Change in the Environmental Literacy of German Students in Science Education Between 2006 and 2015

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ABSTRACT
This empirical study intends to present core results of the change in environmental literacy of German students by analysing PISA 2006and 2015 data. The study is carried out within the scope of environmental literacy in science education. The data are based on findings of both PISA 2006 data (N= 4891) and PISA 2015 data (N= 6504) of German students which were published in the official PISA site (http://www.pisa.oecd.org). In this study, a valid and a reliable 'environmental literacy' scale is developed. In addition, students' attitudes towards science affecting their environmental literacy are compared between 2006 and 2015. The study is conducted based on the paradigm of a descriptive field study survey. The validity and reliability of the 'environmental literacy' scale is tested in two stages by applying exploratory factor analysis with SPSS and confirmatory factor analysis with AMOS. In addition, parametric tests (ANOVA) and correlation are used to assess the data obtained from the analysis of quantitative data. The findings demonstrate a positive and meaningful relationship between 'environmental literacy' and the sub-factors (Environmental Awareness (EA), Environmental Responsibility (ER), and Development of Environmental Behavior (DEB)) (r_{EA} = 0.73, r_{ER} = 0.43, r_{DEP}= 0,37, $p < .01$). Moreover, there is an increase in the mean of the environmental literacy ($\bar{x}_{2006}$ = 2,55; $\bar{x}_{2015}$ = 2,58). According to the results, the major of students (63 % and over) indicate that 'they can describe the role of antibiotics in the treatment of disease' and 'they can predict how changes to an environment will affect the survival of certain species' easily on their own in both 2006 and 2015. However, approximately 20 % of German students point out that they cannot recognize the science question that underlies a newspaper report on a health issue' on their own. In addition, the majority of German students (80 %) point out that they have information about the consequences of clearing forests for other land use in 2006 and 2015. On the other hand, more than 60 % of German students think that they do not have sufficient knowledge about the use of GMO in 2006 and 2015. In the light of the results of this study some suggestions related to environmental issues for the development of science curricula are discussed. For instance, one of the suggestions is that the subject of genetically modified organisms and health issue should be more comprehensive in the German science curricula. In addition, critical reflection and decision making about science issues is important to educate an environmental literate citizen.

Keywords: Science Education, Environmental Literacy, PISA

INTRODUCTION
In 2005, UNESCO launched its Decade of Education for Sustainable Development (2005-2014), a project by which educational institutes around the world would focus on educating more qualified individuals for a more sustainable future (Kaya and Elster, 2017). It is critical for the enhancement of the quality of future science education, especially environment education, that researchers bring to light the outcome of this educational project. One of the main purposes of this study is to present the results of the changes in environmental literacy (EL) of German students before and after implementation of this education by analysing PISA 2006 and 2015 data.

Another main purpose is to develop a model for assessing EL directly by using PISA data. It has been reported that PISA will be expanded in the scope of measurement coverage after the PISA 2015 evaluation (TEDMEM, 2017). It is the belief of the researchers that the present study will have a positive effect on this expansion, because, as Kaya and Elster (2017) mentioned, not enough research has been conducted on EL using PISA data, and although scientific literacy tasks in PISA include items related to environmental issues, it does not measure the score of EL directly.

The purpose of this research is to determine the change in the EL of German pupils from 2006 to 2015. Within the scope of this research, the development of environmental issues based on the PISA data is first presented. Next, before defining the research questions, the theoretical framework of literacy, especially science and EL, is introduced in order to reveal the importance of the research.

How is Environmental Education Linked to PISA?

International organizations have reported on the development of environmental education from past to present by organizing conferences or/and meetings on environmental education (The Belgrade Charter, 1972; WCED, 1987; UNESCO-UNEP, 1976, 1978; UNCED, 1992; UNESCO, 1997; United Nation, 2002). Environmental studies and sciences programs were first established in the 1970s and gave rise to the increase of public awareness on environmental studies and issues (Coppola, 1999). In 1972, environmental education gained international acclaim with the Stockholm Declaration (Belgrade Charter, 1975; Wright, 2002). In the report of the Belgrade Charter (1975), it was explained that the six frameworks of environmental education are awareness, knowledge, attitude, skills, evaluation ability and participation. Similarly, the Tbilisi Declaration reported that there are four objectives: awareness, knowledge, attitudes, skills, and participation in environmental education (UNESCO, 1978).

At the beginning of the 1980s, the first environmental education curriculum, named "Procedures for Developing an Environmental Education Curriculum", was published under the auspices of UNESCO-UNEP, and then revised in the mid-1980s (UNESCO-UNEP, 1994). In 1987, The Brundtland Report, also known as the Common Future, was published by the World Commission on Environment and Development. This report outlines the concept of sustainable development, which is seen as an interrelation of the concepts of environmental protection and economic growth (McCrea, 2006). The transition from the concept of environmental education to the concept of sustainable development began after it was highlighted at the international conference in Thessaloniki on Environment and Society: Education and public awareness for sustainability hosted by UNESCO in 1997 (Pavlova, 2011).

In 1997, the OECD Programme for International Student Assessment (PISA) was created by OECD member countries (OECD, 2013a), and the first PISA survey was launched in 2000 (OECD, 2000), which involves PISA assessing students every three years in three subjects (science, reading and mathematics literacy) (MoNE, 2010). Most of the countries make certain that the PISA assessment tools are internationally accepted and take into consideration the culture and curriculum of the participating countries and their economies (OECD, 2016b). The latest PISA assessment in 2015 was centred on science literacy, an area that has continued to play an increasing role in our economic and social lives (OECD, 2016a). The international organization, UNESCO, has been very active, from past to present, in the development of environmental education and will continue to support this education in the future. The educational outcomes from international assessments, especially the PISA, are important insofar as they serve to maintain the quality of this development.

What is Literacy?

Literacy is a basic element of the right to education, as recognised by the Universal Declaration of Human Rights (UNESCO, 2013a). Despite there being general agreement that literacy is a human right (Keefe and Copeland, 2011), a common definition, accepted by everyone, is still lacking, as discussed in the previous section. Moreover, the idea of literacy has evolved in line with changes in cultural communicative practices and technological developments (Fellowes and Oakley, 2014). As a result, its usage has significantly expanded up to today (McBride, Brewer, Berkowitz, & Borrie, 2013). In recent years, the scope of its definition has grown to include many areas of interest, such as science literacy and EL (Monseley, 2000; Ozturk, Tuzun & Teksoz, 2013).

However, following the start of the Industrial Revolution, the concept of literacy began to be associated with the ability to read and write (Roth, 1992; Coppola, 1999; Monseley, 2000; Daley, 2003; Cambridge Assessment, 2013; McBride, Brewer, Berkowitz, & Borrie, 2013). UNESCO has had a significant role in developing literacy among its member states ever since the middle of the 20th century, and its definition of literacy has evolved substantially over time (Newman and Beverstock, 1990). In 1951, literacy was defined by UNESCO as the capability of a person to read, write, and fully comprehend a brief and uncomplicated expression in daily life (Newman and Beverstock, 1990: 45). Similarly, an alternative definition of literacy is the skill of individuals to get involved in the activities that need literacy to maintain the efficient functions of the society they live in, and to read, write and calculate for both personal and social development (UNESCO, 1978). In this sense, literacy provides a foundation for many other learning opportunities (UNESCO, 2013a), with the reason being that the innovative concept of "literacy" is concerned with the capacity of students to analyse, reason and communicate effectively as they pose, solve and interpret problems in a variety of subject matter areas. (PISA, 2005). It is anticipated that in time to come this innovative concept of literacy will move beyond the skill of reading and writing and be rather described as the ability to transform knowledge into practice.

