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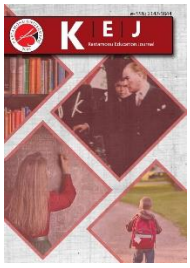

The Change of Students' Science Related Affective Characteristics over Years: The Comparison of PISA 2006-2015 Assessments

Türkiye'deki Öğrencilerin Fen Dersine Yönelik Duyuşsal Özelliklerinin Yıllar İçindeki Değişimi: PISA 2006-2015 Karşılaştırması

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Keywords

1. Science literacy
2.Affective characteristics
3. Enjoyment of science
4. Science self-efficacy
5. Science activities

Anahtar Kelimeler

1. Fen okuryazarlığı
2. Duyuşsal özellikler
3. Fenden zevk alma
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5. Fen etkinlikleri

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Abstract

Purpose: In this study, it was aimed to investigate the trend of the affective characteristics related to science literacy of the students who participated in PISA 2006 and 2015 assessments from Turkey based on their responses to the common items. In this regard, the characteristics measured by common items in both assessments, which are enjoyment of science, instrumental motivation, science self-efficacy, science activities, environmental awareness and optimism were discussed.

Design/Methodology/Approach: The sample of this research, that cross-sectional survey model was used, consisted of PISA 2006 and 2015 Turkey sample. Data analysis was carried out based on the common items in both assessments. The percentage distribution of the students' responses to the response categories of these items according to their years of assessment was summarized and was presented by comparative graphics. Whether there is a significant difference between the percentage distribution of students' responses to response categories according to the assessment years was analyzed by z test.

Findings: According to the results of the research, between 2006-2015 assessments it was observed that there was a decrease in the rate of students who enjoyed science and had high environmental optimism; however, an increase in the rate of students with high self-efficacy and high participation in science activities. On the other hand, no significant chance was observed in students' instrumental motivation. For the environmental awareness characteristics, increases and decreases were concluded depending on the context of the environmental problem.

Highlights: The results of this study revealed that there is not a trend with a specific pattern in students' science-related affective features over assessment years. This situation puts an emphasis for students to be competent in science literacy as they need it to understand society and nature better and determine the relationship with affective features.

Öz

Çalışmanın amacı: Bu çalışmada PISA 2006 ve 2015 uygulamalarına Türkiye'den katılan öğrencilerin fenle ilgili duyuşsal özelliklerindeki eğilimin ortak maddelere verilen tepkiler üzerinden karşılaştırmalı olarak incelenmesi amaçlanmıştır. Bu doğrultuda her iki uygulamada ortak maddelerle ölçülen fen öğrenmekten zevk alma, fen öğrenimine yönelik araçsal motivasyon, fenle ilgili öz yeterlik, fen etkinlikleri, çevresel konular hakkında farkındalık ve çevresel konular hakkında iyimserlik özellikleri ele alınmıştır.

Materyal ve Yöntem: Kesitsel tarama modelinin kullanıldığı bu araştırmanın örneklemini PISA 2006 ve 2015 Türkiye örneklemleri oluşturmaktadır. Buna göre araştırmanın örneklemi PISA 2006 ve 2015 uygulamaları için sırasıyla 4942 ve 5895 öğrenciden oluşmaktadır. Araştırma verileri 2006 ve 2015 PISA uygulamaları kapsamında toplanan verilerin ayıklanması ve düzenlenmesiyle elde edilmiştir. Verilerin analizi ortak maddeler üzerinden yürütülmüştür. Uygulama yıllarına göre öğrencilerin bu maddelere verdikleri tepkilerin tepki kategorilerine yüzdelik dağılımları özetlenerek bu bilgiler karşılaştırmalı grafikler kullanılarak sunulmuştur. Uygulama yıllarına göre öğrencilerin tepki kategorilerine yüzdelik dağılımları arasında manidar farklılık olup olmadığı z testi ile analiz edilmiştir

Bulgular: Araştırma sonuçlarına göre 2006-2015 uygulamaları arasında fenden zevk alan ve çevresel iyimserliği yüksek olan öğrenci oranlarında azalış, fen özyeterliği ve fen etkinliklerine katılımı yüksek olan öğrenci oranlarında artış olduğu görülmüştür. Diğer yandan öğrencilerin araçsal motivasyon özelliğinde manidar bir değişim olmadığı dikkati çekmiştir. Bunlara ek olarak çevresel farkındalığın, çevre sorununun bağlamına göre artış ya da azalış gösterdiği sonucuna ulaşılmıştır.

Önemli Vurgular: Bu çalışmanın sonuçları göstermiştir ki öğrencilerin fenle ilişkili duyuşsal özelliklerinde uygulama yılları arasında belirli bir örüntüye sahip eğilim bulunmamaktır. Bu durum doğanın ve toplumun daha iyi anlaşılması için öğrencilerin yetkin olması gereken fen okuryazarlığı alanındaki öğrenci performansının duyuşsal özelliklerle ilişkisinin kurulmasının önemini ortaya koymaktadır.

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INTRODUCTION

Comparability of the measurement results is as important as measuring learning outcomes in education. While having reliable and valid measurement results has always been a focus for measurement and evaluation process, obtaining comparable data gained importance by time; therefore, required different standards. It was the 1950's when researchers started to collect comparable data in order to match learning outcomes between states in the USA have begun. Objections to the studies which tried to collect data about student achievement and educational practices using standardized achievement tests had begun to increase through the mid 20 century. The main points of the criticism are that not every school has the same economical input, students' profile is different in every school, the main focus is only the measured content because of the concern of the high scores and they ignore the other content areas and such like. Additionally, due to the requirements such as the interpretation and use of the information provided by the standard achievement tests in different contexts, economies have started to apply large-scale tests. The first large-scale assessments started in the United States. The purpose of these studies was determined as collecting comparative data between states countries and using social dynamics in directing education policies (Kirsch, Lennon, Davier, Gonzales & Yamamoto, 2013). Thus, the educational levels of the countries can be determined, developed countries can be taken as an example in this sense, student achievement, which is getting more complex, can be measured in a more systematic and planned setting and how successful the education policies of countries are can be answered. Accordingly, First International Mathematics Study (FIMS) was conducted with 13 years old students from 11 countries in 1964 by International Association for the Evaluation of Educational Achievement (IEA). Later, First International Science Study (FISS) was held in 1970-1971 (Medrich & Griffith, 1992). These studies led to the first application of Trends in Mathematics and Science Study (TIMMS), which was conducted in 1995. In 1999, only eighth grade students participated to the TIMMS assessment (https://www.iea.nl/about/org/history#section-480). In the context of TIMMS assessments, which is carried out every four years, comparative data are collected from fourth and eighth grade students.

Programme for International Student Assessment (PISA) is one of the survey studies which is held by the Organization for Economic Co-operation and Development (OECD) every 3 years to collect comparable data between countries, to specify educational policies and to make determinations about the related variables. Within the context of PISA, fifteen-year-old students' reading literacy, mathematical literacy and science literacy are measured and various information about student, teacher, parents and school characteristics are collected. Every three year makes a cycle and each round focuses on a major domain, which is called a major domain. Various information related to the major domain are collected from students, teachers, parents and schools. The very first PISA assessment took place in 2000 (OECD, 2002). In 2003, which was the first assessment that Turkey participated, the focus was on mathematics, science in 2006, reading in 2009, mathematics in 2012, science in 2015 and reading in 2018 (OECD, 2004; OECD, 2006; OECD, 20010; OECD, 2013; OECD, 2017; OECD, 2019a). In each assessment, affective characteristics that are thought to be related to the major domain are evaluated together with the major domain. Science literacy has been the major domain only twice until today in 2006 and 2015 assessments, and affective characteristics related to science literacy have been measured only in these assessments (OECD, 2006; OECD, 2017).

