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Original Article

Seventh-Grade Students' Levels of Associating Science Courses with Real Life [*]

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Abstract

This study aims to reveal the extent to which secondary seventh-grade students can associate what they learn in science courses with real life. The study was conducted with a descriptive method after selecting participants through probability-based sampling methods, namely, stratified sampling and cluster sampling. The research was carried out with 274 seventh-graders from 12 secondary schools in the central districts of Ankara province during the 2017-2018 academic year. The students' levels of associating science with real life were studied from two perspectives: proposing solutions to real life problems by drawing on scientific principles and identifying the scientific principles applicable in solving related life problems. To properly assess these measures, two tests were developed by the researcher and were used. These tests consist of open-ended problem scenarios and are called the "Test of Life in Science" and the "Test of Science in Life". The data analysis results revealed that the students cannot sufficiently associate science courses with life, as they cannot propose solutions for life problems employing scientific principles and they also cannot elicit the principles applied in solving life problems related to science. Moreover, the students' levels of associating science courses with life significantly vary depending on the students' socioeconomic status, access to supplementary science courses, domestic Internet access, and out-of-school experience of science learning. The study results seem significant, as they imply the need for necessary arrangements to educate students as individuals who are able to do the following: solve real-life problems by using their scientific knowledge; make decisions and put forward useful outcomes for the good of society by using such knowledge from good science education; adapt easily to their community; and develop favorable consumption habits.

Keywords

Science course
Nature of science
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Introduction

Science is a part of daily life; nevertheless, in the context of the performance of simple daily life events, due to estimation, data collection, and questioning functions, the scientific way of thinking differs from other ways. While within everyday life, students find it enjoyable and interesting to engage in or watch examples of science, such as playing with a wobble board or monitoring the development of a plant, they have difficulty learning science subjects, such as "force and balance" or "photosynthesis", which help explain these happenings. Not only does the close relationship between science and daily life go unnoticed, but during their education, many students cannot connect school knowledge with life; therefore, they lose their motivation for learning. Dewey (1956) explains this disconnect between school and life as the children's lack of opportunity to fully and freely apply their extra school experiences to school and due to artificial learning tools, the isolation of schools from real life. It has been stressed that true learning and development will not take place unless a connection is established between school activities and children's life experiences. This situation has motivated and resulted in much research studies on science literacy or on understanding the nature of science.

Science literacy, which is considered the root of the progressive change in science education, centers on preparing society for the future by making decisions at the personal and social scale on sociological issues (Sadler & Zeidler, 2009). Science literacy refers to the individuals' ability to do the following: find answers to questions arising from a curiosity about daily events; define and explain and predict natural phenomena; understand and discuss scientific publications; evaluate scientific information according to the quality of its source and the processes in which this information is produced; and to put forth evidence-based arguments and follow such arguments in practice (National Academy of Science, 1996). In short, what makes science literacy distinguishable is an ability to understand and use science in a daily life context (Collins, 1997). Accordingly, the importance of qualified science education in preparing individuals for life by equipping individuals with the ability to easily deal with the problems they encounter in life and to produce solutions to social issues becomes apparent (Roberts & Bybee, 2014).

Understanding the nature of science is underlined as the most important aspect and educational goal of scientific literacy, which helps students gain scientific knowledge, respond to social scientific problems, make responsible decisions, and understand science as a part of culture (Smith & Scharmann, 1999). To understand the nature of science, students must be able to explain how a kite flies, ships float, or how birds hatch as well as how to interpret a variety of situations by means of scientific applications rather than by having abstract conceptions. These actions are in fact more than entertainment for children. Scientific practices that show that school and the outside world are connected allow children to learn scientific concepts, to listen to their peers, parents and other people who make up a community or to obtain answers to their questions. They also offer opportunities to improve skills, such as addressing original questions, permanent learning retention, problem solving and self-regulation (Feinstein, 2011). Although they are not expected to be scientists, students should be able to rationally analyze, evaluate and make a decision on socioscientific issues by following the steps of the scientific method (Allchin, 2013; Bosser, 2017; Deboer, 2000). The nature of science should be the rationale of science teaching: science should be regarded as a way of research and beyond being a mere entirety of information, a way of thinking and transferring information to technology (Lederman, 1992). Once students, acting as citizens who will have a voice in the future, understand the methods and processes of science, they will not only raise individuals with a desire to learn seeking scientific solutions to life problems but also lay foundations of a society that can keep up with scientific and technological developments and produce things (Doğan Bora, Arslan, & Çakıroğlu, 2006).

Given that the goal of science education is to create a science-literate society, it is of the highest priority to portray the current status of science literacy. Science literacy does not comprise the pieces of knowledge learned by heart for the sake of achieving in certain tests but consists of well-digestive information that cannot be tested with ordinary measurement techniques. Under normal circumstances, upon the ending of a lesson, it is relatively easy to reveal what students know about that lesson. This measurement does not show how much of the information becomes available to the students when a life problem is encountered after a few months (Trefil, 2008). It is precisely for this reason that the relationship between science and life should be made visible to students and the goals of science education should be made life skills.

Observations in teaching-learning environments show that science teaching is still carried out on a conceptual level and that students do not have sufficient learning opportunities in laboratory and out-of-class learning environments (Derman, 2019; Işık, 2014; Kasanda et al., 2005; Koosimile, 2004; Mayoh & Knutton, 1997; Rubini, Ardianto, Pursitasari, & Permana, 2016). Science education in schools is based on methods that are not relevant to everyday life and that do not help students discover the world they live in. The lists of knowledge and skills created are too technical, the students' learning is built on concepts, and laws are learned through memorization by emphasizing what is learned from course books. In this way, students who have memorized information that they will never use in life are far from seeing even the simplest relationships between life and science (Dwianto, Wilujeng, Prasetyo, & Suryadarma, 2017; Fourez, 1997; Roth & Barton, 2004; Senemoğlu, 2020). Although one can readily see the students' curiosity about everyday life happenings as a natural drive for learning, science classes continue failing to draw on this opportunity. Again, it is considered a function of science education to relate science to life. On the contrary, when the value of science education is questioned, "everyday life" does not refer to regular or habitual actions at school but an imaginary life imported from somewhere to the setting of science teaching performed by someone (Andree, 2005). Creating an appropriate link between the students' lives in their living spaces and the subject area would motivate students and make good conceptions possible. To achieve meaningful learning in this way, students should play an active role in the teaching-learning environments and teachers should guide the process of structuring information (Senemoğlu, 2018). For this reason, science education at school should respond to the changing social content and help young people contribute as citizens to shaping the future world. To this end, science curricula should be developed in such a way as to attract the students' interest and engage them in science-related issues (Jenkins, 1999). In the light of realistic and contemporary research findings regarding the use of science in daily life, science literacy should be turned into a meaningful educational goal rather than a motto (Feinstein, 2011).

