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| Research Article / Araştırma Makalesi |

Determination of Cognitive Structures of Primary School Fourth-Grade Students on the Concept of Recycling

İlkokul 4. Sınıf Öğrencilerinin Geri Dönüşüm Kavramına İlişkin Bilişsel Yapılarının Belirlenmesi

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Keywords
1. Environmental education
2. Misconception
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Abstract

Purpose: In this study, it was aimed to determine the cognitive structures of primary school 4th grade students regarding the concept of recycling

Design/Methodology/Approach: In the research, the phenomenology design, which is one of the qualitative research designs, was used. The participants of the study consisted of 150 fourth grade students in the central district of Demirci district of Manisa province. In order to determine the cognitive structures of primary school fourth grade students regarding the concept of recycling, expert opinion was taken, and the word association form prepared by the researcher was used as a data collection tool. The responses of the fourth-grade primary school students to the key concept of "Recycling" were examined. For the key concept, main categories were created, and answer words were placed in line with the answer words given, considering the recycling stages determined in line with the "Zero Waste" project implemented by the Ministry of Environment and Urbanization in 2017, in order, appropriate categories. The answers given by the students to the key concept with the word association form were examined in detail for analysis, first descriptive analysis was made, codes were determined, and cognitive levels were determined by content analysis. The data obtained were analysed using the number of words, the number of answers and the semantic relationship technique. A frequency table was created for the scientific and non-scientific sentences of the key concept.

Findings: According to the results obtained in the study, the number of words that primary school students associate with concepts related to recycling is high. In the study, it is seen that the concept of "recycling" creates meaningful sentences at the word level, and the sentences contain some misconceptions at the sentence level. In the sentences they create about the concept of recycling, there are misconceptions such as everything can be recycled, unused items can be recycled, old things can be renewed.

Highlights: It was observed that students often confuse the concepts of "recycling" and "reusability," and this misconception is reflected throughout the findings. Additionally, some students hold incorrect beliefs, such as the idea that all materials can be recycled or that used items automatically become recyclable. These misconceptions may hinder the development of a scientifically accurate understanding of recycling.

Öz

Çalışmanın amacı: Bu araştırmada ilkokul dördüncü sınıf öğrencilerinin geri dönüşüm kavramına ilişkin bilişsel yapılarının belirlenmesi amaçlanmıştır.

Materyal ve Yöntem: Araştırmada nitel araştırma desenlerinden fenomenoloji deseni kullanılmıştır. Araştırmanın katılımcıları Manisa ili Demirci ilçesinde öğrenim gören 150 dördüncü sınıf öğrencisi oluşturmuştur. Araştırma verileri araştırmacılar tarafından uzman görüşleri alınarak hazırlanan kelime ilişkilendirme formu ile toplanmıştır. Araştırma verileri içerik analizi yöntemi ile analiz edilmiştir. Veri kodlama süreci araştırmacılar tarafından bağımsız bir şekilde ve eşzamanlı gerçekleştirilmiştir. Öğrencilerin kelime ilişkilendirme formu ile anahtar kavrama verdikleri cevaplar analiz için detaylı olarak incelenmiş, ilk olarak betimsel analiz yapılmış, kodlar belirlenmiş ve içerik analizi ile bilişsel düzeyleri belirlenmiştir. Elde edilen veriler kelime sayısı, cevap sayısı ve anlamsal ilişki tekniği kullanılarak analiz edilmiştir. Anahtar kavramın bilimsel ve bilimsel olmayan cümleleri için frekans tablosu oluşturulmuştur. Ayrıca elde edilen bulgular içerisinde yer alan kavram yanılgıları belirlenmeye çalışılmıştır.

Bulgular: Araştırmada elde edilen sonuçlara göre ilkokul öğrencilerinin geri dönüşüm ile ilgili kavramlarla ilişkilendirdikleri kelime sayısı fazladır. Çalışmada "geri dönüşüm" kavramının kelime düzeyinde anlamlı cümleler oluşturduğu, cümlelerin ise cümle düzeyinde bazı kavram yanılgıları içerdiği görülmektedir. Geri dönüşüm kavramı ile ilgili oluşturdukları cümlelerde her şey geri dönüştürülebilir, kullanılmayan eşyalar geri dönüştürülebilir, eskiler yenilenir gibi kavramsal hatalardır.

Önemli Vurgular: Çalışma sonucunda öğrencilerin, "geri dönüşüm" ve "yeniden kullanılabilirlik" kavramlarını karıştırdığı tespit edilmiştir. Ayrıca öğrencilerin bazılarının, geri dönüşümle ilgili her şeyin yeniden dönüştürülebileceği gibi yaygın kavram yanılgılarına sahip olduğu görülmüştür. Elde edilen bulgular, bu yanılgıların öğrencilere kazandırılmaya çalışılan bilimsel anlayışta ciddi bir engel oluşturabileceğini göstermiştir.

