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Prediction of Physics Lesson Learning Level by Students' Characteristics and Teaching-Learning Process

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Abstract

The aim of this study is to determine the predictive strength of the students' characteristics and their teaching-learning process on the physics course learning level. The variables were also examined according to the academic achievement levels. The study is a descriptive study in survey model. Purposive sampling method was used in the formation of the study group, and 621 ninth grade students were selected for the study group. Cognitive Entry Behaviors (CEB) test, Academic Self-Concept (ASC) scale, Perception of Teaching Service Adequacy (PTSA) scale, Time Allotted to Learning (TAL) form and Learning Level (LL) test were used to collect the data. One-way variance, simple linear regression, and stepwise regression technique were used in the data analysis. The results of the study showed that the predictive strength of the variables examined about the student and the teaching-learning process was significant. The variability in the learning level is 59.9% in CEB, 18.1% in ASC, and 17.1% in PTSA. The relationship between the individual time allocated to learning and the learning level is negative, and has the power to explain the variability in learning level by 2.9%. All variables have the power to explain the variability in learning level by 62.7% together. One of the most important results of this study is that the magnitude of the predictive power of cognitive entry behaviors on the learning level has been revealed. It is thought that the results of the study will contribute to the literature aimed at increasing the learning level of the physics course.

Introduction

Physics, one of the oldest academic disciplines, asks fundamental questions about how to understand the universe and aims to answer these questions through observation and experiment. The discipline of physics asks important questions such as how the universe was formed, how it will change in the future, how the sun continues to radiate energy, what the basic structures that make up the matter, and tries to reveal the laws of nature that seem like a mystery before they are discovered. Feynman (2000) describes the laws of physics as an invisible rhythm and order among natural phenomena that can only be noticed when viewed with an analytical eye. The curiosity and effort to understand many natural phenomena encountered in daily life lay in the emergence and advancement of physics. Knowledge of Physics is important in economic, scientific, and technological development (Wambugu & Changeiywo, 2007).

Physics teaching starts in the ninth grade at the high school level as an independent discipline in Turkey. Physics topics are included and taught in the science course of 3-8th grades. The purpose of the science curriculum for 3-8th grades is described as gaining the basic knowledge of physics, chemistry, and biology disciplines, understanding nature, and human-nature interactions, acquiring scientific process skills and adopting a scientific study approach, understanding the interaction of science-technology-society. In addition, it is explained as developing curiosity, positive attitude, and interest in natural phenomena and raising life-long learners and science-literate individuals (Ministry of National Education [MEB], 2013a). In the secondary education physics curriculum for 9-12th grades planned in parallel with the aims of the science curriculum, students are aimed to understand the nature of science, produce scientific knowledge, develop scientific literacy, use physics knowledge in daily life, and comprehend the interaction between science-technology-society (MEB, 2013b). Although the objectives of the 2018 physics curriculum are more comprehensive than in 2013 (Bezen, Aykutlu & Bayrak, 2020), the 2018 curriculum aims to raise students with basic level skills and competencies specific to the discipline of physics in addition to the knowledge and skills gained in the science course (MEB, 2018). Understanding the nature of science, understanding the ways to reach information, knowing that the information in science is based on scientific facts and this information can change and develop as soon as new evidence is obtained, understanding the difference between scientific knowledge and personal judgments are possible with the provision of scientific literacy, which is one of the main objectives of physics education (Çepni, Ayas, Johnson, & Turgut, 1997).

In Turkey, the 9th and 10th-grade physics curricula are common to all types of schools at the high school level and aim to provide a basic level of physics knowledge. In other words, it is aimed to provide all students with basic physics knowledge regardless of whether the students study in different school types or which fields they will head towards in the future. Student achievement in national and international exams can be considered as an important indicator of the achievement of the science and physics curricula objectives. International test results can be considered as a pointer of how science and physics learning level in Turkey compared to other countries. The questions used to determine the level of science literacy in Program for International Student Assessment (PISA) generally contain real examples in which field knowledge is associated with daily life. According to the results of the PISA, Turkey ranked 43rd in science literacy among 65 countries in 2012 and ranked 54th among 72 countries in 2015 (Özgürlük, Ozarkan, Arıcı, & Taş, 2016). Turkey ranked 39th among 79 countries in 2018 (MEB, 2019).

Achievement in physics is measured in Trends in International Mathematics and Science Study (TIMSS) based on the understanding of concepts in general physics and relating them to everyday life through reasoning. According to the results of the TIMSS, Turkey is among the countries with below-average scores in science and ranked 21st among 39 countries in 2015 (TIMSS & PIRLS International Study Center, 2020). Also, Turkey ranked 37th among 51 countries in 2011 (Martin, Mullis, & Stanco, 2012). According to the results obtained in

2007, it was in the 32nd place among 50 countries and was in the group of countries with a low level of success in the field of science in 1999 (Şişman, Acat, Aypay, & Karadağ, 2007).

One of the national exams in Turkey is the Secondary Education Entrance Exam (OGES). The mean scores in science in OGES are presented in Table 1. The data in Table 1 were compiled from sources related to exam results published on the official website of the Ministry of National Education (MEB, 2015a; MEB, 2015b; MEB, 2016a; MEB, 2016b; MEB, 2017). Since there are no national exams in transition to secondary education since 2018, there are no data for 2018 and beyond.

Table 1. Mean Scores on OGES

Academic Year	OGES 1st Term Science k=20		OGES 2nd Term Science k=20	
	$\bar{X}$	%	$\bar{X}$	%
2016-2017	-	-	13.15	65.75
2015-2016	11.61	58.05	11.21	56.05
2014-2015	11.14	55.70	10.68	53.40

The OGES, which is held twice a year at the end of the fall and spring semesters, consists of 20 questions on physics, chemistry, and biology in the field of science. In Table 1, it is seen that the mean scores in science in OGES vary between 10.68 (53.4%) and 13.15 (65.75%). The results of this exam, which is prepared to determine the learning level, show that students can reach only half of the goals set the field of secondary school science.

The Transition to Higher Education Examination (YGS) and the Undergraduate Placement Examination (LYS) were held in Turkey since 2018. The mean scores in science in YGS and LYS are presented in Table 2a. The data in Table 2a were compiled from sources related to exam results published on the official website of the Student Selection and Placement Center (ÖSYM) (ÖSYM, 2013a; ÖSYM, 2013b; ÖSYM, 2014a; ÖSYM, 2014b; ÖSYM, 2015a; ÖSYM, 2015b; ÖSYM, 2016a; ÖSYM, 2016b; ÖSYM, 2017a.; ÖSYM, 2017b).

Table 2a. Mean Scores in YGS and LYS

Exam Year	YGS Science k=40		LYS Physics k=30		LYS Chemistry k=30		LYS Biology k=30	
	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$	%
2017	4.6	11.50	6.82	22.73	10.23	34.10	10.13	33.77
2016	4.7	11.75	5.03	16.77	9.53	31.77	7.73	25.77
2015	3.9	9.75	6.48	21.60	8.75	29.17	9.78	32.60
2014	3.5	8.75	5.28	17.60	7.54	25.13	9.33	31.10
2013	3.5	8.75	6.46	21.53	10.19	33.97	11.05	36.83

The YGS, which is held in the middle and end of the spring semester at three-month intervals, includes 40 questions in the field of science while there are 30 questions each in the fields of physics, chemistry, and biology in LYS. In Table 2a, it is seen that the mean scores in science in YGS vary between 3.5 (8.75%) and 4.7 (11.75%) from 2013 to 2017. On the other hand, the mean scores in science in LYS are seen to vary between 5.03 (16.77%) and 6.82 (22.73%).

