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Determining the Cognitive Structures of Secondary School Students on COVID-19

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ABSTRACT This research aims to determine the cognitive structures of secondary school students about COVID-19. In this research, a case study, one of the qualitative research methods, was used, and demographic information and a word association test were the data sources. The study group of the research consists of 226 students who continue their education in the 6th and 7th grades of a public secondary school. The data were collected via Google Form, and the obtained data were analyzed by content analysis. The cognitive structures of secondary school students on the concept of COVID-19 are grouped under 11 categories. These categories are COVID-19 Prevention Methods, COVID-19 Reflections in Press, COVID-19 Results, COVID-19 Perceptions, Causes of COVID-19 Transmission, COVID-19 Treatment, COVID-19 Symptoms, Countries where COVID-19 are Common, Characteristics of COVID-19, COVID-19 Carriers and COVID-19 Diagnostic Ways. When these categories were examined, it was seen that the students' cognitive structures about the concept of COVID-19 focused on COVID-19 Prevention Methods, COVID-19 Reflections in Press, COVID-19 Results, and COVID-19 Perceptions. In addition, it has been determined that some students have misconceptions about the COVID-19 virus.

Keywords COVID-19, Cognitive Structure, Secondary School Students, Word Association Test

1. INTRODUCTION

A virus is a small infectious agent that remains within the host cell. A virus is a tiny particle with similar properties to living things but is not alive. Therefore, it cannot reproduce by itself (Hendaus, Jomha, & Alhammadi, 2015). Viruses are a bridge between the living (inside the host) and the dead (that show no signs of life when taken out). Viruses generally range between 20 and 400 nm and are round in shape. Viruses are biological entities of protein and nucleic acid (DNA or RNA). Viruses are dependent on other living cells for reproduction. Viruses cause many diseases in human beings, such as AIDS, hepatitis, chicken pox, herpes, measles, poliomyelitis, etc. (Bosch, Biesbroek, Trzcinski, Sanders, & Bogaert, 2013; Hendaus et al., 2015). In 1892, tobacco mosaic virus, 1898; foot and mouth disease, 1901; yellow fever virus was discovered (Berkhout, 2015). Coronavirus is a new virus that has not been recognized in humans beforehand.

Coronavirus is an RNA virus that can cause various symptoms, including pneumonia, fever, difficulty breathing, and cough. These viruses are common in animals worldwide, but very few cases are known to affect humans. The World Health Organization (WHO) announced that the official name of the new Coronavirus in 2019 is COVID-19 (WHO, 2020). The COVID-19 epidemic, which emerged in Wuhan city, the capital of the Hubei region of China, on December 1, 2019, was declared a pandemic by the World Health Organization (WHO) worldwide on March 11, 2020 (WHO, 2020). Experts know the Coronavirus family as a virus that previously caused loss of life due to Sars-CoV and Mers-CoV epidemics. The COVID-19 virus is more dangerous than other virus types with its contagious feature. The most crucial point is that the patient with COVID-19 disease is contagious and spreads the disease to the environment (Karcıoğlu, 2020).

The fact that the virus was seen in a very short time, first in China, in Iran, then in European countries, and then

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in the Americas, is proof of how high the rate of spread of the new type of Coronavirus is (WHO, 2020). On the other hand, considering its lethal effect, it was determined that in March 2020, COVID-19 caused more damage and death than the sum of Sars and Mers diseases (Karcıoğlu, 2020). Despite the significant measures taken in 2020, COVID-19 continued to spread rapidly worldwide by undergoing mutations in 2021 and affected many countries' people, economies, and administrations. These measures have been implemented within the scope of these measures, such as taking a break from school, travel restrictions, stopping sports competitions, and switching to flexible working hours. In addition, people are encouraged not to go out as much as possible, to stay at home, and to implement individual hygiene measures (Budak & Korkmaz, 2020). COVID-19 affects individuals in many different ways. The highly contagious disease, especially inhalation, has caused thousands of people to become ill and continues to do so. While it used to affect older people, especially those with chronic diseases, it now affects middle-aged and young people, even children. With the number of infected cases every day, the number of deaths is also increasing.

The education sector is one of the most affected sectors after the health sector due to COVID-19 (Gonzalez et al., 2020; Telli Yamamoto & Altun, 2020). Schools have been closed in 188 countries due to the COVID-19 pandemic (UNESCO, 2020a). This affected approximately 92% of the worldwide student population (1.576.021.818 students). The pandemic has caused distance education to be used in primary and secondary education institutions worldwide, apart from universities (UNESCO, 2020b). Thus, students had to stay at home for a long time. Students had difficulties adapting to the new home order, which was changed by distance education, starting with a break from face-to-face education. Therefore, it can be said that students, who are the main subjects of the education sector, are more affected by this situation than teachers and parents (Ercan, Rodopman-Arman, İnal Emiroğlu, Öztop, & Yalçın, 2020). These effects affect students because they are separated from their teachers and friends, and their school life is suddenly interrupted. The factors that enable secondary school students, who are accepted as adolescents, to gain spiritual, mental, motor, and social skills are peer groups and school. Changes in students' daily lives and disruption of their routine habits due to COVID-19 may disrupt children's mental, social, academic, motor, and mental development (Ercan et al., 2020).