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INTRODUCTION

The primary school period is one of the important steps in acquiring the necessary information, developing the skills and transforming all these abilities into behaviour. The child uses the knowledge, skills and behaviours gained in this process to recognize both themselves and society. Primary school provides an environment that will increase the child's skills and contribute to their development as individuals who are beneficial to themselves and the society.

Attitudes and behaviour developed by the child in primary school; If they can be developed in a positively toward the environment, they can take on an important mission in increasing responsibilities toward themselves, society and the environment in later years. Children in this period are very attentive to changes in their environment. They have a high interest in learning and are very energetic. If these developmental characteristics are supported positively, research skills can be increased. Therefore, children who are interested in research try exploring the environment by asking questions about their environment.

Society needs environmentally sensitive and conscious individuals. Protecting the environment, knowing environmental responsibilities and transforming them into behaviour can be achieved with environmental education. The main purpose of environmental education is; to support people's interest in nature (Bahl et al., 2016; Güven & Yılmaz, 2017; Jickling & Walls, 2019) to teach the language of nature (Saraç, 2017). Environmental education beginning at an early age can be more effective (Erol, 2016; Güneş, 2018; Yılmaz et al., 2020). Environmental education is an effective way to focus on environmental issues.

The environmental knowledge and awareness offered to individuals allows especially knowing and solving environmental problems and develop behaviours to protect the environment. Recycling is one of the effective methods for protecting the environment. The recycling of used materials is getting more and more important every day. This process has accelerated because of the enrichment of the technological infrastructure of industrialization. Increasing population, rapid urbanization and diversification of human activities increase the degradation of the environment. However, the increase in the amount of garbage, its types and risk threaten human and environmental health. Environmental disasters, which are heard almost every day, draw attention around the world and in our country. Burying or burning used products, which are generally regarded as garbage, is seen as the most preferred method (Muise et al., 2016). Additionally, the activities to be carried out at the stages such as collection, storage, reprocessing and back distribution that will occur after the products reach the consumer is gaining importance day by day. Recycling is the reuse of various waste materials (glass, paper, concrete, organic waste and electronic waste, aluminum, plastic, battery, motor oil, accumulator, etc in the production process, which are converted into secondary raw materials either by chemical, physical, or physical-chemical processes (Büyüksaatçi et al, 2008). The main purpose of recycling is to reduce the amount of garbage, reuse waste and prevent unnecessary use of resources (UNESCO, 1992). Therefore, it is considered sustainable as an important part of the future (Edgell, 2016; Henchion et al., 2017; Wichaisri & Sopadang, 2018).

When the literature was examined, it was found that the attitudes of students toward the environment regarding recycling (Boca & Saraçlı, 2019; Aguilar-Jurado et al., 2019), students' awareness levels (Hammami et al., 2017; Katırcıoğlu, 2019), perceptions (Keleş & Keleş, 2018), opinions on waste and recycling (Altikolatsi et al., 2021; Yoldaş, 2019) were found. When the studies are examined, it is seen that the studies are mostly aimed at the application. This study aims to determines the conceptual perceptions of the elementary school fourth-grade students toward the concept of “recycling.

When the studies conducted are examined, it is seen that the studies are more application oriented. In this study, it is aimed to determine the conceptual perceptions of the elementary school fourth-grade students toward the concept of "recycling.". It is considered important to determine the status of the recycling concept and to realize it before the implementation processes. The fact that the study is a phenomenological study is important in terms of revealing the meanings that students attribute to the concept of "recycling.". It is seen that there are no similar studies in the literature, and the study differs from other studies in the literature. In the 6th, 7th or 8th grades of secondary school as of the 2022-2023 academic year of the Ministry of National Education. The fact that the existence of wastes will be processed in the content of "environmental education and climate change" course, increases the importance of understanding the concept of recycling (MEB, 2022).

Even though the concept of recycling has been widely used in recently, it is thought that it is not clearly understood and there are misconceptions about this concept. The experiences gained through the lives of the individual, structures that do not comply with scientific facts and are resistant to change form a basis for misconceptions. These fulcrums are also concepting that significantly affect new learning (Pfund & Duit, 1991). A reason for negatively affecting the cognitive structure is the abstract concepts that cannot be fully associated the concepts related to the subject in the mind and individuals can (be explained by their thoughts) because of learning about these concepts (Bjorklund, & Causey, 2017; Friedman & Miyake, 2017; Klahr & Wallace, 2022; Stiles et al., 2015). Some measurement techniques have been developed for individuals to associate the concepts they have with new information. The word association test (WAT) is one of these techniques (Doğan et al, 2018). WAT, which is one of the alternative measurement technique and has been determined that it is used both in the field of science and social fields, is a tool for observing the concepts formed with the cognitive structure, the information network formed in the mind and determining whether the relationships between concepts are sufficient and meaningful (Akyurt, 2020; Onat & Keskin, 2019; Kaya & Taşdere, 2016; Timur et al., 2020).