The Higher Education Institutions Examination (YKS) is held for admission to universities in Turkey since 2018. The first stage of this exam is the Basic Proficiency Test (TYT), and the second stage is the Field Proficiency Test (AYT). The mean scores in science in TYT and AYT in Turkey are presented in Table 2b. The data in Table 2b were compiled from the sources related to the exam results published on the official website of ÖSYM (ÖSYM, 2018; ÖSYM, 2019).

Table 2b. Mean Scores in TYT and AYT

	TYT		AYT					
Exam Year	Science k=20		Physics k=14		Chemistry k=13		Biology k=13	
	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$	%
2019	2.24	11.20	1.03	7.35	0.96	7.38	1.30	10.00
2018	2.83	14.15	0.46	3.28	1.11	8.53	1.67	12.84

There are 20 questions in the field of science in TYT. There are 14 questions in physics and 13 questions in both chemistry and biology in AYT. In Table 2b, it is seen that the mean score on science in AYT is 2.83 (14.15%) in 2018 and 2.24 (11.20%) in 2019. On the other hand, the mean scores on physics in TYT are seen to vary between 0.46 (%3.28) and 1.03 (%7.35). It is also noteworthy that the physics course has the lowest mean scores among physics, chemistry, and biology courses in Table 2a and Table 2b. According to the results of these exams held for recognition and placement in the transition to higher education in Turkey, the students are far from acquiring the behaviors tested in the exams. Similarly, although physics education is given great importance, students still show low levels of achievement in the physics course all over the world (Awodun, Oni, & Aladejana, 2014).

Physics course is perceived as a difficult lesson by students (Wambugu & Changeiywo, 2007) In the study by Çermik (2020) conducted with 188 high school students, it was found that 94% of the students had difficulties in learning physics. Undergraduate students have similar misconceptions about physics and there are too many false conceptual notions (Airey, 2020). Additionally, it has been revealed that even the candidate physics teachers have difficulties in some physics subjects because they do not have a basic knowledge of physics concepts (Taşkın & Ünlü Yavaş, 2020).

Significant Variables Affecting Physics Achievement

The importance of school learning is related to the ways teachers use the time available for learning, the quality of instruction, and to what extent students have the prerequisite knowledge for a particular learning task (Bloom, 1974). Increasing student success and learning level by reaching the targets foreseen in the curriculum depends on many variables. Individual differences among students such as interests and experiences, cultural characteristics, gender, expectations for the future, and perspectives are among the variables that affect achievement in science (Sjoberg, 2000). Previous studies have shown that students' general point averages (GPA), previous science achievements and their success in university entrance exams affect their subsequent success (Taslidere, 2020).

One of the variables affecting academic achievement in the physics course is academic self-concept. Dupe (2013) defined academic self-concept as a significant predictor of success in physics course. According to Hanze and Berger (2007), academic self-concept in the physics course is an important variable in explaining and predicting success, and academic self-concept, which also mediates variables related to motivation, facilitates the learning process at school. According to Senemoğlu (2018), academic self-concept is a style of self-perception regarding whether a student can learn any learning unit based on his learning background and is very important in forming the basis of an individual's future success.

There is a direct relationship between success in the physics course and previous achievements (Lawrenz et al, 2009). Taslidere (2020) revealed in his study that previous science and physics course achievements affect subsequent achievement in the physics course. Success in the physics course depends on previous achievements. In the study by Salar and Uğurel (2020) on the subject of electricity at the 10th grade in the physics course, it was determined that students' cognitive entry behaviors, especially for practice, were low. Cognitive entry behaviors have the power to explain 50% of the variability in achievement (Bloom, 1976).

It is critical for the teacher to plan an appropriate teaching process in physics teaching (Wambugu & Changeiywo, 2007). In physics learning, it is important for the teacher to solve problems, create a discussion environment, include experiments, and help students preparing for exams to provide meaningful learning. Whereas, it is prominent for the student to value physics science, have positive feelings about the course, and provide self-discipline (Berge, Danielsson, & Lidar, 2020). Since the subjects in the fields of science and mathematics are hierarchical and sequential, the processes in the instruction are likely to increase success (Guskey & Gates, 1986). In the theory of mastery learning, Bloom (1976) points out that the variability in school achievement in collective learning can be reduced by 90% by controlling cognitive entry behaviors, affective entry characteristics, and the quality of teaching service.

Considering the studies examining the variables related to academic achievement or learning level in physics and science courses, it was observed that the predictive strength of physics/science course achievements in high school or university entrance exams has been investigated. According to the results of these studies, it was revealed that the predictive strength of the physics/science course achievement level in national exams was remarkable. Although its importance is clearly demonstrated, it has been observed that there are quite a limited number of studies examining the variables that are related to success in physics/science course (Kabataş, 2006; Gazioğlu, 2009) or that predict physics/science course success (Kocakaya, 2008; Taslidere, 2020). There is no comprehensive study that discusses the changeable features with the potential to explain the success of high school physics course in the literature.

Considering other studies on physics teaching in Turkey, it has been observed that the effects of different methods or techniques on student achievement have often been investigated. Experimental studies, in which models, methods or techniques are tried to increase the effectiveness of physics teaching or physics learning level (Kert & Tekdal, 2008; Can Şen, 2010; Baran, 2011; Başkan, 2011; İrven, 2011; Gürbüz, 2012; Orçan, 2013; Tekin, 2013; Çopur, 2014; Korsacılar, 2014; Büyükbayraktar Ersoy, 2015; Yaşar & Baran, 2020; Karakaş & Özerbaş, 2020), were often conducted at the secondary school, high school and undergraduate levels. In addition, there are studies examining the effects or mutual relationships of affective and cognitive student characteristics on the success of physics course at different grade levels (Sezgin Selçuk, 2004; Çalışkan, 2007). There is no study that handled academic self-concept and high school physics course in Turkey in the literature. Students' attitudes towards the physics course (Uz & Eryılmaz, 1999; Büyükkara, 2011; Yeşildal, 2012; Akbulut, 2013) appear to be the most frequently studied affective feature. However, academic self-concept explains the relationship between the student's attitude towards a particular subject and herself, and school success alone. Thus, it can be said that there is a lack of study related to academic self-concept in the physics course.

Considering the studies conducted around the world, it is seen that studies testing new curricula and new teaching methods (Hanze & Berger, 2007; Lawrenz et al, 2009; Ketola, 2011; Winter, 2013; Scott, 2016; Liliarti & Kuswanto, 2018; Jax, Ahn, & Lin-Siegler, 2019; Zhai, Li, & Chen, 2019; Batlolona, Diantoro, Wartono, & Leasa, 2020) for increasing the learning level of students and their academic success in the physics course are common. In addition, studies that aim to determine the variables that predict or are related to academic achievement, and to reveal their predictive strength in the physics course are carried out (Sjoberg, 2000; Blickenstaff, 2004; Lawrenz et al., 2009; Götz et al., 2010; Dupe, 2013; Akanbi, Omosewo, & Ilorin, 2018; Binder, Sandmann, Sures, Friege, Theyssen, & Schmiemann, 2019; Qazdar, Er- Raha, Cherkaoui, & Mammass, 2019). While Lawrenz et al. (2009) dealt with cognitive entry behaviors and attitude towards the course from affective entry characteristics, Götz et al. (2010), Hanze and Berger (2007), and Dupe (2013) addressed academic self-concept from affective entry behaviors. Blickenstaff (2004) and Ketola (2011) investigated the level of physics course learning by considering the variables of the teaching-learning process. Akanbi, Omosewo, and Ilorin (2018) investigated the predictive strength of teacher qualifications, teacher experience, and participation in laboratory studies in physics course success and concluded that these variables were effective in predicting physics course success. Binder et al. (2019) tried to determine the relationship between success in the physics course and pre-learning and knowledge types, and they determined that pre-learning, knowledge of principles and concepts, and application of knowledge in problem-solving are related to physics success. The most important common point of the studies investigated is that they were made to reach the findings that will increase the level of physics learning.

