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High School Students' Levels of Relating the Chemistry Knowledge to Daily Life: Acid-Base Example

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ABSTRACT
This study aims to determine to what extent high school students are able to associate their knowledge of acid-base concepts with daily life. A form consisting of six open-ended questions was used to collect data in line with the specified purpose. Case study design, which is one of the qualitative research methods, was preferred as a method. Participants of the study consist of a total of 158 Anatolian High School students from 10th and 11th grade classes, 77 males, and 81 females (who ages were 16-17 years old), studying in a medium-sized district in the Central Anatolia Region in Turkey. Student responses obtained from the data collection form were categorized as understanding, partial understanding, misunderstanding, and unanswered. This study determined that the students could not adequately correlate their knowledge about acid-base concepts with the acid-base events they encounter in daily life. Recommendations were made based on the results obtained in the study.

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Introduction

One of the main objectives of science education is to help individuals to become science literate and to make them understand the events that take place in daily life by associating them with the subjects they learn. Science courses and other courses in the science field have a very significant role in achieving this basic goal (Coştu et al., 2007). The abstract structure of some subjects and concepts in science classes and their excessive theoretical aspects cause students to have difficulties in perceiving these concepts and associating them with daily life (Anagün et al., 2010). Teaching science lessons in relation to daily life is essential in terms of achieving permanent and meaningful learning (Cajas, 1999; Mayoh & Knutton, 1997). Meaningful learning occurs when students can transfer their scientific knowledge to their daily lives (Campbell & Lubben, 2000).

Chemistry, which is a science course, includes many concepts that can be associated with daily life. In teaching these concepts, associating new knowledge with daily life is essential in terms of achieving meaningful and permanent learning. Chemistry is regarded as a difficult course to be understood by students due to abstract concepts in its subject contents (Reid, 2000). However, chemistry course is an enjoyable field that helps students to understand the world they are in (Demircioğlu et al., 2006). The acid-base subject is a subject related to daily life and has an important

place in the science curriculum and chemistry curriculum. When the literature is examined, there are studies on the levels of understanding of the concepts of acid-base by students, determination of misconceptions, and the effectiveness of teaching with different teaching methods. In addition, the mastery of acid-base concepts requires the mastery of other basic concepts in chemistry, such as chemical reactions (Ben- Zvi et. al, 1987; Boo & Watson, 2001), redox reactions, chemical equilibrium, electrochemistry (Chinaka, 2021), particulate nature of matter, and chemical change (Briggs & Holding, 1986). Therefore, students have difficulty understanding acid-base concepts and have many misconceptions at all grade levels (Bradley & Mosimege, 1998; Cros et al., 1988; Demircioğlu & Demircioğlu, 2005; Hand & Treagust, 1991; Nakhleh & Krajcik, 1993, 1994; Ross & Munby, 1991; Schmidt, 1991; Shappard, 2006).

Concepts only make sense when they are associated with the lives of students (Yılmaz & Huyugüzel Çavas, 2006). When the literature is examined, it is seen that there are not many studies on the issue of associating the information learned with the events in daily life (Ayas et al., 2001; Balkan-Kıyıcı & Aydoğdu, 2011; Coştu et al., 2007; Canpolat et al., 2019; Gürses et al., 2004; Pekdağ et al., 2013; Özmen, 2003; Pabuçcu, 2016; Şenocak & Sözbilir, 2005; Yadigaroğlu & Demircioğlu, 2012; Yadigaroğlu et al., 2017; Yıldırım & Birinci Konur, 2014; Yüzbaşıoğlu & Atav, 2004). The chemistry curriculum emphasizes that the gains should be associated with daily life and individuals who can transfer the learned knowledge to their daily life are needed (Ministry of National Education [MNE], 2018b). Despite this, the literature reveals that the students cannot achieve the desired level in relating the information they learn with the events they encounter in daily life (Ay, 2008; Üce & Sarıçayır, 2002; Yıldırım & Konur, 2014). Yıldırım and Konur (2014) investigated science teacher candidates' levels of associating some chemistry concepts with everyday life events.