The "Human and Environment Relationship" unit in the Primary School 4th Grade Science curriculum is "Are we conscious consumers?" The concept of recycling is included. According to the achievements in teaching human and environment in the curriculum, primary school 4th grade students are expected to gain a cognitive structure for understanding the importance of

mutual interaction between human and the environment and the negative effects of environmental pollution on people's health. It is important to reveal the cognitive structure for the concept of recycling in the mutual interaction between humans and the environment. For this reason, it is aimed to determine the cognitive structures of primary school 4th grade students regarding the concept of recycling. For this purpose, it is searched for an answer to the question "What are the cognitive perceptions of primary school 4th grade students toward the concept of recycling?" The sub-questions of the research are,

• Under which conceptual categories can they be grouped according to the similarities and differences between the cognitive perceptions that students produce for recycling?

• Under which conceptual categories can these cognitive perceptions be grouped in terms of their common features?

• What are the scientific, non-scientific and misconceptional expressions of primary school students regarding the key concept of “Recycling”?

METHOD/MATERIALS

In this study, the phenomenology study model, one of the qualitative research methods, is used. While qualitative studies try to reveal how people attribute and interpret meaning to their experiences, the task of phenomenological studies is to describe the basic structure or source of experience (Merriam & Grenier, 2019; Patton, 2014; Yıldırım & Şimşek, 2021). In this study, a phenomenological study was used to determine which concepts the students associate their experiences the concept of "recycling,", which is included in the Primary School 4th Grade Science course. The study group of the research participants is the fourth-grade primary school students in the central district of Demirci, Manisa in the 2021-2022 academic year. In the literature, it is seen that the number of participants in phenomenological studies is from one person to 325 participants (Creswell, 2020). For this reason, a group of 150 students was included in the study, considering the research data collection process and the quality of the data to be obtained. Of the students examined, 79 (53%) were female and 71 (43%) were male

Data Collection Tool

To determine the cognitive structures of the primary school fourth-grade students regarding the concept of recycling, expert opinions were taken, and the word association test prepared by the researcher was used as a data collection tool. In the word association test, the concept selection was made based on the key concept of "Recycling" in the "Human and Environment" unit in Chapter 6 of the 4th Grade Science textbook. In the Word Association test, they are expected to write words that they can associate with a concept in a short time. With the word association test, the key concept of "Recycling" was written 10 times one under the other and presented to primary school students and they were asked to write down the words about what it connoted as an answer and to write a sentence about the concept of recycling at the bottom. A key concept can only be associated with a concept at the level of recall, as well as a connotation that does not have a meaningful relationship with the key. A sentence about a key concept requires a higher level of skill than a single word. Whether these sentences are scientific or not and whether they contain misconceptions of different nature can affect the evaluation process (Allen, 2019). Writing down the key concept as much as the expected number of answers; to prevent the risk of chain responses. Instead of writing the answer words that come to mind for the given key concept, the student is to prevent them from writing the word that the answer word can bring to mind. Thus, the test can be prevented from going beyond its purpose. When the research is examined, it is stated that the appropriate response time for the key concept should be 30 seconds (Işıklı et al., 2011; Şimşek, 2013), the reason why the students are in primary school, it was deemed appropriate to give 60 seconds for the key concept (Ercan et al., 2010). First, an example of the word "school" was presented to primary school students, and an example application was made in the classroom to ensure students' understanding.

Then the key concept is presented.

Key Concept: Recycling:…….. Recycling:…….. Recycling:…….. Recycling:…….. Recycling:……..

Validity and Reliability Studies

Validity, the investigate phenomenon; attentive, careful and impartial, is the most powerful and decisive criterion to be expressed as it is. Reliability is an important element in qualitative research (Bryman, 2016; Creswell, 2020). In this context, the data obtained from primary school students were analysed separately. The researcher analysed the results of the analysis according to different categories. Additionally, the raw data were examined by two science educators who are experts in their fields. Validity was tried to be ensured by writing in detail how the data were collected and how the results were obtained from the collected data. Reliability: It can be defined as the repetition of a study conducted to measure a certain feature from another study in the same way under similar conditions and yielding similar or the same results. The researcher conducting the study should report in detail and clearly the stages of the study, the process, his/her own position and approach (Bryman, 2016; Merriam & Tisdell, 2015). The answer words given by the primary school fourth-grade students for the key concept of "Recycling" were examined. For the key concept, main categories were created in line with the given answer words, considering the recycling stages determined in line with the "Zero Waste" project implemented by the Ministry of Environment and Urbanization in 2017 and the answer words were placed in the appropriate categories. This process was repeated a week later, and some answer words were shifted to other categories. Two experts validated the categories created for the key concept and the answer. In terms of coder consistency during the coding process, two researchers coded twice with the code-re-code logic. Coding was done by two people

