High School Students' Physics Achievement in Terms of Their Achievement Goal Orientations, Self-Efficacy Beliefs and Learning Conceptions of Physics

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Abstract

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. Comparisons in terms of gender, grade level and field were also made for these variables. The sample of this study consisted of 518 students from ninth, tenth and eleventh grades. The instruments that were administrated to students were the Achievement Goal Orientation Questionnaire (AGQ), Physics Learning Self-Efficacy Questionnaire (PLSEQ) and Physics Learning Conceptions Questionnaire (PLCQ). Multiple regression analysis, two-way ANOVA and one-way MANOVA were used to analyze data. The results of this study suggested that 12.4 percent of variance of students' physics performance was explained by these variables. Gender and field differences were also detected.

Keywords: Motivation, achievement goal orientation, self-efficacy, learning conception, physics performance

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, & 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. According to these reforms in curricula, science, particularly physics, is viewed from a constructivist viewpoint 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 (MEB, 2013).

Pintrich and Schrauben (1992) stated that models that explain student performance in terms of only cognitive factors do not consider 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

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perseverance in the face of difficulties. Thus, they emphasized the importance of explaining students' learning in terms of both cognitive and motivational factors.

Students' motivation in learning has been conceptualized in terms of their goals and beliefs (Eccles & 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). Students' ultimate learning is determined by whether their aim is to gain mastery or to show their competence to others. Students' engagement in their science classes is also determined by their confidence in themselves to properly learn the presented material (Britner & Pajares, 2006). Thus, 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).

While theories of goal orientation and self-efficacy explain individuals' motivated behavior, learning conceptions explain individuals' 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, Johanson, & Tsai, 2008). Thus, 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).

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 which 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 & Martinez-Pons, 1990). In addition, male students possess higher self-efficacy levels compared to female students especially for physical sciences (Britner, 2008).

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). Students' motivation towards science was found to be different among female and male students (Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011). Particularly, female students perceive biology classes more meaningful and display higher anxiety towards physics (Koul, Lerdpornkulrat, & Chantara, 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). The present 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 important factors that shape students' motivation to learn physics. In Turkey, at the end of 10th grade, students make choices for different fields such as science-mathematics, literature-mathematics or social sciences, and they take different tests on the university entrance exam according to their fields they choose at high school. Generally, introductory physics topics are covered in the first two years of high schools. In eleventh and twelfth 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 physics knowledge.

The present study aims to investigate the contribution of high school 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.

Literature Review

Students' motivation towards learning has been a central issue for science educators. Several theories of motivation have been proposed to understand the underlying factors that energize people to engage in several actions. These theories have been widely used by science educators to explore students' willingness, confidence and determination to learn science.

Several motivational theorists emphasize achievement behavior 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). This orientation is defined as *performance-goal* and characterized in terms of outperforming others and showing ability (Nicholls, 1984). 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. Thus, they avoid challenging tasks that may harm their competent appearance (Ames, 1992).

Elliot (1999) 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. Thus, 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 value individuals give to the task. Thus, 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 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. 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.

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. Therefore, students' ultimate learning in various topics such as physics may be influenced by their achievement goal orientation.

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 Bandura (1997), 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 to attain several desired outcomes. Individuals decide to perform several actions if they think that they have the necessary skills to perform those actions. Bandura (1993) also stated that self-efficacy beliefs are major determinants of individuals' choices of action. He pointed out that individuals with the same skills may perform differently with respect 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 (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. 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.

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 & 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 peers.

Caprara et al. (2008) conducted a longitudinal study 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. Caprara et al. (2008) indicated that over the transition from middle school to high school, students' perceived self-efficacy levels significantly decreased. This finding suggested that as grade level increases, students encounter with more 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, Donovan and Costa (1991) also stated that peer pressure to engage in nonacademic activities is more salient among male students (as cited in Caprara et al., 2008). Zimmerman and Martinez-Pons (1990) conducted a study about the developmental patterns of students' self-efficacy beliefs and indicated contrary results to Caprara et al's (2008) findings. Additionally, Caprara et al. (2008) investigated students' self-efficacy levels in relation to their achievement and self-regulation strategy use. Caprara et al. (2008) 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. Thus, their efficacy beliefs compatibly increase with their grade levels. According to Caprara et al. (2008), 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.