When the information gained in the education process is associated with the events encountered in daily life, they become permanent in the mind of the individual and are easily used in solving the problems encountered (Özmen, 2003). In other words, students' level of associating their knowledge with events and situations in daily life is an indicator of their level of understanding of chemistry (Pınarbaşı et al., 1998). Undoubtedly, the most important task here falls on teachers who teach chemistry concepts. In order to relate chemistry concepts with daily life, first of all, it is necessary to determine where we encounter chemistry concepts in our daily life. One of the aims of science education is to enable students to use the concepts they learn at school to explain the events they encounter in daily life. However, daily life appeals to the cognitive structure and is often structurally more complex for the student than rote teaching. While students in schools generally encounter principles, theories, concepts and concept examples, they encounter events that contain cognitive, affective and psychomotor domains together in daily life. For example, the fear of bee stings can be expressed as affective, the acidic or basic structure of the bee sting can be expressed as cognitive, and the rushes experienced in the process can be expressed as psychomotor dimension. In other words, while the student deals with the cognitive side of the event in the classroom environment, he encounters every aspect of it in daily life. Therefore, everyday life events require a more complex and advanced understanding of chemistry. When a concept is taught through daily life events, it becomes more meaningful and permanent for the student since a three-dimensional coding is done (Özmen, 2003). It is important for meaningful and permanent learning to determine such related daily events and transfer them to the classroom environment. In addition, it is understood from the literature that there are a limited number of studies on the students' level of relating chemistry concepts with daily events. It is thought that this study will contribute to filling this gap in the literature. In this study, it was tried to determine to what extent the acid-base concepts, which have an extremely important place in daily life from the vegetables and fruits we eat to the cleaning materials we use in our homes, can be associated with daily life events by high school students.

Method

Research Design

The purpose of the study is to determine the level of associating the acid-base concepts of high school students with daily life events. To achieve this aim, it was decided to use a holistic single case design among case study designs. Holistic single case design deals with a single unit of analysis such as an individual, school, program, or institution (Yıldırım & Şimşek, 2008). In this context, tenth-grade high school students, who constitute the participants of the study, were considered as a single unit of analysis. In the research, open-ended questions were used that allowed 158 Anatolian high school students to freely express their thoughts on acid and base and to reveal their scientific thoughts clearly (Bauner & Schoon, 1993).

Participants

The study was carried out in the fall semester of the 2018-2019 academic year. Participants of the study consist of a total of 158 Anatolian High School students from 10th and 11th grade classes, 77 males, and 81 females (who ages were 16-17 years old), studying in a medium-sized district in the Central Anatolia Region in Turkey.

Data Collection Tool

In the present study, as a data collection tool, a form consisting of 6 open-ended questions, which requires students to give written answers, based on associating acid-base concepts with daily life events, was used. The open-ended question form was taken from the literature (Özmen, 2003; Yadigaroğlu & Demircioğlu, 2012). While 1, 2, 3rd questions were developed by Özmen (2003), the other questions (4, 5, 6th questions) were developed by Yadigaroğlu and Demircioğlu (2012). The opinions of two professors in the field of chemistry education were consulted to ensure the validity of the test. In line with the feedback, the data collection tool was finalized. The final form was applied to the participants at the end of the fall semester. Participants were given 30 minutes to answer the questions in the form.

Data Analysis

The data obtained from the study were evaluated with descriptive analysis, one of the qualitative data analysis methods. Descriptive analysis aims to transfer the obtained data to the reader by ordering and interpreting. The data is first systematically described clearly, then these descriptions are explained, interpreted and some results are reached by examining the cause-effect relationships (Yıldırım & Şimşek, 2013). While analyzing the data obtained from the answers given by the students to the "Acid and Base Concepts Test" questions, the categories of "understanding, partial understanding, misconception and unaswered", which are widely used in the literature, were used to determine the level of understanding with open-ended questions (Abraham et al., 1992). These categories are given in Table 1. The frequencies of the answers given by the students were determined according to which of these categories were appropriate. In addition, the data were analyzed transparently without prejudices. The frequencies of the data according to the categories were determined and tabulated, and the answers of the students were shown by quoting.

Table 1

Categories of Student Responses

Understanding	The answers that contain all of the scientific ideas about the question were evaluated in this category.
Partial understanding	The answers that are acceptable about the question, but cannot be accepted as a full answer, are evaluated in this category.
Misunderstanding	The answers that are unrelated to the question, irrational or incorrect information were evaluated in this category.
Unanswered	Answers that leave the question completely blank or lacking scientific value are evaluated in this category.

