physics learning conceptions were analyzed in terms of gender and grade differences. Caprara (2008) indicated that male and female students' academic self efficacy demonstrate different developmental trajectories. While male students' academic self efficacy tend to decrease as their grade levels increase, female students did not show such an inclination. The researchers indicated that male students are prone to engage in non-school activities as they grow up and this may responsible for this finding. In this study, no such an interaction was examined. So, female and male students displayed similar changes in their motivation towards physics as their grade levels increase. In addition, there were no grade differences in high school students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions. In terms of gender, significant differences were observed between female and male students in their performance approach goal orientation, physics learning self efficacy beliefs and qualitative physics learning conceptions. As a lot of research studies suggested, male and female students differ in their motivation towards science (Glynn *et al.*, 2011; Schumm and Bogner, 2016; Neber *et al.*, 2008; Reçber, 2011). In this study, male students were found to possess higher performance approach goal orientation compared to female students. So, male students may study physics according to several normative standards and care to appear successful. Science is conventionally viewed as a male domain and this may lead male students to behave accordingly. They may struggle for an appearance that is compatible with societal expectations such as being successful in physics and consequently work in science related fields (Koul, 2011). In addition, male students were found to possess higher self efficacy levels compared to female students. The presentation of science as a male domain, fostering natural gender differences in science and not emphasizing the importance of effort may be responsible for this gender gap (Glynn *et al.*, 2011; Neber *et al.*, 2008). It was also suggested that female students may possess lower self efficacy beliefs even though they have higher achievement or attitude towards their classes (Britner, 2008; Reçber, 2010). Given the importance of self efficacy beliefs on student outcomes, it is necessary to enhance school practices that foster effort rather than natural differences such as gender.

Another comparison in terms of gender differences implies that male students possess higher qualitative physics learning conceptions compared to male students. So, they tend to learn physics in order to apply what they learn into their real lives, understand the scientific phenomena, and see their worlds from a scientific viewpoint. At first glance, this finding may seem incompatible with the male students' higher performance approach goal orientation. Tsai (2014) also suggested that qualitative conceptions may be related with intrinsic motivation whereas quantitative conceptions may be related with extrinsic motivation. However, Chiou and Liang (2012) indicated that qualitative conceptions may predict both deep and surface motive since individuals may possess both types of motivation at the same time. Deep motive was defined as intrinsic motivation to actively integrate the newly encountered material with the existing knowledge. On the other hand, surface motive was defined as extrinsic motivation to study science in order to get good grades or pass the exams. So, qualitative learning conceptions may predict motivation that is both intrinsic and extrinsic. When we consider achievement goal orientation, a similarity between surface motive and performance goal orientation may be drawn since both constructs emphasize external reasons to engage in motivated behavior. To state differently, male students who learn physics in order to have a deep understanding and see their worlds from a different view point, may also strive to demonstrate a level of performance and outperform others.

Students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions were also analyzed in terms of field differences. Since ninth and tenth graders have not made a field choice yet, they were asked to indicate their intention of field choice. Students who intend to choose science-mathematics field were found to possess higher mastery approach goal orientation, performance approach goal orientation and physics learning self efficacy beliefs. It can be said that these students are more likely to study physics in order to master the materials, demonstrate their success and possess higher confidence. As Bryan *et al.* (2010) indicated, students with higher self efficacy and motivation towards science tend to choose science related fields since they believe that they will be successful in these courses. As distinct from eleventh graders, ninth and tenth graders were found to have higher performance approach goal orientation. This finding seems reasonable because students from science-mathematics field had higher physics performance scores compared to students from literature-mathematics field. So, students who intend to choose science-mathematics field may view higher physics performance sores necessary for choosing science-mathematics field and consequently adopt performance approach goals. Similar findings were obtained from the comparison between science-mathematics and literature-mathematics groups for eleventh graders. Students from the science-mathematics field were found to possess higher mastery approach goal orientation, mastery avoidance goal orientation and physics learning self efficacy beliefs. These field choices may represent the first milestones towards STEM related careers (Bryan *et al.*, 2010). So, classroom practices that enhance students' motivation and self efficacy beliefs may lead more students to choose science-mathematics field. As different from ninth and tenth graders, eleventh graders possessed higher mastery avoidance goals. As indicated before, physics performance scores of science-mathematics group were higher than literature-mathematics group. So, students from science-mathematics group may perceive themselves as successful but they may also fear to become unsuccessful and loosing this perception. This may explain their high levels of mastery avoidance goals. In addition, both student groups who intend to choose and who have already chosen science-mathematics field possessed higher qualitative learning conceptions. So, these students view physics learning as applying physics into related situations, understanding topics in a coherent way and see their worlds from a different view point. It can be said that constructing classroom environments that help students to form such physics learning conceptions may increase the number of individuals who choose STEM related careers.