In this study learning conceptions are defined in terms of individuals' beliefs about the nature of learning (Chiou & 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 students' 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 conducted interviews with 11th and 12th grade students. The data were analyzed by using a phenomenographic approach in which students' responses were coded with several words. As a result, the researcher identified seven distinct categories that represented 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 believe 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. The conception of science learning as *making calculations* refers to manipulating formulas and laws. The category of *increasing knowledge* implies that students perceive science learning as accumulation of scientific knowledge. The researcher sugggests 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* implies that science learning is meaningfully integrating newly acquired and already possessed knowledge structures. Thus, 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 viewpoint 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. Tsai (2004) 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 (2004) stated that students from science and mathematics fields have more qualitative views of science learning compared to students from art majors. Additionally, Tsai (2004) suggested several reasons that might be influential on students' learning conceptions such as their motivation. Thus, 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) hypothesized that students with qualitative learning conceptions use deep learning approaches whereas students with quantitative learning conceptions use surface approaches. Using deep learning approaches was associated with having an inherent interest in the course material and using elaborations to thoroughly understand the course. On the other hand, students with surface learning approaches were characterized as having an instrumental motivation, attending to 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. Thus, Lee et al. (2008) emphasized the importance of establishing qualitative 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. Specifically, qualitative learning conceptions predict the use of deep learning strategies, which in turn predict higher self-efficacy beliefs. On the contrary, quantitative learning conceptions predict the use of superficial strategies. Ultimately, these students possess lower levels of self-efficacy. Therefore, Chiou and Liang (2012) suggested that learning conceptions may be an important source of self-efficacy beliefs by influencing the approaches students choose towards science learning.

Conceptions of science learning can be viewed as individuals' 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.

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 is to raise scientifically literate citizens who can give appropriate decisions when confronted with science related problems in their lives. Yet, it was stated that having scientific knowledge does not necessarily leads people to behave in desired ways. At this point, Bybee and McCrae (2011) emphasize attitudes and interests individuals have with regard to science. Thus, 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.

Lee Hayes, Seitz, DiStefano and O'Connor (2016) investigated the relationship between several motivational constructs such as goal orientation, self-efficacy and achievement in a science course. 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 such 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.

Güngör, Eryılmaz and Fakioğlu (2007) investigated students' physics achievement and their affective characteristics. They developed a scale that measures students' affective characteristics on different dimensions such as interest, achievement motivation, physics anxiety, test anxiety and self-efficacy. They indicated that overall, affective characteristics are positively related with achievement. 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.

Wang (2013) analyzed first year university students' entrance to different fields in terms of several variables. These students were asked about their high school math achievement, math self-efficacy, and the number of science and mathematics courses they took. The results of his 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, Wang (2013) emphasized the importance of early exposure to math and science courses that may influence students' STEM career choices.

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.

In this section, the literature about students' motivational characteristics and learning conceptions has been presented. Motivation towards science learning is analyzed in terms of achievement goal orientation and self-efficacy beliefs. Particularly, the contribution of students' achievement goal orientation, physics learning self-efficacy beliefs and physics learning conceptions into their physics performance is investigated. 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 et al., 2008; Zimmerman & Pons, 1990). Thus, the development patterns of Turkish students' motivational characteristics as they continue in high school is also examined in the current study. 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. Therefore, students' achievement goal orientation, physics learning self-efficacy beliefs and physics learning conceptions were compared between science-mathematics and mathematics-literature groups.

Methodology

Sample

The sample of this study consists 518 ninth, tenth and eleventh graders from a public Anatolian high school located in Istanbul (See Table 1). A purposive sampling method was used in order to have a large sample and sufficient number of students for each grade level, gender, and study field. This large urban high school was founded 20 years ago and had a total of 852 students.