Studies conducted on science education so far have basically aimed at improving high-level thinking skills, such as raising science literate individuals, understanding the essence of natural sciences, and solving problems and making decisions related to natural sciences. It is becoming obvious that science education, which particularly aims to develop high-level thinking skills, appeals to students' interests and triggers their curiosity as well as their desire for exploring and producing; it also plays an important role in preparing students for life and educating active and productive individuals in life. It has become a basic goal to bring up individuals with a skill common to all: the ability to pick up the most valuable piece of accumulated knowledge on science education and use it for a better life. The science curricula developed in Turkey refer to similar learning objectives.

International-scale examinations, such as PISA (Program for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study), have been held heavily since the beginning of the 21st century, and the Republic of Turkey also participates in these assessments. In terms of science skills, examinees are tested for their tendency in the face of everyday life problems referring to those disciplines, to question their knowledge of science and technology, to adopt an approach that generates solutions and to display characteristics of a caring and responsible consumer (Ministry of National Education [MoNE], 2015). In this regard, the results of these international monitoring and evaluation studies are followed closely, and the results are made public and assessed. Subsequently, the exam for transition to secondary education is still not finished in our country because of the ongoing efforts to "prepare pupils for life rather than for exams". In addition to international studies, the first implementation of the Monitoring and Assessment of Academic Skills (ABIDE) study based on an examination approach based on "Verbal and Numerical Ability" was realized in 2016 (MoNE, 2017). In this direction, as in international and national monitoring and evaluation studies, the aim is to evaluate the students' ability to use their scientific knowledge in daily contexts (MoNE, 2013). In general, evaluation, which is defined as the process of determining the degree of realization of the educational objectives, is the final and complementary link of curriculum development (Ertürk, 2013). Therefore, it becomes important and necessary to determine the students' levels of using scientific knowledge in everyday life and according to the study results and attainments in the current curriculum, to make good amendments to the curriculum.

Turkish and international literature focusing on our study's objective reveals that students cannot associate at a sufficient level their learning from primary, middle and high school science lessons with everyday life contexts (Akgün, Çinici, Yıldırım, & Köprübaşı, 2015; Akgün, Tokur, & Duruk, 2016; Anagün, Ağır, & Kaynaş, 2010; Canpolat & Ayyıldız, 2019; Cengiz & Ayvacı, 2017; Crespo & Pozo, 2004; Çınar, 2018; Dede Er, Şen, Sarı, & Çelik, 2013; Emrahoğlu & Mengi, 2012; Enginar, Saka, & Sesli, 2002; Hürcan, 2011; İlkörücü Göçmençelebi, 2007; Murti & Aminah, 2019; Soobard & Rannikmae, 2011; Taşdemir & Demirbaş, 2010). This literature emphasizes that the students do not know about the relationship between the concepts they learned in science courses and problems in daily life and that this is a result of the lack of meaningful learning (Hastuti, Setianingsih, & Anjarsari, 2020; Rubini, Ardianto, Setyaningsih, & Sariningrum, 2019). Particularly, previous studies on science teachers and prospective science teachers similarly have revealed that the essence of science cannot be understood adequately or it cannot be associated with a satisfactory extent with the course of science and everyday life (Balkan Kıyıcı & Aydoğdu, 2011; Doğan, Çakıroğlu, Çavuş, Bilican, & Arslan, 2011; Yıldırım & Birinci Konur, 2014). This seems to account for the students' overall misconceptions of various science subjects. Moreover, the literature suggests that the students' level of associating science with life is dependent on their socioeconomic status (Anagün et al., 2010; Büyükşahin & Demirci Güler, 2014; Taşdemir & Demirbaş, 2010), Internet access (Anıl, 2011; İlkörücü Göçmençelebi, 2007; Karip, 2017), and out-of-school learning environments related to science (Anagün et al., 2010; Bakioğlu, 2017; Erten & Taşçı, 2016; Mayoh & Knutton, 1997; Campbell & Lubben, 2000).

The studies summarized above examine from the perspective of only one of these aspects, the level of associating science courses with real life. Bearing in mind the complexity of daily life events, it is considered as important to analyze the science principles in real cases as to realize what cases are related to the principles in science. Departing from this, in the present research, the students' level of associating science courses with daily life is examined from two dimensions: proposing solutions to life problems integrating the principles of science and identifying the principles applied in solving life problems related to sciences. For this purpose, through the use of open-ended problem scenarios, an attempt is made to realize a holistic evaluation of the students' levels of associating science with everyday life.

The aim of this study is to determine to what extent seventh-grade secondary school students can associate their learnings from science courses with real life. The objective is to determine the level at which they can relate to sciences and life. To this end, the answer is sought for the following questions:

1. In terms of proposing solutions to life problems in which science-related principles are employed, and determining the principle to work in solving life problems related to science, what are the seventh-grade students' levels of associating their learning in science lessons with life? Is there a significant difference between the students' levels of associating science course outcomes with life and the full learning criteria (70%)?
2. Is there a significant relationship between the seventh-grade students' levels of proposing solutions to life problems by drawing on scientific principles and their levels of identifying the applicable scientific principles used in solving related life problems?
3. When measured against t certain variables, is there a significant difference among the seventh-grade students' levels of proposing solutions to life problems by drawing on scientific principles?

4. When measured against certain variables, is there a significant difference among the seventh-grade students' levels of identifying the applicable scientific principles in solving related life problems?

We think that this study will shed light on devising highly qualified science curricula and teacher training programs covering objectives, instructional situations and testing activities centered on the acquisition of the nature of science and whose ultimate aim is to increase the science lesson's capacity of preparing students for life. In the light of the findings obtained here, a number of improvements can be expected in the future. These include the following: creating learner-friendly learning and teaching settings; and raising citizens who are equipped with high-order thinking skills, are able to solve the problems encountered in everyday life by relying on the knowledge of science taught at school, can adapt easily to their environment, have desirable consumption habits, can make decisions for the benefit of community by making good sense of the nature of science, and who can transfer the knowledge into technology.