Achievement goal orientation, physics learning self efficacy beliefs, and physics learning conceptions were also compared between students who have high physics performance and low physics performance. For the whole sample, students who had higher physics performance obtained higher scores from all of the constructs except mean quantitative physics learning conceptions. For all the grade levels, students who have higher physics performance tend to have more mastery approach goal orientation, mastery avoidance goal orientation, performance approach goal orientation, performance avoidance goal orientation, physics learning self efficacy beliefs and qualitative physics learning conceptions. This finding was not fully in line with the results of multiple regression analysis since high achievers were found to possess higher avoidance goals. Their higher avoidance goal orientations seem surprising because avoidance goal orientations most of the time were associated with undesired academic outcomes (Elliot, 1999). So, high achievers desire to be successful but at the same time they fear to be unsuccessful. The results also suggest that these students stress both mastering physics and showing their performance. High achievers aim to master physics in order to increase their own competency. Moreover, individuals with performance goal orientation tend to emphasize ability rather than spending effort for being successful (Nichols, 1984). Results of the analysis also indicated that successful students have also higher performance goal orientation. So, these students may view ability as innate and equate success in physics to innate abilities.. In addition, students from high achievement group had higher qualitative learning conceptions although they had similar levels of quantitative physics learning conceptions with low achievement group. As Tsai (2014) suggested students, may possess both learning conceptions at the same time. In Turkey, high stakes tests are very important for students and these tests may lead them to view physics learning as calculating, and preparing for exams. So, students may have both quantitative physics learning conceptions and qualitative physics learning conceptions at the same time.

In conclusion, this study investigated students' achievement goal orientation, physics learning self efficacy beliefs and physics learning conceptions in relation to their physics performance. The strongest contribution to physics performance was made by quantitative physics learning conceptions. Students who have higher quantitative physics learning conceptions had lower physics performance. In terms of gender differences, male students had higher performance approach goal orientation, physics learning self efficacy beliefs and qualitative physics learning conceptions. These constructs were also compared in terms of field differences and students from science-mathematics groups were found to possess higher mastery goal orientation, physics learning self efficacy beliefs and qualitative physics learning conceptions. So, these findings suggest the importance of establishing learning environments that foster students' mastery goal orientation and physics learning self efficacy beliefs.

6.1. Limitations and Suggestions for Further Research

Since a purposive sampling method was used in this study, the generazibility of the findings are limited to similar schools. Students attended to this investigation were from an old anatolian high school and different findings may be obtained from different student populations. Similarly, the sample consisted of ninth, tenth and eleventh grades and twelfth graders could not participate in this study. So, this study may be replicated with students from different groups as well as grade levels.

Students' physics performance was operationalized as their physics exam performance/course grades from the previous term. Students themselves indicated their physics exam performance grade on the demographic form and this may lead questions about the reliability of the scores. So, further studies may apply separate instruments to measure physics achievement in order to strengthen the findings.In addition, ninth, tenth and eleventh graders took different physics exams due to the difference in their grade level. For this reason, standardized T scores of their physics performance were used. So, further studies may replicate this study by applying the same test to all the grade levels.

Lastly, only quantitative data collection methods were used in this study. In order to gain more insight about students' motivational levels towards physics, in depth interviews could be conducted.