COVID 19, which has turned into a widespread pandemic worldwide, has affected every aspect of our lives individually and socially. Undoubtedly, this process has also affected science education, and new ways, methods, and strategies will come to the fore in terms of science education in the future. When the studies on science education in the COVID-19 process are examined, it has been observed that studies on the pandemic are mainly carried out in the health field. From this point of view, it can be said that there are few studies in the field of education. In a study conducted by Pınar & Dönel Akgül (2020), students' opinions regarding teaching science courses by distance education during the epidemic were examined. As a result of the research, the students stated that they found distance education helpful during the epidemic process but that it was a significant shortcoming that they could not experiment with distance education. Dillon & Avraamidou (2020), who focused on how much science education programs prepare the society for the COVID-19 pandemic period in their research, argued that although the importance of science literacy in science education has been emphasized for years, the public is not functionally scientifically literate. In a study (İmer Çetin, Timur, & Pehlivan, 2021) conducted to determine the metaphorical perceptions of science teachers about the virus, it was concluded that science teachers generally perceived the concept of "virus" as a negative concept during the COVID-19 pandemic process. In their study, Bakioğlu & Çevik (2020) determined science teachers' views on distance education during the COVID-19 process. Teachers also stated that they face problems such as internet connection, communication with students, a low participation rate of students in the courses during the distance education process, and concerns such as not being able to complete the curriculum and laboratory activities with distance education. In their study, Karatepe, Küçükgençay, & Peker (2020) aimed to determine the perceptions of pre-service science teachers about synchronous education and determined that pre-service science teachers were reluctant to provide online distance education in the future and did not consider themselves sufficient in this regard.

Cognition is the knowledge or awareness of living things about any concept or situation (Yılmaz & Arun, 2020). Cognitive activities are perceiving stimuli from the environment through the senses, comparing with previous information, obtaining new information and storing it in memory, bringing it back when necessary, and evaluating it (Özen, 2011). The more meaningful the acquired information is in memory or the better it is associated with old information, the easier it is to remember (Akınoğlu & Bakır, 2003). In this context, the relationships established with old information must be correct for meaningful learning to be realized while creating new information. In learning the concepts, determining the relationship between the new knowledge concepts and whether the relationship with the previous knowledge is meaningful provides a significant convenience (Ayas, 2014).

For this reason, it is crucial to determine how students establish relationships between concepts and their cognitive structures. The cognitive structure is fundamental for individuals to make sense of information, correctly

associate it with each other, and even remember this information when necessary (Ceylan, 2015). In this context, some techniques have gained importance to reveal the students' cognitive structure, the connections between the concepts in this structure, and also to determine whether the relations between the concepts are sufficient (Bahar, Nartgün, Durmuş, & Bıçak, 2006). For this purpose, some strategies that provide and measure conceptual understanding and conceptual change have been developed. The main purpose of these techniques is to reveal the harmony or differences between the students' mental structure and the events in the outside world by creating meaningful learning in students. These techniques include concept analysis tables, concept networks, concept maps, structured grids, analogy, diagnostic branched tree, word association test, etc. (Bahar, 2003; Bahar et al., 2006; Ercan, Taşdere, & Ercan, 2010). Word association tests are an alternative measurement and evaluation tool that is widely used to determine the relationships between the information existing in the minds of individuals and whether these relationships are established in a meaningful way (Hovardas & Korfiatis, 2006; Bahar, Johnstone, & Sutcliffe, 1999). When the literature is examined, it is seen that word association tests are used for different purposes, such as revealing cognitive structure, misconceptions, and conceptual changes (Bahar et al., 1999; Çelikkaya & Kürümlüoğlu, 2019; Shavelson, 1974; Varoğlu, Şen, & Yılmaz, 2020).

When the COVID-19 literature is examined, it is seen that the COVID-19 epidemic is the subject of study for many researchers. Many studies have been found, mainly in the health field, aiming to address different issues related to the COVID-19 pandemic (Bellini et al., 2021; Nalbandian et al., 2021). The COVID-19 disease has taken the whole world under its influence and has had enormous effects on individuals. Secondary school students, who switched to distance education and had to stay at home with the interruption of face-to-face education, may have created different cognitive structures in their minds regarding COVID-19. The cognitive structures in students' minds regarding COVID-19 have the potential to give important ideas in shaping the education to be carried out after the epidemic. Questioning students' thoughts regarding this process will enable them to look at the educational activities given in the continuation or after the epidemic process from a different perspective. Therefore, it is thought that teachers can help students more easily through the concepts obtained from the research. In this context, this research aims to determine the cognitive structures of secondary school students regarding the concept of COVID-19. For this purpose, the following sub-problems are included:

1. Have the students had COVID-19 disease?
2. Have any students had COVID-19 disease in their close circle?
3. Did the students have a relative who died from COVID-19 disease?
4. Are there any healthcare personnel in the family of the students?
5. What are the students' cognitive structures regarding the concept of COVID-19?
6. What are the students' misconceptions about COVID-19?