When students' science literacy performances who participated from Turkey are examined, it can be said they show fluctuations over the years. Although the science literacy performances of 15-year-old students from Turkey increased gradually between PISA 2003-PISA 2012 rounds, a sharp decrease was experienced in 2015 assessments. There was an increase in science literacy performances again in PISA 2018. Science literacy average scores of students who participated from Turkey to PISA assessments increased (424, 454, 463) gradually since 2006, until PISA 2015 assessment that occurred with a big decrease (425) (Özgürlük, Ozarkan, Arıcı & Taş, 2016). In fact, according to the PISA 2015 results, there are no students for science literacy in proficiency level 6, which indicates the most sophisticated learning process of students, in the Turkey sample. The rate of students at the fifth level is only 0.3%. On the other hand, students who show low performance and are also below the second proficiency level performed little decrease (from 46,6 to 44,4) in PISA 2006 when the major domain was science literacy. Together with this, the increase in the student rates who performed at the first proficiency level or below from PISA 2012 to 2015 is quite large. When the distribution of students' science performances by their proficiency levels in PISA 2018 is examined, it is seen that the rate of students below the basic competence level of Turkey is above the OECD average, and the rate of students at the basic competence level and above is below the average (OECD, 2019b). Turkey ranked 33rd among 41 countries in 2003 in terms of international rankings in science literacy; 43rd among 57 countries in 2006; 43rd among 72 countries in 2009 and 2012; 51st among 72 countries in 2015 and 39th among 79 countries in 2018. In PISA 2018, it is seen that Turkey's science literacy average score increased again (468) and rose above the average (463) in the 2012 assessment, which is the highest average until then. Moreover, according to PISA 2018 results, the country with the highest increase in science literacy performance is Turkey (MEB, 2019). In the PISA 2018 assessment, it is seen that Turkey is one of the five countries that increased the average science literacy performance (OECD, 2019b). Based on these, it can be said that the science literacy performance of the students tends to increase except for the 2015 assessment. As PISA provides opportunities to the researchers by repetitive data collection procedures, it presents researchers a wide study area. PISA allows to relate the increase or decrease of students' achievement in a specific domain with the information collected within the context of the assessment. By this, it offers an opportunity to discover the trends of student achievement.

Today, science and science-based technologies have become essential not only for professionals, but also for being a party to many events and situations, and to carry out the process in the most beneficial way for themselves and for people around them. Now, the reason and solution of many problems at the global and local level can only be seen and solved by people who are educated in the field of science. For this reason, countries expect students who have completed secondary education to be "able to participate in conversations about science, present an idea and use technologies based on science". Current programs in science education recognize that having an understanding of science is very important and is a central element in the education of every young person (OECD, 2016). PISA measures students' science performance and their science knowledge in science-related issues in the processes of recognizing problems, acquiring new information, explaining scientific facts and making evidence-oriented conclusions (OECD,2019a). Science literacy, which is one of the subjects of international assessments, is defined as the ability to deal with ideas and issues related to science as an active citizen in PISA 2015 science literacy framework (OECD, 2016). Science literacy is important for individuals and nations, both nationally and internationally. Understanding the problems faced by humanity such as the danger of water shortage, epidemics, and slowing down global warming etc. and solving them can only be achieved by understanding the logic in science and natural phenomena and acquiring the necessary information. Actions that can be taken on an individual scale such as avoiding consuming genetically modified foods, eating healthy and balanced nutrition, paying attention to personal hygiene and reducing the production of non-recyclable waste can also be supported with science education. Making the right decision for human health in avoiding consuming genetically modified foods, eating healthy and balanced nutrition, paying attention to personal hygiene and reducing the production of non-recyclable waste and many other areas will be possible with the contributions of science and technology (OECD, 2017). Joss and Durant (1995) stated that young people should have a certain awareness in science in order to take part in solving problems in science and technology. For this, individuals do not need to become scientists. It will be enough for them to understand the social effects of discussions about science and natural events among experts and to be able to make the best decision for themselves and their environment. In this sense, considering the contributions of science literacy made to the personal, social and academic lives of the individuals, an awareness and understanding in the field of science and technology is important for the "readiness for life" of young people (OECD, 2017). Science literacy, as measured by PISA, refers to the student's knowledge of science, what she/he can do with her/his knowledge, and how she/he can use this knowledge in real life situations (OECD, 2016).

Based on the definition of science literacy, it can be said that students' science performance has an affective aspect. Students' attitudes or tendencies towards science can be considered as an indicator of their interests. In this way, students can be motivated to take action, take responsibility, etc. (Osborne, Simon & Collins, 2003; Schibeci, 1984). When the literature is examined, it can be seen that there are studies that students' academic success in general, science achievement in particular, is related to affective characteristics. Uzun, Gelbal and Öğretmen (2010) conducted a study where they modelled the relationship between science achievement and affective characteristics and concluded that students' science self-efficacy, attitudes towards science, the importance of science and classroom activities related to science are correlated with their science achievement. Attitude scores and self-efficacy scores of high school 2nd grade students towards chemistry courses are predictors of chemistry course performance according to the result of another research by Kan and Akbas (2006). Kazazoglu (2013) studied the relationship between attitude towards courses and academic achievement and found out that there is a relationship between these two variables. Denton and McKinney (2004) measured their students' interest, value, effort, perceived capacity, absence of pressure and belonging to friends and faculty over 2 years in their longitudinal study. Based on the results of that study, there is a positive relationship between each variable and the students' course scores. Şimsek and Demirtaşlı (2012) concluded that academic self-concept and students' university entrance scores are effective predictors of students' academic achievement. Lay, Ng and Chong (2015) investigated the relationship between students' mathematics and science achievement and their value and expectations based on TIMMS data. Results showed that students' positive values towards science and mathematics can be the main factors that forms the students' science and mathematics achievement. The findings of Glynn's (2007) study, which aimed to reveal the relationships between the affective characteristics of non-science students and their achievement in science, showed that students' science motivation had a direct effect on their science achievement. Students' motivation is associated with how much their careers are related to science. Singh, Chang, and Dika (2006) aimed to reveal the relationships between students' science achievement and many affective characteristics in their study, in which they investigated why students in the USA show lower performance in science than their classmates. In this context, attitude towards science, self-concept, motivation, interest and participation characteristics were analyzed with path analysis. The findings of the study revealed that students' affective characteristics are directly or indirectly related to their science achievement. Sikhwari (2007) studied student achievement with affective characteristics at the university level. Self-concept, motivation and attitude are affective characteristics selected for the study. The findings of the study show that the theoretically claimed relationships are empirically verified.

It is essential in large-scale assessments to make use of the maximum amount of information that can be extracted from the data with the help of advanced statistical techniques to benefit from the advantages of repetitive data collection. Test equalization techniques are used to be able to make the results of the assessments, which are conducted on certain times, comparable (von Davier, 2013). There are two options for researchers if they want to examine the trends in PISA assessments. These are either to study through common items or scaled indices. In this study, trends were studied through common items. The reason to decide

on this option is that the comments made based on a single index score do not give as detailed information as item-based analysis could. In addition, there might be different trends for different items in the same subscale, and the examination of trends based on index scores may not reflect these differences. When the literature is examined, it is possible to come upon studies that investigate students' tendencies. When those studies are examined, (Aloisi & Tymms, 2010; Hipkins & Cameron, 2018; OECD, 2010; OECD, 2019b), it can be seen that trends are often limited to cognitive domains. Additionally, trends in learning domains and changes in trends are frequently studied through total scores. In addition to this, it was observed that the tendencies in some affective characteristics of the students in addition to the cognitive domain were also examined through the 2000 and 2009 assessments data, where reading skills were considered as the major domain. In this context, the change in students' attitudes towards reading skills and their relationship with school was examined (OECD, 2010). On the other hand, it was observed that there has been no study examining the trends of 15-year-old students regarding students' the science-related affective characteristics through common items. With this study, it was thought that this gap in the literature can be closed.

In 2006 and 2015 PISA assessments, science literacy was the major domain. Various affective characteristics (interest in learning science, science self-concept, future oriented science motivation, general value of science etc.) that were thought to be related to students' science literacy performance were measured in those assessments. Those affective characteristics are known to be effective on science literacy performance (Fonseca, Valente & Conboy, 2011; Kjærnsli & Lie, 2011; Sun, Bradley & Ackers, 2012; Ozel, Caglak & Erdoğan, 2013). In this context, the aim of this study is to examine the trends in affective characteristics of students participating in PISA 2006 and 2015 from Turkey through analyzing common items. For this purpose, enjoyment of science, instrumental motivation, science self-efficacy, science activities, awareness of environmental issues and environmental optimism subscales, which are related to science literacy and measured in both assessments, were discussed. Research questions to be answered in this study are as follows:

1. How are students' distributions of response categories to the common items of the subscales which measure science related affective characteristics (enjoyment of science, instrumental motivation, science self-efficacy, science activities, environmental awareness and environmental optimism) in PISA 2006 and 2015 Turkey sample?

2. Do the students' distributions to response categories of the common items of these subscales differ significantly between PISA 2006 and 2015?