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APPENDIX A: TURKISH FORM OF THE ACHIEVEMENT GOAL ORIENTATION QUESTIONNAIRE (AGQ)

Table A.1. Başarı Yönelimleri Ölçeği.

	1	2	3	4	5
1-) Fizik dersinde anlatılan konuları tamamen öğrenmeyi amaçlarım.					
2-) Fizik dersinin içeriğini anlamak için gayret sarf ederim.					
3-) Fizik ders süresi içerisinde mümkün olduğunca fazla şey öğrenmeyi amaçlarım.					
4-) Öğrenebileceğimden daha az şey öğrenmekten kaçınırım.					
5-) Fizik dersinde anlatılan konuları eksik öğrenmekten kaçınırım.					
6-) Bir konuyu olabildiğinden daha az öğrenmekten kaçınırım.					
7-) Sınıfımdaki öğrencilere göre daha iyi performans göstermeyi amaçlarım.					
8-) Diğer öğrencilere göre daha başarılı olmak için gayret ederim.					
9-) Diğer öğrencilerden daha iyi performans göstermeyi hedeflerim.					
10-) Diğer öğrencilere göre başarısız görünmekten kaçınmaya çalışırım.					
11-) Diğer öğrencilerden daha kötü performans göstermemeye gayret ederim.					
12-) Diğer öğrencilerden daha kötü performans göstermemeyi amaçlarım.					

APPENDIX B: DIMENSIONS OF THE ACHIEVEMENT GOAL ORIENTATION QUESTIONNAIRE (AGQ)

B.1. Mastery Approach Goal Items

- My aim is to completely master the material presented in this class.
- I am striving to understand the content of this course as thoroughly as possible.
- My goal is to learn as much as possible.

B.2. Mastery Avoidance Goal Items

- My aim is to avoid learning less than I possibly could.
- I am striving to avoid an incomplete understanding of the course material.
- My goal is to avoid learning less than it is possible to learn.

B.3. Performance Approach Goal Items

- My aim is to perform well relative to other students.
- I am striving to do well compared to other students.
- My goal is to perform better than the other students.

B.4. Performance-avoidance goal items

- My aim is to avoid doing worse than other students.
- I am striving to avoid performing worse than others.
- My goal is to avoid performing poorly compared to others.

APPENDIX C: TURKISH FORM OF THE SCIENCE LEARNING SELF EFFICACY QUESTIONNAIRE

Table C.1. Fizik Öz-yeterlilik ölçeği.

	1	2	3	4	5
1-) Fizik laboratuvar deneylerinde malzemelerin nasıl kurulacağını biliyorum.					
2-) Fizik kanun ve teorilerini arkadaşlarıma açıklayabilirim.					
3-) Günlük yaşamda karşılaştığım problemleri çözmek için bilimsel yöntemleri kullanırım.					
4-) Bir bilimsel problem ile karşılaştığımda önce aktif olarak üzerine düşünür ve çözmek için strateji oluşturabilirim.					
5-) Fizik laboratuvarında fikirlerimi uygun bir şekilde ifade edebilirim.					
6-) Fizikle ilgili sosyal meseleleri (ör., nükleer güç, yenilenebilir enerji) bilimsel bir yaklaşımla anlar ve yorumlayabilirim.					
7-) Bir fizik kavramı veya olgusu üzerine sistematik gözlemler ve araştırmalar yapabilirim.					
8-) Fizik laboratuvarında malzemelerin (metre cetvel, terazi, multi-metre) nasıl kullanılacağını biliyorum.					
9-) Okulda fizik ile ilgili öğrendiklerimi günlük yaşama uygulayabilirim.					
10-) Bir fizik sorusunu çözmek için uygun formülü seçebilirim.					
11-) Fizik laboratuvarında kendi görüşlerimi açık bir şekilde ifade edebilirim.					
12-) Fizik laboratuvarında deneysel basamakların nasıl uygulanacağını biliyorum.					
13-) Fizik ile ilgili iş alanlarını tanırım.					
14-) Fizik konularını farklı fen konuları (örneğin biyoloji, kimya) içeriklerine bağlayabilir ve aralarındaki ilişkileri kurabilirim.					
15-) Fizik konularını sınıf arkadaşlarımla tartışırken rahat hissederim.					
16-) Bir fizik olayını incelerken değişim sürecini gözlemleyebilir ve olası nedenleri düşünebilirim.					
17-) Öğrendiklerimi diğerlerine açık bir şekilde açıklayabilirim.					
18-) Fizik laboratuvarı sırasında nasıl veri toplandığını biliyorum.					
19-) Temel fizik kavramlarının tanımlarını bilirim (örneğin, yer çekimi, sıcaklık, kırılma vb.)					
20-) Günlük yaşamı fizik teorileri kullanarak açıklayabilirim.					