Framework for Scientific/Science Literacy

Science is very significant for individuals if they are to make sense of their lives (Godek, 2002). Ultimately individuals have the desire to make daily natural events more understandable and useful for them (Agin, 1974).

The needs of individuals are therefore never-ending and continuous (Kalkandelen, 1979). In today's world, education, especially science education (Agin, 1974) is key to transforming individuals into scientifically literate persons. Scientific literacy has thus become a concept common to the basic goals of science education (Gabel, 1976). Moreover, scientific literacy has become the basis on which individuals can fully participate in society (Bybee, 2008). Through science education and the science literacy that results from it, individuals gain the ability to engage with science-related issues and scientific ideas (PISA, 2013b).

In light of the descriptions of literacy, science literacy is defined as the ability to read, comprehend, and discuss scientific matters intelligently (Shamos, 1988). In other words, it describes the ability of a person to understand scientific laws, theories, phenomena and objects and to be equipped with the necessary base of scientific knowledge to make informed decisions for their life (Dragoş and Mih, 2015). Although scientists, educators, and philosophers of science each have their own definitions of what it means to be scientifically literate, it should not be ignored that this concept is constantly evolving (Gabel, 1976). In these respects, Shen (1975 as cited in Liu, 2009) described six components of science literacy: (a) understanding basic science concepts, (b) understanding the nature of science, (c) understanding the ethics guiding scientists' work, (d) understanding interrelationships between science and society, (e) understanding interrelationships between science and humanities, and (f) understanding the relationships and differences between science and technology. In contrast, according to the Board on Science Education (2016), there are three elements of science literacy, namely, an understanding of scientific practices, content knowledge and an understanding of science. These two alternative definitions serve to demonstrate, in short, that, just as is the case for the definition of science literacy, there is no common view on the categories delimiting the concept of science literacy

In general, it can be said that scientific literacy means to have an appreciation of the basic principles of science and an understanding of what scientific research produces (Smithsonian Institution, 2011). Individuals should have some understanding of or familiarity with the social processes that accompany most environmental issues and how scientific methods work (Schneider, 1997). A scientifically literate citizen must therefore have an understanding of how the scientific and decision-making elements interact (Schneider, 1997). In support of this, Hurd (1998) stated in his study that a literate person uses science knowledge where appropriate in making life and social decisions, forming judgments, resolving problems, and taking action. Although the major advantage of being endowed with science literacy is that it provides a basis, at the school level, of the intentions of science education (Holbrook and Rannikmae, 2009), it entails much more than simply knowing the basic facts established by science (Board on Science Education, 2016). In summary, a definite answer to the question of 'what is science literacy?' should not be sought. Instead, we should seek to find an answer to the question of 'what is the scope of science literacy and how can we meet, within that scope, the expectations of societies in the future?'. In this way, we can train qualified science literate individuals accordingly.

Change in Science Literacy in PISA

The concept of science literacy is constantly being updated by PISA. In 2000, PISA defined scientific literacy as the capability of using scientific information, asking questions and making conclusions based on proof for the purpose of comprehending the natural world, making determinations about it and interacting with it. In 2006 and 2009, PISA redefined science literacy as follows (OECD, 2006: 12; OECD 2009: 128).: the holding and use of scientific information to make new questions, draw new pieces of information, make sense of the phenomena related to science, and reach conclusions related to scientific issues based on proof; also the ability to access the core of unique aspects of science by regarding it as a type of human information and investigation, being conscious about the ways that science and advanced technology determine our living situations, in material, intellectual and cultural terms, and being eager to get involved in scientific subjects, as well as having personal opinions about science as a requirement of being a contemplative citizen In 2015, science literacy was defined by OECD (2013b: 7) as the skill to question and discuss scientific matters and people's opinions related to science, a requirement to being a meditative citizen These regular updates to the concept of science literacy by PISA are made according to the changing conditions of society.

Framing the Concept of Environmental Literacy (EL)

In 1969, Roth (1968), as cited in Roth (1992), indicated that the concept of EL was first revealed in an academic paper. In the 1990s, however, the field of environmental education underwent a maturation period within the framework of formulating the concept of EL (McBeth and Volk, 2010). Environmental education programs are designed to raise and nurture the development of EL throughout the lifetime of the human (Subbarini, 1998). Moreover, the main aim of environmental education continues to be the development of EL, and ultimately behavioural change in terms of making informed decisions related to natural resource management (Bennett and Roth, 2015). As NAAEE informs us, EL includes dispositions, knowledge, and competencies applied for the purpose of responsible environmental behaviour (Daniš, 2013).

However, as stated earlier, there is no universally accepted definition of literacy (Keefe and Copeland, 2011), especially science literacy (DeBoer, 2000) and EL (Loubser, Swanepoel & Chacko, 2001; Morrone, Mancl & Carr, 2001). Despite the fact that the concept of EL has been in use for many years, coming up with a comprehensive description of it continues to be challenging due to its complexity. EL is still highly valued in science education, as it has allowed for many solutions related to environmental problems in science to be found. It is because of this that so many researchers have attempted to classify EL.

Researchers have argued that EL has to accord with the five categories of environmental education concepts (awareness, knowledge, attitude, skills, and participation) in order for it to develop into positive environmental behaviours (Wisconsin Department of Public Administration, 1991). In the study by Roth (1992), six major areas of EL were proposed: environmental sensitivity, knowledge, skills, attitudes and values, personal investment and responsibility, and active involvement. Many researchers have sought to provide a working definition of EL, such as the one offered by Subbarini (1998: pp. 245), which states that EL requires individuals to be able to convey and make use of the main ecological concepts and rules, make sense, on ecological grounds, of the effect of human activities on the environment, determine and do research about environment-related matters to come up with different solutions, and assert the values related to the environment that encourage the use of natural resources in a sensible and responsible manner; or the one put out by the DC Environmental Literacy Workgroup (2012), stating “Environmental literacy is the development of knowledge, attitudes, and skills necessary to make informed decisions concerning the relationships among natural and urban systems”.

An examination of the literature showed that there are three levels of EL: nominal, functional and operational (Chacko, 1998). According to Chacko (1998), a person who has nominal EL has the ability to recognize many of the basic terms used in discussing the environment, a person who has functional EL has a broader range of knowledge and understanding about the nature and interaction of human social systems and other natural systems, and a person who has operational EL has progressed beyond functional literacy in both the breadth and depth of understandings and skills.

Literacy, especially EL, is not a process of indoctrination of any one agenda, but rather a building of knowledge and experiences to help persons make informed decisions (TAEE, 2013). Environmentally literate people are equipped with more than just knowledge about ecology; completely literate individuals combine knowledge with values, which leads to action (Morrone, Mancl & Carr, 2001). Moreover, environmentally literate individuals are capable of individually and collectively making informed decisions concerning the environment, are willing to act on these decisions to improve the well-being of other individuals, societies, and the global environment, and are actively engaged in social life (NAAEE, 2011). In short, EL involves the ability to adapt to changes in environmental resources and systems, and their dynamics (Scholz, 2011).