METHOD

Research Design

In this study, it is aimed to examine the trend in affective characteristics related to science literacy of students who participated in PISA 2006 and 2015 assessments from Turkey. It is survey research. Survey research studies are carried out on a group in the universe in order to define the various characteristics of individuals from the same universe. Research data are collected by asking questions to the individuals in this group (Fraenkel, Wallen & Hyun, 2012). The main purpose of survey research is to define the properties of the universe. It is a cross-sectional survey model since student characteristics were measured both in 2006 and 2015 years. In cross-sectional survey models, data are collected at a single point in time, regardless of the length of the data collection process.

Population and Sample

The population in PISA assessments is defined as the 15 years old students who continue their education. The accessible universe of the research consists of 782875 and 925366 students for 2006 and 2015 assessments, respectively (OECD, 2009; MEB, 2015). In PISA assessments, the sample is selected using the two-stage stratified sampling method. In this context, schools where 15-year-old students are educated are selected by taking into account various school characteristics such as size, location, and type firstly. Secondly, students in the 15-year-old age group studying at these schools are listed, and selected from the lists randomly. The PISA 2006 and 2015 Turkey samples consist of 4942 students in 160 schools (EARGED, 2010) and 5895 students in 187 schools (MEB, 2015), respectively.

Data Collection Tools

The data of this research consists of data collected from PISA 2006 and 2015 Turkey assessments via student surveys. OECD publishes PISA data, reports containing information on data collection tools and various documents related to assessments on its official website (https://www.oecd.org/pisa/). The data used in this study was downloaded from the official website of the institution and organized according to the research purpose. Since science literacy is the major domain in 2006 and 2015 assessments, student surveys include subscales that aim to measure science related affective characteristics. Science related affective characteristics measured in 2006 and 2015 assessments and their subscales are presented in Table 1.

Table 1. Science related affective characteristics measured in PISA 2006 and 2015 assessments

PISA 2006	PISA 2015
Interest and Enjoyment of Science Learning	**Science Interest**
Interest in Science Learning	*Enjoyment of Science*

Enjoyment of Science Learning	Interest in Broad Science Topics
Motivation to Learn Science	**Environmental Awareness and Optimism**
Instrumental Motivation to Learn Science	*Environmental Awareness*
Future-oriented Science Motivation	*Environmental Optimism*
Self-Related Cognitions in Science	**Science-Related Dispositions**
Science Self-Efficacy	*Science Self-Efficacy*
Science Self-Concept	Epistemological Beliefs about Science
Value of Science	St*udents' Science Activities*
General Value of Science	**Science Learning in School**
Personal Value of Science	Disciplinary Climate in Science Classes
Science-Related Activities	Inquiry-based Science Teaching and Learning Practices
Science Activities	Teacher Support in a Science Classes
Scientific Literacy and Environment	Teacher-directed Science Instruction
Awareness of Environmental Issues	Perceived Feedback
Perception of Environmental Issues	Adaption of Instruction
Environmental Optimism	*Instrumental Motivation*
Responsibility for Sustainable Development	
Science Career Preparation	
School Preparation for Science Career	
Student Information on Science Careers	
Science Learning and Teaching	
Science Teaching: Interaction	
Science Teaching: Hands-on Activities	
Science Teaching: Student Investigations	
Science Teaching: Focus on Models or Applications	

Common items measured in both 2006 and 2015 assessments were focused as the aim of this study is to examine the changes in affective characteristics related to science literacy by years. These characteristics, which are common in both assessments and are measured by scales with common items, are presented in italics in Table 1. Enjoyment of science, instrumental motivation, science self-efficacy, science activities, and environmental awareness and optimism are the names of these scales.

Various steps have been taken in the development processes to ensure the international validity of the scales. These steps are basing from the solid theoretical foundations of the psychological feature, composing items that are the indicators of the theoretical foundation, building consensus about the items, running both development and adaptation processes simultaneously, conducting field trials and analyzing psychometric properties, examining the conceptual significance of the scales with other variables and such like (OECD, 2009). Information on the subscales is presented below.

Enjoyment of Science: Enjoyment of science subscale was measured with the same scale consisting of five items in both assessments. Students were asked to indicate to what extent they agreed with the items given. The response categories of the items are 'strongly agree', 'agree', 'disagree' and 'strongly disagree'. The reliability coefficients of this subscale are 0.91 for PISA 2006 Turkey sample and 0.95 for PISA 2015 Turkey sample (OECD, 2009; OECD, 2017).

Instrumental Motivation: While instrumental motivation was measured with a five-item scale in PISA 2006, one of the items in the scale was removed in PISA 2015. Only two of four items remained same. Therefore, there are two common items for this subscale in 2006 and 2015 PISA. Students were asked to indicate to what extent they agreed with the items given. The response categories of the items are 'strongly agree', 'agree', 'disagree' and 'strongly disagree'. The Cronbach reliability coefficients of instrumental motivation are 0.91 for PISA 2006 Turkey sample and 0.90 for PISA 2015 Turkey sample (OECD, 2009; OECD, 2017).

Science Self-Efficacy: Science self-efficacy subscale was measured with the same scale consisting of eight items in both assessments. Students were asked to state their thoughts on how easy it would be to perform the tasks on their own. The response categories are "I could do this easily", "I could do this with a bit of effort", "I would struggle to do this on my own", and "I couldn't do this". Reliability coefficients of science self-efficacy subscale are 0.81 for PISA 2006 Turkey sample and 0.89 for PISA 2015 Turkey sample (OECD, 2009; OECD, 2017).

Science Activities: Science activities subscale was measured with a six-item scale in the 2006 assessments. One of the items in the scale was removed for PISA 2015 and four new items were added. Therefore, there are five common items in both assessments. Students were asked to indicate how often they perform the activities mentioned. The response categories for the items are "very often", "regularly", "sometimes", and "never or hardly ever". Cronbach Alpha reliability coefficients in science activities subscale for PISA 2006 and 2015 Turkey samples are respectively 0.82 and 0.94 (OECD, 2009; OECD, 2017).

Environmental Awareness: While environmental awareness was measured with a five-item scale in PISA 2006, one of the items in the scale was removed in PISA 2015 and three new items were added. There are four items common to both assessments. Students were asked how informed they are about environmental issues. The response categories are in a four-point Likert scale in the categories "I have never heard of this", "I have heard about this but I would not be able to explain what it is really about",

"I know something about this and could explain the general issue", "I am familiar with this and I would be able to explain this well". Cronbach Alpha reliability coefficients for this subscale are 0.72 for PISA 2006 Turkey samples 2006 and 0.90 for PISA 2015 Turkey samples (OECD, 2009; OECD, 2017).

Environmental Optimism: Environmental optimism subscale was measured with a six-item scale in 2006 assessments. One of the items in the scale was removed in PISA 2015 and two new items were added. However, there are five items common to both assessments. Students were asked whether problems associated with the environmental issues would improve or get worse over the next 20 years. The response categories are "improve", "stay about the same", and "get worse". Cronbach Alpha reliability coefficients for environmental optimism subscale are 0.87 for PISA 2006 Turkey samples and 0.93 for PISA 2015 Turkey samples (OECD, 2009; OECD, 2017).

Data Analysis

The data sets containing the student questionnaires of PISA 2006 and 2015 assessments were downloaded from the official website of the OECD. Although the affective characteristics considered within the scope of the study were measured in both assessments, it was observed that some scales were revised by adding new items or removing some of the old items in the 2015. For this reason, analyzes were conducted on common items instead of scale scores or indices. In this context, common items in each subscale were determined. Then, the distributions of responses to these items by years were summarized. This information is presented using comparative graphics. The z test was used to analyze whether there is a significant difference between the percentage distributions of students' response categories over the years. The approaches used to test the significant difference between the two statistics, such as two arithmetic means, ratio, reliability coefficient, variance and examination of the significant difference of percentage distributions are similar. For this purpose, a Z value is obtained by dividing the difference of the coefficients by the standard error of this difference. This value indicates the deviation from the unit normal distribution curve. This value should be equal or greater than the value 1.96 for 0.05 significance level and 2.36 for 0.01 significance level (Akhun, 1982). The reason for using this test is to determine the significance of the difference in the percentages of the response categories of the items by year.

In data analysis, the response categories of the items were examined firstly. Except one of the six subscales have four response categories and one subscale has three categories. For the subscales with four response categories, two sequential categories were combined and interpreted according to the appropriate meaning. For example, in the subscale of enjoyment of science learning, strongly agree and agree categories were combined and interpreted as the students who enjoy learning science. By this, the percentages of students who enjoy and don't enjoy were decided. Then the significance of the difference of the percentages between years was determined. The purpose of this combination is to enable a clearer interpretation of the change in the level of students' participation in items over the years.