2. METHOD

2.1 Research Design

The case study design, one of the qualitative research designs, was used in this research. A case study is a research method that studies a phenomenon within its real-life framework and examines situations in a versatile, systematic, and in-depth manner (Cohen & Manion, 1997; Patton, 1990; Yıldırım & Şimşek, 2006). A case study includes the stages of limiting the situation, identifying the research case, searching the data set, creating the findings, making comments, and writing the results (Denzin & Lincoln, 1996; Bassey, 1999). In this study, the cognitive structures of secondary school students regarding COVID-19 and, in this context, their alternative concepts about COVID-19 were determined through a case study.

2.2 Research Group

This research was conducted in the spring term of the 2020-2021 academic year. 226 students in the 6th and 7th grades of a secondary school in the Fatih district of İstanbul participated in Türkiye. The purposeful working group was chosen in this research due to the need to collect detailed and high-quality data on the subject and the fact that COVID-19 is on the world agenda. Some criteria have been taken into account to minimize the problems in selecting purposeful samples (Coyne, 1997; Given, 2008; Knight et al., 2013; Patton, 1990). In this context, criteria such as having taken a science course in previous years, willingness to participate in the study voluntarily, and easy accessibility of the researcher were considered in the students' selection. Although there is no virus subject in the science curriculum, the students learned the classification of living things and microscopic living things in the 5th grade. In the study, it is important for the study to choose a purposeful sample group, especially to obtain detailed information about the students' cognitive structures on the concept of COVID-19. 113 (50%) of the students were female, and 113 (50%) were male. In addition, 94 (41.59%) 6th grade students and 132 (58.4%) 7th grade students. Before the study, the students were informed about the measurement tools, and they were assisted while filling the measurement tools.

2.3 Data Collection Tools

The data collection tool in the research consists of two parts. In the first part, in addition to the demographic characteristics of the students, such as gender and class, "Have you ever had a COVID-19 disease?", "Has anyone

in your close circle suffered from COVID-19?", "Did you have a relative who died due to COVID-19 disease?" and "Are there any healthcare personnel in your family?" were asked. In the second part, a word association test (WAT) was employed to determine the students' cognitive structures regarding the concept of COVID-19. The word association test is one of the alternative measurement-evaluation techniques that allow us to determine the cognitive structure of the student and the connections between the concepts in this structure, and whether the relationships between concepts in long-term memory are sufficient or meaningful (Bahar et al., 1999).

While using WAT, basic concepts related to the subject are selected, and students are asked to list the words associated with the concept. Thus, it is possible to have an idea about the subject by looking at the number of words the student associates with the basic concept (Başol, 2016). In this research, students were asked about the concept of COVID-19 to complete the independent WAT. The concept of COVID-19 was presented as a stimulant word, and spaces were left for students to write the words they thought related to the concepts in the WAT. An online form was used to get the opinions of the students. Two hundred twenty-six students filled out the online form on 31.05.2021. All data were collected via Google form.

STIMULANT CONCEPT: COVID-19
COVID-19: ……
COVID-19: ……
COVID-19: ……
COVID-19: ……
COVID-19: ……
Related Sentence: ……

Students should first write the five words that come to mind about the concept and then make a sentence about the words they wrote. The constructed sentences provide information about their cognitive structures and an evaluation process regarding students' misconceptions. Therefore, it is crucial for the consistency of the study.

2.4 Data Analysis

In the first part, frequency and percentage were used to determine the demographic characteristics of the students and their views on the COVID-19 outbreak. In the second part, content analysis was used to analyze the data obtained by WAT. The main purpose of content analysis is to reach concepts and relationships that can explain the collected data (Yıldırım & Şimşek, 2006). The process of analyzing and interpreting the content was carried out in four stages: (1) coding and extraction stage: The data obtained with the Google form was transferred to Excel and arranged in frequency tables. As a result, 1130 frequencies were obtained. (2) category development stage: The concepts examined were arranged by considering the categories expressed by Ekici & Kurt (2014). (3) validity and reliability phase, (4) reporting phase (Yıldırım, & Şimşek, 2006). On the other hand, the Mindmeister program was used to model the students' cognitive structures about COVID-19.

2.5 Validity and Reliability

In order to ensure the validity of the research, (1) The data coding and how to reach the conceptual category within the data analysis process are explained in detail (Hruschka et al., 2004), (2) The results obtained in the research for each of the categories, examples from student opinions were selected and presented in the findings section (Roberts & Priest, 2006) and (3) An attempt was made to ensure consistency between related studies in the comments. Two independent experts analyzed data to ensure the reliability of the study. Expert opinions were calculated using the formula [Agreement / (Agreement + Disagreement) x 100] (Miles & Huberman, 1994). The average reliability among coders was found to be 94%. The categories were similarly created by Dönmez & Gürbüz (2020) in their studies to determine the cognitive structures of university students regarding the COVID-19 virus, except for the "COVID-19 Diagnostic Ways" category. The fact that almost all of these categories are created similarly reveals the validity of the research.

