International Journal of Educational Researchers
14(1): 44-52
ISSN: 1308-9501, Copyright © 2023
DOI: 10.29329/ijer.2023.522.4

Educational Research Association Turkiye • 2008
www.eab.org.tr
IJERs

ORIGINAL ARTICLE

Determining Preservice Science Teachers' Cognitive Structures Related to the Environment by Using Word Association Test

Ilgım Özergun[1*] & Betül Timur[2]

[1] Research Assistant, Mathematics and Science Education Department, Çanakkale Onsekiz Mart University, Çanakkale, Turkiye.

[2] Professor, Mathematics and Science Education Department, Çanakkale Onsekiz Mart University, Çanakkale, Turkiye.

Ethical Statement
Ethics committee approval was granted from Çanakkale Onsekiz Mart University (No: 05/13)

Funding Information
No funding was received for the study.

Conflict of Interest
Preliminary findings of this study was presented at 3rd International Conference on Cyprus Issue: Environmental Challenges and Energy Security; (ECES 2022).

ABSTRACT

The aim of this study is to reveal preservice science teachers' cognitive structures related to environment by using word association test. With this aim, some concepts related to environment were selected purposively. In this descriptive case study, the data was collected from 2022-2023 educational term 3rd (*N*=58) and 4th (*N*=46) grade preservice science teachers. Five selected words which were "global warming", "climate change", "sustainability", "environmental problems", and "environmental awareness" were given to preservice science teachers, and they wrote related words in five minutes. For data analysis, frequency table was prepared by analyzing the words of the preservice science teachers for each concept. Then, breakpoint technique was used to develop concept network. According to the preliminary findings of this study, 4th grade preservice science teachers have more conceptions related to the environment compared to 3rd grade preservice science teachers. In addition to that, preservice science teachers' cognitive structures of global warming and climate change is higher compared to other concepts. Lastly, most of the students' cognitive structures of "environmental problems", environmental awareness" and "sustainability" is low.

Keywords: environment, preservice science teachers, word association test

Received: 19/02/2023 **Accepted**: 27/02/2023

***Corresponding Author**
Research Assistant, Mathematics and Science Education Department, Çanakkale Onsekiz Mart University, Çanakkale, Turkiye.
Email: ilgim.ozergun@comu.edu.tr

INTRODUCTION

The concept of environment has always been important since humans cannot be taught without the environment (Keleş, 1997). However, in recent years, human-related environmental problems have increased and inflicted damage to the environment. These problems include but are not limited to pollution (air, solid, light, etc.), population growth, industrialization, urbanization, and depletion of sources. In the long term, these problems have increased and caused global problems such as global warming and climate change (Berkes & Kışlaoğlu, 1993). For this reason, the need for environmental education has increased. Accordingly, increasing awareness related to the environment from younger ages help find solutions and take action against these problems (Hines et al., 1987). In Turkiye, environmental topics in education are included by science teaching programs.

Even though environmental education starts from younger ages, literature review demonstrated that younger individuals do not have high conceptualizations related to the environment (Kola-Olunyasa, 2017; Özcan & Demirel, 2019). To increase the awareness of individuals and society, environmental education should start from younger ages. Therefore, teachers' and preservice teachers' conceptualizations are extremely significant (Sato & James, 1999). In the literature, there is some research on pre-service and in-service science teachers' perceptions and attitudes related to the environment (Arık & Yılmaz, 2020; Powers, 2004; Özsoy, 2012). In Arık and Yılmaz's (2020) systematic review study, the effect of environmental education on attitudes related to the environment was investigated. Similarly in Powers' (2004) study, after environmental education methods course, preservice teachers' attitudes and academic achievements related to environment has increased. And for example, Şahin et al.'s (2018) study revealed that participants' knowledge related to environmental problems such as pollution was low. Similarly, Şen et al. (2009) conducted an empirical study to reveal preservice teachers' opinions related to environmental problems, and results showed that their cognitive structures were not high enough. As seen in the literature, research on environment education in preservice teacher education was limited to achievement and attitudes, and there were limited research studies which focused on preservice science teachers' cognitive structures related to the environment.

In the literature, there are several methods to reveal people's conceptualizations in a given subject. One of the most effective and reliable ways is using word association test, which concentrate on people's long term cognitive structures (Bahar et al., 1999). Word association test is used either to determine people's conceptualizations before and after the instruction for the same group or comparing two different groups' conceptualizations while one has the instruction, but the other does not. In this study 3rd grade and 4th grade pre-service science teachers' conceptualizations were compared. While 3rd grade preservice science teachers haven't taken environmental education course yet, 4th grade preservice science teachers have taken the course. For this reason, the aim of this study is to reveal preservice science teachers' conceptualizations related to environment and to compare 3rd and 4th grade pre-service science teachers' conceptualizations by using word association test.