FINDINGS

Percentage distributions of students' responses to common items in subscales of affective characteristics for science that are common in student surveys in PISA 2006 and 2015 Turkey assessments were presented in graphics. The z test results for comparing the difference between these percentages are presented below.

What is the Trend in the Enjoyment of Science Characteristics of Students Between 2006 and 2015 Turkey PISA Assessments?

The common items of the enjoyment of science subscale used in PISA 2006 and PISA 2015 are as follows:

I1: I generally have fun when I am learning broad science topics.

I2: I like reading about broad science.

I3: I am happy working on broad science topics.

I4: I enjoy acquiring new knowledge in broad science.

I5: I am interested in learning about broad science.

In Figure 1, percentage distributions of students' responses to the common items of the enjoyment of science subscale are presented.

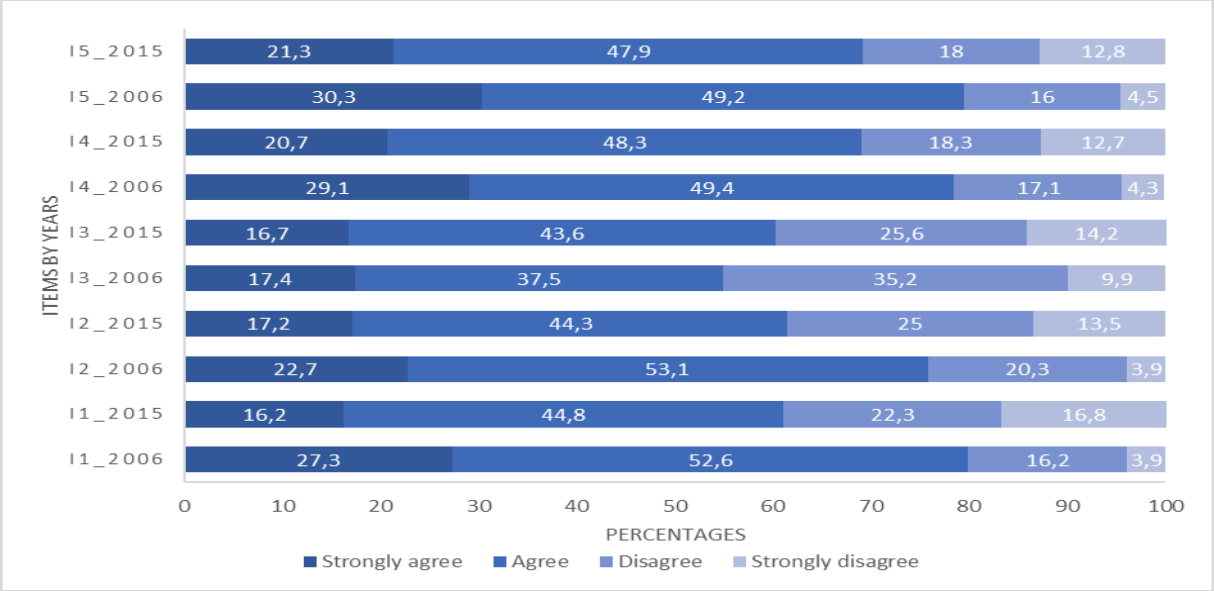

Figure 1. Distributions of students' responses to the common items of enjoyment of science subscale by years

When the percentage distribution of students' responses to the subscale of enjoyment of science, which is presented in Figure 1, is examined, it can be said that most of the students cluster in the "I agree" category. The distribution of the students to extreme response categories, which are "strongly agree" and "strongly disagree" categories, has had a huge change over the years. Accordingly, it is striking that while the rate of students who enjoy learning science decreased (the rate of students who say I strongly agree with the items), the percentage of students who do not enjoy learning science at all increased (the rate of students who say they strongly disagree with the items). Change in middle response categories is less than change in extreme response categories. Another point that draws attention is that the students who agree with the statement *I am happy working on broad science topics*, represented by item 3 (I3), have a lower percentage of participation compared to the other items. Based on these findings, it can be concluded that the rate of students who enjoy learning science very much has decreased and the rate of students who do not enjoy learning science at all has increased.

By combining "strongly agree" and "agree" categories, the students were divided into two groups: those who enjoy learning science and those who do not. Percentages of students who enjoy science and the z test results regarding the significance of this difference between these percentages are presented in Table 2 below.

Table 2. The percentages of students with high science self-efficacy by years and z test results

Items	2006	2015	Change Rate (%)	z
I1	79,9	61	-18,9	21,10**
I2	75,8	61,5	-14,3	15,72**
I3	54,9	60,3	5,4	-5,59**
I4	78,5	69	-9,5	11,00**
I5	79,5	69,2	-10,3	12,02**

**p<0.01

When Table 2 is examined, it is seen that the proportion of students who enjoyed learning science generally decreased between 2006 and 2015. In other words, the rate of students who agreed to learn about broad science topics (I1), to read articles (I2), to gain new information (I4) and being interested in science topics (I5) decreased in PISA 2015. It has been concluded that the difference is significant at the 0.01 level (z> 2.58). Unlike the other items, there is a significant increase (p<0.01) in the rate of students who agreed to the statement I am happy working on broad science topics (I3). On the other hand, agreement with this statement is relatively less in both assessments.

What is the Trend in the Instrumental Motivation Characteristics of Students Between 2006 and 2015 Turkey PISA Assessments?

The common items of the instrumental motivation subscale used in PISA 2006 and PISA 2015 assessment are as follows:

I1: Making an effort in my <school science> subject(s) is worth it because this will help me in the work I want to do later on.

I2: Studying my <school science> subject(s) is worthwhile for me because what I learn will improve my career prospects.

In Figure 2, the percentage distributions of students' responses to the common items of the instrumental motivation subscale are presented.

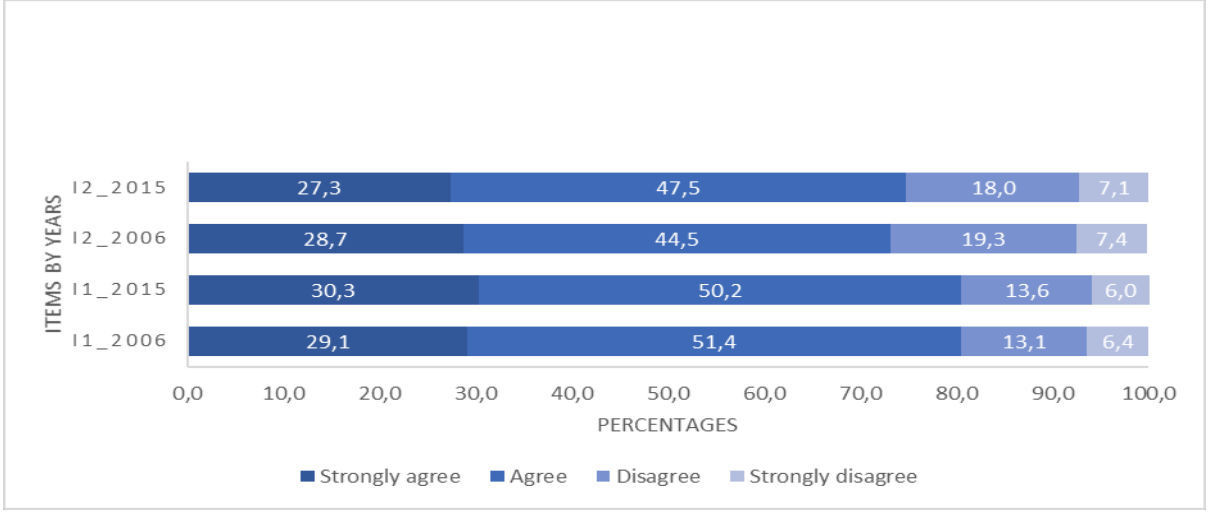

Figure 2. Distribution of students' responses to the common items of the instrumental motivation subscale by years

When Figure 2 is examined, it points that most of the students cluster in the "I agree" category. Between PISA 2006 and PISA 2015 Turkey assessments, it can be easily seen that there is no big difference in the distribution of the students' responses to the common items of the instrumental motivation subscale. Percentages of students with high instrumental motivation was determined by combining the "agree" or "strongly agree" categories. Z test results regarding the significance of the difference between these percentages are presented in Table 3 below.