In the literature, there are studies in which classifications similar to the above categorization are made (Abraham et al., 1992; Özmen, 2003; Yadigaroğlu & Demircioğlu, 2012; Yadigaroğlu et al., 2017). The written answers given by the students were analyzed in detail. In this way, it has been tried to determine to what extent they associate their knowledge about the concept of acid-base with acid-base events in daily life. The answers given by the students were classified and scored independently by four experts in the field of chemistry education, according to the categories indicated in Table 1. Inter-rater reliability was calculated using one of the non-parametric tests, 'Kendall's W'. As a result of the analysis, a statistically significant agreement was determined between the raters ($W_{(157)}$= .82; p<.001). The p-value less than .05 and the W value over .70 show that there is a statistically significant agreement between the evaluations made by the raters (Can, 2013). As a result of the test, the closer the value to 1 indicates a greater degree of unanimity among the raters (Legendre, 2010: 165).

Findings

Students' answers were classified in accordance with the specified categories (Table 1), and their percentage values were calculated. In addition, some of the answers given by the students are included in this section as an example. Students' answers are given in Table 2 in percentages.

Table 2

Percentage Distribution of the Answers According to the Categories

Categories	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6
Understanding	28.48%	37.34%	22.15%	15.82%	17.72%	%17.09
Partial understanding	21.52%	36.08%	25.95%	21.52%	21.16%	18.35%
Misunderstanding	45.84%	21.52%	41.77%	51.9%	51.26%	46.84%
Unanswered	3.16%	5.06%	10.13%	10.76%	8.86%	17.72%

As can be seen in Table 2, the rate of the answers in the 'understanding' category ranges between 15.82% and 37.34%, in the 'partial understanding' category was between 18.35% and 36.08%, and in the 'misunderstanding' category ranges between 21.52% and 51.26%. It is striking that the answers given by the students had a low percentage in the understanding category.

In the first question of the test, the students were asked the reason why they felt pain in events such as bee sting and ant sting, and what could be done to reduce this pain. The answer that the researchers expected to receive from the students is "insect bites such as bee sting or ant bites, due to the presence of acidic substances in the secretions of these creatures when these substances penetrate the body cause a burning sensation; to relieve the pain (to reduce the effect of the acidic secretion) substances with base ingredients should be applied to the bitten area. As can be seen in Table 2,

28.48% of the students answered the question in the understanding category, 21.52% in the partial understanding category, and 45.84% in the misunderstanding category. The answer examples given by the students to the first question of the test and placed in appropriate categories are shown below.

Table 3

Answers Given to Question 1 of the Test According to Categories

Understanding	Since insects such as bees or ants contain acid-containing substances such as formic acid in their secretions when these insects bite a person, their secretions enter our body, and we feel pain. If the base substances are applied to the bitten area it will relieve pain and suffering in the region, that would be the neutralization lighter.
Partial understanding	When insect species such as bees and ants bite us, their venom passes to the area where they bite, and substances with base properties should be applied to the bitten area to reduce the pain.
Misunderstanding	Since there are antibiotics in the bee secretion, we become allergic when it stings. Since we get allergic, we feel burning in that area.

In the second question of the test, the students were asked why the soaps used at home often felt slippery on hand. The answer that the researchers expected from the students is: "soaps are composed of fatty acids and have base properties, and bases have slippery properties". As can be seen in Table 2, 37.34% of the students answered the question in the understanding category, 36.08% in the partial understanding category, and 21.52% in the misunderstanding category. The answer examples given by the students to the second question of the test and placed in appropriate categories are shown below.

Table 4

Answers Given to Question 2 of the Test According to Categories

Understanding	The soap contains oil and fatty acids. In addition, since soaps are alkaline substances, they show a slippery feeling like one of the general properties of bases.
Partial Understanding	Soap shows a foaming feature, it gives a feeling of slipperiness in the hand because it is a base.
Misunderstanding	Soap becomes slippery when in contact with water

In the third question of the test, the students were asked the reason for the occurrence of rancidity when items such as milk and yogurt are kept in a warm environment. The answer that the researchers expected to be given by the students is: "when substances such as yogurt and milk are kept in warm environments, the bacteria in the structure of these substances produce lactic acid as a result of fermentation, and rancidity will occur with the effect of temperature". As can be seen in Table 2, 22.15% of the students answered the question in the understanding category, 25.95% in the partial understanding category, and 41.77% in the misunderstanding category. The answer examples given by the students to the third question of the test and placed in appropriate categories are shown below.

Table 5

Answers Given to Question 3 of the Test According to Categories

Understanding	Milk and yogurt contain beneficial bacteria in their structure. Bacteria can ferment and lactic acid is formed. The increase in temperature will accelerate the formation of lactic acid and rancidity will occur.
Partial Understanding	There are bacteria in yogurt and milk, as the temperature increases, these bacteria produce acid, producing excess acid, causing rancidity.
Misunderstanding	There is a base in yogurt and milk, if they are kept in a hot environment, they cannot take oxygen and rancidity occurs.