Method

In this study, a survey model was used to reveal the extent at which secondary school seventh-grade students are able to associate learning in school science classes with everyday life problems. The survey model is a type of research that is used in order to describe an existing situation together with its specific conditions (Karasar, 2009). Here, using problem scenarios consisting of open-ended questions, we attempt to determine the students' level of associating principles learned in science lessons with real life problems as well as their levels of relating science to everyday life by associating real life problems with scientific principles.

Population and Study Group

The population of the study consists of students attending the seventh grade in the public secondary schools of the Ministry of National Education (MoNE). The schools are located in the central districts of Ankara. The implementation schools for the study were selected by applying a stratified sampling technique, a probability-based sampling method, to public secondary schools in each of the central districts of Ankara province, and one classroom was selected from each of the schools by means of cluster sampling (Fraenkel, Wallen, & Hyun, 2012). The study sample consists of 274 participants, and the distribution of the participants by demographic characteristics is presented in Table 1.

Table 1. Distribution of Study Participants by Demographic Information

Demographic variable	Group	f	%
Gender	Female	134	48.9
	Male	140	51.1
Socioeconomic Status*	Upper	84	30.6
	Middle	95	34.7
	Lower	95	34.7
Access to Additional Science Courses	None	147	53.7
	MoNE-run extra course/Private course	127	46.3
Domestic Internet Access	No	125	45.6
	Yes	149	54.4
Out-of-school Experience of Science Learning	Never	81	29.6
	Once or twice	116	42.3
	3 times or above	77	28.1

*Socioeconomic data about districts refer to Mutlu et al. (2012).

Table 1 shows that the sample of the study consists of 274 seventh-grade students: 134 girls and 140 boys in 12 different schools. Regarding the distribution by districts, 34.67% of the students come from lower socioeconomic parts of the city (Mamak, Gölbaşı, and Altındağ), another 34.67% from middle status section (Sincan, Keçiören, and Pursaklar), and the last 30.66% are in the upper sections (Etimesgut, Çankaya, and Yenimahalle) of the socioeconomic level. Apart from these, approximately half of the students (53.6%) do not receive any reinforcing course of science in addition to the regular school classes. Of the remainder, 33.2% of all the participants attend extra science courses held in their schools, and 13.1% benefit from private lessons or science courses in paid evening courses. As another variable, Internet access at home is available to 45.6% of the students; the opposite is true for 54.4% of the students. Last, 29.6% of the students have never participated in scientific learning environments outside the school, while 42.3% have attended such occasions once or twice and 28.1% have enjoyed these three times or more.

Data Collection Instruments

In this research, the objective was, through using two related measurement instruments developed by the researcher, to determine the levels of the seventh-grade students' ability to relate science lesson learnings with everyday life. The instruments were correlated, as they both were intended to measure similar educational attainments. The first one contained principles presumably learned in science courses and instructed respondents to explain by giving examples, the situations in which they could consult these principles in their lives. In the latter, the respondents were given samples of everyday problems that could be solved by using the knowledge they had learned in the science courses. Despite constituting two separate instruments of measurement, these forms were connected in that the scientific principle concerning the question in the first form was the answer to the problem status in the second form and vice versa. The measurement instruments were named the "Test of Life in Science" (TLS) and the "Test of Science in Life" (TSL) They were designed to cover all science subjects from unit one in the fifth grade curriculum to unit four in the seventh grade curriculum, taking into account the date of application in this study. The instrument of measurement is represented through a few items in Table 2.

Table 2. Example Item Pairs in TLS and TSL

	TLS	TSL
Example Item Pair 1.	Beings that are stable at a certain height above the ground move when they are released. What causes this movement is the potential gravitational energy stored by beings, who move them when released. The beings' potential gravitational energy due to their position can be converted into kinetic energy. Explain the conversion between potential gravitational energy and kinetic energy with an example from your everyday life.	On a playground, a child rides down a slide and becomes accelerated from the top towards the bottom. Please explain this in relation with the energy conversion.
Example Item Pair 2.	Plant seeds germinate by using their nutrient storage when they are exposed to the appropriate water, oxygen and temperature. The plant does not photosynthesise during germination since it does not have green leaves. Therefore, it does not need light. Based on this information, specify an experiment to be made by a scientist who wants to test the hypothesis "A plant seed does not need light during germination".	Ezgi's science teacher asked the students to germinate bean seeds in a room at a certain temperature by giving the seeds a certain amount of water each day. However, However, half of the students were told to germinate seeds in a dark environment, and the other half were told to do it in a bright place. After a while, all students could germinate the bean seeds. Explain the goal of this experiment by considering the factors affecting the germination of the bean seeds.

By using the item pairs exemplified in Table 2, draft forms of TLS and TSL were drawn up and applied as an example. To reach the sufficient number of tests consisting of parallel questions, TLS was applied (n = 272) to students in the seventh grade level in five different secondary schools, and after three weeks, TSL (n = 266) was applied to the same students. As another precaution, to check the skewness and kurtosis coefficients, descriptive statistics were obtained from the pilot implementation of both tests. The coefficients were found to remain between -1 and +1, indicating that there was no excessive deviation in the receiving group (Büyüköztürk, Çokluk, & Köklü, 2011).

Following the pilot application, as intended, qualitative item analyses were performed for a product. In item selection, an item discrimination index and item difficulty index was applied. Since the answers to the items were scored from 0 to 2, the following formula was used to calculate the discriminatory feature of structured or performance-measuring items (Nitko & Brookhart, 2014):

$$D = \frac{(\text{upper group average} - \text{lower group average})}{(maximum\ item\ score - minimum\ \text{item score})}$$

As a result of the pilot implementation, the difficulty indices of the items in the Test of Life in Science (TLS) were found to be 0.26 and 0.74, and the item discrimination indices were between 0.38 and 0.76. In the other test, TSL, the values for the difficulty indices and the discrimination indices were found to fall within the range of 0.15 to 0.72 and 0.46 and 0.77, respectively. The items with a difficulty index below the reference value (0.20) were reexamined by an expert and made clearer. In addition, as all items had good discrimination indices (rjx > 0.40) and were fairly difficult as a natural result of the study's purpose, the TLS and TSL were made ready for the main implementation, and each included 20 items.