Ultimately, studies have shown that the two general concepts of science and environmental education and science and EL are related to each other; that is, environmental education is a prerequisite for qualified science literacy (O’Hearn, 1972). In viewing this relationship as such, it is possible to see how the problems related to environmental education can be overcome (Longbrake, 1974). The influence of these interrelated and interdependent concepts should be a reflection of the impact of science education on the quality of the education.

RESEARCH QUESTIONS

To be consistent with the PISA definition of scientific literacy, assessment items are required to be designed via the application of scientific knowledge and through the demonstration of the scientific competencies within certain contexts, such as environmental issues. Although PISA was not designed specifically to assess environmental science, by taking the questions used in the PISA science assessment, it was determined that some were related to environmental science (Erbaş, Tuncer Teksöz & Tekkaya, 2012). Furthermore, while PISA assesses reading, science, and mathematics literacy every three years, EL is not directly assessed, although some of the items do fall within an environmental context. As it has been argued that not enough research on EL has been conducted using PISA data (Kaya and Elster, 2017), this study seeks to do research on EL by using PISA data from 2006 to 2015. In conducting this research, the main aim was to determine the change in the EL of German pupils from 2006 to 2015. More specifically, the research questions investigated in this study were:

- What factors influence EL?
- In what way do the EL factors (development of environmental behaviour, environmental awareness and environmental responsibility) change from 2006 and 2015?
- How does the change in the influence of students’ attitudes towards science (such as enjoyment of science, interest in science) impact EL from 2006 to 2015?
- What changes occur from 2006 to 2015 in the influence of teaching methods for lessons on EL?

RESEARCH METHODS AND DESIGN

In this section, we present the ‘type of study’, ‘the sampling and data collection’, and the analysis of data.

Type of study

For this field study, descriptive research methods were employed. The basic aim of descriptive analysis is to provide the reader with the ability to summarize and interpret the findings (Yıldırım and Simsek, 2003). Specifically, a survey format was used in the context of the method of description for this research. Surveys, which are used to determine the current situation, have the advantage of allowing more quantitative data to be gathered (Cepni, 2007). Questions related to the environmental issues in the PISA 2015 student questionnaire were included in this study. In the context of this study, the questionnaire was used with structural equation modelling to examine the factors affecting German students' development of environmental behaviour (DEB), environmental responsibility (ER) and awareness (EA).

Sampling and data collection
In this study, the sample population was restricted to 15-year-old German students who were attending school in either 2006 or 2015. The PISA sample selection was conducted randomly by applying the two-stage stratified sampling method (Albayrak Sarı, 2015). The study sample included 4891 pupils from 2006 and 6504 pupils from 2015, determined using PISA data from both 2006 and 2015. The data were obtained via the internet from the official PISA website (http://www.pisa.oecd.org). In this study, the data obtained with the participation of students from Germany involved PISA data from 2006 and 2015.

Analyses of data
This section consists of two parts, with the first part describing how the scale was developed, and the second part explaining the analysis used in this study. The Environmental Literacy scale was developed in two stages: exploratory and confirmatory factor analysis stages. .

Theoretical framework of scale
In PISA 2006, approximately 33 percent of the context included resources and environments (Bybee, 2008), while in PISA 2015, approximately 11% of the context included environmental issues, and the number of items were found to have decreased compared to 2006-PISA. According to PISA results, the definition of EL includes environmental awareness and environmental responsibility (Kaya and Elster, 2017). When the theoretical framework of EL is examined (Figure 1), EL includes environmental behaviours. According to the scope of EL, as shown in Figure 1, the EL scale was developed using common items related to environmental issues from both 2006 and 2015. Moreover, two of the three sub-factors, namely environmental awareness and environmental responsibility, were included in the PISA data. However, the "Development of Environmental Behaviour (DEB)", a new factor, was added to the scale of EL. DEB is used to determine whether the students in the school are given responsibilities to improve their skills in demonstrating environmental behaviours.
Scholz (2011) argues that 'environment' must be redefined as a co-evolving system coupled to a human system. Thus, in line with this view, he recommends that future research should be designed on the basis of human and environment systems, and he linked trans-disciplinary and disciplined interdisciplinary to the concept of EL. In this respect, the focus points are the interaction of human systems and environmental systems, how individuals learn from feedback and can avoid rebound effects, and what information they react to or ignore. Here, EL is linked to learning, and so the question of how this literacy can be transmitted to future generations receives special attention. For this reason, in this study, the DEM factor, which is related to participations and skills, is included in the EL scale, especially considering that the academic support related to the science education provided to the students is one of the most important factors in securing EL.

According to Tbilisi Declaration for EE (UNESCO, 1977)	Science Literacy (MoNE, 2005)	Environmental Literacy (Roth, 1992)	Frameworks for developing scale
Knowledge	Key Science Concepts	Knowledge	Environmental Awareness*
	Nature of Science		
Attitude	Attitude and Values in Science	Sensitivity, Attitudes and Values, Personal Investment and Responsibility	Environmental Responsibility*
	Scientific Values		
Skills	Scientific and Technical Psychomotor Skills	Skills	Development of Environmental Behavior
	Scientific Process Skills		
Participation	Science- Technology-Society –Environment Interactions	Active involvement	

*The concepts used in the PISA have been preferred so as not to cause confusion.

Figure 1: Theoretical framework of environmental education (EE), Science Literacy (SL), Environmental Literacy (EL), all of which underpin the framework for the developed scale.

Exploratory factor analysis

A scale was developed for this research. The developed scale was applied on 15-year-old students who were attending schools in Germany. The total sample of this study consisted of 9833 students who were selected using PISA 2006 Data. In the first part of developing the scale, exploratory factor analysis, conducted with the SPSS Program, was used to examine the construct validity of the scale. In the second part, confirmatory factor analysis, conducted with the AMOS Program, was used to show the relationships between variables. Prior to performing the exploratory factor analysis, in order to determine whether or not to conduct a factor analysis, the KMO (Kaiser-Meyer- Olkin) Value and Bartlett's Test of Sphericity were calculated. The KMO and Bartlett measurement results are presented in Table 1.

Kaiser-Meyer-Olkin Value		.82
Bartlett's Test Value		28905.55
		105
	p	.00

* p<.01

A KMO Value that is over 0.50 (KMO= 0.82, $p<0.01$) indicates that factor analysis sampling was appropriate. The Bartlett's Test of Sphericity result of 28905.55 ($p<.01$) was significant in that it showed that the measuring tool could be differentiated into factor structures.

Using item-total correlation for the EL scale analysis, the reliability of test items, the t-test for the reliability of the meaningfulness of the median of the top 27% and bottom 27% groups, and the reliability of Cronbach alpha were determined. The results are shown below in Table 2.

Table 2: Item-Total Correlation

Item	**t (Bottom 27%-top 27%)[1]**
1	33.64^{***}
2	36.89^{***}
3	39.80^{***}
4	38.34^{***}
5	40.69^{***}
6	34.95^{***}
7	10.76^{***}
8	7.48^{***}
9	7.96^{***}
10	11.11^{***}
11	48.21^{***}
12	47.58^{***}
13	50.88^{***}
14	49.56^{***}
15	45.66^{***}

[1] $n_1 = n_2 = 2655$, alpha= .78, N of Items =20, $^{***}p < .01$

According to the initial data obtained by the exploratory factor analysis, 15 of the items (variables) included in the analysis were gathered under 3 factors and had a value greater than 1. The explanatory variance of these three factors was 47.45%. The commonalities of the 3 factors defined as related to the items should vary between 0.40 and 0.59.