It is observed that variables related to previous achievements, academic self-concept, and instruction come to the fore among the variables that affect learning physics in the literature. It can be said that it is a necessity to investigate the variables that are open to change and may have the power to predict the learning level to increase the learning level. Determining the sources of the variance in the physics learning level, which is observed to be low according to the national and international exam results, will shed light on the measures to be taken to increase the learning level. This comprehensive study was conducted to address cognitive entry behaviors, academic self-concept, student perception of the quality of teaching service, and the time allocated to learning.

Significance of Study

Basic physics knowledge is important for individuals who will advance in this field in the following years of education to be able to produce and transfer information to technology as well as facilitating daily life. Considering the results of the international and national exams in the field of science and physics, it is possible to say that the level of physics learning is very low. It is necessary to investigate the variables that affect physics learning and to determine to what extent which variables affect physics learning to increase the level of physics learning. It is thought that it will be possible to improve the quality of these variables and increase the level of physics learning by determining whether the levels of gaining cognitive entry behaviors, academic self-concept, perception of the adequacy of the teaching service, and the time allocated to learning differ significantly according to school achievement levels and determining the predictive power of physics lesson learning level. Thus, it is thought that the results of the study will contribute to the studies aimed at increasing the learning level of the physics course. Considering the fact that physics course has the lowest level of success in the field of science in national and international exam results and that physics lesson is defined as one of the most difficult lessons in the teaching-learning process in the literature, it can be said that this study is of great importance. It is thought that the results of the study will help students to be more successful and teachers to understand the importance of organizing qualified learning environments about what they should do to make their students more successful.

Purpose of the Study

The primary of this study is to determine the predictive strength of cognitive entry behaviors, academic self-concept, the adequacy of teaching service, and the time allocated to learning on the physics learning level. The secondary aim is to determine whether these variables show significant difference based on school success level. Therefore, the answers to the following questions were sought:

1. What is the predictive strength of the student's level of acquisition of cognitive entry behaviors, academic self-concept, perception of teaching service adequacy, time allocated to learning on the physics learning level?
2. Do students' level of acquisition of cognitive entry behaviors, academic self-concept, perception of teaching service adequacy, time allocated to learning, and learning level change based on their school success level?

Method

The survey model was used in this descriptive study. Because the main aim of this study was to see and describe what is the predictive strength of the student's level of acquisition of cognitive entry behaviors, academic self-concept, perception of teaching service adequacy, time allocated to learning on the physics learning level. Study approaches aiming to describe a situation in the past or still existing are named the survey model (Karasar, 2005). This study was conducted as a correlation survey since the aim was to determine the existence and level of change between independent variables with the quantitative data obtained to answer to the study problem (Karasar, 2005).

Study Group

The study group from which data will be collected was determined using the purposive sampling method in line with the aim of this study. The study determines the most suitable group for the aim of the study by using his/her own judgment in the sampling (Balcı, 2013). The study group was selected among the 9th grade students in the public schools affiliated with the MEB in Ankara, Turkey.

The reason for selecting Ankara was that the secondary schools in the city had different success levels according to the high school entrance exam scores, and their mean scores reflected Turkey's mean. In addition there were different types of school in the city center and districts, socioeconomic levels varied, and the numbers of students and teachers were sufficient for the study (TÜİK, 2014; MEB, 2014). Other reasons for choosing Ankara are the ease of transportation, and its being economic in terms of time and costs.

The reasons for choosing the 9th grade students were that the physics course was included in the 9th grade curriculum as a separate discipline for the first time, the Physics Curriculum including the same basic physics topics in all types of schools, and no selection for a field was made regarding the university placement exam in this grade. It was thought that since the students taking the physics course, choose the field of Science and Mathematics field (11th and 12th grade in the field of SM), it would have the risk of being homogeneous in terms of both learning level and academic self-concept in a study to be conducted after the field selection.

Types of schools were considered a determinant measure for the selection of the study group. Vocational and Technical high schools and Religious Education high schools are excluded from the study as they provide vocational education. Special Education Vocational High Schools were also excluded as they provide education to individuals with special needs. The study was carried out with the 9th grade students studying in the general secondary education institutions in Ankara, Turkey.

Considering the distribution of 152 general secondary education institutions in Ankara by districts, the district of Cankaya came first with 32 general high schools followed by Yenimahalle district with 23 general high schools, and Kecioren and Mamak districts with 14 general high schools each. Eighty-three high schools located in the Cankaya, Yenimahalle, Kecioren, and Mamak districts were listed based on the TEOG (Transition from Basic Education to Secondary Education) placement base points from top to bottom to maximize the heterogeneity of the study group. The schools were separated into the upper (21 schools at the top of the list), middle (41 schools in the middle) and lower (21 school at the bottom of the list) success levels. A total of 7 schools including 2 from the schools at the upper success level, 3 from the schools at the middle success level, and 2 from the schools at the lower success level, were selected for the study group equipotently. Two or four classes from the

9th-grade classes in 7 schools were selected equipotently, and the students in these classes were included in the study group. The study group included 621 9th grade students from 22 classes in seven schools including two at the upper and lower success levels each, and three at the middle success level based on the TEOG placement base points among the general high schools in Cankaya, Yenimahalle, Kecioren, and Mamak districts.

Data Collection Tools

Five tools were used to collect data in this study. Data collection tools were developed by the researcher in line with the aim of the study. Validity and reliability studies of all data collection tools have been carried out and these tools have been proven to be valid and reliable. Detailed information about the data collection tools is presented in subtitles.

Cognitive Entry Behaviors (CEB) Test

The aim of the cognitive entry behaviors test is to determine the level of reaching the prerequisite targets for the 9th-grade physics course. The scope of the test is limited to 5th, 6th, 7th, and 8th grade Science units that are prerequisite targets for Substance and Properties, Force and Motion and Energy units in the 9th grade physics course. The item discriminant power of 34 items in the CEB test changed between 0.27 and 0.68 while their item difficulty indices changed between 0.28 and 0.80. Considering the option analyses, all distractors of 34 items functioned. Two items (Item No: 33 and 45) with the discriminative power index below 0.30 were corrected based on the distractors. The KR reliability coefficient of the test is 0.83 indicating that the test is highly reliable.

The application duration of the test was 40 minutes. The items are coded as zero for incorrect answers and one for correct answers. The minimum score that can be obtained from the test is zero while the maximum score is 34. Low scores obtained from the test refer to the lack of cognitive entry behaviors while high scores indicate that the deficiency in the cognitive entry behaviors is small.

Academic Self-concept (ASC) Scale

The Academic Self-Concept in Physics Scale developed by Şen Akçay and Senemoloğlu (2020) was used to determine the academic self-concept of high school students regarding physics. Chronbach's alpha reliability coefficient of the ASC scale including 12 items about positive and negative ASC is 0.82 and the total variance it explains is 48.15%. The application duration of the scale is 10 minutes.