In the fourth question of the test, the students were asked why the indigestion problem can not be solved if too much mineral water is consumed, although mineral water is recommended for indigestion. The answer that researchers expect to be given by the students is: "The food in the stomach is broken down by gastric acid secretion. If enough acid is not secreted to break down food, indigestion occurs. Mineral water is a base substance due to its structure. When mineral water is consumed, acid secretion increases in the stomach and the food in the stomach is broken down. If too much mineral water is consumed, the stomach acid secreted is neutralized, and indigestion continues". As can be seen in Table 2, 15.82% of the students answered the question in the understanding category, 21.52% in the partial understanding category, and 51.9% in the misunderstanding category. The answer examples given by the students to the fourth question of the test and placed in appropriate categories are shown below.

Table 6

Answers Given to Question 4 of the Test According to Categories

Understanding	Foods in the stomach are broken down with the help of stomach acid and turn into energy. The inability of the stomach to secrete enough acid is a cause of indigestion. When mineral water is drunk, stomach acid secretion increases. If you drink too much mineral water, there will be neutralization in the stomach, we cannot digest the food enough.
Partial Understanding	Gastric juice is acidic, mineral water is alkaline. When we drink mineral water in case of indigestion, there is a relief in our stomach.
Misunderstanding	Mineral water regulates the pH level of the stomach, if the pH is too high, mineral water will not affect this.

In the fifth question of the test, the students were asked about the formation of acid rains and their effects on the environment. The answer that researchers expect to be given by the students is: "A chemical reaction takes place when nitrogen and sulfur-containing gases combine with water vapor in the air. Sulfuric acid and nitric acid are categorized as strong acids are formed as a result of this reaction. These acids have a very corrosive trait. Acid rains affect all living things in nature. Acid rain, which is an important threat to human health, affects the vision center, our skin, and our respiratory system. It can harm not only living things but also historical structures on earth". As can be seen in Table 2, 17.72% of the students answered the question in the understanding category, 21.16% in the partial understanding category, and 51.26% in the misunderstanding category. The answer examples given by the students to the fifth question of the test and placed in appropriate categories are shown below.

Table 7

Answers Given to Question 5 of the Test According to Categories

Understanding	Sulfur and nitrogen gases are released in places where there are many factories and fossil fuels are consumed. These gases combine with water vapor in the air to form H_2SO_4, HNO_3 acids and these substances fall to the earth with natural events. It has many harms to people and the environment.
Partial Understanding	Gases from factory fumes and exhaust gases mix into the air and fall to the earth with rain as dangerous acids. It harms living things.
Misunderstanding	It is the rain of substances in the atmosphere.

In the sixth question of the test, students were asked the reason why our mothers used baking soda when making a cake. The answer that researchers expected is: "Sodium bicarbonate base is widely used in baking soda. This base is popularly known as Carbonate. In addition to Carbonate, some phosphate and sulfate compounds are also used as acids in dry baking soda. With the addition of liquid substances such as water, milk, and oil, dry powder substances dissolve slightly and form carbonic acid with the effect of heat. Carbonic acid is an unstable compound due to its structure. For this reason, carbon dioxide and water are released in a short time. The carbon dioxide formed in the heated dough expands and causes swelling in the dough". As can be seen in Table 2, 17.09% of the students answered the question in the understanding category, 18.35% in the partial understanding category, and 46.84% in the misunderstanding category. The answer examples given by the students to the sixth question of the test and placed in appropriate categories are shown below.

Table 8

Answers Given to Question 6 of the Test According to Categories

Understanding	The swelling of the dough is the result of the acid-base reaction. When the substance in the baking soda combines with milk, carbonic acid occurs, the temperature increases during the baking of the dough, thus the dough swells.
Partial Understanding	Baking soda is alkaline, it swells the dough.
Misunderstanding	Baking powder swells the dough, and the volume of the dough increases so that the cake is eaten by more people.

It is understood that as the number and rate of misconceptions in students' answers increase, their level of relating with daily life decreases. It also gives important information about the reasons why students cannot relate concepts with daily life. For this reason, students' misconceptions and their rates are included here.

The misconceptions more than 10% of the students carry within the scope of the study are given in Table 9.