Table C.1. Fizik Öz-yeterlilik ölçeği cont.

21-) Bir fizik problemini çözmek için çok sayıda geçerli çözümler önerebilirim.					
22-) Fizik laboratuvarında öğrendiklerimi başkaları ile yaptığım tartışmalarda kullanabilirim.					
23-) Günlük yaşamda yer alan birçok olgunun fizik ile ilgili kavramları içerdiğini bilirim.					
24-) Fiziği kullanarak günlük problemlere çözümler önerebilirim.					
25-) Fizik problemlerin çözümlerini eleştirel olarak değerlendirebilirim.					
26-) Fizik laboratuvarında arkadaşlarımın yaptığı sunumlar üzerine yorum yapabilirim.					
27-) Televizyonda izlediğim fizikle ilgili haber ve belgeselleri anlayabilirim.					
28-) Fizikle ilgili hipotezlerimi doğrulamak için bilimsel deneyler tasarlayabilirim.					

APPENDIX D: DIMENSIONS OF THE SCIENCE LEARNING SELF EFFICACY QUESTIONNAIRE

D.1. Conceptual Understanding

- I can explain scientific laws and theories to others.
- I can choose an appropriate formula to solve a science problem.
- I can link the contents among different science subjects (for example biology, chemistry and physics) and establish the relationships between them.
- I know the definitions of basic scientific concepts (for example, gravity, photosynthesis, etc.) very well.

D.2. Higher Order Cognitive Skills

- I am able to critically evaluate the solutions of scientific problems.
- I am able to design scientific experiments to verify my hypotheses.
- I amabletopropose many viable solutions to solve a science problem.
- When I come across a science problem, I will actively think over it first and devise a strategy to solve it.
- I am able to make systematic observations and inquiries based on a specific science concept or scientific phenomenon.
- WhenIamexploring a scientific phenomenon, I am able to observe its changing process and think of possible reasons behind it.

D.3. Practical Work

- I know how to carry out experimental procedures in the science laboratory.
- I know how to use equipment (for example measuring cylinders, measuring scales, etc.) in the science laboratory.
- I know how to set up equipment for laboratory experiments.
- I know how to collect data during the science laboratory.

D.4. Everyday Application

- I am able to explain everyday life using scientific theories.
- I am able to propose solutions to everyday problems using science.
- I can understand the news/documentaries I watch on television related to science.
- I can recognize the careers related to science.
- I am able to apply what I have learned in school science to daily life.
- Iam able to use scientific methods to solve problems in everyday life.
- Ican understand and interpret social issues related to science (for example nuclear power usage and genetically modified foods) in a scientific manner.
- I am aware that a variety of phenomena in daily life involve science-related concepts.

D.5. Science Communication

- I am able to comment on presentations made by my classmates in science class.
- I am able to use what I have learned in science classes to discuss with others.
- I am able to clearly explain what I have learned to others.
- I feel comfortable discussing science content with my classmates.
- In science classes, I can clearly express my own opinions.
- In science classes, I can express my ideas properly.

APPENDIX E: TURKISH FORM OF THE CONCEPTIONS OF LEARNING SCIENCE QUESTIONNAIRE

Table E.1. Fizik Öğrenme Anlayışı Anketi.