3. RESULT

3.1 Findings from "Have the students had COVID-19 disease?" Sub-problem

In the first sub-problem of the research, the students were asked whether they had COVID-19, and the results are presented in Figure 1.

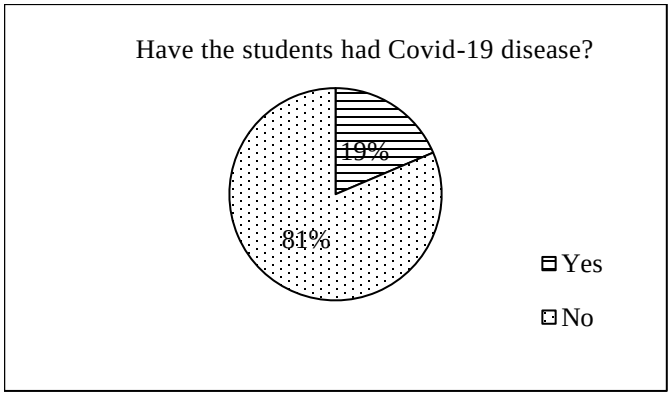

Figure 1 The status of students having Covid-19 disease

Figure 1 shows the answers given by the students about whether they have had COVID-19 or not. 18.6% (f = 42) of the students stated that they had COVID-19, 81.43% (f = 184) stated that they did not.

3.2 Findings from "Have any of the students had COVID-19 disease in their close circle?" Sub-problem

In the second sub-problem of the research, it was asked whether the students had COVID-19 in their close circle, and the results are presented in Figure 2.

Figure 2 shows the answers given by the students about whether they have had COVID-19 in their close circle.

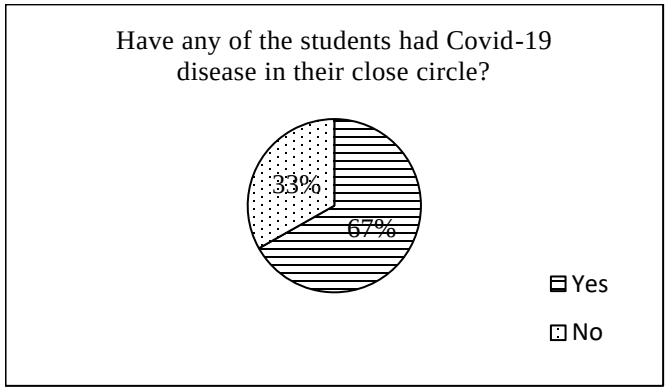

Figure 2 The status of the students' close circles to have Covid-19 disease

66.8% (f = 151) of the students stated that they had COVID-19 in their close circle, while 33.2% (f = 75) stated that they did not.

3.3 Findings from "Did the students have a relative who died due to COVID-19 disease?" Sub-problem

In the third sub-problem of the study, it was asked whether the students had a relative who died due to

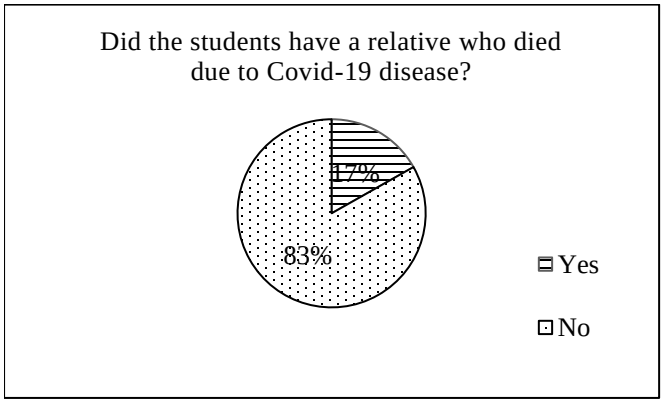

Figure 3 The status of the death of one of the relatives of the students due to Covid-19

COVID-19, and the results are presented in Figure 3.

Figure 3 shows the answers given by the students about whether they have a relative who died due to COVID-19. 16.8% (f = 38) of the students stated that they had a relative who died due to COVID-19, while 83.2% (f = 188) stated that they did not.

3.4 Findings from "Are there any healthcare personnel in the family of the students?" Sub-problem

In the fourth sub-problem of the study, the students were asked whether there was healthcare personnel in their families, and the results are presented in Figure 4.

Figure 4 shows the answers given by the students about whether there is healthcare personnel in their family. 16.8% (f = 38) of the students stated that healthcare personnel was in their family, and 83.2% (f = 188) stated that they did not.