The items are coded between 1 and 4, and the total score is calculated by reverse scoring the negative items. The lowest possible score in zero while the highest possible score is 48. High total scores refer to high level of ASC about physics course. Scores between 0-12 indicate low level of ASC while scores between 13-35 indicate moderate level of ASC, and the scores between 36-48 indicate high level of ASC.

Perception of Teaching Service Adequacy (PTSA) Scale

The PTSA was developed by the researchers to determine the perceptions of high school students about teaching service adequacy in physics lessons. It consists of 24 items and explains 56.512% of the total variance. Of the 24 items in PTSA, 10 items form the "participation" factor (Cronbach Alpha: 0.90), 8 form the "clue/hint" factor (Cronbach Alpha: 0.89), and 6 form the "reinforcement-correction" factor (Cronbach Alpha: 0.81). Stratified alpha coefficient of the three-factor scale including 24 items was calculated and found as 0.95. The correlation coefficients of the factors were found as $r_{\text{participation-clue/hint}}=0.73$, $r_{\text{hint-reinforcement}}=0.65$ and $r_{\text{reinforcement-participation}}=0.64$, and the correlations between the factors were significant ($p<.01$). The application duration of the scale is 20 minutes. The total score is calculated by coding the items between 4 and 0. The lowest score possible score is zero while the highest possible score is 96. High scores refer to high level of perception about teaching service adequacy for physics course. The scores obtained from the scale are interpreted as follows; 0-24 as low, 25-71 as moderate, and 72-96 as high.

Time Allocated to Learning (TAL) Form

The TAL form was developed by the researchers to determine the time students allocate for physics learning in a year. The scale has 10 items and aims to determine the individual time allocated to physics including preparation for the course, revising after the course, and the time allocated to physics learning in school courses, training centers, special courses and getting help from relatives. The application duration of the scale is 10 minutes. The individual (TAL-I) and supported (TAL-S) time allocated to physics learning in an academic year is calculated in hours by adding up the students' answers. The lowest possible score in zero while the highest possible score is not specific as the questions are open-ended. High scores on individual and supported studying show that the time allocated to physics learning is high.

Learning Level (LL) Test

The aim of the LL test is to determine the level of reaching critical targets of 9th grade physics course. The scope of the test is limited to the Substance and Properties, Force and Motion, and Energy units in the 9th grade physics curriculum. The item discriminant power of 34 items in the CEB test changed between 0.28 and 0.68 while their item difficulty indices changed between 0.25 and 0.76. Considering the option analyses, all distractors of 34 items functioned. Two items (Item No: 28, 29 and 42) with the discriminative power index below 0.30 were corrected based on the distractors.

The KR reliability coefficient of the test is 0.85 indicating that the test is highly reliable. The application duration of the test was 40 minutes. The items are coded as zero for incorrect answers and one for correct answers. The minimum score that can be obtained from the test is zero while the maximum score is 34. Low scores obtained from the test refer to low level of reaching the critical targets of the 9th grade physics course while high scores indicate high level of reaching the critical targets of the 9th physics course.

Data Collection

The study proposal and the measurement tools used in the study were presented to Hacettepe University Ethics Committee. The school list, which was decided to be suitable for practice by the ethics committee, was submitted to the Ankara Provincial Directorate of National Education Study and Development Unit (MONE-R&D) and the application permission was obtained. The application permission and the approved measurement tools were electronically sent to the schools in the study group by MONE-R&D.

The data collection tools developed by the researcher were applied to the 9th grade students in the study group in line with the aim of this study. Appointments were made for suitable course hours for the application of the scales with the administrators and physics teachers to collect the data in time. The applications were carried out by the researcher and in cases where the application was to be made in more than one class, assistant researchers supported the application process after getting informed about the aim, significance, and what should be paid attention to in the application of the scales. The students were informed about the aim and significance of the study and they were made to answer the data collection tools voluntarily. Optical forms were prepared to facilitate the application of tests and scales and the processing of the data, and the students were made to record their answers to the optical forms.

The first part of the data was collected using the CEB and ASC scales at the beginning of the fall semester. The second part of the data was collected using the PTSA scale, TAL form and LL test at the end of the spring semester. Since identity information including name and student numbers was not obtained during the data collection, the back covers of all measurements were numbered and the measurement tools were given to students in sets to determine the CEB, ASC, PTSA, TAL and LL scores of the same student. The measurement tools with the same number were given to each student during the applications at the beginning of the fall semester and at the end of the spring semester so that the data would be collecting enabling the researchers to know all scores of the same student.

Data Analysis

One-way variance analysis (One-Way ANOVA), simple linear regression and stepwise regression technique, one of the multiple regression analysis techniques, were used in the data analysis to obtain results in line with the aim of the study. Variance analysis is used to test hypotheses about the differences between two or more independent variables. The reason why variance analysis is used to determine the significance of the difference between variables in cases where there are more than two independent variables is that it enables determining the significant differences without increasing the margin of error (MacDonald and Headlam, 2008).

Regression analysis is used to calculate and predict the effect of an independent variable on a dependent variable and to model casual relationships (Cohen, Manion, & Morrison, 2007; MacDonald & Headlam, 2008). Multiple regression analysis is used to calculate the effect of more than one independent variable on a dependent variable (Cohen, Manion, & Morrison, 2007). The stepwise regression technique, where independent variables are automatically listed by the program based on their predictive strength of the dependent variable and placed in the regression equation, was used in this study (Tabachnick & Fidell, 2007).

Conformity of the Data to Regression Analysis

The necessary sample size (N) for the data to be included in the regression analysis was determined using the $N \geq 50+8m$ and $N \geq 104+m$ equations proposed by Green (1991) by taking the number of independent variables as m. The number of independent variables was 4 ($m=4$) in this study; thus, the smallest sample size for data to be suitable for regression analysis was 108 (Tabachnick & Fidell, 2007, p. 123). This precondition was ensured as the study group included 621 students.

Whether the assumptions that must be met to use multiple regression analysis was tested before the analysis (Cohen, Manion, & Morrison, 2007; Kalaycı, 2009). The indicators showing that the data of this study were suitable for multiple regression analysis are presented as follows:

1. Students were selected from schools at different success levels in different districts of Ankara so that the study group would be heterogeneous and reflect the general population even though equipotent assignments were made while forming the study group.
2. The data were collected using the measurement tools developed within the scope of this study. The TAL form was developed uniformly while other measurement tools were developed at equal intervals. The scores obtained from all measurement tools are expressed in real numbers.
3. Extreme values were determined for all data collected within the scope of the study and were excluded from the study.
4. The literature was reviewed in detail, the characteristics were defined with direct indicators, and expert opinion was obtained at every stage to prevent errors arising from the characteristic to be measured. The reliability of the measurement tools was ensured for errorless measurements. The lowest reliability coefficient among the measurement tools used was calculated as 0.82. The data were mostly collected by the researcher to prevent errors arising from the person making the measurement. When the help of assistant researchers was needed in the data collection process, the points to be considered during data collection were explained to the assistant researchers in detail.
5. Skewness and Kurtosis coefficients of mean, standard deviation, and data distribution on CEB, ASC, PTSA, TAL (TAL-I and TAL-S), and LL variables that were planned to be included in the regression analysis were calculated. The skewness and kurtosis coefficients of all variables were in the +1 range except for the scores on time allocated to support learning. It was determined that the data were close to normal distribution and presented in Table 3.
6. It was determined that binary correlations calculated among the variables that were planned to be included in the regression were between -.90 and .90 (see Table 4). The fact the correlation coefficients were between -.90 and .90 indicates that there was no multicollinearity between the variables.