	1	2	3	4	5
1-) Fizik öğrenmek, kitaplardaki tanımlamaları, formülleri ve kanunları ezberlemektir.					
2-) Fizik öğrenmek, fizik kitabında bulunan önemli kavramları ezberlemektir.					
3-) Fizik öğrenmek, öğretmenin sorularını kolay cevaplayabilmek için fizik kitabındaki isimleri ezberlemektir.					
4-) Fizik öğrenmek, öğretmenin derste neler anlattığını hatırlamaktır.					
5-) Fizik öğrenmek sembolleri, kavramları ve gerçekleri ezberlemektir.					
6-) Fizik öğrenmek sınavlardan yüksek not almaktır.					
7-) Eğer sınav yoksa fizik öğrenmem.					
8-) Sınavlardan yüksek not almadıkça fizik öğrenmemim bir faydası yoktur. Aslında bilimsel gerçekleri bilmeden de iyi bir şekilde yaşayabilirim.					
9-) Fizik öğrenmemdeki temel amaç test soruları hakkında daha fazla bilgi edinmektir.					
10-) Fizik öğreniyorum böylece fizik ile ilgili soruları daha iyi yapıyorum.					
11-) Fizik öğrenmek ve testleri cevaplamak arasında sıkı bir ilişki bulunmaktadır.					
12-) Fizik öğrenmek, bir dizi hesaplama ve problem çözmeyi kapsar.					
13-) Bence hesaplama ve problem çözmeyi öğrenmek sınıftaki performansımı artırır.					
14-) Fizik öğrenmek problem çözerken doğru formülleri nasıl kullanacağını bilmektir.					
15-) Fizik öğrenmenin en iyi yolu sürekli hesaplama yapmak ve problem çözmektir.					
16-) Fizik öğrenmek ile çok iyi hesaplama ve sürekli alıştırma yapmak arasında yakın bir ilişki vardır.					
17-) Fizik öğrenmek daha önce bilmediğin bilgilere sahip olmaktır.					
18-) Öğretmenim bana daha önce bilmediğim bilimsel gerçekleri anlattığı zaman fiziği öğrenirim.					
19-) Fizik öğrenmek, doğa ile ilgili konular ve doğa olayları hakkında daha fazla bilgi edinmektir.					
20-) Fizik öğrenmek, doğa ile ilgili daha fazla gerçeği öğrenmemde yardımcı olur.					

Table E.1. Fizik Öğrenme Anlayışı Anketi cont.

21-) Doğa ile ilgili konular ve doğal olaylar hakkında bilgimi artırdığım zaman fizik öğreniyorum.					
22-) Fizik öğrenmenin amacı, problemleri çözmek için daha önce bildiğim metotların nasıl kullanılacağını bilmektir.					
23-) Fizik öğrenmek, problemlerin çözümünde daha önce bildiğim bilgi ve becerileri nasıl uygulayacağını öğrenmektir.					
24-) Yaşam kalitemizi geliştirmek için fizik öğreniriz.					
25-) Fizik öğrenmek, bilinmeyen olayları ve soruları çözmek ve açıklamaktır.					
26-) Fizik öğrenmek, hayatımdaki problemleri çözmemde yardımcı olsun diye bilgi ve becerileri artırmaktır.					
27-) Fizik öğrenmek, bilimsel bilgileri anlamaktır.					
28-) Fizik öğrenmek, bilimsel kavramlar arasında bağlantıları anlamaktır.					
29-) Fizik öğrenmek, bilgi ufkumu genişletmektir.					
30-) Fizik öğrenmek, doğa olaylarını ve bilgilerini anlamamda bana yardımcı olur.					
31-) Fizik öğrenmek, doğa olaylarında ve doğa ile ilgili konularda yeni bir bakış açısı oluşturmamda yardımcı olur.					
32-) Fizik öğrenmek, doğa olayları ve doğa ile ilgili konulardaki bakış açımı değiştirmektir.					
33-) Fizik öğrenmek, doğa olayları ve doğa ile ilgili konulardaki bakış açısı oluşturmamda en iyi yolu bulmaktır.					
34-) Fizik öğrenerek doğa olayları ve doğa ile ilgili konularda daha fazla düşünme yollarını öğrenebilirim.					
35-) Fizik öğrenmek, hayatımızdaki konuları mantıklı bir şekilde açıklama yollarını bulmaktır.					