According to the eigenvalue measure, the number of significant factors in the scale was determined to be 3, as clearly seen in Figure 2. While there are 3 factors in the graph with a high ascending curve, the general trend of the graph in the fourth and subsequent factors are horizontal and do not have a significant declining trend. In short, the contributions of the fourth and subsequent factors to the variance are very similar.

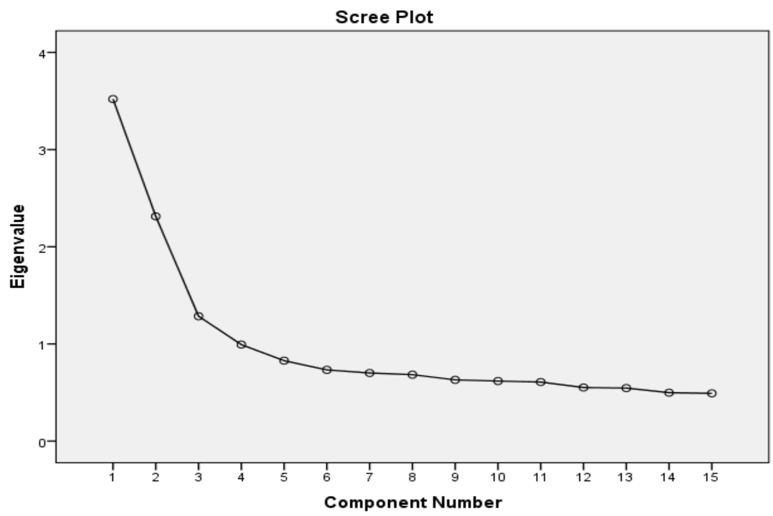

Figure 2: Eigenvalue Graph

Analysis of the scale were made on 3 factors and over 15 items (appendix 1). The analysis of converted basic item components is presented in Table 3.

Table 3: Factor Analysis (analysis of converted basic components)

Item	Factor Common Variance	Factor-1 Load Value	Analysis of converted basic components		
			Factor-1	Factor-2	Factor-3
3	.52	.65	**.70**	.06	.13
4	.47	.65	**.67**	.03	.13
1	.46	.62	**.66**	.04	.12
2	.45	.61	**.65**	.02	.13
6	.47	.61	**.65**	.00	.22
5	.40	.58	**.61**	.11	.11
15	.40	.52	.05	**.75**	.04
12	.51	.51	.05	**.71**	.06
11	.49	.11	.06	**.67**	.06
13	.44	.17	.10	**.65**	.07
14	.56	.22	.04	**.63**	.02
9	.59	.16	.12	.09	**.75**
10	.56	.26	.12	.00	**.74**
8	.43	.53	.21	.01	**.62**
7	.45	.50	.25	.09	**.61**
Explained Variance Total 47.45 %, **Factor-1:** 23.47%, **Factor-2:** 15.42%, **Factor-3:** 8.57 %					

Through factor analysis, an attempt was made to bring together variables that measure the same structure with a small number of factors (Buyukozturk, 2009). Item loads larger than 0.61 were chosen and included in the scale. The remaining 15 items were loaded on the 3 factors labelled Environmental Responsibility (ER), Development of Environmental Behavior (DEB), and Environmental Awareness (EA). These factors, along with the number of items attached to them are as follows (see appendix 1):

- Factor-1: Environmental Responsibility (between 1 and 6 items)
- Factor-2: Development of Environmental Behaviour (between 11 and 15 items)
- Factor-3: Environmental Knowledge (between 7 and 10 items)

In summary, although different researchers have preferred to form different EL categories, in this research, three categories (EA, ER, DEB) were established.

Table 4: Correlation of Factors

		EL	ER	DEB	EA
	r	1			
EL	p				
	N	9833			
	r	$.43^{**}$	1		
ER	p	.00			
	N	9833	9833		
	r	$.37^{**}$	$-.44^{**}$	1	
DEB	p	.00	.00		
	N	9833	9833	9833	
	r	$.73^{**}$	$.114^{**}$	-.02	1
EA	p	.00	.00	.07	
	N	9833	9833	9833	9833

** p< 0.01

As can be seen in Table 1, there is a positive relationship between EL and the sub factors ($p < .01$).

Confirmatory factor analysis

Structural validity was tested by confirmatory factor analysis, as described above. According to the initial results obtained by confirmatory factor analysis, some of the values were not within the acceptable limits. For this reason, covariance was created between the error terms of the items within each latent variable in the model. The findings are listed in Table 5. Each correction should be made on a theoretical basis (Meydan and Sesen, 2015; Karagoz, 2016). The error terms of the items in each factor were therefore identified (Karagoz, 2016) before performing the confirmatory factor analysis for a second time. The corrected confirmatory factor analysis appeared to be a good fit in general. The notions of good fit and acceptable fit are taken at different value ranges. It is possible that a model may fit the data despite having one or more fit measures that are of a bad fit (Schermelleh-Engel & Moosbrugger, 2003).

Table 5: Fit Criteria (Schermelleh-Engel, Moosbrugger & Müler, 2003) and Model Fit Measures

	Good Fit	Acceptable Fit	Model Fit
c2/sd	$0 \leq c^2/sd \leq 2$	$2 \leq c^2/sd \leq 3$	29.49
P	$0.05 \leq p \leq 1$	$0.01 \leq p \leq 0.05$	.00
RMSEA	$0 \leq RMSEA \leq 0.05$	$0.05 \leq RMSEA \leq 0.08$	.05
NFI	$0.95 \leq NFI \leq 1.00$	$0.90 \leq NFI \leq 0.95$	.91
TLI	$0.95 \leq TLI \leq 1.00$	$0.90 \leq TLII \leq 0.95$	.88
CFI	$0.97 \leq CFI \leq 1.00$	$0.95 \leq CFI \leq 0.97$	.91
RFI	$0.90 < RFI < 1.00$	$0.85 < RFI < 0.90$	.87

As shown in Table 5, the significance value was .00. Moreover, the P-values as well as most of the other values indicate that the model had a good fit.

FINDINGS

Factors influencing Environmental Literacy

In this research, parametric tests (t test) were applied in evaluating the data derived from the analysis of quantitative data. ANOVA, T-test and descriptive statistics were used. The change in ER is included in Figure 3. In Figure 3 and appendix 2, it can be seen that among the factors related to the 'environmental responsibility' – acid rain, food items and garbage – of the German students, the factor of "acid rain", with a coefficient of 1.00, had the highest factor value in 2006. However, in 2015 the highest factor was "food items" with a coefficient of 1.04. The factor, "health issue", had the lowest factor value in 2006, with a coefficient of .76 and in 2015, with a coefficient of .91.