Table 1. Number of students based on their fields/intention of fields and grade level

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

Data Collection

Self-report instruments were used to measure students' achievement goal orientation, physics learning self-efficacy beliefs, and physics learning conceptions. Specifically, the Turkish versions of the Achievement Goal Orientation Questionnaire (AGOQ), the Science Learning Self-Efficacy Questionnaire and the Conceptions of Learning Science Questionnaire (CLSQ) were the instruments. A pilot study was conducted with 25 high school students from different schools in order to arrange timing and it was observed that 30 minutes was sufficient to complete the instruments. The Achievement Goal Orientation Questionnaire (AGOQ) was developed by Elliot and Murayama (2008) to measure students' achievement goal orientations. The Likert type instrument consists of four subscales: *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. The Cronbach's α reliability for each subscale ranges from .84 to .94 (Elliot & Murayama, 2008). In the present study, the Turkish form of the AGOQ which was translated to Turkish by Arslan and Akın (2015) was used. The Cronbach's α reliability coefficients calculated for the subscales were as follows: .72 for mastery approach subscale, .68 for mastery avoidance subscale, .62 for performance approach subscale, and .69 for performance avoidance subscale. The researchers ensured the validity of the adapted scale by consulting expert opinions and conducting confirmatory factor analysis.

Another instrument used in the present study is The Science Learning Self-Efficacy Questionnaire, which 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. 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 & 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. The overall Cronbach's α reliability coefficient of the questionnaire was .94 (Alpaslan & Işık, 2016). The reliability coefficients for each subscale ranged from .74 to .89. They ensured the construct validity of the instrument by conducting exploratory and confirmatory factor analysis. Items that are related with physics laboratories were removed from the analysis in the current study, because the school principal indicated that students do not have any laboratory experiences in their physics classes. As such, *practical work* dimension of the Science Learning Self-Efficacy Questionnaire was not included in the analysis.

The Conceptions of Learning Science Questionnaire (CLSQ), which was developed by Lee et al. (2008), is used to measure students' conceptions of learning science. Lee et al. (2008) 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*. 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 and she reported that the general Cronbach's α reliability coefficient of the scale is .89 where the Cronbach's α reliability coefficient for each subscale ranges from .63 to .85. Factor analysis was used to demonstrate the construct validity of the scale.

In addition to the scales described above, students's reported their physics course grades/exam performances from the previous term which were used as their physics performances.

Data Analysis

A *multiple regression analysis* 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. 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. Lastly, 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-mathematics and literature mathematics groups. Two different one-way MANOVAs were conducted because ninth and tenth graders haven't made a field choice yet. Thus, 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.

Results

Students' physics performance levels with respect to their gender, grade level, and field of study are presented in Table 2.

Table 2. Students' physics exam performance from the previous term

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

Students' mean scores for their achievement goal orientation, physics learning self-efficacy and physics learning conceptions are provided in Table 3.

Table 3. Descriptive statistics of the measures for the total sample

Measures	*M*	*SD*
Mastery approach goal orientation	4.10	.78
Mastery avoidance goal orientation	4.05	.78
Performance approach goal orientation	3.97	.96
Performance avoidance goal orientation	4.05	.92
Physics learning self-efficacy	3.33	.75
Quantitative physics learning conception	3.29	.62
Qualitative physics learning conception	3.66	.84

Note. N = 518

A multiple regression analysis was conducted in order to analyze the unique contributions of 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 to physics performance scores. Students from ninth, tenth and eleventh grades took different exams throughout the semester. Thus, standardized t scores were used 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 between female and male students, gender was also not included in the model. Before conducting the multiple regression analysis, multicollinearity, outliers, normality, linearity and homoscedasticity assumptions were tested and all assumptions were satisfied (Hinkle, Wiersma, & Jurs, 2003). Specifically, the independent variables did not highly correlate with each other ($r < .9$). The visual analysis of the standardized residual plots also indicated that the dependent and independent variables are normally distributed and have a linear relationship. Furthermore, all variables were found to have homogeneous variances. Lastly, standardized residuals that have values beyond -3.29 and +3.29 were removed from the dataset since these values can be regarded as outliers (Pallant, 2011). Thus, the assumptions were satisfied,

The regression analysis indicated that 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, and qualitative physics learning conceptions significantly predicted physics performance, $F(9,508) = 9.12$, $p < .001$, $R^2 = .124$. A variance of 12.4 % in physics performance can be explained by the linear combination of the independent variables, yielding medium effect size, *(*Cohen & Cohen, 1983).