APPENDIX F: DIMENSIONS OF THE CONCEPTIONS OF LEARNING SCIENCE QUESTIONNAIRE

F.1. Memorizing

- Learning science means memorizing the definitions, formulae, and laws found in a science textbook.
- Learning science means memorizing the important concepts found in a science textbook.
- Learning science means memorizing the proper nouns found in a science textbook that can help solve the teacher’s questions.
- Learning science means remembering what the teacher lectures about in science.
- Learning science means memorizing scientific symbols, scientific concepts, and facts.

F.2. Testing

- Learning science means getting high scores on examinations.
- If there are no tests, I will not learn science.
- There are no benefits to learning science other than getting high scores on examinations. In fact, I can get along well without knowing many scientific facts.
- The major purpose of learning science is to get more familiar with test materials.
- I learn science so that I can do well on science-related tests. .
- There is a close relationship between learning science and taking tests.

F.3. Calculating and Practicing

- Learning science involves a series of calculations and problem-solving.
- I think that learning calculation or problem-solving will help me improve my performance in science courses.
- Learning science means knowing how to use the correct formulae when solving problems.
- The way to learn science well is to constantly practice calculations and problemsolving.
- There is a close relationship between learning science, being good at calculations, and constant practice.

F.4. Increasing One’s Knowledge

- Learning science means acquiring knowledge that I did not know before.
- I am learning science when the teacher tells me scientific facts that I did not know before.
- Learning science means acquiring more knowledge about natural phenomena and topics related to nature.
- Learning science helps me acquire more facts about nature.
- I am learning science when I increase my knowledge of natural phenomena and topics related to nature.

F.5. Applying

- The purpose of learning science is learning how to apply methods I already know to unknown problems.
- Learning science means learning how to apply knowledge and skills I already know to unknown problems.

- We learn science to improve the quality of our lives.
- Learning science means solving or explaining unknown questions and phenomena.

F.6. Understanding and Seeing in a New Way

- Learning science means understanding scientific knowledge.
- Learning science means understanding the connection between scientific concepts.
- Learning science helps me view natural phenomena and topics related to nature in new ways.
- Learning science means changing my way of viewing natural phenomena and topics related to nature.
- Learning science means finding a better way to view natural phenomena or topics related to nature.
- I can learn more ways about thinking about natural phenomena or topics related to nature by learning science.

APPENDIX G: DESCRIPTIVE STATISTICS FOR EACH GRADE

Table G.1. Descriptive statistics of the measures for ninth graders.

n = 197	M	SD
Mastery approach goals	4.12	.75
Mastery avoidance goals	4.10	.74
Performance approach goals	4.02	.89
Performance avoidance goals	4.12	.90
Conceptual understanding	3.51	.81
Higher order cognitive skills	3.37	.77
Everyday application	3.26	.83
Science communication	3.53	.96
Self efficacy	3.38	.75
Quantitative learning conceptions	3.27	.67
Memorizing	2.84	1.08
Preparing for the exam	3.01	.90
Calculating and practicing	3.70	.88
Increasing one's knowledge	3.60	.90
Qualitative learning conceptions	3.60	.89
Application	3.51	.88
Understanding	3.70	.96
Seeing in a new way	3.61	1.07

Table G.2. Descriptive statistics of the measures for tenth graders.

n = 196	M	SD
Mastery approach goals	4.11	.73
Mastery avoidance goals	4.02	.80
Performance approach goals	3.98	.96
Performance avoidance goals	4.02	.93
Conceptual understanding	3.46	.80
Higher order cognitive skills	3.27	.84
Everyday application	3.22	.82
Science communication	3.51	.94
Self efficacy	3.32	.77
Memorizing	2.84	1.07
Preparing for the exam	3.10	.83
Calculating and practicing	3.81	.75
Increasing one's knowledge	3.63	.89
Quantitative learning conceptions	3.33	.59
Application	3.53	.88
Understanding	3.78	.93
Seeing in a new way	3.62	1.00
Qualitative learning conceptions	3.63	.85