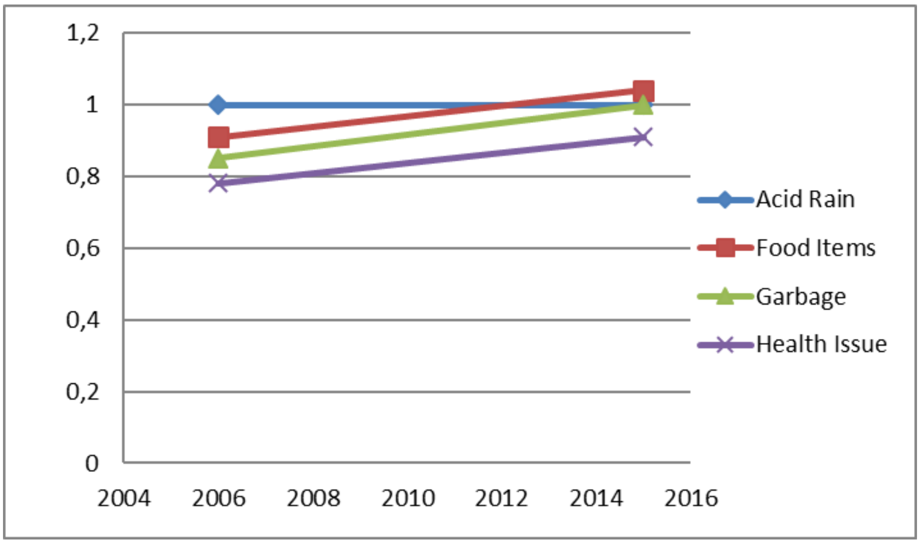

Figure 3: Change in ER based on PISA 2006 data and PISA 2015 data

In Figure 4 and in appendix 2, it can be seen that among the factors related to "development of environmental behaviour" (DEB) in the German students, the factors of “explain ideas” and “practical experiments” had the highest factor value, with a coefficient of 1.33, while the factor of “class debate” had the lowest factor value, with a coefficient of 1.00 in 2006. However, in 2015 the highest factor was “class debate”, with a coefficient of 1.00.

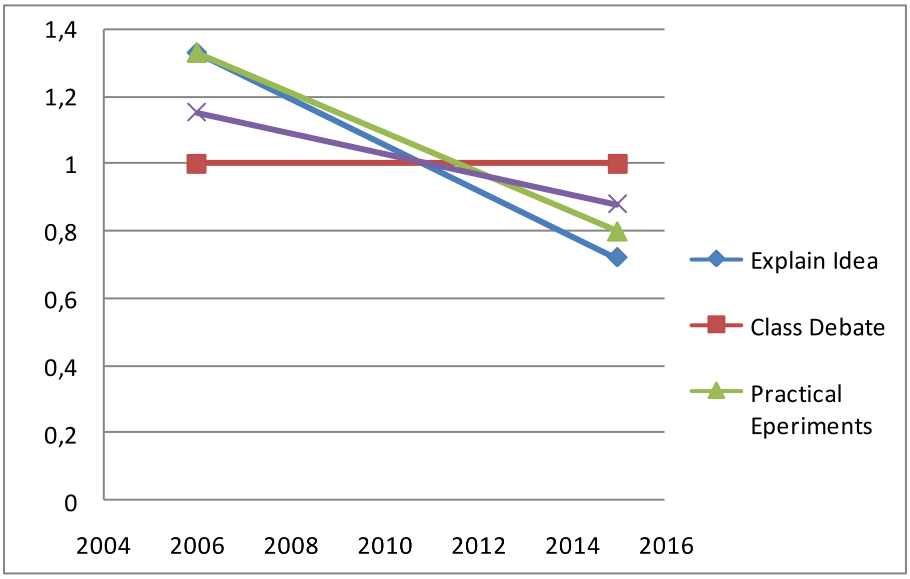

Figure 4: Change in EDB based on PISA 2006 and PISA 2015 data

In Figure 5 and in appendix 2, it can be seen that among the factors related to the "environmental awareness" of the German students, the factor of “greenhouse gases” had the highest factor value in 2006, with a coefficient of 1.12, and in 2015, with a coefficient of 1.07. In addition, the "use of genetically modified organisms (GMO)" had the lowest factor value in both 2006 (with a coefficient of .82) and 2015 (with a coefficient of .72).

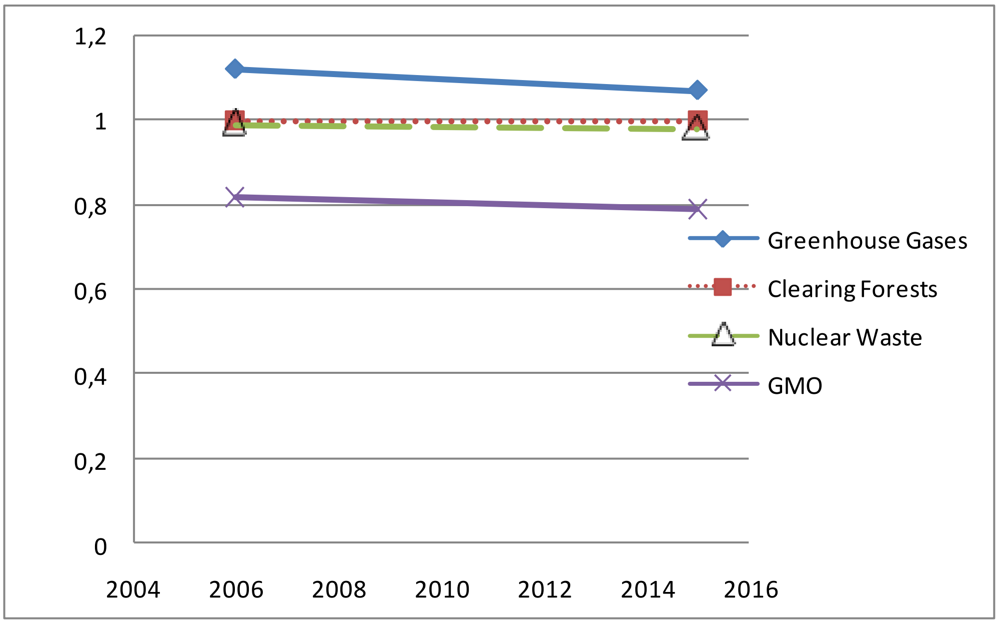

Figure 5: Change in EA based on PISA 2006 and PISA 2015 data

In the questionnaires, the students' views regarding environmental responsibility (ER) were obtained. The responses are shown in Table 6.

Table 6: Views on Environmental Responsibility (questionnaire results)

Year	Environmental Responsibility	I couldn't do this f (%)	I would struggle to do this on my own f (%)	I could do this with a bit of effort f (%)	I could do this easily f (%)
2006	Health Issue	929 (**20.4**)	2640 (**57.9**)	796 (17.5)	193 (4.2)
2015		700 (**20.8**)	1712 (**51.0**)	631 (18.8)	316 (9.4)
2006	Antibiotics	375 (8.2)	1246 (27.3)	1894 (**41.6**)	1041 (**22.8**)
2015		285 (8.6)	818 (24.5)	1424 (**42.7**)	806 (**24.2**)
2006	Garbage	336 (7.4)	1391 (30.6)	2204 (48.4)	619 (13.6)
2015		374 (11.3)	998 (30.2)	1517 (45.9)	419 (12.7)
2006	Certain Species	378 (8.3)	1034 (22.7)	1978 (**43.4**)	1165 (**25.6**)
2015		273 (8.2)	745 (22.5)	1505 (**45.5**)	788 (**23.8**)
2006	Food Items	421 (9.2)	1335 (29.3)	1897 (41.7)	901 (19.8)
2015		398 (12.1)	983 (29.9)	1349 (41.1)	555 (16.9)
2006	Acid Rain	536 (**11.8**)	1105 (24.2)	1719 (37.7)	1199 (26.3)
2015		556 (**17.0**)	894 (27.3)	1201 (36.6)	626 (19.1)

As shown in Table 6, the majority of the students (63% and over) indicated that 'they can describe the role of antibiotics in the treatment of disease' and 'they can predict how changes to an environment will affect the survival of certain species' easily on their own in both 2006 and 2015. However, approximately 20 % of the German students pointed out that they could not recognize on their own the science question underlining a newspaper report on a health issue. Moreover, more than half of the students mentioned that they struggled to understand the health issue. An increase was seen in the percentage of students who stated they could not identify the better of two explanations for the formation of acid rain, from 2006 (11.8%) to 2015 (17%).