Validity and Reliability of the Study

To ensure the reliability and validity of the printed scales, four factors, including the number of items, item uncertainty, and scoring and item difficulty, were tried as controls (Turgut & Baykul, 2010). To start with, the number of items was calculated by taking into consideration the levels of the students and the time for answering. In this scope, the Lawshe technique (Yurdugül, 2005) was used, and 22 science teachers currently working in public elementary schools were asked to check the scientific accuracy and content validity of the 25 pairs of items. In the light of their review, the content validity ratios were calculated, and the scales were finished accordingly with 20 pairs of items. For the item pairs in the tests, Table 3 displays the distribution of the content validity by topics of teaching.

Table 3. Distribution of TLS and TSL Item Pairs by Topic and Unit of Teaching

Topic	**Secondary School (5 through 8th Grade) Science Units**	**Item Pairs**		**Subtotal**	**Total**
A. Living Beings and Life	1. Let's Solve the Puzzle of Our Body (5th Grade)				
	2. Systems in Our Body (6th Grade)	I1		3	
	3. Systems in Our Body (7th Grade)	I17	I6		6
	4. Reproduction, Growth and Development of Plants and Animals (6th Grade)	I9	I16	2	
	5. Let's Visit and Meet the World of the Living (5th Grade)	I4		1	
B. Physical Phenomena	6. Measurement of the Magnitude of Force (5th Grade)	I2			
	7. Force and Movement (6th Grade)	I7		4	
	8. Force and Energy (7th Grade)	I15	I18		
	9. Spread of Light and Sound (5th Grade)				
	10. Light and Sound (6th Grade)	I14		2	7
	11. Mirror Reflection and Light Absorption (7th Grade)	I19			
	12. Electricity: Indispensable for Our Life (5th Grade)			1	
	13. Electrical Conduction (6th Grade)	I11			

Table 3. Continued

Topic	Secondary School (5 through 8th Grade) Science Units	Item Pairs	Subtotal	Total
C. Matter and Its Change	14. Particle Structure of Matter (6th Grade)	I8 I12 I13		
	15. Matter and Heat (6th Grade)	I3	5	5
	16. Structure and Features of Matter (7th Grade)	I10		
D. The Earth and The Universe	17. The Mystery of the Earth's Crust (5th Grade)	I5	2	2
	18. The Earth, The Moon and The Sun: Our Source of Life (6th Grade)	I20		
TOTAL				20

As seen in Table 3, in the measurement instruments developed here, an attempt was made to ensure the content validity by including questions with varying weight depending on each of the four topics under the Science Lesson. The units of teaching in the curriculum were prepared with a spiral approach, and the most comprehensive ones were selected as the units from which questions were chosen. Totaling 20 pairs of items, the final version of the instrument contained 6 items on "Living Beings and Life", 7 on "Physical Phenomena", 5 on "Matter and Its Change", and 2 on "The Earth and The Universe".

Once the number of items was determined, before the implementation stage, five students from the seventh grade were asked to read aloud the items to make sure that the items were suitable for the particular purpose of this study and to eliminate item uncertainty (Senemoğlu, 2016). During this precautionary work, the statements that were found to be unclear or misunderstood were reviewed for necessary amendments. Following that stage, the trial measuring tools were administered in compliance with the rules regarding test development.

To reduce the negative impact of rating on reliability, a "Scoring Key" was generated. In this key, each complete response was scored as "2", a partially complete response was given "1" point, and the items that were answered incorrectly/insufficiently or left unanswered were scored as "0". The criteria for complete, partial and incorrect/inadequate answers to each item were included in the scoring key along with sample/possible answers.

In addition, to ensure consistency between the raters, the data obtained from the pilot application of both tests were assessed by two different experts by using the scoring key. To this end, a Spearman-Brown rank-difference correlation coefficient was calculated and revealed a high, positive and significant relationship between the scorings by independent raters ($r=0.99$, $p<0.01$). For items rated with excessive difference, before giving the final score, a third rater's professional opinion was obtained (Johnson, Penny, & Gordon, 2009).

As a result of the main application, using the scoring key, two independent raters assessed all of the data collected with the TSL and TSL. When divergent scores appeared in the first assessment, the final rating was done by taking the opinion of an upper-level rater. As another precaution for ensuring the raters' agreement, the responses from 12 students were taken on a random basis from the data sets of each test. Then, they were rescored by an independent expert in the subject area, and "Fleiss's Kappa Coefficient" was calculated. In this way, a very good level of agreement developed among the three raters (0.84 for TLS; 0.90 for TSL) (Fleiss, 1971).

Analysis of Data

An outlier analysis was performed to extract valid results from the data set obtained from the TLS and TSL. Since the z scores calculated for TLS (min: -1.92; max: 2.14) and TSL (min: -1.51; max: 2.78) were in the range of +3 and -3, it was concluded that there was no unidirectional outlier in the data set (Mertler & Vannatta, 2005).

Before deciding to use parametric or nonparametric methods in solving the study subproblems, the normality assumption regarding the dependent variables subject to analysis was examined. From the data obtained from the 274 students who participated in the main application, the coefficient of skewness was calculated as 0.55, and indicating no excessive deviation from normal values, the kurtosis coefficient was calculated as -0.60 for the TLS and TSL (Büyüköztürk et al., 2011).

As required by the particular study, the analysis methods below were employed to answer subproblems.

For analyzing the collected data, several statistical techniques were used. First, a quantitative analysis was performed to determine the students' attainment levels of proposing solutions for real-life problems by engaging scientific principles and their attainment levels of spotting the specific scientific principles governing the solution of science-related real-life problems. It included the calculation of an arithmetic mean, frequency, and percentage. For each of the tests, the significant difference between the level of attainment and the full learning criterion was analyzed by using the "Ratio Test" after calculating the "Z Score". In the assessment of the students' level of attaining the test items, 70% was taken as the relative criterion for full learning and as an indication that the science course showed a moderate level of progressivity (Özçelik, 2009).

Second, the Pearson Product-Moment Correlation Coefficient was calculated to check the existence of a significant relationship between the students' attainment levels of proposing solutions to life problems where scientific principles are employed (TLS) and their attainment levels of determining the principles employed in the solution of life problems related to sciences (TSL).