in terms of consistency between the coders. After the coding on the compatibility between the coders, the process of persuasion between the coders was used in case of disagreement. The aim here is to perceive all data are important in qualitative research. During the persuasion process, the two coders tried imposing the correctness of the code they had expressed in the notes they kept on the incompatible codes. In case of incompatibility, the process of recoding and applying to a third coder was made and a third coder's opinion was received for the coding on the "Benefits of recycling" theme.

Data Analysis

The answers given by the students to the key concept with the word association test were examined in detail for analysis, the codes were determined by conducting descriptive analysis first, and the cognitive levels were determined by content analysis. Descriptive analysis is an analysis that is generally based on “invivo,”, coding as it was, or in accordance with the real logic of the specified concepts, without producing any semantic interpretation in the code creation process. Content analysis is a type of analysis used to analyse the content of any document, numerically or statistically (Bryman, 2016; Merriam & Tisdell, 2015). The main purpose of this analysis was to reveal the relationships that can explain the obtained data. In this process, the data were conceptualized, organized in logically, and the themes that explain the data were created (Bryman, 2016). In the study, students' answer sheets were numbered for content analysis. The obtained data were analysed using the number of words, the number of answers, and the semantic relationship technique. A frequency table was created for the scientific and non-scientific sentences of the key concept. The frequency table was prepared to show how many times that word or concept is used in response to the key concept. The words answered with the same meaning are the most repetitive words. Irrelevant words, unrelated words and repeated words were not evaluated. Words are categorized using semantic relationship criteria. The sentences of the students related to the concept of recycling (S……) were given with the participant number, and the sentences made by the students were given as a one-to-one quotation without changing the essence. The ethical permission (06.02.2020 /03 numbered) was taken from the ethics committee of Manisa Celal Bayar University, Institute of Social Sciences, to conduct the study. Students whose parents did not give permission for the study /did not receive the consent form and did not want to fill out the questionnaire were excluded from the study and only participated in the training.

FINDINGS

The findings obtained from theses according to the determined criteria are discussed in this section in the order of subproblems. The findings regarding the answer to the question of the first sub-problem, “What is the distribution of theses addressing the subject of ‘organizational commitment’ in the field of education by year?” are given in Figure 1.

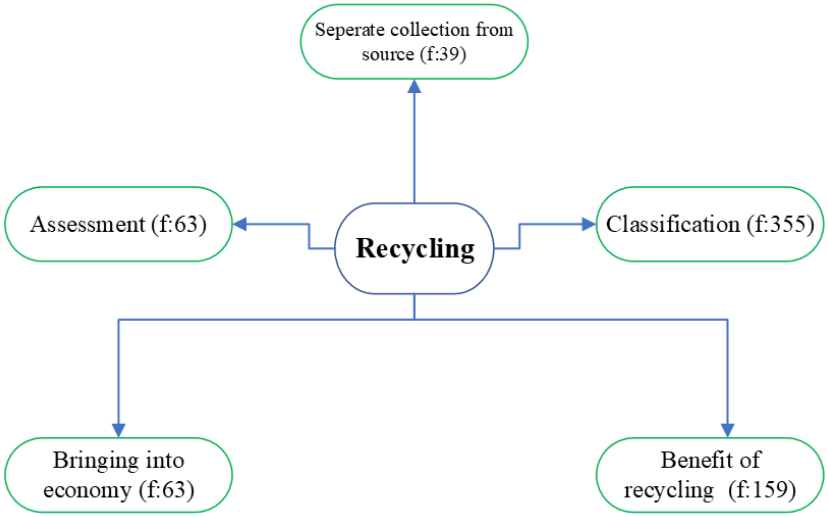

Figure 1. Categories and code distributions obtained from primary school students' perceptions of the concept of "Recycling"

Five different categories related to the concept of "recycling" were formed in the primary school students who participated in the study. The answers received from the primary school students who participated in the study were 39 words belonging to 5 different concepts in the "collection separate from the source" category, 355 words belonging to 7 different concepts in the "classification" category, 97 words belonging to 13 different concepts in the "evaluation" category, 14 words in the "bringing the new product to the economy" category. They created 63 words belonging to different concepts and 159 words belonging to 21 different concepts in the "benefits of recycling" category. A total of 713 words were evaluated under all the categories. A total of 60 concepts were produced in five categories. The category of “benefits of recycling” was the one that produced the most 21 different concepts. However, although 7 different concepts were produced in the "classification" category, it was observed that the category with the highest number of words was produced with 355 total words.