Table 3. The percentages of students with high instrumental motivation by years and z scores

Items	2006	2015	Change Rate (%)	z
I1	80,5	80,4	-0,1	0,13
I2	73,3	74,8	1,5	-1,74

When Table 3 is examined, it is observed that there is a weak decrease in the proportion of students who reported agree or strongly agree for the first item (0.1%) while a weak increase in the proportion of students who reported agree or strongly agree for the second item (1.5%). However, the changes for both items in the percentages of students with high instrumental motivation by years are not significant ($z<1.96$). In the light of these findings, it can be said that the trend for students' instrumental motivation remained stable between 2006 and 2015 Turkey assessments.

What is the Trend in the Science Self-Efficacy Characteristics of Students Between 2006 and 2015 Turkey PISA Assessments?

The common items of the science self-efficacy subscale used in PISA 2006 and PISA 2015 assessment are as follows:

I1: Recognize the science question that underlies a newspaper report on a health issue.

I2: Explain why earthquakes occur more frequently in some areas than in others.

I3: Describe the role of antibiotics in the treatment of disease.

I4: Identify the science question associated with the disposal of garbage.

I5: Predict how changes to an environment will affect the survival of certain species.

I6: Interpret the scientific information provided on the labelling of food items.

I7: Discuss how new evidence can lead you to change your understanding about the possibility of life on Mars.

I8: Identify the better of two explanations for the formation of acid rain.

In the science self-efficacy subscale, students were asked to report on how easy they thought the expressions stated in the items would be for them. Response categories for these items are "I could do this easily", "I could do this with a bit of effort", "I would struggle to do this on my own", and "I couldn't do this". In Figure 3, the percentage distributions of students' responses to items of the science self-efficacy subscale that has all items common in both assessments are presented.

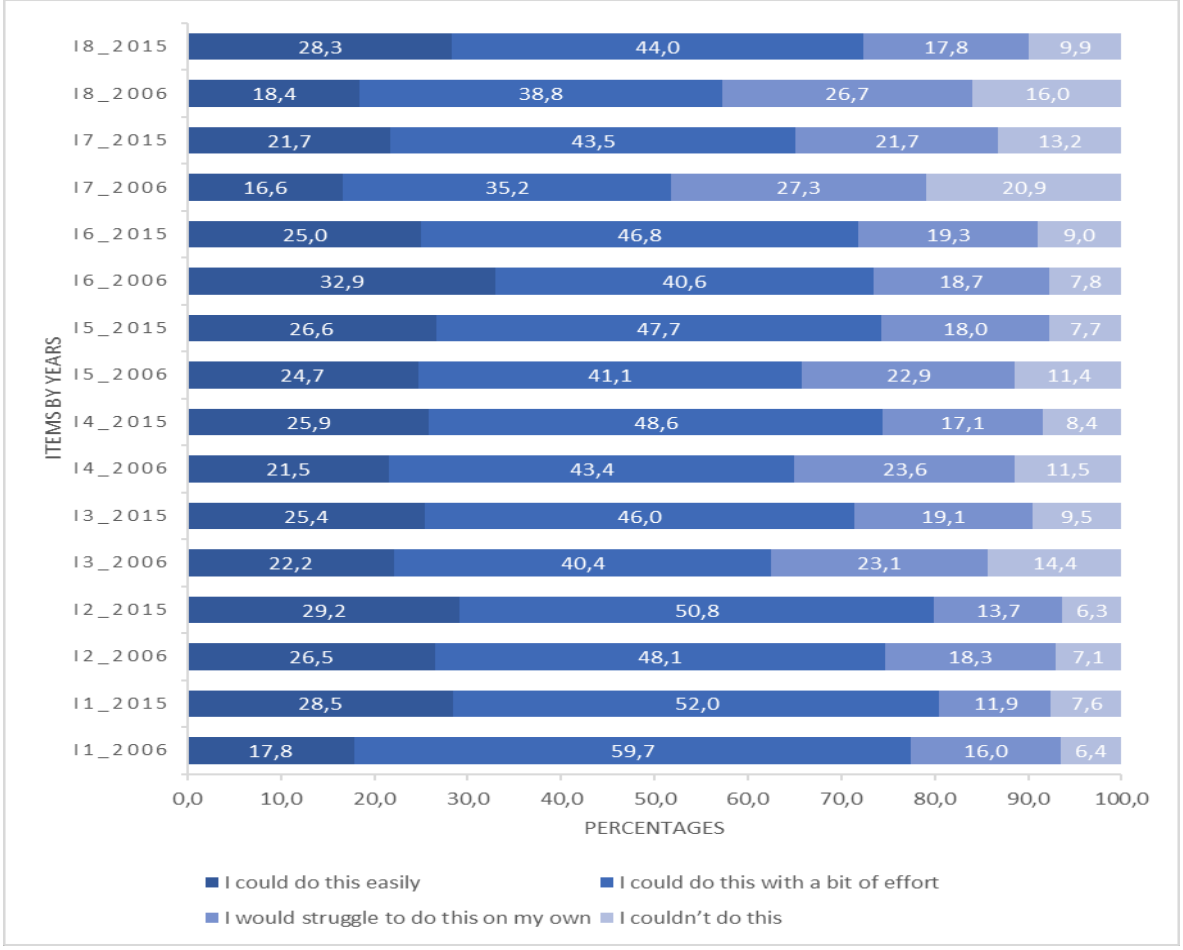

Figure 3. Distribution of students' responses to the common items of the science self-efficacy subscale by years

When the percentages according to response categories which are presented in Figure 2 are examined, it points to the fact that most of the students cluster in the "I could do this with a bit of effort" category. It was observed that for six items except for item 1 (I1) and item 6 (I6), the proportion of students who said "I could do this easily" and "I could do this with a bit of effort" increased. However, for item 1, it has been observed that there is an increase in the proportion of students who state that they could do it easily or they could do it with a bit of effort. Only the proportion of students, who stated that they could easily interpret the scientific information provided on the labelling of food items, specified in the item 6 (I6) decreased. Another remarkable finding is the increase in the proportion of students who reported that they couldn't either *recognize the science question that underlies a newspaper report on a health issue* (I1) or *Interpret the scientific information provided on the labelling of food items* (I6).

Students with high science self-efficacy, in other words, students who believe that they could do are determined by combining the response categories of "I could do this easily" and "I could do this with a bit of effort". The other two response categories are accepted to indicate the students with low self-efficacy. Percentages of students with high science self-efficacy and the z test results regarding the significance of this difference between these percentages are presented in Table 4 below.

Table 4. The proportion of students with high science self-efficacy based on common items by years and z scores

Items	2006	2015	Change Rate	z
I1	77,5	80,5	3	-3,77**
I2	74,7	79,9	5,2	-6,35**
I3	62,5	71,4	8,9	-9,66**
I4	64,9	74,5	9,6	-10,67**
I5	65,8	74,3	8,5	-9,48**
I6	73,5	71,8	-1,7	1,94
I7	51,8	65,2	13,4	-13,88**
I8	57,2	72,3	15,1	-16,17**

**p<0.01

Table 4 is examined, it is seen that the proportion of students with high science self-efficacy generally increased across the items except for item 6 in 2006 and 2015 assessments. In other words, in the 2015 assessment, there was a significant increase in the proportion of students who stated that they could do the mentioned behaviors for all items except item 6 easily or with a bit of effort ($p<0.01$). For item 6, the difference between student proportions is not significant. To put it another way, students' science self-efficacy did not show a significant difference for this item. In the light of these findings, it can be said that although students' self-efficacy did not change in terms of interpreting the scientific information provided on the labelling of food items, it generally increased in terms of other common items of the subscale.

What is the Trend in Students' Participation of Science Activities Between 2006 and 2015 Turkey PISA Assessments?

The common items of the science activities subscale used in PISA 2006 and PISA 2015 assessments are as follows:

I1: Watch TV programs about <broad science>

I2: Borrow or buy books on <broad science> topics

I3: Visit websites about <broad science> topics

I4: Read <broad science> magazines or science articles in newspapers

I5: Attend a <science club>

In science activities subscale, students were asked to report on how often they do the activities mentioned in the items. Response categories for these items are "very often", "regularly", "sometimes" and "never or hardly ever". In Figure 4, the percentage distributions of students' responses to the common items of science activities subscale are presented.