In the questionnaires, the students' views regarding academic development support were obtained. The responses are shown in Table 7.

Table 7: Views on Development of Environmental Behaviour (questionnaire results)

Year	Development of Environmental Behaviour	Never or hardly ever f (%)	In some lessons f (%)	In most lessons f (%)	In all lessons f (%)
2006	Explain Ideas	1004 (**22.2**)	1683 (37.2)	1394 (30.8)	441 (9.8)
2015		1394 (**30.3**)	1843 (40.0)	1024 (22.2)	345 (7.5)
2006	Practical Experiments	1135 (25.1)	2406 (53.3)	819 (18.1)	157 (3.5)
2015		1254 (27.4)	2333 (50.9)	808 (17.6)	186 (4.1)
2006	Draw Conclusion	378 (8.4)	1212 (27.0)	1933 (43.1)	958 (21.4)
2015		484 (11.0)	1315 (29.8)	1775 (40.2)	842 (19.1)
2006	Design Own Experiments	2776 (**62.0**)	1106 (24.7)	454 (10.1)	145 (3.2)
2015		2837 (**64.0**)	1026 (23.1)	402 (9.1)	168 (3.8)
2006	Class Debate	705 (**15.6**)	2038 (45.1)	1254 (27.7)	526 (11.6)
2015		972 (**22.0**)	1753 (39.6)	1286 (29.1)	414 (9.4)

As shown in Table 7, in 2006, 62% of the students reported that in science lessons they were never or hardly ever allowed to design their own experiments, and 25 % mentioned that they never or hardly ever spent time in the laboratory doing practical experiments as part of the science lessons. Furthermore, 22 % indicated that they never or hardly ever were given opportunities in the science lessons to explain their ideas. However, in 2015, 64% of the students reported that they never or hardly ever were allowed to design their own experiments in science lesson, 30% reported that they never or hardly ever were given opportunities in the science lessons to explain their ideas, and finally, 27% mentioned that never or hardly ever spent time in the laboratory doing practical experiments as part of the science lessons.

In the questionnaires, the students' views regarding environmental awareness were obtained. The responses are shown in Table 8.

Table 8: Views on Environmental Awareness (questionnaire results)

Year	Environmental Issue	I have never heard f (%)	I have heard about this but I would not be able to explain what it is really about f (%)	I know something about this and could explain the general issue f (%)	I am familiar with this and I would be able to explain this well f (%)
2006	The increase of greenhouse gases	465 (10.2)	1376 (30.1)	1823 (39.9)	901 (19.7)
2015		464 (11.1)	949 (22.8)	1686 (40.5)	1066 (25.6)
2006	The use of GMO	817 (**17.9**)	2005 (44.0)	1410 (30.9)	329 (7.2)
2015		968 (**23.4**)	1683 (40.7)	1114 (27.0)	366 (8.9)
2006	Nuclear waste	311 (6.8)	1457 (32.0)	1958 (43.0)	832 (18.3)
2015		317 (7.7)	1111 (27.0)	1804 (43.8)	888 (21.6)
2006	The consequences of clearing forests	248 (5.4)	676 (14.8)	1716 (**37.6**)	1925 (**42.2**)
2015		230 (5.6)	620 (15.1)	1753 (**42.7**)	1501 (**36.6**)

As shown in Table 8, in 2006 and 2015, the majority of the German students (80%) pointed out that they had information about the consequences of clearing forests for other land use. More than 60% of the German students indicated in 2006 and 2015 that they had knowledge about nuclear waste. On the other hand, in 2006 and 2015, more than 60% of the German students believed that they did not have sufficient knowledge about the use of GMO.

Table 9 presents the mean of the German students' EL (environmental literacy) and sub-factors.

Table 9: Mean of German students' EL and sub-factors

	2006		2015	
	Mean	**Participant**	**Mean**	**Participant**
EL	2.55	4891	2.58	4942
ER	2.20	4891	2.28	4942
EDB	2.72	4891	2.73	4942
EA	2.72	4891	2.73	4942

As shown in Table 9, the means of EL were 2.55 in 2006 and 2.58 in 2015. Therefore, there was an increase in the mean of the EL from 2006 to 2015.

Environmental Literacy and Interest in Science

The results of ANOVA, as related to EL and having fun when learning science, were obtained. The responses are shown in Table 10.

Table 10: The results of ANOVA, as related to EL and having fun when learning science

	View	N	$\bar{X}$	Source of Variance	Sd	Mean Square	F	p	Sig dif
2006	Strongly agree(a)	1145	1.87	Between groups	3	1.90	24.82	.00	a-b, a-c, a-d
	Agree(b)	1850	2.15	With-in group	4702	.08			
	Disagree(c)	1273	2.41	Total	4705				
	Strongly disagree(d)	438	2.73						
2015	Strongly agree(a)	899	2.57	Between groups	3	.176	1.93	.12	-
	Agree(b)	1499	2.58	With-in group	4058	.091			
	Disagree(c)	1044	2.60	Total	4061				
	Strongly disagree(d)	620	2.57						

The results of the analysis show that there was a meaningful difference in terms of EL averages and having fun when learning science topics in 2006 (F_{2006} (3, 4702) =24.82, $p < .01$), whereas in 2015 there was no meaningful difference (F_{2015} (3, 4058) =1.93, $p > .01$). According to the results of the Scheffe test, the EL of the students who strongly disagreed with the fun of learning science (d) (X =2.73) was stronger than that of the other students in 2006. Moreover, while there was a significant increase from 2006 to 2015 in the average of the students who strongly agreed with the fun of learning science (X= 1.87) (X =2.57), there was a decrease in the average of the students who strongly disagreed with the fun of learning science (X_{2006} = 2.73; X_{2015} = 2.57).
Table 11 shows the results of ANOVA as related to EL and the interest in learning about science.

Table 11: The results of ANOVA as related to EL and the interest in learning about science

	View	N	$\bar{x}$	Source of Variance	sd	Mean Square	F	P	Sig Dif
2006	Strongly agree(a)	1015	2.51	Between groups	3	2.45	32.03	.00	a-c, a-d
	Agree(b)	1799	2.53	With-in group	4699	.08			
	Disagree(c)	1331	2.57	Total	4702				
	Strongly disagree(d)	558	2.64						
2015	Strongly agree(a)	794	2.56	Between groups	3	.379	4.13	.006	-
	Agree(b)	1492	2.57	With-in group	4023	.092			
	Disagree(c)	1032	2.60	Total	4026				
	Strongly disagree(d)	709	2.60						

The results of the analysis show that there was a meaningful difference in terms of EL averages and interest in learning about science between 2006 and 2015 (F_{2006} (3.4699) =32.03, F_{2015} (3.4023) =4.13, $p < .01$). According to the results of the Scheffe test, the EL of the students who strongly disagreed with interest in learning about science was stronger than that of the other students in 2006 ($X_{2006} = 2.64$) and 2015 ($X_{2015} = 2.60$). However, by 2015, the averages of those who strongly disagreed with the interest in learning science decreased, while the averages of those who strongly agreed with the interest increased.