Third, in search of an answer to subproblem three and four, an attempt was made to ascertain whether the students' scores from the TSL and TLS varied significantly against a number of variables including their gender, socioeconomic level, Internet access at home, access to supplementary science courses, and participation in out-of-school learning programs on sciences. For this purpose, a Multivariate Analysis of Variance (MANOVA) was performed in order to determine the effect of more than two independent variables on two dependent variables. However, because of the small number of participants (n = 274) and the high number of variables (five independent variables), the conditions for MANOVA could not be met. Therefore, it was decided to perform a Multi-Factor ANOVA to examine the effect of more than two independent variables on each dependent variable. However, the conditions could again not be met n.

Therefore, a t-Test was preferred to determine whether there was a meaningful difference between the students' TSL and TLS scores and the independent variables of gender, Internet access at home, and taking supplementary science courses. To ascertain if there was a difference between the students' socioeconomic status and their participation in outside-school learning processes, a One Way Variance Analysis (ANOVA) was used.

The requirement of the One-Way ANOVA, i.e., the equality of the variance of the groups, was tested by applying the Levene Test to the data obtained from the TSL and TLS. In addition, the Bonferroni test was chosen to see the group variance in terms of the means resulting from the ANOVA since each group had a different sample size (Field, 2005).

Results

This study was carried out to determine the extent to which seventh-grade secondary schoolers can connect science courses with real life. The findings reached in this regard are presented below in order of answers to the subproblems.

Secondary Seventh-Grade Students' Levels of Associating Their Learnings in Science Course with Real Life

In search of the answer to the research questions *"In terms of proposing solutions to life problems in which science-related principles are employed and determining the principle to work in solving life problems related to science, what are the seventh-grade students' levels of associating their learning in science lessons with life?" and " Is there a significant difference between the students' level of associating science course outcomes with life and the full learning criteria (70%)?"*, the arithmetic mean and standard deviation values of the TLS and TSL were calculated at first hand. The results are shown in Table 4.

Table 4. Arithmetic mean and standard deviation values of the TLS and TSL Scores

	n	$\bar{x}$ *	ss
Test of Life in Science (TLS)	274	18.51	9.11
Test of Science in Life (TSL)	274	14.05	9.32

* The minimum and maximum scores in TLS and TSL are 0 (zero) and 40, respectively.

As seen in Table 4, the arithmetic mean of the scores the students (n=274) obtained from the TLS was 18.51, and the standard deviation was 9.11. As for the TSL, the arithmetic mean and the standard deviation values were recorded as 14.05 and 9.32, respectively. The findings from the TLS imply that at the level of 46.28%, the students can propose solutions to life problems where the principles of science were employed. There was a significant difference between this achievement level and the full learning criterion ($z_{total}=8.57$, $p<0.05$). It can thus be said that the students' level of suggesting solutions to life problems that can be explained with scientific principles remained significantly lower than the level consistent with the full learning criterion. In other words, the students in this study are not able to sufficiently relate the science course to life.

According to the data obtained from the TSL, the students' success of determining the principle employed in the solution of life problems related to sciences was 35.13%, which indicates a significant difference between the achievement level and the full learning criterion ($z_{total} = 12.59$, $p < 0.05$). To put it in another way, the students in our study remained below the full learning criterion for determining the scientific principle that would be beneficial to solving science-related life problems at a meaningful level. This means that the students lag behind in their ability to explain everyday life events with science learnings.

Relationship between Secondary Seventh-Graders' Levels of Proposing Solutions for Life Problems Drawing on Scientific Principles and Their Levels of Identifying the Applicable Scientific Principles in Solving Related Life Problems

To find an answer to the question *"Is there a significant relationship between the seventh-grade students' levels of proposing solutions to life problems by drawing on scientific principles and their levels of identifying the scientific principles applicable in solving related life problems?"*, the relationship between the students' scores in the TLS and TSL was examined.

The relationship between the mentioned scores gathered from 274 students was calculated by using the Pearson Product-Moment Correlation Coefficient. The results are displayed in Table 5.

Table 5. Correlation Coefficient between the TSL and TLS Scores

Variable	Scores from TSL
Scores from TLS	0.871**

n:274, **p<0.01

As can be understood from Table 3 above, at the significance level of 0.01, there is a high and positive correlation (0.871) between the TSL and TLS scores of the students. This means that the levels at which students offer solutions to life problems by drawing upon certain scientific principles and the level at which they detect the principles managing the solution of relevant life problems, vary together.

Variance of Secondary Seventh-Grade Students' Levels of Proposing Solutions for Life Problems Drawing on Scientific Principles (TLS Scores) against Certain Variables

For the research question *"When measured against certain values, is there a significant difference among the seventh-grade students' levels of proposing solutions to life problems by drawing on scientific principles (TLS scores)?"*, the students' TLS scores were analyzed to depict the variance related to independent variables, such as gender and the access to a supplementary science course. The breakdown of findings for each variable is given below.

Gender. The study analyses also included an inquiry to determine if based on the students' gender, there was a significant difference in the seventh-grade students' attainment levels of offering solutions to life problems by engaging scientific principles. The t-test results for the independent groups are given in Table 6.

Table 6. Arithmetic Mean, Standard Deviation and t-Test Results of the TLS Scores by Gender

Groups	n	$\bar{x}$	ss	sd	t	p
Girls	134	18.63	9.41	272	0.199	0.842
Boys	140	18.41	8.85			

Table 6 above shows that in the seventh-grade students' levels of offering life problem solutions by drawing on science-related principles, no significant difference exists by gender: $t_{(273)}=0.199$, and $p<0.05$.

Socioeconomic status. To determine whether the students' levels of proposing solutions for everyday problems differ by the socioeconomic neighborhood of the schools, statistical analyses, such as the arithmetic mean, standard deviation and ANOVA, were conducted on the TLS scores of respondents attending schools in lower, middle and upper socioeconomic layers. The results of the analyses are given in Table 7.

Table 7. Arithmetic Mean, Standard Deviation and ANOVA Results of TLS Scores according to the Socioeconomic Environment of Schools

Socioeconomic status	n	$\bar{x}$/40	ss	F	p
Upper	84	22.35	8.569	13.513	0.000
Medium	95	18.03	8.888		(Upper*-Medium)
Lower	95	15.61	8.689		(Upper*-Lower)

*Significant difference in favor of this side.