It can be stated that CEB, ASC, PTSA and TAL-I variables were suitable for the regression analysis performed to measure these variable predictive strength of LL. Therefore, variance analysis and regression analysis were not performed for the data on TAL-S. Advanced statistical analyses were made using only the TAL-I data about the time allocated to learning.

Table 3. Information on the CEB, ASC, PTSA, and LL Variables (n=621)

Variables		Arithmetic mean ($\bar{X}$)	Standard deviation (ss)	Coefficient of Skewness	Coefficient of Kurtosis
Cognitive Entry Behaviors (CEB)		23.24	5.78	-.360	-.351
Academic Self-Concept (ASC)		32.84	8.053	-.497	.245
Perception of Teaching Service Adequacy (PTSA)		51.76	21.77	,076	-.579
Time allocated to learning (TAL)	Individual (TAL-I)	86.18	66.76	.894	.431
	Supported (TAL-S)	25.91	42.66	2.095	5.614
Learning Level (LL)		20.69	5.76	-.010	.707

Results

In the study, it was tried to determine whether the student's level of acquiring cognitive entry behaviors, academic self-concept, perception of teaching service adequacy, and the predictive strength of the time spent learning physics courses, learning level and whether the variables studied differ according to school achievement levels. To ensure meaningful integrity, the findings and study questions are presented in order.

To reveal the predictive power of the student's level of gaining cognitive entry behaviors (CEB), academic self-concept (PTSA), perception of teaching service adequacy (AES) and the individual time allocated to learning (TAL-I), the level of physics lesson learning (LL), first of all, CEB, Arithmetic mean and standard deviation values of ASC, PTSA and TAL-I scores were calculated. These values were presented in Table 4.

Table 4. Values of CEB, ASC, PTSA and TAL-I Scores

Variable	N	$\bar{X}$	sd	Minimum score	Maximum score
CEB	621	23.24	5.78	0	34
ASC	621	32.84	8.05	0	48
PTSA	621	51.76	21.77	0	96
TAL-I	621	86.18	66.76	0	-

In Table 4, it is seen that the point average of the CEB of 621 students in the study group is 23.24 and the standard deviation of the scores is 5.78, the average of the ASC scores is 32.84, the standard deviation of the scores is 8.05, the average of the PTSA scores is 51.76, the standard deviation of the scores is 21.77 and the average of the TAL-I scores is 86.18 and the standard deviation of the scores is 66.76. Relationships between the variables of CEB, ASC, PTSA, TAL-I and Learning Level (LL) were determined by calculating the Pearson correlation coefficient and presented in Table 5 with their significance levels.

When Table 5 is examined, it is seen that the correlations between the learning level of the dependent variable and the independent variables are significant (p<.01). The relationship between CEB and LL is significant, positive, and strong (R=.774, p<.01); The relationship between ASC and LL is significant, positive, and moderate (R=.426, p<.01); The relationship between PTSA and LL is significant, positive, and moderate (R=.414, p<.01); The relationship between TAL-I and LL is significant, negative, and very weak (R= -. 169, p<.01).

Table 5. Correlations between CEB, ASC, PTSA, TAL-I and LL (N=621)

Variables	LL	CEB	ASC	PTSA	TAL-I
Learning Level (LL)	1.000				
Cognitive Entry Behaviors (CEB)	.774*	1.000			
Academic Self-Concept (ASC)	.426*	.442*	1.000		
Perception of Teaching Service Adequacy (PTSA)	.414*	.378*	.217*	1.000	
Individual Time Allocated to Learning (TAL-I)	-.169*	-.153*	-.095*	.012	1.000

**p<.01*

While determining the regression between the predictive variables and the learning level, firstly, simple linear regression analysis was performed by considering the variables one by one. The results of the simple linear regression and the regression analysis of variance between the predictive variables CEB, ASC, PTSA, and the predicted variable LL are given in Table 6.

Table 6. Simple Linear Regression and Analysis of Variance between Predictive Variables

Variables	R	R^2	se	F	p
CEB	.774	.599	3.655	924.85	.000*
ASC	.426	.181	5.223	137.04	.000*
PTSA	.414	.171	19.840	127.87	.000*
TAL-I	-.169	.029	5.690	18.21	.000*

**p<.01*

Table 6 shows that 59.9% of the variability in learning level can be explained by cognitive entry behaviors, 18.1% of the variability in learning level with academic self-concept can be explained, 17.1% of the variability in learning level can be explained by the perception of teaching service adequacy and 2.9% of the variability in learning level can be explained with individual time allocated to learning. It is seen that the results of the variable analysis between CEB and LL (F=924.85, p<.01), ASC and LL (F=137.04, p<.01), PTSA and LL (F=127.87, p<.01) and TAL-I and LL (F=18.21, p<.01) are meaningful and that every single CEB, ASC, PTSA and TAL-I variable are a meaningful predictor of the learning level.

These findings show that cognitive entry behaviors are strong enough to explain more than half of the variability in learning level, academic self-concept and perception of teaching service adequacy are strong enough to explain the variability in learning level significantly, and individual time allocated to learning is strong enough to explain a small part of the variability in learning level.

After the simple linear regression analysis in which the predictive variables were considered one by one, stepwise regression analysis, one of the multiple regression analysis techniques, was performed by taking all variables together. The results of the variance analysis result of the stepwise regression analysis and the scalar regression analysis between CEB, ASC, PTSA, TAL-I and LL are given in Table 7.

Table 7. Stepwise Regression and Analysis of Variance between Predictive Variables

Step	Predictive Variable (s)	*R*	R^2	se	F	*p*
1	CEB	.774	.599	3.65	258.92	.000*
2	CEB, PTSA	.785	.616	3.57		
3	CEB, PTSA, ASC	.790	.624	3.54		
4	CEB, PTSA, ASC, TAL-I	.792	.627	3.53		

*$p<.01$

When Table 7 is examined; It is seen that 62.7% of the variability in learning level can be explained by using cognitive entrance behaviors, academic self-concept, perception of teaching service adequacy and individual time variables allocated to learning (R^2 =.627). The predictive strength obtained from the stepwise regression analysis between CEB, ASC, PTSA, TAL-I and LL was significant (F=258.92, p<.01).

This result shows that cognitive entry behaviors as the strongest predictor explaining 59.9% of the variability in learning level (R = .774, R^2=.599). It is seen that the increase in the multiple correlation coefficient and therefore the increase in the regression coefficient is not much when the PTSA, ASC, and TAL-I variables, respectively, are included in the equation (R=.792, R^2=.627). Cognitive entry behaviors alone have the power to explain the variability in learning level as well as almost all other variables.

To reveal whether the student's level of acquisition of cognitive entry behaviors (CEB), academic self-concept (ASC), Perception of Teaching Service Adequacy (PTSA), individual time allocated to learning (TAL-I) and learning level (LL) differ according to school achievement levels. First, arithmetic average and standard deviation values of CEB, ASC, PTSA, TAL-I and LL scores were calculated according to school achievement levels. These values were presented in Table 8.