Environmental Literacy and Reading Science

The results of ANOVA, as related to EL and like reading science, were obtained. The responses are shown in Table 12.

Table 12: The results of ANOVA, as related to EL and like reading science

	View	N	$\bar{x}$	Source of Variance	sd	Mean Square	F	p	Sig Dif
2006	Strongly agree(a)	1421	2.51	Between groups	3	2.34	30.52	.00	a-b, a-c, a-d
	Agree(b)	585	2.52	With-in group	4704	.08			
	Disagree(c)	1921	2.55	Total	4707				
	Strongly disagree(d)	781	2.62						
2015	Strongly agree(a)	518	2.55	Between groups	3	.787	8.67	.00	d-a, d-b, d-c
	Agree(b)	1128	2.57	With-in group	4031	.09			
	Disagree(c)	1453	2.58	Total	4034				
	Strongly disagree(d)	936	2.62						

The results of the analysis show that there was a meaningful difference in terms of EL averages and like reading science between 2006 and 2015 (F_{2006} (3.4704) =30.52, F_{2015} (3.4031) =8.67, $p < .01$). According to the results of the Scheffe test, the EL of the students who strongly disagreed with like reading science was stronger than the EL of the other students in 2006 ($X_{2006} = 2.62$) and 2015 ($X_{2015} = 2.62$). However, by 2015, the averages of those who strongly disagreed with like reading science stayed at the same value, while the averages of those who strongly agreed with like reading science increased.

Environmental Literacy and Teaching Methods

The results of ANOVA, as related to EL and teacher's explanation about how a school science idea can be applied were obtained. The responses are shown in Table 13.

Table 13: The results of ANOVA, as related to EL and teacher's explanation about how idea can be applied

	View	N		Source of variance	Sd	Mean Square	F	P	Sig Dif
2006	All lessons (a)	792	2.44	Between groups	3	8.67	116.25	.00	a-b, a-c, a-d
	Most Lessons(b)	1797	2.52	With-in group	4483	.08			
	Some lessons (c)	1463	2.60	Total	4486				
	Hardly ever (d)	435	2.71						
2015	All lessons (a)	749	2.43	Between groups	3	12.73	160.71	.00	a-b, a-c, a-d
	Most Lessons(b)	1720	2.54	With-in group	4387	.08			
	Some lessons (c)	1471	2.65	Total	4390				
	Hardly ever (d)	451	2.74						

The results of the analysis show that there was a meaningful difference in terms of EL averages and teacher's explanation about how idea can be applied between 2006 and 2015 (F_{2006} (3.4483) = 116.25, F_{2015} (3.4387) =160.71, $p < .01$). According to the results of the Scheffe test, when students were never or hardly ever informed by the teachers in the science lessons (d) (X_{2006} = 2.71; X_{2015}=2.74), the EL average of the students was stronger than that of the other students. From 2006 to 2015, the literacy average increased when the teacher never or hardly ever offered explanations during their science lessons.

The results of ANOVA, as related to EL and teacher's provision of an explanation of the relation of science concepts to our life, were obtained. The responses are shown in Table 13.

Table 13: The results of ANOVA, as related to EL and teacher's provision of an explanation of relation of science concepts to our life

	View	N		Source of Variance	Sd	Mean Square	F	p	Sig Dif
2006	All lessons (a)	417	2.40	Between groups	3	8.81	118.49	.00	a-b, a-c, a-d
	Most Lessons(b)	1296	2.49	With-in group	4456	.074			
	Some lessons (c)	1972	2.57	Total	4459				
	Hardly ever (d)	775	2.67						
2015	All lessons (a)	457	2.39	Between groups	3	12.10	153.16	.00	a-b, a-c, a-d
	Most Lessons(b)	1175	2.52	With-in group	4380	.08			
	Some lessons (c)	1745	2.61	Total	4383				
	Hardly ever (d)	1007	2.69						

The results of the analysis show that there was a meaningful difference in terms of EL averages and teacher explaining the relation of science concepts to our life between 2006 and 2015, F_{2006} (3.4456) =118.49, F_{2015} (3.4380) =153.16, $p < .01$. According to the results of the Scheffe test, when students are never or hardly ever informed about the relevance of science concepts to our lives by teachers in the science lessons (d) (X_{2006} = 2.67; X_{2015}=2.69), the EL average of the students was stronger than that of the other students. The El average was found to increase when the teacher never or hardly ever provided explanations about the relevance of science concepts to our lives during their science lessons.

DISCUSSION

According to 2006 and 2015 data, the students constituting the study had more knowledge about greenhouse gases than about other items. More than half of the German students had knowledge on the greenhouse gases, the consequences of clearing forests for other land use, and nuclear waste, in 2006 and 2015. In line with this finding, in the research conducted by Yurttas and Sulun (2010), second-grade primary school students specified global warming, ozone layer depletion and acid rain to be the biggest environmental problems in the world. In another study which reported similar results, elementary students were shown to be mostly aware of the environmental problems stemming from environmental contamination, air pollution and waste materials (Demirbas and Pektas, 2011). To continue, in a study by Negev et al. (2010), it was reported that most of the twelfth-grade student participants indicated solid waste, or air pollution, to be major environmental issues. In general, studies have shown that students view air pollution, global warning and greenhouse gases as the most important environmental issues. People tend to have more knowledge about matters that have a concrete impact on their lives. Moreover, social media has helped to draw attention to global problems, including of course those related to environmental issues. The study by Incekara and Tuna (1991) give support to the role that social media plays in spreading environmental knowledge, as they reported that secondary students tended to have sufficient information on issues such as air pollution, desertification and climate change. Similar results have been observed in research conducted on the environmental awareness of teacher candidates. In a study conducted by Artun, Uzunoz and Akbas (2009), teacher candidates pointed to global warming and air pollution as important environmental problems. Diken and Sert Cibik (2007) suggested that teacher candidates have cognitive and sensitive dimensions of environmental consciousness. However, these dimensions are not sufficient in terms of reflecting the environmental knowledge they have onto their behaviours (Diken and Sert Cibik, 2007; Kaya et al., 2009). This could be attributed to their lack of environmental awareness (Guven and Aydogdu, 2012; Ercengiz, et al., 2014). According to the study by Kahyaoglu et al. (2008) environmental behaviour is influenced environmental knowledge and awareness. Therefore, teacher candidates, especially science teachers, should be provided the necessary support to increase their level of environmental awareness, and they should be encouraged to translate their environmental awareness into environmentally responsible behaviour. For the sake of securing our future, it is crucial that students be taught a high level of environmental awareness. The German students in the present study had the lowest awareness of “use of GMO” in 2006 and 2015. However, interestingly, more students in 2015 seemed to have never heard of this concept. When the opinions of the students were taken to determine their knowledge level on this subject, the German students reported that they did not have sufficient knowledge about GMOs. Similarly, in a separate study, it was found from the opinions taken of students that they had insufficient information and misleading concepts about greenhouse gases (Bahar and Aydin, 2002). These results were in line with those from Darcin et al. (1991), who reported that the levels of knowledge elementary students had on the greenhouse effect were too low. In another study, it was indicated that biology teacher candidates had incorrect ideas about the greenhouse effect (Selvi and Yildiz, 2009). Regarding the subject of GMO, Gurbuzoglu Yalmanci (2016) reported that both high school students and teacher candidates had some misunderstandings about GMO. University students too have been shown to not have enough knowledge about GMO (Temelli and Kurt, 2011). In a study conducted by Cankaya and Filik Iscen (2015), however, it was stated that science teacher candidates had sufficient information about the meaning of the concept of GMO, although, they did have incorrect knowledge about the production of GM crops, the use of GMO in their country, and their effects.