Table 9

Student Misconceptions Detected İn The Study

Students' misconceptions	f	%
Swelling occurs as a result of an ant bite and a bee sting, so it is a physical change.	17	10,75
There is a change in the taste of milk and yogurt. Only their physical properties change.	20	12,65
Mineral water is acidic, we relax when we drink it.	25	15,8
Since mineral water is alkaline, there is an acid-base neutralization reaction in the stomach.	24	15,18
Sulfur gas in the atmosphere reacts with water vapor in the clouds.	37	23,4
Sulfur and nitrogen gases in the atmosphere react and fall to the soil with rain.	34	21,5
Acid rains are formed when harmful gases in the air dissolve in clouds	29	18,3
It is formed by the chemicals that are released into the air when it rains.	26	16,4
Acid rains are formed as a result of the combination of acids in the air and raindrops	23	14,5
When the oxygen in the dough starts to heat up, the cake begins to rise.	27	17,08

When Table 9 was examined, 10 misconceptions carried by more than 10% of students were identified within the scope of the study. Rates of these misconceptions range from 10.75% to 23.24%.

Discussion

In this study, it was tried to determine to what extent high school students were able to associate the acid-base concepts with the events in daily life. While the students participating in the study showed the highest success (37.34% in the understanding category) in the second question, they showed the lowest success (15.82%) in the fourth question. In the light of these findings, it can be said that most of the students participating in the study could not associate the acid-base concepts with daily life. From this, it is understood that the learned information is not permanent. It is understood from Table 2 that the ratio of misconceptions carried by students towards the concepts studied in the study varies between 21.52-51.9% (6th question 46.84%; 5th question 51.26%; 4th question 51.9%; 3rd question 41.77%; 2nd question 21.52%; 1st question 45.84%) from Table 2. When the table of misconceptions created as a result of the detailed analysis (table 9) is examined, it is seen that the rate of misconceptions that the students have about the subjects studied varies between 10.75-23.24%. As it is known, misconceptions are accepted as ideas that are not accepted by scientific circles and can be encountered in almost every subject, they can be detected in students at all education levels, and they are logical and consistent from the student's point of view, are resistant to change, and can prevent the learner from learning later (Guzzetti, 2000; Hewson & Hewson, 1984). As can be seen from here, the individual's misconception prevents him from understanding the relevant topic and other related issues (Ben-Zvi et al., 1986). When the misconceptions identified are examined, it can be said that the misconceptions are mostly caused by a lack of knowledge in the chemistry field. When students ' answers to questions are examined, it is seen that they try to explain the event superficially with a sentence rather than explaining it in all aspects. For example, in the question about acid rains, a student answered the question as "acid rains are formed by the dissolution of harmful gases in the air in clouds". Similar situations apply to many other students. The students who participated in the study did not explain what the gases were and how the dissolution reaction occurred. This indicates

that students have insufficient knowledge of the subject and that their ability to explain is not sufficiently developed. For students to be able to relate their theoretical knowledge and develop their explanation skills, concept teaching should be done through related events.

A chemistry education through continuous daily events will contribute significantly to the upbringing of its students as chemistry literate individuals. On the other hand, it is understood from the answers given by the students to the questions that they answered the questions by using the pattern sentences they memorized. For example, "Swelling occurs as a result of an ant bite and bee sting, so it is a physical change." statement can be given as an example of this situation. While students encode physical change as a change in the external structure of matter in general, they encode chemical change as a change in the internal structure of matter. As a result of teaching based on memorization, several pattern sentences mostly remain in the minds of the students.

These set pattern sentences are not sufficient to explain an event that is naturally encountered and requires explanation. In the main philosophy and general objectives of the high school chemistry curriculum, it is stated that students should be able to transfer their knowledge to daily life (MNE, 2018b). Considering this statement and the fact that students cannot adequately associate chemistry knowledge with daily life from the research findings, it can be said that teachers don't read the chemistry curriculum carefully, don't examine it adequately and don't organize their lessons as stated in the curriculum. When the literature is examined, it is possible to find results showing teachers do not examine the curriculum adequately (Demircioğlu et al., 2015).

When Table 2 is examined, it is seen that the students answered the 5th question in the high rate of misunderstanding category and also had the most misconception in this question (51.26%) (Table 2). Question 5 of the test is about the formation of acid rain and its effects on the environment. The ratio of students' answers to this question in the understanding category is 17.12% (Table 2). This indicates the students do not have sufficient knowledge about the formation of acid rain and are lacking in chemistry field knowledge. It also shows that the students don't have enough information about environmental problems, and they fail to explain these problems in scientific terms. It is believed that students don't have sufficient knowledge about the question and can't provide a scientific explanation to the event because their respective teachers don't make sufficient explanations for the subject, and they only aim for success in central exams and organize their courses for this purpose. When the literature is examined, it is seen that statements parallel to this result are reported (Khalid, 2003).