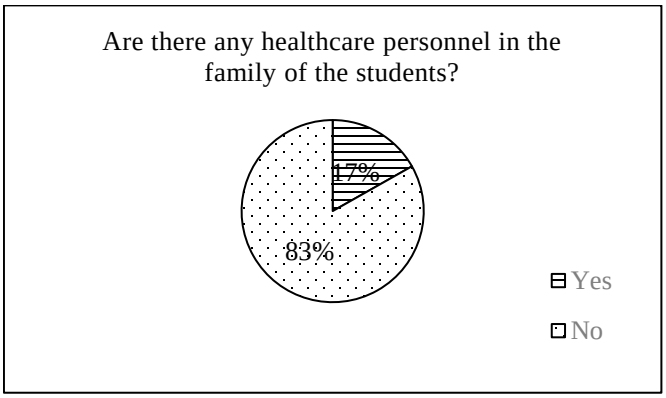

Figure 4 The status of students having healthcare personnel in their families

3.5 Findings from "What are the cognitive structures of the students about the concept of COVID-19?" Sub-problem

In Figure 5, students' cognitive structures about COVID-19 are divided into 11 categories, including COVID-19 Prevention Methods, COVID-19 Reflections in Press, COVID-19 Results, COVID-19 Perceptions, Causes of COVID-19 Transmission, COVID-19 Treatment, COVID-19 Symptoms, Countries where COVID-19 are Common, Characteristics of COVID-19, COVID-19 Carriers and COVID-19 Diagnostic Ways.

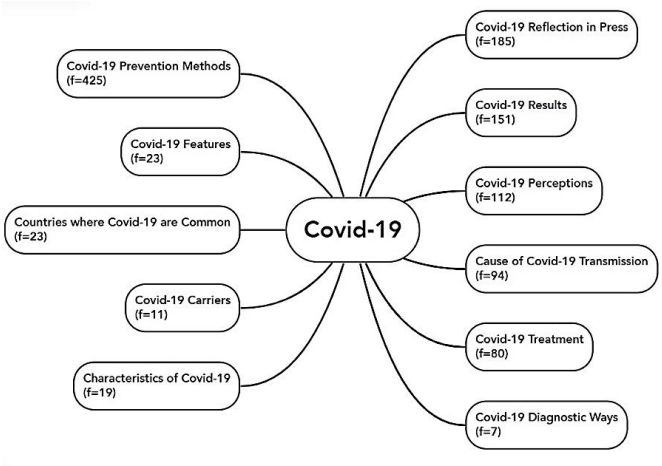

Figure 5 Students' Covid-19 cognitive structures

Table 1 shows the categories and codes related to the concept of COVID-19. COVID-19 Prevention Methods are listed as Mask, Social Distance, Restrictions, Cleaning, Disinfectant, and Glove in the first category. Four hundred twenty-five concepts are listed in this category. In the second category, 185 concepts, including Quarantine, Stay at Home, Pandemic, Epidemic, Healthcare personnel, Case numbers, and Minister of Health, were determined as COVID-19 Reflections in Press. In the third category, COVID-19 Results were examined. In this category, 151 concepts are listed as Disease and Death. In the fourth

Table 1 The distribution of the cognitive structures of students obtained by the WAT on the concept of Covid-19 by categories

Categories	Code	Total
Covid-19 Prevention Methods	Mask-148 Social Distance-89 Restrictions-72 Cleaning-58 Disinfectant-55 Glove-3	425
Covid-19 Reflections in Press	Quarantine-48 Stay at Home-39 Pandemic-33 Epidemic-30 Healthcare personnel-19 Case numbers-10 Minister of Health-6	185
Covid-19 Results	Disease-87 Death-64	151
Covid-19 Perceptions	Distance learning-32 Fear-18 Health-15 Longing-11 Stress-10 Anxiety-9 Danger-2 School-9 Zoom-4 Year 2020-2	112
Causes of Covid-19 Transmission	Virus-74 Corona-11 Microbe-6 Covid-3	94
Covid-19 Treatment	Vaccine-49 Hospital-24 Intensive Care-5 Intubated-2	80
Covid-19 Symptoms	Shortness of Breath-7 Cough-4 Fever-3 Loss of Smell-3 Loss of Taste-3 Headache-3	23
Countries where Covid-19 is Common	China-18 Türkiye-5	23
Characteristics of Covid-19	Infectious-12 Mutation-4 Fatal-3	19
Covid-19 Carriers	Family-8 Bat-3	11
Covid-19 Diagnostic Ways	Test-5 Filiation-2	7
Total	**48 words**	**1130**

category, COVID-19 Perceptions are listed. One hundred twelve concepts were determined, including Distance learning, Fear, Health, Longing, Stress, Anxiety, Danger, School, Zoom, and the Year 2020. In the fifth category, Causes of COVID-19 Transmission, 94 concepts, including Virus, Corona, Microbe, and COVID, were determined. COVID-19 treatments are listed in the sixth category. Eighty concepts, including Vaccine, Hospital, Intensive Care, and Intubated, have been determined in this category. In COVID-19 Symptoms, the seventh category, 23 concepts, including Shortness of Breath, Cough, Fever, Loss of Smell, Loss of Taste, and Headache, have been determined. It is seen that 23 concepts are listed in the eighth category of Countries where COVID-19 is Common, including China and Türkiye. In the ninth category, Characteristics of COVID-19, ten concepts, including Infectious, Mutation and Fatal, were determined. In the tenth category, COVID-19 Carriers, 11 concepts were determined, including Family and Bat. In the category of COVID-19 Diagnostic Ways is seen, which is the eleventh category, seven concepts, including Test and Filiation, have been determined.