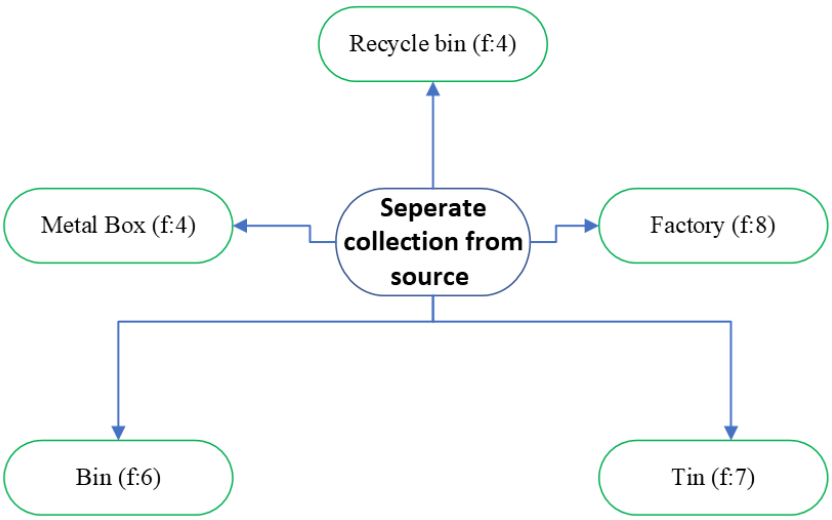

Figure 2. The Response word distributions of the students for the "separate collection from the source" category

In Figure 2., it is determined that the answer words given by the students in the category of " Separate Collection from the Source " were five and the frequency was 39. In this category, the Recycle Bin (14) ranks first among the associations made by primary school students. After that Factory (8), Tin (7), Trash (6), Metal box (4) come. In the category of "Separate Collection from Source"; Container, Piggy bank, indoor boxes, Recycling bags etc. are available. It is thought that the answers in the category of " Separate Collection from the Source " are related to the concept of "Recycling,". Sentences were made for the issue;

- We recycled glass, paper, batteries and plastic items. (M, 22. S)
- We should dispose of wastes in glass, plastic and paper places. (F, 12. S)
- Let's not throw plastic, glass, paper in normal garbage. Garbage separately trashes cans, let's throw them. (F,78. S)
- The class made a presentation by hanging up recycling papers and making a recycling bin. (F,88.S)

When the sentences formed by primary school students in the category of " Separate Collection from the Source " regarding the key concept are evaluated in terms of recycling bins are at the forefront.

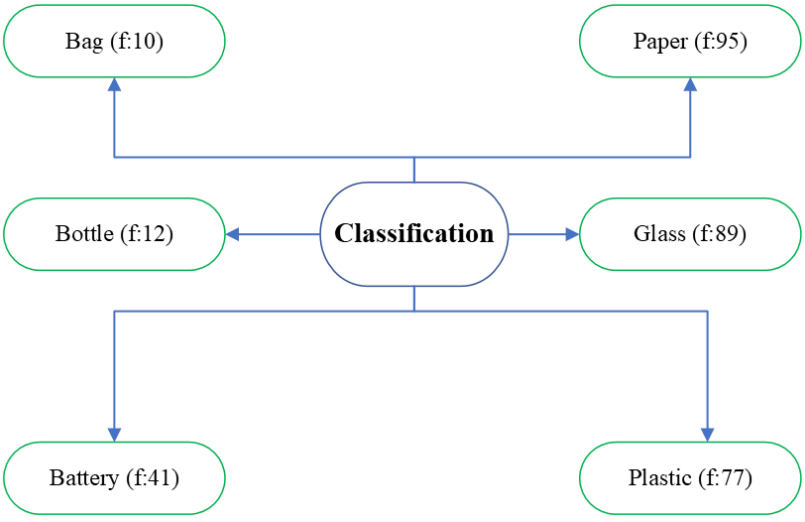

Figure 3. Students' answer word distributions regarding the "classification" category

Figure 3. Students' answer word distributions regarding the "classification" category In Figure 3, it has been determined that the answer words given by primary school students to the "Classification" category are seven and the frequency is 355. In this category, Paper (95) ranks first among the associations made by primary school students. Glass (89), plastic (77), Batterys (41), Waste (31), Bottle (12) and Bag (10) come next. In the "Classification" category; Paper, Metal, Glass, Plastic, Composite etc. are available. All the answers in the "Classification" category are thought to be related to the concept of "Recycling.". Sentences were made for the issue;

- We should throw materials such as paper, metal and glass into recycling bins. (F, 37.S)
- My friend threw a battery in the recycling bin. (M, 62. S)
- Let's separate our garbage and throw it in the recycling bins. (M, 90. S)

- Recycling is vital for all of us. Because we use nature as plastic, glass, battery, paper, etc. separates things. Reuses products for another purpose. (F,91. S) In the "Classification" category of the key concept, when the sentences formed by primary school students are evaluated in terms of recycling, it is seen that this action is vital and its effect on gaining behavior comes to the fore.