According to Table 8, the average of the scores obtained from the CEB test of the students studying at upper achievement level is 28.95; The average of the scores obtained from the CEB test by the students studying in upper achievement level high schools is 22.42, and the average of the scores from the CEB test of the students studying at low achievement level is 18.84. The average of the scores of all students (N = 621) in the study group is 23.24. Cognitive entry behaviors, which are a prerequisite for achieving ninth grade physics course goals, have 85% of high-achieving high school students, 66% of middle-achieving high schools, and 55% of low-achieving high school students. All students in the study group have 68% of cognitive entry behaviors.

According to Table 8, the average of the scores obtained from the ASC scale of the students studying at upper achievement level is 37.18; The average of the scores obtained from the ASC scale by the students studying at high school at middle achievement level is 32.87, and the average of the scores obtained by the students at lower achievement level from the ASC scale is 28.36. The average of ASC scores of all students (N = 621) in the study group is 32.84. It was determined that the academic self-concept of the students studying at upper achievement level high schools was *high* (36-48 points), and the academic self-concept of the students studying at middle and low achievement high schools was *medium* (13-35 points).

Table 8. Values According to School Achievement Levels

Variables	School Achievement Levels	N	$\bar{X}$	sd
Cognitive entry behaviors (CEB)*	High	169	28.95	3.19
	Moderate	286	22.42	5.08
	Low	166	18.84	4.05
	Total	621	23.24	5.78
Academic Self-Concept (ASC) **	High	169	37.18	6.38
	Moderate	286	32.87	7.88
	Low	166	28.36	7.43
	Total	621	32.84	8.05
Perception of Teaching Service Adequacy (PTSA) ***	High	169	67.78	16.30
	Moderate	286	47.55	20.81
	Low	166	42.70	19.66
	Total	621	51.76	21.77
Personal Time Allocated to Learning (TAL-I) ****	High	169	71.75	59.93
	Moderate	286	85.91	68.14
	Low	166	101.32	68.01
	Total	621	86.18	66.76
Learning level (LL)*	High	169	24.47	3.38
	Moderate	286	20.56	4.26
	Low	166	15.03	3.93
	Total	621	20.69	5.76

**Score range for CEB and LL tests: 0-34; **Score range for ASC scale: 0-48; ***Score range for PTSA scale: 0-96; ****Score range for TAL-I form: 0-∞.*

According to Table 8, the average of the scores obtained from the PTSA scale of the students studying in upper achievement level is 67.78; The average of the scores obtained from the PTSA scale by the students studying at high school at middle achievement level is 47.55, and the average of the scores obtained from the PTSA scale by the students at the lower achievement level is 42.70. The average of PTSA scores of all students (N = 621) in the study group is 51.76. It was determined that the Perception of Teaching Service Adequacy of the students studying in high, middle, and low achievement level high schools was *medium* (25-71 points). According to Table 8, the average of 169 ninth grade students studying in upper achievement high schools obtained from the TAL-I form is 71.75; The average TAL-I scores of 286 ninth grade students studying at middle achievement level high schools is 85.91, and the average of TAL-I scores of 166 ninth grade students studying at lower achievement high schools is 101.32. The average of the ÖAZ-B scores of all students (N = 621) in the study group is 86.18.

To reveal whether the students' CEB, ASC, PTSA, TAL-I and LL scores differ according to their school achievement levels, the obtained data were analyzed by analyzing variance. Since the number of groups to be compared is more than two and the scores of the groups obtained from the same test will be compared, one-way ANOVA was used as a variance analysis method for unrelated samples. Multiple comparison tests were conducted to determine between which groups the differences or differences existed. To determine the multiple comparison test, Levene's test was conducted for every variable. In cases where variances were homogeneous (*p*>.05), Scheffe multiple comparison test was preferred to determine the difference between groups. In cases where the variances were not homogeneous (*p*<.05), the Dunnett C multiple comparison test, which gives more effective results in determining the difference between the groups, was preferred, considering the increase in the probability of the first type of error due to the difference in the number of observations in the groups. One-way variance analysis results and multiple comparison results of CEB, ASC, PTSA, TAL-I and LL scores according to school achievement levels are presented in Table 9.

Table 9. Results According to School Achievement Levels

Variables	Source of the Variance	KT	sd	KO	F	*p*	Difference
Cognitive Entry Behaviors (CEB)	Intergroup	8905.15	2	4452.57	232.91	.000*	All pairs
	Intragroup	11814.09	618	19.11			
	Total	20719.25	620				
Academic Self-Concept (ASC)	Intergroup	6526.75	2	3263.37	59.88	.000*	All pairs
	Intragroup	33676.46	618	54.49			
	Total	40203.21	620				
Perception of Teaching Service Adequacy (PTSA)	Intergroup	62044.16	2	31022.08	82.65	.000*	All pairs
	Intragroup	231954.04	618	375.33			
	Total	294000.20	620				
Individual Time Allocated to Learning (TAL-I)	Intergroup	73279.81	2	36639.90	8.41	.000*	High-Low
	Intragroup	2690259.98	618	4353.17			
	Total	2763539.80	620				
Learning Level (LL)	Intergroup	10963.58	2	5481.79	350.39	.000*	All pairs
	Intragroup	9668.28	618	15.64			
	Total	20631.86	620				

**p<.01*

When Table 9 is examined, variance analysis results according to school achievement levels, CEB ($F_{(2,618)}$=232.91, *p*<.01.), ASC ($F_{(2,618)}$=59.88, *p*<.01.), PTSA ($F_{(2,618)}$=82.65, *p*<.01.), TAL-I ($F_{(2,618)}$=8.41, *p*<.01.) and LL ($F_{(2,618)}$=350.39, *p*<.01) points show a significant difference.

It is seen that the difference between upper and middle achievement level schools in Cognitive Entry Behavior (CEB) test scores is in favor of upper achievement level schools, and the difference between middle and low achievement level schools is in favor of middle achievement level schools. Looking at the average CEB score ($\bar{X}_{upper}$=28.95, $\bar{X}_{middle}$=22.42, and $\bar{X}_{lower}$=18.84); It was determined that the students studying at upper achievement level schools acquired the cognitive entry behaviors at the upper level compared to the students studying at the schools with middle and lower achievement level, and the students studying at middle achievement level schools have higher cognitive entry behaviors than the students studying at low achievement schools.

In Academic Self-concept (ASC) scale scores, it is seen that the difference between upper and middle achievement level schools is in favor of upper achievement level schools, and the difference between middle and low achievement level schools is in favor of schools with middle achievement level. Looking at the average score of ASC ($\bar{X}_{\text{upper}}$=37.18, $\bar{X}_{middle}$=32.87, and $\bar{X}_{lower}$=28.36); It has been determined that the students studying at upper achievement level schools have higher academic self-concept than the students studying at middle and low achievement schools, and the students studying at middle achievement level schools have higher academic self-concept than the students studying at low achievement schools.

It is seen that the difference between upper and middle achievement level schools is in favor of upper achievement level schools, and the difference between middle and low achievement level schools is in favor of middle achievement level in the scores of the Perception of Teaching Service Adequacy (PTSA) scale. Considering the average scores of PTSA ($\bar{X}_{upper}$=67.78, $\bar{X}_{middle}$=47.55, and $\bar{X}_{lower}$=42.70); It has been determined that the students studying at upper achievement level schools have higher perceptions of the adequacy of the teaching service than the students studying at middle and low achievement schools, and students studying at middle achievement level schools have higher perceptions of the adequacy of the teaching service than the students studying at low achievement level schools.