Under this category headings, the sentences formed by the students for the concepts were analyzed. Finally, to reveal the students' cognitive structures about the COVID-19 concept in detail, the sentences they expressed about this concept were examined according to their relationship with the concept and categorized according to their meanings. At this stage, it was determined that some students did not write sentences.

Category 1. COVID-19 Prevention Methods

S32: We can protect ourselves by wearing masks.

S41: Let's wear a mask and keep social distance.

S48: Restrictions increased due to COVID-19.

S16: Mask, distance, and cleaning. Let's follow these three rules, take measures, and protect our loved ones.

S4: We need masks and disinfectants very much during the pandemic period.

S51: It is important to wear gloves while shopping.

Under this category, it is seen that the students emphasize concepts such as Masks, Social Distance, Restrictions, Cleaning, Disinfectant, and Gloves. These concepts indicate the students' thinking about the prevention methods for COVID-19.

Category 2. COVID-19 Reflections in Press

S139: If we get COVID-19, we will have to go into quarantine.

S148: We have to stay at home during the pandemic.

S54: We are tired of the pandemic and social distance.

S99: The epidemic has taught us to live differently.

S181: Since the virus entered our lives, healthcare personnel have made an effort for us.

S19: Case numbers are constantly decreasing and increasing. We are not as comfortable as in our life before COVID-19.

S170: The Minister of Health announced that masks and cleaning should be necessary.

Under this category, it is seen that the students emphasize concepts such as Quarantine, Stay at Home, Pandemic, Epidemic, Healthcare personnel, Case numbers,

and Minister of Health. It can be thought that these concepts may have taken place in students' minds with the introduction of new definitions of COVID-19 into our daily lives thanks to the press.

Category 3. COVID-19 Results

S40: A deadly disease affecting the whole world.

S174: I don't want to die.

Under this category, it is seen that the students emphasize concepts such as Disease and Death. It was determined that the students emphasized the negative consequences of COVID-19 on health.

Category 4. COVID-19 Perceptions

S78: Due to the virus, distance education has been started.

S26: I am terrified of this epidemic.

S220: Let's wear our masks and stay healthy.

S197: I miss my relatives; I miss the days before COVID-19.

S222: COVID-19 is stressing me out.

S215: The thought of getting sick worries me.

S98: This virus is dangerous for the Earth.

S136: I want to go to school.

S206: We started distance education due to COVID-19. Zoom has become indispensable.

Under this category, it is seen that the students emphasize concepts such as Distance learning, Fear, Health, Longing, Stress, Anxiety, Danger, School, Zoom, and Year 2020. Therefore, it can be thought that these concepts are the concepts that have the most place in the minds of the students during the long-term restrictions.

Category 5. Causes of COVID-19 Transmission

S169: Let's focus on the social distance to protect from the virus.

S25: I was separated from my loved ones due to Corona.

S193: If we get COVID-19, we must be treated by doctors and use medicine to get rid of microbes.

S45: I want to get rid of COVID.

Under this category, it is seen that the students emphasize concepts such as Virus, Corona, Microbe, and COVID. These concepts express the causes of the transmission of COVID-19.

Category 6. COVID-19 Treatment

S146: Let the vaccine end Corona.

S9: We went to the hospital because of the virus.

S162: If we don't wear masks, we can get Corona and stay in intensive care in the hospital for days.

Under this category, it is seen that the students emphasize concepts such as Vaccine, Hospital, Intensive Care, and Intubated. These concepts are listed for the treatment forms of COVID-19.

Category 7. COVID-19 Symptoms

S87: Shortness of breath is a horrible thing.

S66: Cough and Fever are symptoms of COVID 19.

Under this category, it is seen that the students emphasize concepts such as Shortness of Breath, Cough, and Fever. These concepts are listed by considering the symptoms of people with COVID-19.

Category 8. Countries where COVID-19 is Common

S143: The Chinese ate bats; the whole world became Corona.

S117: COVID-19 is a deadly pandemic spreading worldwide and in Turkey.

Under this category, it is seen that the students emphasize concepts such as China and Türkiye. These concepts result from the students' seeing China as the source of the spread of the COVID-19 epidemic. The epidemic affected Turkey as well as the whole world. However, even though the epidemic was seen in other countries, the students did not specify the concept of other countries.

Category 9. Characteristics of COVID-19

S34: A fatal and infectious disease.

S173: The health minister announced that the virus had undergone a new mutation.