When the literature on chemistry education is examined, it was stated that the students prefer to rote (Smith & Metz, 1996) instead of learning the information about acid-base concepts at the desired level (Vidyapati & Seetharamappa, 1995). The reason for this situation might be fact that chemistry is accepted as a difficult lesson for both the teachers and the students and that it contains a large number of concepts that require abstract high-level thinking skills (Reid, 2000). When the Science Curriculum (MNE, 2018a) and the Chemistry Curriculum (MNE, 2018b) are examined, it can be seen that the concepts of chemistry have started to be taught from the primary school level and continue more intensively in middle-school education. Acid-base concepts are related to daily life and have an important place in curricula. As can be seen in Table 2, high school students cannot associate the acid-base concepts with the events they encounter in their daily lives at the desired level. When the learning outcomes in the secondary school chemistry teaching program are examined, it is seen that the concepts studied in the present study are associated with daily life, and their usage areas in daily life are emphasized. The reason for the students' failure to make connections at the desired level might be the fact that they were exposed to information bombardment during their education. Also, the lack of ensuring conceptual understanding of the students during the education and the insufficiency of teachers on correlating the information given and daily life at the required level may be among the reasons. Teachers have great duties and responsibilities in this regard. Teachers definitely should explain how the information they try to provide students will be useful and what needs they will meet. Therefore, it is very essential to explain the information desired to be acquired in relation to daily life. The students' high level of ability to use the information they learn in explaining the events

in their daily lives is an indicator that learning is far from rote. Knowledge is permanent to the extent that it can be associated with events encountered in daily life (Coştu et al., 2007; Özmen, 2003). It should not be overlooked that learning can be meaningful and permanent if the students can use that knowledge in events they encounter in their daily lives.

The central examinations done in Turkey differ from each other in terms of their justifications. These exams, which are made to select and place students in a higher education institution, are very important for students and parents. The examination of the literature reveals that, due to these exams, students have difficulties in developing metacognitive skills such as problem-solving, research, interpretation, and analysis (Üstüner & Şengül, 2004), cannot achieve permanent and meaningful learning, and they can't establish a connection between their knowledge and daily life events (Büyüköztürk, 2016). The fact that the information learned cannot be associated with daily life events at the desired level is closely related to the fact that the exam systems adopted in Turkey are based on the logic of testing, which aims to solve too many questions in a short time. In this system, where success is based on giving correct answers to more questions, it is stated that teachers do not deal with the subject at a conceptual level and prefer methods that will enable students to reach the correct answer in the shortest way (Yadigaroğlu et al., 2017). The pressure created by parents who want their child to be at the forefront of the competition in the examination system and administrators with high-achieve expectancy may also lead teachers, which are the cornerstones of educational activities, to choose these methods. Minarechová (2012) and Buyruk (2014) stated in their studies that central exams are a source of considerable pressure and stress for teachers. In addition to this, Çetin and Ünsal (2019) stated in their study that families and administrators' expectations of success in exams have a negative effect on teachers. As it can be understood from here, a rote learning based on the exam system is adopted in schools in our country. For the sake of preparing for the exam in the short term, long-term permanent and meaningful learning is avoided. The results obtained from the study show that the current paradigm prevents meaningful and permanent learning of the students. The fact that the student answers the multiple-choice questions asked in exams correctly does not mean that the student understands the concepts related to the questions. Students' correct explanation of an event related to the concept shows that they have learned the concept. For this reason, it is thought that teaching the subjects within the context will support the meaningful learning of the students.

Conclusion and Implications

- Studies should plan with wider participants, using interviews, which enable the determination of students' knowledge in more depth, in addition to open-ended questions for determining the level of students' ability to use their knowledge in daily life events.
- The questions asked in the central exams should be chosen from the types of questions that students can solve by using the knowledge they have learned and question their thinking skills, rather than questions that students can answer with rote information.
- In order to eliminate the pressure of central exams on students, parents, administrators, and teachers, necessary studies should be initiated to make career planning starting from pre-school education in line with the interests and abilities of students.
- By adding laboratory activities to the curriculum, it should be ensured that students can apply the knowledge they learn in daily life situations.

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