The results of the analysis above show that depending on the district where the schools are located, there is a significant difference between the seventh-grade students' levels of suggesting solutions to life problems by drawing on scientific principles: $F_{(2. 271)}=13.513$, and $p<0.05$. This result is reflected in the significant difference in TLS scores of the students from different socioeconomic backgrounds. In particular, the strata exhibiting a significant difference were determined by looking at the results of the Bonferroni test. The results revealed that the TLS scores obtained by students from schools in upper-level districts ($\bar{x}$=22.35) were significantly higher than those in districts with medium ($\bar{x}$=18.03) and lower socioeconomic features ($\bar{x}$=15.61).

Access to supplementary science course. Another independent variable probed in the assessment of the seventh-grade students' level of proposing solutions to life problems by employing scientific principles was whether students receive reinforcing science courses outside science classes at school. A t-test was applied to independent groups in order to check if in the students' level of proposing solutions, there was a meaningful difference based on their receiving such courses. The results are presented in Table 8 below.

Table 8. Arithmetic Mean, Standard Deviation and t-Test Results of TLS Scores according to Access to Supplementary Science Course

Groups	n	$\bar{x}$/40	ss	sd	t	p
MoNE-run extra course/Private course	127	20.42	8.625	272	3.269	0.001
None	147	16.87	9.232			

Table 8 reveals that depending on whether the students take a supplementary science course, there is a significant difference between the seventh-grade students' levels of suggesting solutions to life problems by employing scientific principles: $t_{(272)}$=3.269, and $p < 0.05$. A comparison of the TLS averages obtained by students who are enrolled in such courses and others indicated a significant difference in favor of the former group.

Domestic Internet access. As part of assessing the seventh-graders' levels of proposing solutions to life problems concerning scientific principles, their domestic Internet access was checked to determine whether there is a significant difference based on Internet access, in the attainment levels. The t-test results for the independent groups are given in Table 9.

Table 9. Arithmetic Mean, Standard Deviation and t-Test Results of TLS Scores according to Access to Internet at Home

Groups	n	$\bar{x}$	ss	sd	t	p
Access to Net at home	149	20.97	8.96	272	5.078	0.000
No Access to Net at home	125	15.59	8.43			

Table 9 shows that depending on the students' access to the domestic Internet, between the groups of participants, there is a significant difference in suggesting solutions for everyday life problems concerning scientific principles: $t_{(272)}$=5.078, and $p<0.05$. Students with access to that facility recorded a significantly higher level in average TLS scores than did those without access.

Out-of-school experience of science learning. In pursuit of finding a distinction, if any, based on joining outside-school learning events for science, in the students' levels of suggesting solutions to life problems by drawing on scientific principles, the arithmetic mean, standard deviation, and ANOVA results of the students' TLS scores were checked. The results are listed in Table 10.

Table 10. Arithmetic Mean, Standard Deviation and t-Test Results of TLS Scores according to Out-of-school Experience of Science Learning

Out-of-school Experience of Science Learning	n	$\bar{x}$/40	ss	F	p
3 times and above	77	21.61	9.161	6.765	0.001
1-2 times	116	17.73	8.959		(3 times and above* – 1-2 times)
Never	81	16.69	8.650		(3 times and above* – Never)

* Significant difference in favor of this side.

The calculations above reveal that depending on their experience of out-of-school scientific learning processes, there is a significant difference among the seventh-grade students in proposing life problem solutions where scientific principles are employed: $F_{(2, 271)}=6.765$, and $p<0.05$. More succinctly, the scores of the students from the TLS varied significantly if they had ever taken part in such events. When the results of the Bonferroni test were examined in order to locate such differences between different subgroups, it was observed that students who had participated in out-of-school scientific learning processes three times or more ($\bar{x}=21.61$) received significantly higher scores from the TLS than did their peers who had never done so ($\bar{x}=16.69$) and their peers who have experienced such events once or twice ($\bar{x}=17.73$). Nevertheless, subgroup three (Never) received lower scores from the TLS than did those in the preceding subgroup (1-2 times), but the scores did not reflect a significant difference.

Variance of Secondary Seventh-Grade Students' Levels of Identifying the Applicable Scientific Principles in Solving Related Life Problems (TSL Scores) against Certain Variables

In respect to the research question *"When measured against certain variables, is there a significant difference among the seventh-grade students' levels of identifying the scientific principles applicable in solving related life problems?"*, the TSL Scores were analyzed from the aspects of gender, access to supplementary science course, Internet access at home, socioeconomic environment, and out-of-school experience of science learning. The findings for each variable were presented below.

Gender. In the study, an investigation was conducted to determine if based on gender, there was a significant difference in the seventh-grade students' levels of determining the scientific principle used in the solution of real-life problems. The t-test results for the independent groups are given in Table 11.

Table 11. Arithmetic Mean, Standard Deviation and t-Test Results of the TSL Scores by Gender

Groups	n	$\bar{x}$	ss	sd	t	p
Girls	134	14.31	9.27	272	0.449	0.654
Boys	140	13.81	9.40			

The examination of Table 9 shows that based on gender, there was no significant difference in the students' levels of determining the applicable scientific principle in solving related life problems: $t_{(273)}=0449$, $p<0.05$.

Socioeconomic status. For the same research question, the arithmetic mean, standard deviation, and ANOVA values of the students' TSL scores were checked for all the lower, middle and upper socioeconomic neighborhoods of schools. The results reflected the difference based on the respondents' socioeconomic status, in their levels of identifying the applicable scientific principles in solving related life problems below.

Table 12. Arithmetic Mean, Standard Deviation and t-Test Results of the TSL Scores by the Socioeconomic Environment of Schools

Socioeconomic Status	n	$\bar{x}$	ss	F	p
Upper	84	17.75	9.341	13.618	0.000
Middle	95	14.06	9.365		(Yüksek*-Orta)
Lower	95	10.78	8.036		(Yüksek*-Düşük)

* Significant difference in favor of this side.

As seen in Table 12, based on the socioeconomic environment of schools, a significant difference existed in the seventh-grade students' ability to determine the applicable scientific principles in solution of related life problems: $F_{(2.271)}=13.618$, and $p <0.05$. The TSL results varied significantly by different socioeconomic backgrounds. Specifically, according to the Bonferroni test results, the difference in the TSL scores was significant in all three statuses. The respondents enrolled in schools situated in upper socioeconomic districts ($\bar{x}$=17.75) obtained higher TSL scores than did the other two socioeconomic levels, ($\bar{x}$=14.06) and ($\bar{x}$=10.78). At the same time, those coming from a middle socioeconomic status had significantly higher points in the test than did the students with a lower socioeconomic status.