Under this category, it is seen that the students emphasize concepts such as Infectious, Mutation, and Fatal. These concepts result from students' mental perceptions of the characteristics of the disease process of COVID-19.

Category 10. COVID-19 Carriers

S177: A man in China started the spread of the virus by eating bat soup.

Under this category, it is seen that the students emphasize concepts such as Family and Bat. These concepts created by students are based on living things that can be carriers of COVID-19.

Category 11. COVID-19 Diagnostic Ways

S172: Let's follow the mask, distance, and cleaning rules. Let's have a COVID test if there are symptoms.

Under this category, it is seen that the students emphasize concepts such as Test and Filiation. Therefore, these concepts can be evaluated as findings pointing to diagnosing COVID-19.

3.6 Findings from "What are the students' misconceptions about COVID-19?" Sub-problem

The 226 sentences formed as WAT results were examined, and the sentences of the students who were thought to have misconceptions are as follows;

S10: I can't go out and meet my friends because it is quarantined. I am alone.

S24: Many people died because COVID-19 is such a great plague.

S39: Doctors working in the intensive care unit in Wuhan, China, are getting the virus daily.

S42: If we are not clean, we can become Corona.

S83: Because humanity's ridiculous curiosity about everything, it is causing the death of people in the world right now.

S143: The Chinese ate bats; the whole world became Corona.

In sentence S10, the concept of quarantine is used instead of restrictions. However, quarantine is the separation of people who have had the disease from other people. S24 has confused COVID-19 with the plague. S39

said that the doctors working in the intensive care unit in China were infected with the virus. However, the virus infects people in other professions and all humanity worldwide. S42 stated that you could catch the COVID-19 disease if you are not clean. However, not only cleaning but also other rules must be followed. According to S83, an unscientific explanation was made by stating that people died in the world because of people's curiosity. S143 has a detection that the virus spread because the Chinese ate bats. However, there are other ideas about the cause of COVID-19.

4. DISCUSSION

This research aims to determine secondary school students' cognitive structures and misconceptions about COVID-19 by word association test during the COVID-19 pandemic seen worldwide. The research was conducted with 6th and 7th-grade students in a secondary school in Türkiye. The reason for the planning of this research is that no other study in the literature examined the cognitive structures of secondary school students with the word association test for the concept of COVID-19. Learning occurs as a result of the interaction between what is taught to the student and the existing concepts in the student's mind. For this reason, identifying and revealing existing concepts in students' cognitive structures is important in learning. It is not very easy to explain the cognitive structures of individuals as a result of learning, but by revealing their thoughts about key concepts, vital data can be provided, and individuals' cognitive structures can be revealed (Kurt & Ekici, 2013). According to the findings, it was determined which concepts were related to the subject in the students' cognitive structure and how the relations/connections between these concepts were established. In addition, some misconceptions were determined by looking at the quality of the associated concepts and words. The research results show that the word association test is a diagnostic and highly effective measurement and evaluation technique.

When the situation of secondary school students who have had the COVID-19 disease is examined, the rate of the students participating in the research who have had the disease themselves is low, but the rate of those who have had this disease in their close circles is relatively high. It was determined that the death rate in the close circles of the students participating in the study was also low. In addition, the ratio of healthcare personnel in the families of the students participating in the research was low. The cognitive structures of secondary school students on the concept of COVID-19 are grouped under 11 categories. These categories are COVID-19 Prevention Methods, COVID-19 Reflections in Press, COVID-19 Results, COVID-19 Perceptions, Causes of COVID-19 Transmission, COVID-19 Treatment, COVID-19 Symptoms, Countries where COVID-19 are Common, Characteristics of COVID-19, COVID-19 Carriers and COVID-19 Diagnostic Ways. It is seen that the most repeated area among these categories is for COVID-19 prevention methods. Under this category, it is seen that it is mainly repeated as a mask, social distance, restrictions, and cleaning. These findings can be interpreted as an indication that the students are worried about catching the disease caused by the COVID-19 virus because there are people who often have the disease in their close circle and focus on remedies to protect themselves. In particular, the mask and social distance concepts among subjective measures have been mentioned by many students, and this issue's importance has been emphasized in literature (Til, 2020). While the precautions mentioned by the students contain valuable information of vital value in the COVID-19 epidemic, it is an undeniable fact that it is important to spread this information to the whole society. Another result obtained under this category is the increasing importance given to cleanliness, which many students mention because the benefit of personal cleaning and hygiene in this disease is undeniably great (İşsever, İşsever, & Öztan, 2020). Similarly, in a study conducted by Dönmez & Gürbüz (2020) to determine the cognitive structures of university students regarding the COVID-19 virus, they stated that the category of ways of protection from COVID-19 is the second most substantial cognitive structure and that the students often stated concepts such as mask, cleaning, social distance, and disinfectant.

When the second category, COVID-19 reflections in the press, is examined, it is seen that the students frequently repeat the new concepts such as quarantine, pandemic, and epidemic. This is an indication that students are serious about COVID-19 and that they have knowledge about the subject. It is thought that the reason for the emergence of such data may be the media and the information channels they follow (Görgülü-Arı & Hayır-Kanat, 2020).