Despite the increase in the health coefficient from 2006 to 2015, it was nonetheless seen that health issues are still not given importance (appendix 2). In support of this finding, approximately 20% of the German students, in both 2006 and 2015, revealed that they were unable to recognize a health problem. Moreover, more than half of the students mentioned that they struggled to understand the health issue. Research shows that overuse of antibiotics poses a threat, not only to human health but also to the environment (Yesil Aski, 2013).

Individuals need to be taught greater awareness about health issues in order to create a healthier public in the future. In addition to the lack of understanding of health issues, it was also found that there was an increase in the percentage of the students who indicated that they were unable to explain acid rain. Therefore, acid rain and health issues should be emphasized in future science curricula.

While in 2006 the students stated that they were not able to express themselves enough in science classes, in 2015, the students mentioned class discussions and their expectations regarding the planning of science lessons so as to allow for the discussion of different opinions. On the other hand, in both 2006 and 2015, approximately 25% of the students reported that they never or hardly ever spent time in the laboratory doing practical experiments as part of their science lessons. Furthermore, more than half of the students noted that they never or hardly ever were allowed to design their own experiments in the science lessons. It can be seen from the students expressed expectations that they would like their science lessons to be more student-centred. In other words, they want to actively participate in the process by taking responsibility in lessons. When the teacher never or hardly ever provides explanations showing the relevance of science concepts to our lives or/and explanations about how a school science idea can be applied during a science lesson, the average rate of EL increases. In fact, it can be

argued that teacher-centred education has a negative effect on EL. Therefore, student-centred lessons should be applied to provide more academic support for the improvement of EL skills. A student-centred approach also provides opportunities for students to increase their interest and attitude towards science. If these are increased, the students will have a chance to improve their literacy. Interest and positive attitude towards science, academic development support and EL are concepts that affect each other.
Last but not least, in this study, there was a positive relationship determined between EL and ER and ADS and EA (Figure 6). Otherwise stated, when EA, ER and DEB are positively supported, this will provide a positive contribution to the students' EL development.

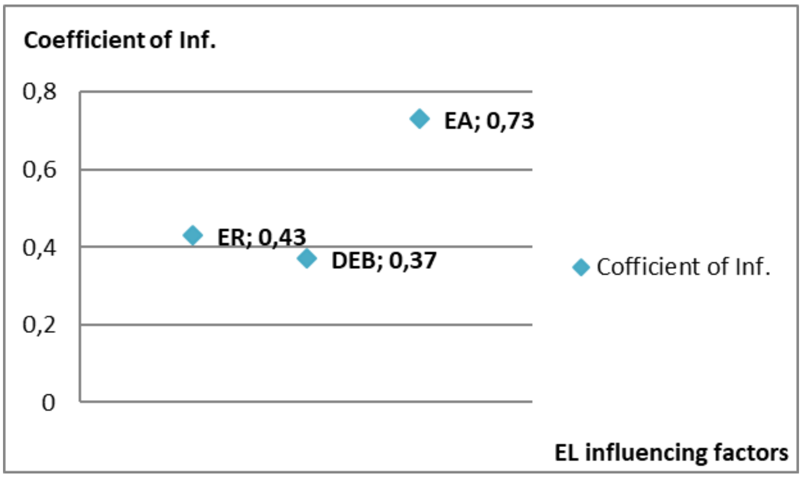

Figure 6: Environmental Literacy (EL) influencing the factors of Environmental Awareness (EA), Environmental Responsibility (ER), and Development of Environmental Behaviour (DEB).

IMPLICATIONS
First, when PISA 2006 and 2015 data were compared, it was initially anticipated that the increase in the average of EL would positively impact environmental education and thereby, in turn, contribute positively to EL between these years.
What are the challenges and solutions for school education?
According to the results gathered in the study, it might be said that the subjects of genetically modified organisms and health issues should be more comprehensively taught as part of the science curricula in Germany. Teachers should allow students to access new information instead of simply sharing information with students. The students' interest and attitudes towards science should be improved, and students should be encouraged to read science books.
Students should be informed about the effect of these on the environment, and in social terms, individuals should have raised awareness of these issues. Furthermore, teachers especially science and biology teachers, should be informed about these issues through in-service training.
In addition, science teachers should design classroom environments in which

- students can express their thoughts,
- students can engage in class discussions, and
- students have access to new knowledge during environmental education.

Ultimately, it is important that teachers are aware of the changing roles of environmental education, that they design student-centred education and/or that they facilitate inquiry-based learning in the classroom environment. Moreover, it is important that improvements be made to secure the professional development and science process skills of the students. Lastly, the importance, scope and competencies of EL should be determined more clearly to ensure a higher quality of science education.

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Appendix 1: Items on the Scale

Factor Name	Code	Items
Development of Environmental Behavior	ST098Q01TA	Students are given opportunities to explain their ideas.
	ST098Q02TA	Students spend time in the laboratory doing practical experiments.
	ST098Q05TA	Students are asked to draw conclusions from an experiment they have conducted.
	ST098Q07TA	Students are allowed to design their own experiments.
	ST098Q08NA	There is a class debate about investigations.
Enviromental Awareness	ST092Q01TA	How informed are you about this environmental issue? The increase of greenhouse gases in the atmosphere
	ST092Q02TA	How informed are you about this environmental issue? The use of genetically modified organisms (<GMO>)
	ST092Q04TA	How informed are you about this environmental issue? Nuclear waste
	ST092Q05TA	How informed are you about this environmental issue? The consequences of clearing forests\other land use
Enviromental Responsibility	ST129Q01TA	Recognise the science question that underlies a newspaper report on a health issue.
	ST129Q03TA	Describe the role of antibiotics in the treatment of disease.
	ST129Q04TA	Identify the science question associated with the disposal of garbage.
	ST129Q05TA	Predict how changes to an environment will affect the survival of certain species.
	ST129Q06TA	Interpret the scientific information provided on the labelling of food items.
	ST129Q08TA	Identify the better of two explanations for the formation of acid rain.

Appendix 2: Structural Equation Modeling of Environmental Literacy (Appendix 1)

Sub-Factor	PISA	The First Important Item	Coeff.	The Second Important Item	Coeff.	The Third Important Item	Coeff.	The Last Item	Coeff.
ER	2006	Acid Rain	1,00	Food Items	,91	Certain Species	,88	Health Issue	,78
	2015	Food Items	1,04	Garbage	1,00	Acid Rain	1,00	Health Issue	,91
DEB	2006	Explain Ideas	1,33	Practical Experiments	1,33	Design Own Experiments	1,19	Class Debate	1,00
	2015	Class Debate	1,00	Draw Conclusion	,88	Practical Experiments	,80	Explain Ideas	,72
EA	2006	Greenhouse Gases	1,12	Clearing Forests	1,00	Nuclear Waste	,99	GMO	,82
	2015	Greenhouse Gases	1,07	Clearing Forests	1,00	Nuclear Waste	,98	GMO	,79