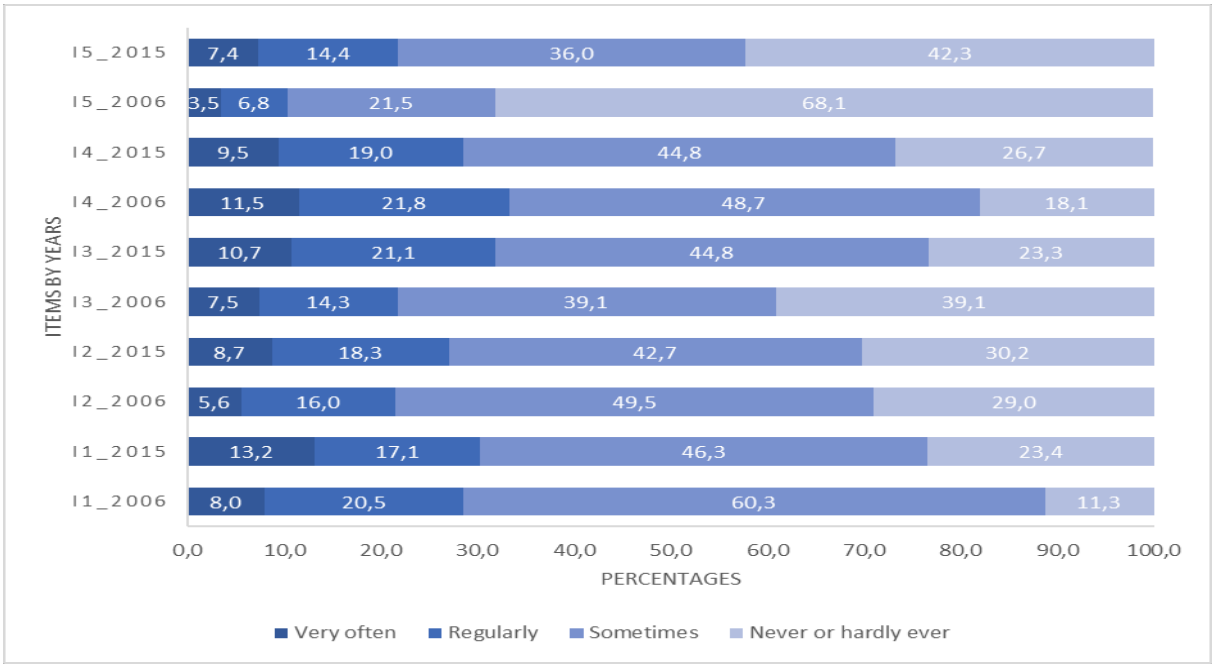

Figure 4. Distribution of students' responses to the common items of the science activities subscale by years

As presented in Figure 4, most of the students clustered in the "sometimes" response category and between the two assessments, the frequency of performing the activities generally tends to increase. However, regarding the frequency of participating in the science club in the fifth item, it is striking that in both assessments, the majority of the students (68% and 42%) clustered in the "never do" category. On the other hand, it is seen that the frequency of reading broad science magazines or science articles in newspapers, mentioned in I4, generally tends to decrease. In the light of these findings, it can be concluded that although the frequency of students attending a science club has increased between the two assessments, it is still rare and the frequency of reading broad science magazines or science articles in newspapers has decreased.

Students with high participation in science activities are determined by combining the response categories of "very often" and "regularly". Percentages of students with high participation in science activities and the z test results regarding the significance of the difference between these percentages are presented in Table 5 below.

Table 5. The percentages of students with high participation in science activities based on common items by years and z scores

Items	2006	2015	Change Rate	z
I1	28,5	30,3	1,8	-2,02*

I2	21,5	27	5,5	-6,53**
I3	21,8	31,9	10,1	-11,59**
I4	33,3	28,6	-4,7	5,19**
I5	10,4	21,7	11,3	-15,57**

**p<0.01, *p<0.05

When Table 5 is examined, it can be said that the proportion of students with high participation in science activities increased across the items between 2006 and 2015 assessments. In the 2015 assessment, while the proportion of students with high participation in the activity stated in the fourth item decreased, the proportion of students with high participation in the activities specified in the other items increased. The increase in the item 1 (I1) was found to be significant at the 0.05 level, the decrease in the item 4 (I4) and the increases in the other items were found to be significant at 0.01 level. According to these findings, while students' frequency of reading broad science magazines or science articles in newspapers decreased significantly, their frequency of watching TV programs about broad science, borrowing or buying books on broad science topics, visiting websites about broad science topics and attending a science club increased significantly.

What is the Trend in the Environmental Awareness Characteristics of Students Between 2006 and 2015 Turkey PISA Assessments?

The common items of the environmental awareness subscale used in PISA 2006 and PISA 2015 assessment are as follows:

I1: The increase of greenhouse gases in the atmosphere

I2: The use of genetically modified organisms (<GMO>)

I3: Nuclear waste

I4: The consequences of clearing forests for other land use

Within the environmental awareness subscale, students were asked to report on how informed they are about the environmental issues which are presented by items. Response categories for these items are stated as "I have never heard of this", "I have heard about this but I would not be able to explain what it is really about", "I know something about this and could explain the general issue", "I am familiar with this and I would be able to explain this well". In Figure 5, the percentage distributions of students' responses to the common items of the environmental awareness subscale are presented.

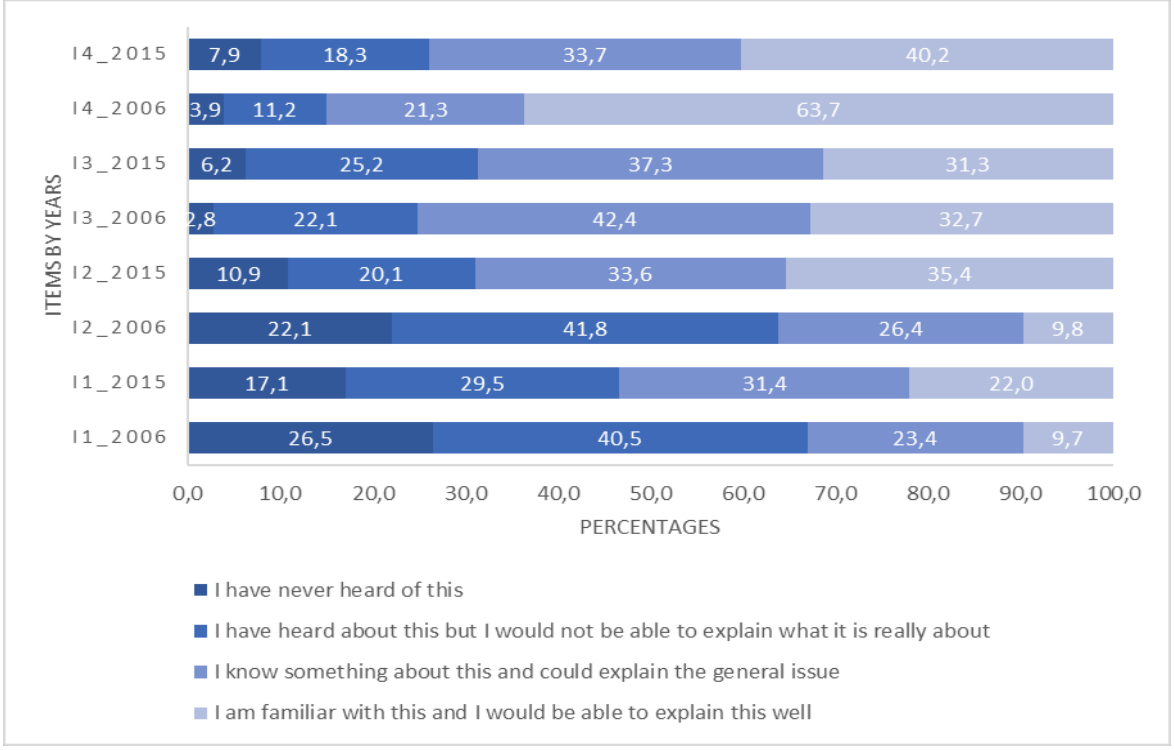

Figure 5. Distribution of students' responses to the common items of environmental awareness subscale by years

When the percentage distributions according to the response categories are examined in Figure 5, it is seen that there is no general trend regarding the students' environmental awareness. While the proportion of students with high environmental

awareness about the increase in greenhouse gases in the atmosphere and the use of genetically modified organisms has increased, the proportion of students with high environmental awareness about nuclear waste and the *consequences of clearing forests for other land use has decreased*. Another remarkable finding in Figure 5 is the excess rates of students who have never heard of these problems, which are very important problems of the world. According to the results of 2015 assessment, the issues with the lowest awareness of students are the increase in greenhouse gas, genetically modified organisms, the results of deforestation and nuclear waste, respectively.