In the third category, disease and death were shown by students as a result of COVID-19. Therefore, it would be correct to say that this epidemic had a negative impact on students. This can be explained by the fact that students, who constantly hear about deaths due to COVID-19 disease and the increasing number of positive cases on the media agenda, associate this epidemic with negative thoughts.

It is seen that the concepts of distance learning, fear, health, and longing are mostly repeated under the category of COVID-19 perceptions. With the secondary school students having to take distance learning during the epidemic process, the students' perceptions against distance education stand out in this category.

Virus, Corona, and COVID are shown to cause the COVID-19 transmission. The fact that people with COVID-19 have a highly contagious effect plays a critical role in this process (Jin et al., 2020; Shen et al., 2020).

Therefore, it can be said that the concepts stated by the students regarding the epidemic support this situation.

The most mentioned concept in the COVID-19 treatment category was the vaccine. As soon as COVID-19 was identified, studies on developing a vaccine against the disease began. Various types of vaccines have been developed by various centers and are still being developed. Although there are many different discourses about when and how the epidemic will end, it is known that the vaccines developed are essential. Therefore, it can be interpreted that students' belief that the virus will disappear through vaccination permanently may be a reflection of their belief in the current health system and the vaccines applied (Görgülü-Arı & Hayır-Kanat, 2020). In addition, it can be thought that this subject is on the students' agenda as it is frequently emphasized in the information sources.

In the category of COVID-19 symptoms, the concepts of shortness of breath, cough, and fever are often mentioned. However, common symptoms of COVID-19 have been described as fever, fatigue, and cough. In addition, shortness of breath, sore throat, and diarrhea in very few individuals have also been reported (WHO, 2020). This information suggests that students know the symptoms of the COVID-19 disease by hearing or seeing them in their close circle.

China comes to the fore in the category of countries where COVID-19 is common. Since China is shown as the starting point of the virus on the agenda of the whole world (WHO, 2020), it can be thought that this concept has an important place in students. In the COVID-19 characteristics category, it was emphasized by the students that the disease was primarily infectious. Therefore, it can be said that the results obtained from the study conducted by Dönmez & Gürbüz (2020) are parallel to the results of this research.

In the category of COVID-19 carriers, the concepts of family and bat are specified. It is thought that the students say the concept of family because the ways of transmission of the virus are from person to person, and attention to social distance is emphasized. In addition, bats are accepted as the COVID-19 source and have an important place in the transmission of the disease. As a result, bats are thought to be the COVID-19 cause (Malik et al., 2020), and it is estimated that the students also started the bat concept because this situation was emphasized in the press.

In the category of COVID-19 diagnostic ways, the students focused on the concept of testing. A definitive diagnosis of COVID-19 is provided by detecting COVID-19 ribonucleic acid (RNA) taken from suspected individuals. Among the available methods, the most preferred is the PCR test. This test's accuracy and reliability level is 70% (Corman et al., 2020; Choe et al., 2019). It can be thought that the students said this concept because this test is widely used, and the way it is done is also included in the media.

It has been observed that very few of the students have misconceptions about the COVID-19 virus. However, misconceptions may be caused by following unreliable sources. Therefore, ensuring appropriate access to the mass media and disseminating accurate information can reduce misunderstandings about the COVID-19 pandemic (Bakebillah, Billah, Wubishet, & Khan, 2021).

CONCLUSION

COVID-19 is not the first virus to threaten humans; it probably will not be the last. Although pandemics are rare, they have a potentially devastating impact on people's lives. It is stated that the epidemic has turned into a global trauma with its social, political, economic, and psychological reflections and that the situation experienced with the epidemic is not only a health problem but also a mental health problem with effects such as anxiety and social isolation (Aşkın, Bozkurt, & Zeybek, 2020). For these reasons, the need to know people's thoughts on COVID-19 has arisen.

According to the results obtained from the sub-problems of the research, the rate of the students participating in the research who have had the disease themselves is low, but the rate of those who have had this disease in their close circles is relatively high. It was determined that the death rate in the close circles of the students participating in the study was also low. In addition, the ratio of healthcare personnel in the families of the students participating in the research was low. The cognitive structures of secondary school students on the concept of COVID-19 are grouped under 11 categories. It has also been determined that students have some misconceptions about COVID-19.

Determining the cognitive structures of secondary school students, who will be adults of the future, against COVID-19; It will be beneficial in terms of developing strategies on issues such as crisis management, coping with stress, and ways of protection. In addition, it has been well understood during the epidemic process how viruses, one of the essential subjects of science education, can affect daily life. For this reason, the virus can be re-evaluated in the science curriculum, and it can be possible to organize the science education content by considering the categories obtained from this research. Since the conceptual structures of secondary school students regarding the concept of COVID-19 are important in structuring many concepts, especially the ways of protection from the disease, it is thought that the results of this research will contribute to the development of science education programs and the literature.

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