Table G.3. Descriptive statistics of the measures for eleventh graders.

n = 125	M	SD
Mastery approach goals	4.07	.90
Mastery avoidance goals	4.03	.81
Performance approach goals	3.91	1.05
Performance avoidance goals	3.98	.93
Conceptual understanding	3.44	.77
Higher order cognitive skills	3.18	.85
Everyday application	3.22	.78
Science communication	3.49	.95
Self efficacy	3.28	.74
Memorizing	2.73	1.13
Preparing for the exam	2.95	.92
Calculating and practicing	3.81	.78
Increasing one's knowledge	3.63	.85
Quantitative learning conceptions	3.26	.59
Application	3.68	.74
Understanding	3.94	.85
Seeing in a new way	3.81	.90
Qualitative learning conceptions	3.80	.72

APPENDIX H: PERMISSIONS

T.C.
KAĞITHANE KAYMAKAMLIĞI
İlçe Milli Eğitim Müdürlüğü

Sayı : 80921160/200E629848 17.01.2017
Konu: Araştırma Yapılması

KAYMAKAMLIK MAKAMINA
KAĞITHANE

İlgi : T.C. Boğaziçi Üniversitesi Eğitim Fakültesinin 16.01.2017 tarih ve 4 sayılı yazısı.

Boğaziçi Üniversitesi Eğitim Fakültesi Matematik ve Fen Bilimleri Eğitimi Bölümü Öğretim üyesi Prof.Dr. Ayşenur YONTAR TOĞROL danışmanlığında yürütülmekte olan, Havva SAĞLAM tarafından hazırlanan "Lise Öğrencilerinin Başarı Yönelimleri Öz-yeterlilik İnançları, Öğrenme Anlayışları ve Fizik Başarıları Arasındaki İlişki" adlı çalışma kapsamında İlçemiz Kağıthane Anadolu Lisesi ve Cengizhan Anadolu Lisesi"nden 9, 10 ,11 ve 12. Sınıf 800-850 öğrenciyi kapsayan ve Ocak 2017-Haziran 2017 tarihleri arasında çalışma yapma istedikleri ilgi yazı ile belirtilmektedir.

Bu kapsamda araştırma yapmaları Müdürlüğümüzce uygun görülmekte olup Olurlarınıza arz ederim.

Metin ONUR
Müdür a.
Şube Müdürü

OLUR
17/01/2017

Muhammed ÇAYIR
Kaymakam a.
İlçe Milli Eğitim Müdürü

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Figure H.1. Permission from national education directorate.

T.C.
BOĞAZİÇİ ÜNİVERSİTESİ
İnsan Araştırmaları Kurumsal Değerlendirme Alt Kurulu

Sayı: 2016/40

12 Aralık 2016

Havva Sağlam

Matematik ve Fen Bilimleri Eğitimi Bölümü

Sayın Araştırmacı,

"Lise Öğrencilerinin Başarı Yönelimleri, Öz Yeterlilik İnançları, Öğrenme Anlayışları ve Fizik Başarıları Arasındaki İlişki" başlıklı projeniz ile ilgili olarak yaptığınız SBB-EAK 2016/43 sayılı başvuru İNAREK/SBB Etik Alt Kurulu tarafından 12 Aralık 2016 tarihli toplantıda incelenmiş ve uygun bulunmuştur.

Saygılarımızla,

İnsan Araştırmaları Kurumsal Değerlendirme Alt Kurulu

Doç. Dr. Ebru Kaya

Doç. Dr. Mehmet Yiğit Gürdal

Yrd. Doç. Dr. Gül Sosay

Yrd. Doç. Dr. Mehmet Nafi Artemel

Dr. Nur Yeniçeri

Figure H.2. Permission from Ethics Committee of Boğaziçi University.