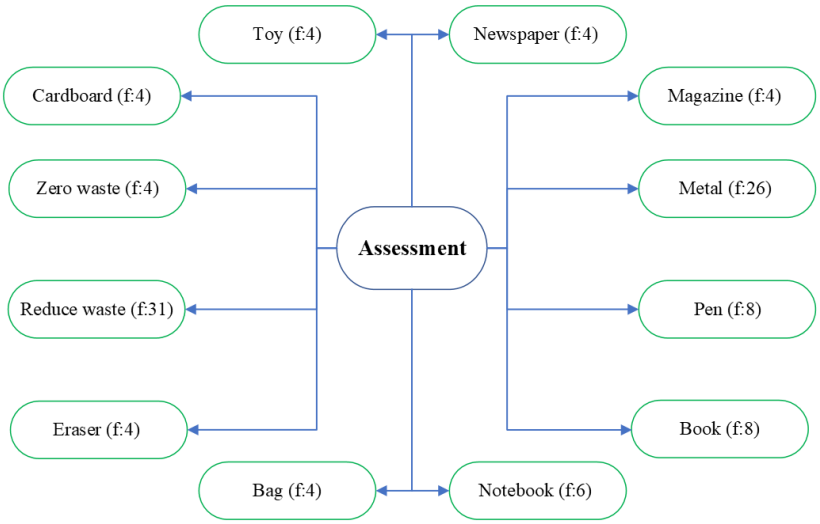

Figure 4. Response Word Distributions of Primary School Students for the "Assessment" Category

Figure 4. Response Word Distributions of Primary School Students for the "Assessment" Category in Figure 4., it is determined that the answer words given by primary school students in the "Assessment" category were 13 and the frequency was 97. In this category, Metal (26) ranks first in associations made by primary school students. After that Recycle (16), Pen (8), Book (8), Notebook (6), Reduce waste (5), Bag (4), Zero waste (4), Eraser (4), Cardboard (4), Toy (4), Newspaper (4), Magazine (4) comes. In the "Assessment" category; returning to the economy as a raw material after going through physical and chemical processes in the recycling facility, etc. are available. All the answers in the "Assessment" category are thought to be related to the concept of "Recycling.". Sentences were made for the issue;

- Recycling is the renewal of old glass, plastic and paper. (M, 53.S)
- Recycling reminds me of saving. (F, 95. S)
- In my opinion, recycling means reclaiming recyclable waste. (F, 100. S)
- An item becomes reusable. (F, 115. S) In the "Evaluation" category related to the key concept, the sentences formed by primary school students were reused when evaluated in terms of recycling, emphasizing saving.

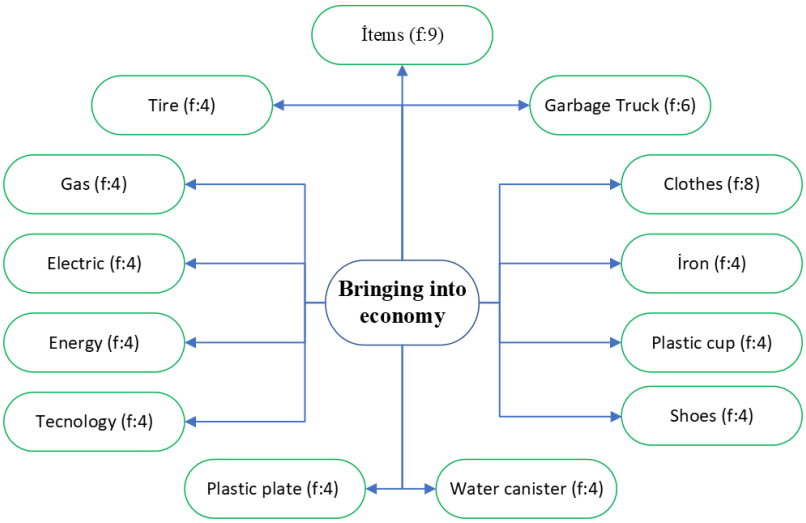

Figure 5. Response word distributions of primary school students for the category of "bringing in new product to the economy"