Access to supplementary science course. The third independent variable, the students' access to extra science lessons, was at a significance level investigated in relation to the students' level of proposing solutions to life problems by employing scientific principles a. A t-test was applied to independent groups to see if there was a meaningful difference between subgroups, and the results were tabulated below.

Table 13. Arithmetic Mean, Standard Deviation and t-Test Results of TSL Scores according to Access to Supplementary Science Course

Groups	n	$\bar{x}$	ss	sd	t	p
MoNE-run extra course/Private course	127	15.65	9.297	272	2.655	0.008
None	147	12.68	9.130			

According to Table 13, based on the availability of a supplementary science course, there was a significant variance between the respondents' levels of identifying the applicable scientific principle in solving related life problems: $t_{(272)}$=2.655, and $p<0.05$. The difference between the TSL averages was significant in favor of the subgroup receiving such courses.

Domestic Internet access. We also examined whether based on their access to the Internet at home, there was a significant difference between the seventh-graders' level of determining the scientific principle applicable in solving life problems. The t-test results for the independent groups are given in Table 14.

Table 14. Arithmetic Mean, Standard Deviation and t-Test Results of TSL Scores according to the Access to Internet at Home

Groups	n	$\bar{x}$	ss	sd	t	p
Access to Net at home	149	16.37	9.632	272	4.654	0.000
No Access to Net at home	125	11.30	8.153			

The findings above revealed that based on the students' Internet access at home, there was a significant difference between the two subgroups in their success in locating the scientific principles applicable in problem-solving: $t_{(272)}$=4.654, $p<0.05$. Regarding the TSL averages, the significance was recorded in favor of the students who were able to go online at home.

Out-of-school experience of science learning. To determine the significance level of the difference based on attendance at outside-school learning science events, in the students' ability to identify the scientific principle applicable in solving related life problems, an analysis was applied to the arithmetic mean, standard deviation, and ANOVA of the TSL scores. The results are listed in Table 15.

Table 15. Arithmetic Mean, Standard Deviation and t-Test Results of TSL Scores according to the Out-of-school Experience of Science Learning

Out-of-school Experience of Science Learning	n	$\bar{x}$/40	ss	F	p
3 times and above	77	16.87	9.592	5.468	0.005
1-2 times	116	13.46	9.240		(3 times and above*– 1-2 times)
Never	81	12.23	8.653		(3 times and above* – Never)

* Significant difference in favor of this side.

Similarly, the findings above revealed that depending on their experience of out-of-school scientific learning processes, there was a significant difference among the seventh-grade students in identifying the scientific principles applicable in the solution of related life problems: $F_{(2. 271)}=5.468$, and $p<0.05$. This means that the TSL scores changed significantly if the students had ever joined such events. For particularly locating the difference between the subgroups, the Bonferroni tests were used: the results revealed that students who have participated in out-of-school scientific learning processes 3 times or more ($\bar{x}$=16.87) received significantly higher TSL scores than did their peers who had never done so ($\bar{x}$=12.23) and those peers who have experienced such events 1 to 2 times ($\bar{x}$=13.46). However, the subgroup three (no such experience) received lower scores from the TSL than did those in the preceding subgroup (1-2 times), but the scores were away from the significance level.

Discussion and Conclusion

The starting point for the present research is the ability of science literate individuals as persons who understand the nature of science, to put into use in everyday life the knowledge they have acquired in science teaching. In this scope, by using the Test of Life in Science (TLS) and the Test of Science in Life (TSL), the secondary seventh-grade students' levels of associating science lessons with real-life were investigated from two opposite directions: their levels of proposing solutions to real-life problems by using scientific principles and their levels of identifying the specific scientific principles used in solving real-life problems. The results of the TLS showed that at the level of 46.28% ($\bar{x}$=18.51/40), the secondary seventh-grade students could suggest solutions to life problems by drawing on scientific principles. The other test, the TSL, yielded a result of 35.13% ($\bar{x}$=14.05/40), which represented the level of the students' ability to determine the principle of science in solution of related real-life science problems. It was concluded that in both proposing solutions to real-life problems by engaging science lesson learnings and in identifying the scientific principle applicable in the solution of real-life problems, the participants remained significantly below the full learning level. The students were not sufficiently capable of associating science courses with everyday life. The literature provides a number of other studies that have reported comparable findings (Akgün et al., 2015, 2016; Anagün et al., 2010; Campbell & Lubben, 2000; Canpolat & Ayyıldız, 2019; Cengiz & Ayvacı, 2017; Crespo & Pozo, 2004; Dede Er et al., 2013; Doğan, Kıvrak, & Baran, 2004; Emrahoğlu & Mengi, 2012; Hastuti et al., 2020; Hürcan, 2011; Kirman Bilgin & Yiğit, 2017; Murti & Aminah, 2019; Önder & Beşoluk, 2010; Rubini et al., 2019; Soobard & Rannikmae, 2011; Taşdemir & Demirbaş, 2010). In a similar vein, Pursitasari, Suhardi, and Sunarti (2019) reported that in the face of everyday problems, students cannot recall their science learning and that they are not accustomed as a part of their everyday life, to a critical thinking process in science-related problems; moreover, they have a lower level of science literacy.

Note that although the average of the students' TLS and TSL scores was below the sufficiency level, their level of proposing solutions to everyday problems where principles of science are employed (46%) was higher than that of determining the principles applicable in the solution of related everyday problems (35%). According to Sak and Kaltakçı Gürel (2019), who conducted research at secondary schools, students faced more difficulty in answering context-based questions associated with daily life than in answering conventional questions. This could imply that students find it hard to concretize abstract learnings and analyzing everyday life problems with reference to scientific principles because they do not have access to opportunities for hands-on application both inside and outside school, of science topics (Crespo & Pozo, 2004). Similarly, Er Nas (2013) defends that making intuitive and unscientific decisions in the case of everyday problems could lead to fallacious consequences. Other studies in the literature also revealed that students lag behind in giving satisfactory explanations for examples implying an association between science and real life since they are not provided examples other than those in textbooks and learning-teaching settings (Akgün et al., 2015; Karataş, 2017; Yıldırım & Birinci Konur, 2014). Those findings seem to account for the students having a higher level of ability to propose solutions to life problems where scientific principles are used than to determine the scientific principles applicable in the solution of life problems related to science. Therefore, the students benefit from the examples they learned in the course to explain the given principles, but they have difficulty or misconceptions in explaining brand new examples of everyday problems by using the principles learned in a science course. In this respect, the current findings seem to be in conformity with and support the previous research results.