Students who have environmental awareness at a certain level are determined by combining the response categories of "I know something about this and could explain the general issue" and "I am familiar with this and I would be able to explain this well". Percentages of students with environmental awareness at a certain level and the z test results regarding the significance of the difference between these percentages are presented in Table 6 below.

Table 6. The percentages of students with environmental awareness at the certain level based on items by years and z scores based on common items

Items	2006	2015	Change Rate	z puanı
I1	33,0	53,3	20,3	-20,98**
I2	36,1	69,0	32,8	-33,65**
I3	75,1	68,6	-6,5	7,36**
I4	85,0	73,9	-11,1	13,95**

**p<0.01

When Table 6 is examined, it is seen that while the proportion of students with high environmental awareness increased for the increase in greenhouse gases in the atmosphere and the use of genetically modified organisms, it was observed that nuclear waste and the consequences of deforestation for other purposes decreased over years. These changes in the proportions of students with high environmental awareness were found to be significant at the 0.01 level.

What is the Trend in the Environmental Optimism Characteristics of Students Between 2006 and 2015 Turkey PISA Assessments?

The common items of the environmental optimism subscale used in PISA 2006 and 2015 assessments are as follows:

I1: Air pollution

I2: Extinction of plants and animals

I3: Clearing of forests for other land use

I4: Water shortages

I5: Nuclear waste

Within the environmental optimism subscale, students were asked to report on their thoughts about whether environmental issues which are presented by items will improve or get worse over the next 20 years. Response categories for these items are as "improve", "stay about the same", and "get worse". In Figure 6, the percentage distributions of students' responses to the common items of the environmental optimism subscale are presented.

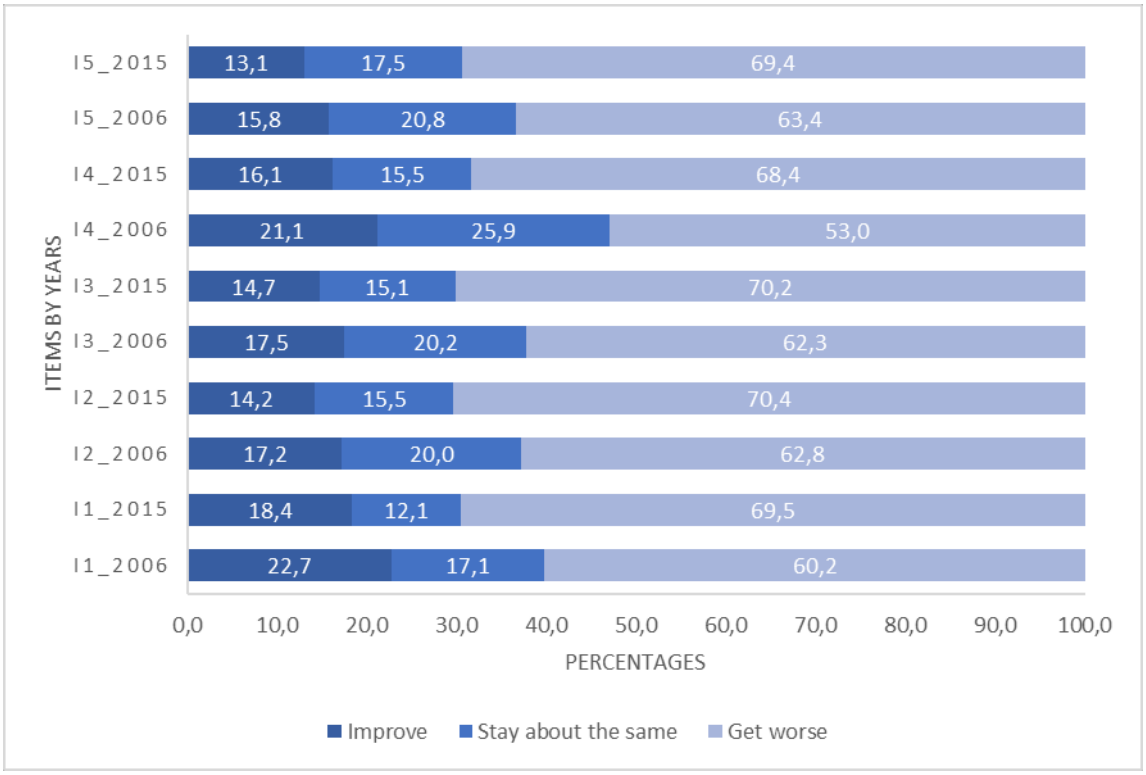

Figure 6. Distribution of students' responses to the common items of the environmental optimism subscale by years

When the distribution given in Figure 6 is examined, it can be easily seen that most of the students cluster in the "get worse" category for the future situation of environmental problems. In other words, the proportion of students who are optimistic about environmental issues is low in both assessments. In addition, the proportions in these categories have increased between two assessments. In the light of these findings, it can be said that the optimism of the students about environmental issues, which was already low, tends to decrease between two assessments.

The proportions of students with high environmental optimism determined by based on the "improve" category and the z test results regarding the significance of the difference between these proportions are presented in Table 7 below. The reason why changes in the proportions are examined for the 'improve' response category is that it is thought to reflect students' optimism better. For example, the change in the proportion of students who think that air pollution will improve would reflect their environmental optimism better.

Table 7. The percentages of students with high environmental optimism based on items by years and z scores

Items	2006	2015	Change Rate	z
I1	22,7	18,4	-4,3	5,48**
I2	17,2	14,2	-3	4,24**
I3	17,5	14,7	-2,8	3,91**
I4	21,1	16,1	-5	6,60**
I5	15,8	13,1	-2,7	3,94**

**p<0.01

When Table 7 is examined, it is seen that the proportion of students with high environmental optimism decreased for all items over the years. This decrease in these proportions was found to be significant at 0.01 level (z> 2.58). The change of the proportions is the highest for the expression "destruction of forests for other uses of the land" stated in the item 3 (I3). When these findings are examined, it can be said that students' environmental optimism, especially about the clearing of forests for other land use, has decreased between 2006 and 2015.

DISCUSSION

Within the scope of this study, it was aimed to reveal the trends in the common affective characteristics of students who participated in PISA 2006 and 2015 assessments from Turkey. In this context, enjoyment of science, instrumental motivation,

science self-efficacy, science activities, environmental awareness and optimism were discussed. It was concluded that there was no general trend for all science-related affective characteristics in PISA 2006 and 2015 assessments.

It was concluded that enjoyment of science subscale, which was considered in the context of science interest, tended to decrease over assessment years. It has been observed that there is a general and significant decrease in the proportion of students who enjoy learning science. Another important result of this study is the decrease in the proportion of students who enjoy learning science at a high level and the increase in the rate of students who do not enjoy learning science at all. Block (1971) stated that students' success in subject areas increases their enjoyment of the subject they are interested in. Between PISA 2006 and 2015 assessments, it is known that 15-year-old students in Turkey have a decrease in their enjoyment of science as well as their science literacy performance. This situation can be explained by the positive relationship between success and enjoyment suggested by Block. In addition, there are several studies showing that enjoyment of science has a positive and statistically significant relationship with science literacy performance (Yetişir, Batı, Kahyaoğlu & Birel, 2018; Ötken, 2019). Yetişir et al. (2018) revealed that enjoyment of science is a significant predictor of science literacy performance for both socio-economically disadvantaged and non-disadvantaged groups in PISA 2015 Turkey sample. Considering the decrease in students' enjoyment of science education and their science achievement scores, it is noteworthy that more concrete steps should be taken to support the affective characteristics of students and to make science learning enjoyable.

It was concluded that there was no significant change in the instrumental motivation characteristic. Studies on instrumental motivation of students showed that instrumental motivation is a characteristic that contributes to learning (Soodman Afshar, Rahimi & Rahimi, 2014). Gardner (1991) states that both integrative motivation and instrumental motivation contribute to learning. It was pointed out that students with instrumental motivation studied longer than students without instrumental motivation and thought about science-related issues longer. Clement, Dörnyei, and Noels (1994) asserted that motivational features are related to student achievement. On the other hand, Yetişir et al. (2018) revealed that instrumental motivation is not a significant predictor of science literacy performance for the PISA 2015 Turkey assessment. From this point of view, it can be said that despite the decrease in students' science literacy performance in PISA 2006 and 2015 Turkey assessments, the lack of change in instrumental motivation is expected.