In Figure 5, it is determined that the answer words given by primary school students in the category of " Bringing in a New Product to the Economy" were 13 and the frequency was 63. In this category, the items (9) are in the first place in the associations made by primary school students. After that Clothes (8), Garbage Truck (6), Iron (4), Plastic cup (4), Shoes (4), Technology (4),

Plastic plate (4), Water canister (4), Energy (4), Electric (4), Gas (4) and Tire (4) come. In the category of “Bringing in a New Product to the Economy”; it is used in the production of a new product and there is new life-giving. All the answers in the category of "Bringing in a New Product to the Economy" are thought to be related to the concept of "Recycling.". Sentences were made for the issue;

- One day while walking on the road, I saw a man throwing paper in the trash and I was upset. (M, 43. S)
- In recycling, products are renewed for reuse. (M, 85. S)
- Instead of throwing away all products, we can recycle them and contribute to the economy. (F, 86. S)
- Recycling is to evaluate the unused item for me. (M, 98. S)

When the sentences formed by primary school students are evaluated in terms of recycling in the category of "Bringing in New Product to the economy" related to the key concept, it is seen that the emphasis is on bringing the waste materials into the economy after they are processed.

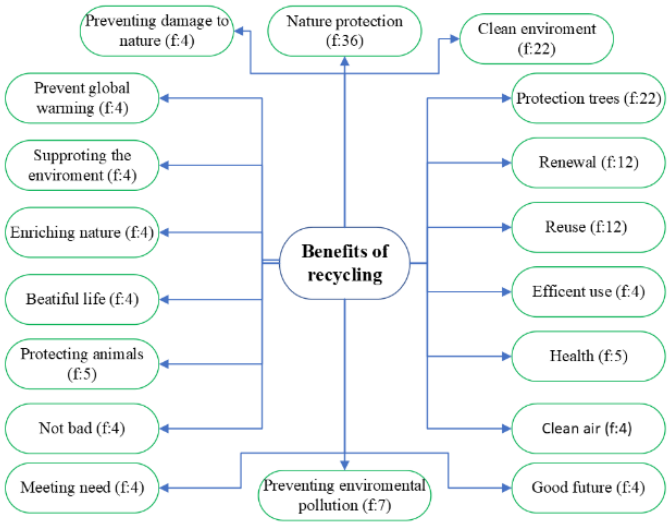

Figure 6. Response word distributions of primary school students regarding the “benefits of recycling” category

Figure 6. Response word distributions of primary school students regarding the “benefits of recycling” category In Figure 6, it is determined that the answer words given by primary school students to the "Benefits of recycling" category are 21 and their frequency is 159. In this category, nature protection (36) is in the first place among the associations made by primary school students. After that Clean environment (22) and Protecting trees (22), Renewal (12) and Reuse (12), Preventing environmental pollution (7), Health (5) and Protecting animals (5), Beautiful life (4), Enriching nature (4), Doing new things (4), Prevent global warming (4), Clean air (4), Good future (4), Meeting needs (4), Thrift (4), Not bad (4), Supporting the environment (4), Efficient use (4), Not wasting (4), Preventing damage to nature (4) comes. All the answers in the "Benefits of recycling" category are thought to be related to the concept of "Recycling.". Sentences were made for the issue;

- Let's not throw our garbage into nature. (M,9.S)
- Love nature and convert waste. (M, 19. S)
- Recycling contributes to our world. (F,40.S)
- Recycle, does not pollute the environment. (M, 47. S)

In the category of "benefits of recycling" related to the key concept, when the sentences formed by primary school students are evaluated in terms of recycling, statements about environmental protection come to the fore. Scientific, Non-Scientific and Misconception Statements in the Sentences of Primary School Students Regarding the Key Concept of "Recycling" The sentences formed by primary school students on the key concept of "Recycling" were examined and categorized. The analysed sentences were categorized as scientific, non-scientific and misconceptions developed (Ercan et al., 2010).

Table 1. Scientific, non-scientific and misconception expression frequencies in the sentences of primary school students regarding the key concept of "recycling"

Key Concept	Number of Sentences Containing Scientific Information	Number of Sentences Containing Non-scientific and Superficial Information	Number of Sentences Containing Misconceptions	Empty
Recycling	44	50	33	23

In Table 1, it was seen that primary school students could not form a meaningful sentence containing key concepts, with a high number of sentences containing non-scientific and superficial information, misconceptions and sentences left blank. Failure to

construct a meaningful sentence containing the key concept and leaving it blank is a finding that shows that students cannot learn this concept meaningfully and at a conceptual level (Ercan et al., 2010).