It is seen that the difference between the upper and lower achievement level schools between Individual Time Allocated to Learning (TAL-I) scores is in favor of lower achievement level schools. Considering the average scores of TAL-I ($\bar{X}_{\text{upper}}$=71.75, and $\bar{X}_{lower}$=101.32); It has been determined that students studying at schools with lower achievement levels spend more time learning individually than students studying at higher achievement schools.

It is seen that the difference between the upper and middle achievement level schools in Learning Level (LL) test scores is in favor of the higher achievement level schools, and the difference between the middle and lower achievement level schools is in favor of the schools at the middle achievement level. Looking at the average score of the LL ($\bar{X}_{upper}$=26.47, $\bar{X}_{middle}$=20.56, and $\bar{X}_{lower}$=15.03); It has been determined that the students studying at upper achievement level schools have a higher learning level than the students studying at middle and low achievement schools, and students studying at schools middle achievement level more than students studying in low achievement level schools.

Discussion

According to the results of this study on CEB; Cognitive entry behaviors, which are a prerequisite for achieving the goals of 9th grade physics course, have 85% of upper achievement high school students, 66% of middle achievement high school students, and 55% of low achievement high school students. All students in the study group have 68% of cognitive entry behaviors. Students who study in upper achievement schools have a higher level of cognitive entry behaviors than students studying at schools with middle and lower achievement, and middle achievement level students have a higher level of cognitive entry behaviors than students studying at schools with low achievement level. Cognitive entry behaviors have the power to explain the variability in learning level by 59.9%. This result shows that cognitive entry behaviors are strong enough to explain more than half of the variability in learning level.

It is important to reduce the variability in the learning level by identifying and completing the deficiencies in cognitive entry behaviors in courses that have a strong relation of progressiveness, that is, the behaviors that must be learned as a prerequisite for learning a unit, are built on each other, and the relationships between goals are strong (Senemoğlu, 2018). In physics courses, the subjects progress as being the continuation of each other. In addition, a hypothesis / theory / law used in any sub-branch of physics is also used in other sub-branches. Therefore, in learning physics lesson, previously learned subjects should be remembered for new subjects (Öztürk & Yıldız, 2015).

In courses that are at the beginning of a progressive series and can be learned especially in school, the strongest predictor of the learning level is the duration of the course, and in the courses at the end of the progressive series, the cognitive entry behaviors related to the lesson (Senemoglu, 1989). When the findings obtained in this study and the results of previous studies (Bloom, 1976; Lawrenz et al, 2009; Öztürk & Yıldız, 2015; Salar & Uğurel, 2020; Taslidere, 2020) are considered together, it can be said that it is important to reduce the variability in cognitive entry behaviors in order to decrease the variability in learning level in a physics lesson, which is a field with a strong relationship with progressiveness.

According to the results of this study regarding ASC; While the students who study at high-achievement high schools start their 9th grade, their academic self-concept regarding physics lessons is high, and the academic self-concept of the students who study at middle and low achievement level high schools is medium. According to the scores obtained from the ASC scale, it has been revealed that the academic self-concept of the students at the beginning of the 9th grade varies according to their school achievement level. The academic self-concept of the students studying at upper achievement level schools is higher than the students studying at middle and low achievement schools, and students studying at middle achievement level schools have more academic self-concept than the students who study at low achievement level schools. Since school achievement levels in this study are determined according to the OGES scores of the schools, the change in academic self-concept according to the school achievement level can be interpreted as changing according to the previous achievements. Although academic self-concept is fed by previous achievements, it also carries motivational features that have the power to make a change in subsequent success (Byrne, 1984). Senemoğlu (2018) emphasizes that academic self-concept is based on the learning background of the student. Bloom (1976) states that for students to learn better, they should have affective entry characteristics and that students should have a taste of success to achieve this. Because students who feel that they are successful or can be successful will have increased interest in new units and their attitudes will become more positive. Therefore, their belief in what they can achieve, in other words their academic self-concept will increase.

Calsyn and Kenny (1977), in their study investigating the causality relationship between academic self-concept and academic achievement, revealed that the causality of academic achievement in academic self-concept is quite dominant. Therefore, they argued that academic self-concept was primarily a result of previous academic achievements. Uz and Eryılmaz (1999) determined that the most important factors affecting attitudes towards physics courses are achievements in mathematics and previous achievements. Similarly, although Marsh's (1990) study supports the work of Calsyn and Kenny (1977), it was also revealed that causality is mutual between academic self-concept and success (Marsh, Byrne, & Yeung, 1999). According to Marsh (1990), the best way to increase academic self-concept is to develop stronger academic skills and ensure the academic success of students. Senemoglu (2018) states that for the development of academic self-concept, which will form the basis of future success, each child should be given responsibility to the extent of his / her own power to ensure success and ensure that he/she enjoys success. Academic self-concept has the power to explain 18.1% of the variability in learning level.

According to the results of this study regarding TS; Regardless of the school achievement levels, the perceptions of high school students about the adequacy of the teaching service are at a medium level. The perceptions of the students who study at upper achievement schools are higher than the students who study in middle achievement and lower achievement schools, the perceptions of the students who study at middle achievement schools are higher compared to the students who study at low achievement level. Although students' satisfaction with the teaching service varies according to their school success levels, it can be said that students think that the quality of the teaching service they receive is not sufficient. With this study, it can be stated that by determining the perception of the efficacy of teaching service has the power to explain the variability in learning level by 17.1%, it can be said that teaching service significantly affects the variability in student achievement.

The nature of the teaching service; In Bloom's theory, refers to the quality of the learning environment in the classroom, not the teacher qualifications or the physical facilities of the classroom. The most important variables that determine the quality of teaching service are signs, reinforcement, active participation, and feedback-correction (Bloom, 1976). To realize effective physics education, general teaching principles should be applied according to the characteristics of the course (Hammer, 1994). Teachers need to diversify and make their teaching methods qualified to reduce learning difficulties related to physics lesson and to prevent misconceptions that prevent meaningful learning. It is important to add the improvements in the field and the contribution of technology to the instructions (McDermott, 1993). Learning environments in which students construct their own meanings should be created by ensuring active participation, the time when the student is passive listeners should be minimized, and students should be allowed to gain first-hand experience by doing experiments. It is very important that students interact with each other, with other groups and with the teacher in the teaching-learning process (Blickenstaff, 2004).

The teacher plays an important role in creating an understandable and enjoyable physics course. More experiments and applications should be done in the instructions, and students should actively participate in the course (Alptekin, Demirbas, & Arikan, 2009). One of the most influential factors on student success is teacher dependent, ensuring the student's participation in teaching activities and keeping the student's active period long in the instructions (Brophy, 1986). Teachers are also perceived by students as the most important variable in their belief that they can be successful and their success, according to their families, peers and even their academic self-concept (Brookover, Thomas, & Paterson, 1964). When the report prepared by EARGED in 2010 to determine the achievement indicators of primary schools is inspected, the students see their teachers' competencies in the first place in evaluating school success (MEB, 2010).

According to the results of this study on TAL; the average of the time allocated *individually* for learning physics in an academic year is higher for the students studying at lower achievement level high schools compared to those studying at upper achievement levels. In other words, students studying in lower achievement schools spend more time learning physics individually than students studying at higher achievement schools. The relationship between the individual time allocated to learning and the learning level is negative, and the individual time allocated to learning has the power to explain the variability in learning level by 2.9%.