It was concluded that the characteristics of science self-efficacy and science activities, which were handled in the context of Self-Related Cognitions in Science, tend to increase. It was observed that the change in students' responses to science self-efficacy generally tended to increase. When the increasing tendency of the students' science self-efficacy and the decrease in their science literacy performance are evaluated together, it is seen that this result is inconsistent with the information in the literature. Several studies in the literature affirm a positive relationship between students' science self-efficacy and science literacy performance (Acar & Öğretmen, 2012; Çalışkan, 2008; Lavonen & Laaksonen, 2009). In addition, Ötken (2019), in his study with PISA 2015 Turkey data, showed that science self-efficacy plays a partial mediating role in the structural model he established regarding the mediating role of science self-efficacy in the relationship between science learning pleasure and science literacy achievement scores. The reason for the increase of students' science self-efficacy may be either due to the social desirability effect or the students' lack of awareness about their own knowledge and skills. Therefore, it is thought that there is a need for further studies to determine the causes. Another outstanding finding is that students' self-efficacy in interpreting labels on foods did not change significantly over years. When the literature is examined, reading the labels on foodstuffs stands out as one of the important issues addressed within the scope of food safety, nutritional information and health literacy (Besler, Buyuktuncer, & Uyar, 2012; Güneş, Aktaş, & Korkmaz, 2014; Karabacak 2019). Güneş, Aktaş, and Korkmaz (2014) found out in their study which was focused on examining the safe food purchase and consumption behaviors of consumers that approximately half of the people did not read the label information when purchasing packaged foods. Besler, Buyuktuncer and Uyar (2012) stated that the importance of food label information is not known in Turkey, the information on the labels is not understood and therefore not used effectively. In the same study, it was determined that the rate of people between the ages of 12-17 who read food labels frequently was 17%, and the rate of those who did not read at all was 40%. Karabacak (2019), in his study to evaluate the health literacy level of adolescents, revealed that 62% of the students between the ages of 14-15 were insufficient in the health literacy scale for food labels, healthy choices and keeping body weight in balance. These results in the literature, which are consistent with the findings of this study, reveal that students should be supported with various training in order to use the information on food labels.

It has been found that the rate of students performing science-related activities tends to increase. Students watch more science-related television shows, borrow or buy more books, attend science clubs and visit websites more often. On the other hand, there is a decrease in the proportion of reading broad science magazines or science articles in newspapers. One of the reasons for this could be the decrease in the proportion of reading newspapers and articles, as today a wide variety of information and sources of information can be easily accessed online. Another reason could be that students' desire to reach information in a faster and a more practical way may explain this situation. In addition to these, while some science related activities are more common among students, some are quite rare. Among the 15-year-old students participating in PISA 2015 assessment, the average rate of students who regularly follow websites and news related to science in OECD countries is 19% (OECD, 2016). In the Turkey sample, it is noteworthy that although this rate increased from 7.5% in 2006 to 10.7% in 2015, it remained quite below the OECD average. The fact that the average of Turkey is below the OECD average may be due to the students' limited digital and technological opportunities such as internet infrastructure and not having a technological product.

In the context of environmental awareness and optimism, it has been concluded that there is no general trend for environmental awareness while environmental optimism tends to decrease. Students' environmental awareness decreased for some subjects while increased for others. While students raised awareness of the increase in greenhouse gases and genetically modified organisms, their awareness of nuclear waste and deforestation for other uses of land decreased. Sachsman (2000) emphasizes that the mass media has a very important role in improving and developing the awareness of environmental issues. In that study, it was stated that communication tools that prioritize the events occurring in society tend to focus less on environmental issues and provide less information about environmental issues; therefore, people have little awareness of environmental issues and problems. According to the findings of another study conducted in China, primary and secondary school students' environmental awareness is low (Jinliang, Yunyan, Ya, Xiang, Xiafei, & Yuanmei, 2004). Studies in the literature revealed that different age groups generally have information about the same environmental problems (Islam, 2008; Strong, 1998). This situation makes the finding of the study meaningful. Studies show that environmental education and environmental awareness have not been developed sufficiently so far (Erten, 2006). Demir and Yalçın (2014) state that environmental education is generally considered as a spontaneous process in Turkey and therefore, environmental education is not as developed as desired. In their study, in which they examined the learning outcomes in the curriculum, it is concluded that there is no lesson related to environmental education in the curriculum in Turkey. According to the results of another study conducted by Demirbaş and Pekcan (2009), secondary school students are aware of environmental problems if they are arising from environmental pollution, air pollution and waste. Students mostly gave correct answers to the environmental problems they encounter and frequently see in daily life. However, the same students mostly gave wrong answers to the questions about the greenhouse effect, global warming, etc., which are among the current problems and are thought to be underestimated in the teaching environment. The findings of the study conducted by Bozkurt and Cansüngü-Koray (2002) point out that the greenhouse effect is not known by middle school students and is full of misconceptions. Considering all these, it can be concluded that the increase in greenhouse gases and students' awareness about genetically modified foods, which are the findings of this study, and the decrease in the awareness of nuclear waste and deforestation for the use of land for different purposes, is related to the inclusion of these issues in mass media and their teaching in school lessons.

It was concluded that students' environmental optimism decreased significantly between two assessments. According to the results of a study conducted in America, individuals' optimism regarding global environmental problems has also decreased. 83% of the study group saw global warming as a serious threat in 2007, it was reported that this level was only 70% in 2004 (Global Strategy Group, 2007). In another study conducted by Mor-Dirlik and Karatekin (2015), researchers tried to determine which students' characteristics are related with environmental awareness and optimism. The findings showed that students who are more successful in science courses have higher environmental awareness and optimism. In addition, the socioeconomic status of the family was also found to be a predictor of students' optimism and awareness. Considering the findings of this study together with the results obtained from the literature, it can be said that the decrease in students' environmental optimism can be explained by the increasingly apparent environmental problems and the increase in deaths due to environmental problems.

RESULTS AND RECOMMENDATION

According to the results of the study, affective characteristics examined were classified in four categories: characteristics that tend to increase, characteristics that tend to decrease, characteristics that there is no meaningful change and characteristics that a certain trend is not observed. While students' science self-efficacy and participation in science activities tend to increase, it is observed that their enjoyment of science and environmental optimism tend to decrease. Participation in science activities and science self-efficacy were expected to yield similar results. On the other hand, the decrease in the trend for enjoyment of science, which is closely associated with them, is an unpredictable finding of this study. It is also expected for students with high self-efficacy in science-related matters to participate in science activities. However, it is an unexpected and contradictory result that these students enjoy less science. It is recommended to examine the possible causes of this result. On the other hand, the lack of a meaningful trend in the students' instrumental motivation characteristics, that emphasizes the role of science as a mediator for realizing their wishes or achieving something, may indicate that there has not been a great change in the role of the science for acquiring a profession in the country conditions in the that ten years. Another result of the research is that environmental awareness does not show a general trend. It can be said that the increase in greenhouse gases and in students' awareness about genetically modified foods, and the decrease in the awareness of nuclear waste and deforestation for the use of land for different purposes, are related to the inclusion of these issues in mass media and their teaching in school lessons. The trend for environmental optimism to decrease can be considered as an indication that students think that adequate measures are not taken to protect the environment.

When the remarkable findings in the research results were examined, some suggestions could be made to researchers, policy makers and teachers. The first suggestion for researchers is to examine the reason for the increase in the proportion of students who enjoy solving problems related to science, although there is a general decrease in the proportion of students who enjoy science. Another point is the relationship between students' self-efficacy and science achievement and its contradiction with the literature. At this point, it is considered as important to determine the reasons for the increase in students' science self-efficacy.

It is also suggested to investigate the reasons why environmental awareness depends on the scope of the environmental issue, which is an interesting finding of this study.

One of the suggestions for teachers and policy makers is to take concrete steps to support and increase students' affective characteristics in science and to use new practices in curricula and classroom processes. Considering that students' environmental awareness is generally quite low, content that will increase students' awareness can be included within the scope of science education. Finally, it may be suggested that as students need some information to understand and use the information on food labels, necessary activities and training should be given inside or outside the classroom.

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Statements of publication ethics

We hereby declare that the study has no unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

This study requires no ethics committee approval.

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