The relative contributions of independent variables to physics performance were analyzed through unstandardized and standardized coefficients, significance values and partial correlations for each independent variable (see Table 4). The standardized beta values indicated that mastery approach goal orientation, performance approach goal orientation, and quantitative physics learning conceptions 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 but negatively predicts physics performance. The regression equation that predicts physics performance is as the following:

Physics performance = $2.26_{\text{M.approach}} + 2.06_{\text{P.appraoch}} - 2.81_{\text{quantitative}}$

Table 4. Summary of coefficients

Model	B	SE	Beta	T	p	Part R
Constant	38.44	3.10		12.38	.00	
MAPGO	2.26	.82	.18	2.75	.01	.11
MAVGO	.05	.79	.00	.07	.95	.00
PAPGO	2.06	.62	.20	3.33	.00	.14
PAVGO	-1.01	.62	-.09	-1.65	.10	-.07
PLSEB	.90	.71	.07	1.26	.21	.05
QAPLC	-2.81	.69	-.16	-4.09	.00	-.17
QUPLC	1.17	.63	.10	1.86	.06	.08

Note. MAPGO = mastery approach goal orientation; MAVGO = mastery avoidance goal orientation; PAPGO = performance approach goal orientation; PAVGO = performance avoidance goal orientation; PLSEB = physics learning self-efficacy; QAPLC = quantitative physics learning conception; QUPLC = qualitative physics learning conception

Separate two-way ANOVA tests were conducted to analyze students' achievement goal orientation, physics learning self-efficacy beliefs, quantitative physics learning conceptions and qualitative physics learning conceptions in terms of gender and grade differences. Before conducting the analysis, initial assumption tests were carried out. All the variables had skewness and kurtosis values between -2 and +2, so it can be said that mean scores for each variable have a normal distribution (Pallant, 2005). Furthermore, results of Levene's test indicated that all groups have homogeneous variances for each variable ($p > .05$). For all the variables, there was no interaction between gender and grade level. Similarly, grade level had no main effect on any of the variables. Only gender had a main effect on students' performance approach goal orientation, physics learning self-efficacy beliefs and qualitative physics learning conceptions. Specifically, male students had significantly higher performance approach goal orientation scores, $F(1, 512) = 5.13$, $p = .02$, $\eta_p^2 = .010$, physics learning self-efficacy scores, $F(1, 512) = 37.32$, $p < .001$, $\eta_p^2 = .07$ and qualitative physics learning conception scores, $F(1, 512) = 5.78$, $p = .02$, $\eta_p^2 = .01$ compared to female students. Pairwise comparisons between female and male students are presented only for variables that were significantly different in terms of gender (Table 5).

Table 5. Pairwise comparisons between female and male students

	M		Mean difference	
	Female	Male	Female-Male	*p*
Performance approach goal orientation	3.88	4.08	-.20	.00
Physics learning self-efficacy	3.16	3.56	-.41	.00
Qualitative physics learning conception	3.61	3.79	-.18	.00

A one-way MANOVA was conducted to analyze students' achievement goal orientation, physics learning self-efficacy beliefs and physics learning conceptions in terms of field differences. 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 to compare the combination of dependent variables for field differences. Normality, outliers, linearity, multicollinearity, and homogeneity of variance-covariance matrices assumptions were checked before proceeding with the analysis. The results indicated that, for 9th and 10th graders, there was a statistically significant difference in students' scores between those 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 indicated significant differences between the two groups in terms of 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 $\eta^2 = .05$. For all the mentioned variables, students who intend to choose science-mathematics field obtained higher results than those who intend to choose literature-mathematics field. Effect size for all the variables were moderate.