According to the present study findings, there is a positive and highly significant relationship between the TSL and TLS scores of the students. The students' levels of proposing solutions to real life problems by engaging scientific principles and their levels of eliciting the principle applicable to solution of real life problems covary. The higher-level positive relationship seems to further strengthen the findings of the research. In parallel, Campbell and Lubben (2000) argue that science education that serves to develop higher-order thinking skills should develop a two-way flow of information and a holistic understanding between science learned at school and everyday life experiences.

In this research, both test scores were discussed in measurements against several variables including gender, socioeconomic level, taking additional science courses, Internet access at home, and experience in out-of-school science learning events. The findings concerning each of the variables were interpreted together for a more holistic approach.

The participants' scores from the TSL and TLS do not vary significantly with respect to gender variables. Furthermore, previous findings reveal that based on gender, students do not differ in their level of associating science lessons with real life (Anagün et al., 2010; Balkan Kıyıcı & Aydoğdu, 2011; Taşdemir & Demirbaş, 2010; Toma, Greca, & Orozco Gomez, 2019)

Regarding the socioeconomic environment of schools, both the TSL and the TLS scores of the students show a significant difference in favor of the students who attend schools with upper socioeconomic standards. In the same way, previous research examining the students’ socioeconomic context in connection with their ability to transfer science into everyday life situations (Anagün et al., 2010; Büyükşahin & Demirci-Güler, 2014; Hampden-Thompson & Bennett, 2013; Taşdemir & Demirbaş, 2010) reported that students coming from schools in upper socioeconomic settings proved more competent in the target outcome. Moreover, PISA 2015 and TIMSS 2015 results refer to socioeconomic structure as a variable explaining the science literacy levels of students (Karip, 2017; OECD, 2018).

In the present study, the students’ TLS and TSL scores exhibited a significant difference in favor of those who receive a supplementary science course. In the literature, no specific research was found that examines the students’ level of addressing science in everyday life and their access to supportive science courses outside regular compulsory ones. According to some studies, however, supplementary courses offered at secondary schools offered to boost students' achievement ultimately increase academic success in science, as they allow students to perform more applications and review science topics (Biber, Tuna, Polat, Altunok, & Küçükoğlu, 2017; Daşdemir & Okutan, 2019; Nartgün & Dilekçi, 2016; Ünsal & Korkmaz, 2016). Thus, it can be suggested that the findings regarding the effect of supplementary courses on success in science lessons are in conformity with the present findings.

Another finding here suggests that the TSL and TLS scores change meaningfully in favor of students with Internet access at home. In the same direction, İlkörücü Göçmençelebi (2007) stated that pupils who use computers have higher levels of associating their knowledge with everyday life. In TIMSS 2015, in the scores obtained from science lessons, among the domestic learning resources at home, an emphasis was placed upon the positive effect of Internet access at home (Karip, 2017). Similarly, among the domestic materials available to pupils, Internet access is regarded as an important predictor for PISA 2006 science scores (Anıl, 2011).

In our study, between the TLS and TSL scores, a significant difference that implies a higher proficiency of those who have experienced out-of-school learning processes at least three times was noted. When the relevant literature is examined (Anagün et al., 2010; Bakioğlu, 2017; Mayoh & Knutton, 1997; Campbell & Lubben, 2000), the positive impact of benefiting from out-of-school science learning environments can also be seen in the ability to bridge science and everyday life. Rubini et al. (2016) point out that eventually leading to a robust association between science and real life, out-of-class applications in science teaching served to develop the students' knowledge, attitudes, and skills.

In conclusion, the secondary seventh-grade students in this study cannot sufficiently associate science courses with life. Although for everyday life problems addressed by utilizing scientific principles acquired in science courses, the students could offer solutions at a higher level than their attainment level in determining the specific principles that should be employed in solving real-life problems encountered, the realization level is not considered satisfactory for both tests. Even though based on gender, students do not vary meaningfully in associating science courses with real-life, the case is completely opposite when factors such as socioeconomic level, receiving extra science courses, Internet access at home, and participating in out-of-school learning processes are considered.

Suggestions

Suggestions for Future Studies

In this research, an attempt was made to identify the seventh grade students' level of associating science with real life, and the data collected were subjected to descriptive analysis according to certain variables. To provide more in-depth information, in future research, educational situations should be examined for their effectiveness in relating to life problems that require using various science principles and that benefit from out-of-school learning environments. This research will pave the way for other curricula to be newly introduced in the future. In addition, the results of this research are limited to the central districts of Ankara. This limitation can be compensated for if more generalizable results are reached in further research carried out across different provinces of Turkey. Apart from this, the current study dealt with the students' levels of relating science with life in the context of the secondary 5th, 6th and 7th grade science topics. Since the main focus was to strengthen the content validity in this study, it was not a priority to gather in-depth information in subfields of science. Therefore, future studies can be an opportunity to collect more extensive data with a focus on a specific area of study. Moreover, if similar studies are conducted at other levels of education, it could be ascertained whether the level of relating science with life varies from one level of education to another.

Suggestions Regarding the Implementation

In the light of the findings here, to help students to proficiently associate science with life, it seems more than necessary to provide teaching and learning situations that enable students to apply the given principles to generate solutions for life problems but also to enable them to refer to scientific principles while producing solutions to life problems. In this way, students can realize that science is a part of life and thus learning difficulties may be prevented. Additionally, in learning and teaching settings, a number of variables are considered likely to affect the level of relationship between science and life. These variables are the following: socioeconomic level, access to supplementary science classes, domestic Internet access, and participation in learning processes outside school. If in considering these variable, certain measures are taken, the success in raising science literate individuals could be increased. The reflection of this understanding in the teaching process of other subject areas will serve to create a society with a high literacy level and one capable of generating rational solutions to the problems faced, questioning, researching, making effective decisions, and transferring knowledge to technology.

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