It is normal that the time required by students to learn a particular learning unit varies according to a number of criteria (Carroll, 1963). The academic learning time that each student should allocate to achieve high success is different from each other (Fisher et al., 1981). The students who devote relatively more time to studying are those in schools with low and middle achievement levels. Time devoted to learning is the time when the student turns towards the learning of the task and is actively trying to learn (Bloom, 1974). How the time allocated is used is more important than the time allocated to (Stallings, 1980). According to Gazioğlu's (2009) study, students' academic achievement in physics lesson is associated with their study habits, even if it is at a low level ($r = 0.33$). Therefore, it is thought that making the study habits that are related to the academic success of the students in physics can increase their success level.

It is necessary to focus on the reasons why students in lower and middle achievement schools in the study group of this study spend more time than higher achievement students, but their learning levels are lower. First of all, considering the high power of cognitive entry behavior deficiencies to explain the variability in learning level, it can be thought that students in low and middle achievement schools do not reach the level of students in upper achievement schools due to their CEB deficiencies even though they spend time to learn. On the other hand, for academic learning time to be effective, it should be considered that learning at school must have occurred at a certain level (Fisher et al., 1981). Senemoğlu (1989) determined the most powerful predictor of the teaching-learning process' characteristics as the duration of class attendance in her study conducted in undergraduate mathematics courses. It was determined that the duration of class attendance alone can explain the variability in learning level up to 50%. Since the school achievement levels are determined by considering the entrance base scores of high schools in this study, it can be said that the learning deficiencies of the students in schools with lower levels of success play an important role in their inability to increase their learning level despite spending more time to learn.

The rate of achieving the ninth-grade physics course goals is 72% for the students at high achieving high schools, 60% for the students at middle achievement high schools and 44% for the students at low achievement high schools. The rate of achieving the goals of the ninth-grade physics lesson is 61% for all students in the study group. The learning level of the students studying at upper achievement level schools is higher than the students studying at middle and low achievement schools, and the students studying at middle achievement level schools have a higher learning level than the students studying in low achievement level schools. It is not surprising that learning levels differ according to school achievement levels. Looking at the variables discussed in this study; It is expected that students who have the highest level of cognitive entry behaviors and academic self-concept, and who also have the highest level of satisfaction with the teaching service, have higher learning levels compared to others. As a result, it is possible to say that successful students continue to be more successful, and the success of students with low success gradually decreases.

Conclusion

As a result, the variability in learning level of ninth grade physics courses is strong enough to explain cognitive entry behaviors with 59.9%; academic self-concept with 18.1%; the perception of the adequacy of the teaching service with 17.1% and the individual time allocated to learning with 2.9%. Taken together, these variables have the power to explain 62.7% of the variability in learning level. Cognitive entry behaviors are the variable that have the highest predictive strength to predict the learning level, and they have the power to explain the variability in learning level alone, as well as with almost all other variables.

Students in upper achievement schools have a great deal of cognitive entry behaviors. Therefore, they start ready to achieve their ninth-grade physics course goals. In addition, these students begin to learn physics with high academic self-concept that is showing that they will be successful. Although they cannot get the education service they need fully, they benefit from the teaching service better than students in middle and lower achievement schools. Although they devote less time to studying physics individually than students studying at schools with lower achievement levels, their learning level is considerably higher than other students. This result supports the knowledge that the progressive relation of physics lesson is high and should be learned with guidance.

There are deficiencies in the cognitive entry behaviors of students in middle achievement schools. They are not fully prepared to achieve their ninth-grade physics course goals because of these deficiencies. Although their academic self-concept is low compared to the students in upper achievement schools and higher than the students in low achieving schools, it is at a middle level. They can get the education service they need less than students in high-achieving schools and more than students in low-achieving schools. The time they devote to learning physics courses individually is at a similar level with the students in high and low achievement schools. Therefore, at the end of the year, the level of learning physics lesson is higher than students studying at schools with lower achievement levels.

The cognitive entry behaviors of students in lower achievement schools are significantly deficient. For this reason, they are not ready to achieve their ninth-grade physics course goals, in other words to learn physics. At the same time, these students are not confident in themselves that they can be successful in physics course. On the other hand, compared to the students in upper and middle achievement schools, they cannot get the education service they need, and their learning level is quite low at the end of the year, although they spend more time studying for this course compared to the students with upper achievement level.

One of the most important results of this study is that the magnitude of the predictive power of cognitive entry behaviors on the learning level has been revealed. Success in physics lesson depends on a great extent on what must be learned beforehand. If step-by-step learning, which shows a progressive relationship, is not controlled and completed in this course it is not possible to expect students to be successful in the following stages. Another important result is that the relationship between the time spent by students individually to learn the physics courses and the learning level is negative, and students in low achievement schools fail despite spending more time on learning physics than students in schools with high levels of success. This shows that although the predictive of learning level's percentage of the time allocated to individual learning is low, physics is a course that is learned through a guide who is familiar with the subject, in other words, teacher's teaching efforts. Unless the individual efforts of the students are supported by a qualified teaching service, it does not seem possible to be successful in physics course. Without increasing the quality of the instructions, students' individual work shows that no matter how much time they spend, the time they spend is wasted. According to these results, cognitive entry behaviors should be determined and completed for success in physics course, and the teaching service should be organized in accordance with the needs of the student.

Recommendations

In line with the results of the study; First of all, teachers are advised to identify and complete the CEB deficiencies in the science course at the beginning of the academic year to reduce the variability in students' academic achievement in physics course and to increase their learning level. Cognitive entry behaviors require examining the new goals that will be gained by teachers and determining what the knowledge and skills students should have to achieve these goals. Before starting the teaching, it can be easily determined with quizzes or question-answer activities in the classroom and, if any, the deficiencies of the CEB can be corrected. Thus, teaching can be started ready to reach new goals.

It is recommended that teachers, school administrators and counselors work to increase the academic self-concept of students to reduce the variability in the academic success of physics course and to increase their learning level. Teachers need to make students taste success to gain academic self-concept and increase their academic self-concept. School administrators can contribute to increasing the academic self-concept of students by monitoring their success and supporting their success. Counselors may be suggested that students determine their beliefs about their own achievements and, when necessary, support them to increase their academic self-concept with field-specific studies and family collaboration.

It is recommended to teachers, school administrators and education faculties to carry out studies to increase the quality of teaching service to reduce the variability in students' academic achievement in physics course and to increase their learning levels. Teachers may be advised to organize the teaching process in line with the interests and needs of the students, to ensure the participation of students with remarkable activities, and to use the feedback and correction processes effectively. School administrators may be advised to enable and support teachers in organizing teaching. Education faculties, on the other hand, may be recommended to take measures to train teachers with knowledge and practical experience who can provide qualified teaching services.

Teachers are advised to support students 'learning efforts outside of their lesson periods to reduce the variability in students' academic achievement in the physics course and to increase their learning levels. Teachers can be suggested to guide students to spend the time they devote to learning individually, and to teach studying and learning strategies that are effective in physics lessons. In line with the results of this study; it may be suggested to new researchers to reconstruct this study carried out in physics lesson in other lessons and class levels, and to determine other variables that are effective in learning, and to conduct predictive power studies that will provide valid and reliable evidence to reduce the variability in learning level.

Notes

This study was based on parts of a dissertation titled, "Prediction Strength of Student and Teaching-Learning Processes on the Learning Level of 9th Grade Physics Course" by the first author. Zeynep Şen Akçay is the first and responsible author of this article.

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