The results of one-way MANOVA for 11th graders 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 $\eta^2 = .34$. Separate analyses for each dependent variable yielded significant differences between science-mathematics and literature-mathematics groups in relation to 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 $\eta^2 = .1$. For all the specified variables, students from science-mathematics groups obtained higher scores and the effect sizes were large.

Discussion and Implications

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. Students' physics performances 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). 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. Students who have higher quantitative learning conceptions tend to have lower physics performance levels. Tsai (2004) 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. Physics is learnt for more external reasons and no coherent view of physics is adopted by the learners. As Lee et al. (2008) 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 this 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. As Tsai (2004) 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. Thus, students may conceptualize physics learning as only preparing for exams and making several calculations.

Students' achievement goal orientation, physics learning self-efficacy beliefs, and physics learning conceptions were analyzed in terms of gender and grade differences. The developmental pattern of these variables was similar for female and male students across grade levels. In addition, there were no significant differences in terms of grade level. However, 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 previous research suggested, male and female students differ in their motivation towards science (Glynn et al., 2011; Schumm & Bogner, 2016; Neber, He, Liu, & Schofield, 2008; Reçber, 2011). In this study, male students were found to possess higher performance approach goal orientation compared to female students. Thus, 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 et al., 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, 2011). 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.

Additional comparisons in terms of gender differences imply that male students possess higher qualitative physics learning conceptions compared to female students. They tend to learn physics 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. 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 to get good grades or pass the exams. 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 to have a deep understanding and see their worlds from a different viewpoint, 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 analyzed in terms of field differences as well. 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. As Bryan, Glynn and Kitlleson, (2011) 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. They may view higher physics performance scores 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., 2011). Different from ninth and tenth graders, eleventh graders possessed higher mastery avoidance goals. Students from science-mathematics group may perceive themselves successful but they may also fear to become unsuccessful and loosing this perception. This may explain their higher levels of mastery avoidance goal orientation. In addition, both student groups who intend to choose and who have already chosen science-mathematics field possessed higher qualitative learning conceptions. 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. In conclusion, the findings of this study suggest that establishing learning environments that foster students' mastery and performance approach goal orientation and physics learning self-efficacy beliefs may contribute to their physics performance.

The results of this study indicated that students' physics achievement is negatively predicted by quantitative learning conceptions whereas positively predicted by mastery approach goal orientation and performance approach goal orientation. Thus, learning environments that promote mastery approach goal orientations should be created since they may positively contribute to physics performance via the use of deep approaches to learning science (Yerdelen-Damar & Aydın, 2015). On the other hand, learning environments that lead students to equate physics learning to memorizing, testing and calculating may negatively impact their performance. This result may imply the importance of creating learning environments in which these learning conceptions are underemphasized. Furthermore, female students were found to possess lower levels of approach goal orientation and physics learning self-efficacy compared to male students. Thus, emphasizing effort rather than natural differences and avoiding gender stereotypes in classrooms may positively impact female students' motivation and performance of physics.

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Öğrencilerin Fizik Başarılarının Başarı Yönelimleri, Fizik Öz Yeterlik İnançları ve Fizik Öğrenme Anlayışları Açısından İncelenmesi

Öz

Bu çalışmanın amacı, lise öğrencilerin fizik dersine karşı başarı yönelimlerinin, öz yeterlik inançlarının ve öğrenme anlayışlarının fizik performansına olan katkısını incelemektir. Bu değişkenler cinsiyet, sınıf seviyesi ve alan karşılaştırması yapılarak da incelenmiştir. Dokuzuncu, onuncu ve onbirinci sınıflardan toplam 518 öğrenci bu çalışmaya katılmıştır. Araştırmada nicel veri toplama araçları kullanılmıştır. Başarı Yönelimleri Ölçeği, Fizik Öz Yeterlik İnançları Ölçeği ve Fizik Öğrenme Anlayışları Ölçeği çalışmada kullanılan veri kaynaklarıdır. Toplanan veriler, çoklu regresyon 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. Cinsiyet ve alan karşılaştırması sonucunda anlamlı farklılıklar elde edilmiştir.

Anahtar Kelimeler: Motivasyon, başarı yönelimi, öz yeterlik, öğrenme anlayışı, fizik performansı