Table 2. Examples of related sentences made by primary school students regarding the concept of recycling

Key Concept	Sentences Containing Scientific Information	Sentences Containing Unscientific or Superficial Information	Sentences Containing Misconceptions
Recycling	• Let's throw garbage in the trash, not the environment • Recycling is important. Glass should be recycled. • Paper, glass, metal are recycled. • Recycling helps reduce waste. • We can contribute to the economy by recycling all products instead of throwing them away. • Let's not throw plastic, glass, paper in normal garbage. We have different kinds of trash bin, let's use them	• Recycling is an exquisite thing. • I think we should recycle old items and items that don't serve us well. And recycling happens. • Today we recycled. • Recycling reminds me of nature. • Recycling is everyone's right. • Recycling makes people happy.	•Everything is recyclable. •1 ton of paper recycled 54 trees. •Recycling means returning used items to me. •Evaluate unused materials for recycling. •Recycling for me is going somewhere and restoring. •think recycling is renewing old ones.

In Table 2, it is seen that in some sample sentences formed by the students regarding the concept of "recycling", they wrote non-scientific sentences containing superficial information or misconceptions. In this case, it can be said that students have misconceptions in their cognitive structures.

DISCUSSION AND CONCLUSION

In the study conducted to determine the cognitive structures of the primary school fourth-grade students regarding the concept of recycling through WAT, the answers obtained were analysed in depth with the analysis method and collected in 5 categories. Cognitive structure associations are sufficient for the categories and the answer words collected from the students in the category fields and the concept of "recycling.".

713 answers were produced under all categories for the recycling concept of students, and 59 different concepts were produced in five categories consisting of words. While the most concepts were produced in the "benefits of recycling" category (21) the answer words were protecting nature (36), clean environment and protecting trees (22), although the concepts produced in the "classification" category (7) were less, the most given answer words were Paper (95), Glass (89), Plastic (77), Battery (41), Waste (31), Bottle (12) and Bag (10). According to the results of the study, the two different “Assessment” (13) and “Bringing in New Product to the Economy” (13) categories are the two most associated with the concept of recycling. Among these categories, the most repeated of the answer words associated with the "assessment" category were metal (96), recycling (16) book and pen (8), while the most repeated answer words associated with the category of "Bringing in New Product to the Economy" were goods (9), clothes (8) and garbage truck (6).

In the study, the category of "Separate Collection from the Source"(5) is the least associated with the recycling concept of the students. In this category, the most repetitive ones in the answers of the students; the concepts of recycling bin (14), factory (8), tin (7), trash (6), metal boxs (4) are coming. They gave importance to the use of recycling bins because of the separate collection of the students at the source in recycling. Katırcıoğlu (2019) and Yılmaz et al., (2020), found in their research that the high level of general environmental knowledge of individuals depends on their knowledge about recycling.

According to the results obtained in the study, the number of words that primary school students associated with concepts related to recycling was high. The criterion used to determine whether the concept is understood is the number and quality of words associated with that concept. The words associated with the concept depend on a good understanding of the concept (Özatlı et al., 2015). Simultaneously, it can be argued that the meaning of the concept increases as the word is associated, and a concept that is not associated with any word is meaningless (Akyurt, 2020; Doğan et al., 2018; Ercan et al., 2010; Kaya & Taşdere, 2016, Robles, 2015). The more words students can associate with a concept, the more meaningfully they can learn the concept.

In the study, it is seen that the concept of "recycling" forms meaningful sentences at the word level and sentences contain some misconceptions at the sentence level. Concept errors such as everything can be recycled, unused items can be recycled, and the old ones are renewed, were identified in the sentences they formed regarding the concept of "recycling.". Işıklı (2011) determined that the related concepts were not correctly expressed in the related sentences formed for the key concepts in the study in which they carried out the cognitive structures of the pre-service teachers for Atatürk's principles by applying the WAT. In the studies of Ercan, et al. (2010) "observing cognitive structure and conceptual change through the word association test,", some misconceptions were identified by looking at the quality of the associated concepts and words. Kaya (2015) and Onat & Keskin (2019) found meaningful associations at the word level in the word association test applied by geography students regarding the key concept of air but encountered misconceptions in sentence examples. As seen in the studies, it was understood that it was effective to make sentences for the related concept and to determine the misconceptions.

From this perspevtive, students organize their cognitive structures for the concept of recycling meaningfully and learn the concepts. In line with the results obtained in the study; The subject of recycling should be expanded or presented as a separate

course in environmental issues in the Life Science, Science and Social Studies course in primary school programs. Collaborating with surrounding institutions and organizations to inform students and increase their awareness; it should be ensured that measures are taken for the storage, separation, reuse of wastes. This study should start from schools and spread to the environment with the multiplier effect.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully

Researchers' contribution rate

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

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