With this aim, the following research questions were posed for this present study:

1. What is preservice science teachers' conceptualizations related to the environmental words?
2. Is there a difference between 3rd and 4th preservice science teachers' conceptualizations related to the environmental words?

METHOD

Research Design

In this research, descriptive case study is selected in order to determine in-depth and multidimensional investigation of a single social case by following qualitative research methodology (Creswell & Poth, 2016). According to Flyvbjerg (2011) case study is a type of qualitative research which concentrates on individuals' already existed conceptualizations related to the given situation. From case study designs, holistic case study is one of the designs where there is only one unit of analysis to investigate holistically. For this study, the aim of using holistic single case was to determine preservice science teachers' (one unit of analysis) cognitive structures related to environmental concepts (holistic analysis) by using word association test.

Participants of this study were 104 preservice science teachers (58 of them were 3rd grade and 46 of them were 4th grade) who were studying in a public university at the western part of Turkiye during 2022-2023 academic year. All the preservice science teachers participated voluntarily in this study. Demographic information of participants is shown in Table 1.

Table 1. Demographic Information of Participants

	3rd Grade	4th Grade	Total	
Girls	43	34	77	Girls
Boys	15	12	27	Boys
Total	58	46	104	Total

Data Collection

In this research, word association test was used as a data collection tool. Word association test is a kind of alternative assessment and evaluation tool, which gives opportunity to investigate cognitive structures of given concepts (Bahar et al., 1999). The test included five words related to the environment and there were ten fill-in-the-blank areas to write reminded concepts without any restriction. Words in the test were "global warming", "climate change", "sustainability", "environmental problems" and "environmental awareness". These concepts were chosen because these were the most used concepts related to the literature. The test was conducted with total 104 preservice science teachers in two steps. In the first step, they had one minute for each word to write with maximum of ten concepts. In the second step they wrote a sentence about the given word in thirty seconds. These time periods were determined according to Bahar and Özatlı's (2003) suggestion.

Data Analysis

For data analysis, each preservice science teachers' written concepts were examined deeply. First, a frequency table was created in order to demonstrate each concepts' frequency among different preservice science teachers. Table 2 demonstrates total number of different responses in concepts for each word. The total number of responses was one of the first analysis for the data's evaluation. Then, the frequency table concept network was used, which was created by using cut-off point by utilising Bahar et al.'s (1999) technique. The maximum number of answers for any concept is called cut-off point, a certain number of times below the word. The words above are written in the first cut-off point, then the

breakpoint is decreased in regular intervals until all words demonstrated in the concept network.

Table 2. Total Number of Different Responses in Concepts

Concepts	3rd Grade	4th Grade	Total
Global Warming	447	478	925
Climate Change	415	699	1114
Sustainability	302	456	758
Environmental Problems	436	456	892
Environmental Awareness	354	573	927

As seen in Table 2, although there are less 4th grade preservice science teachers participating in this research, their total number of words are higher than 3rd grade preservice science teachers. Also, preservice science teachers wrote the least number of words to the word sustainability, whereas they wrote the highest number of concepts to the word climate change.

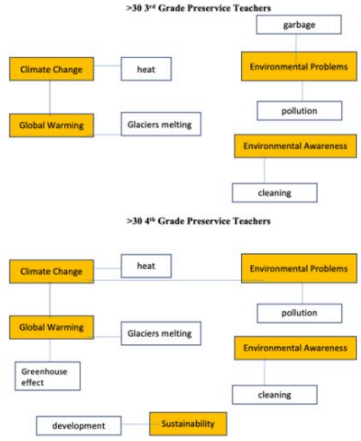
Validity and Reliability

Providing validity and reliability is essential in qualitative research. In this qualitative research, validity was provided via consistency of results. According to Creswell and Poth (2016) consistency in qualitative research can be conducted by accumulating themes to express the data as a whole. Since all words and written concepts were related to environment theme in this study, consistency was provided. For reliability, inter-rater reliability technique developed by Miles and Huberman (1994) was used. First, the main coder coded all the data and then randomly selected 21 preservice teachers' data (more than 20%) was coded by the second coder. Accordingly, codes were compared and contrasted, and then inter-rater reliability was found to be 90.75% which was higher than 80%.

RESULTS

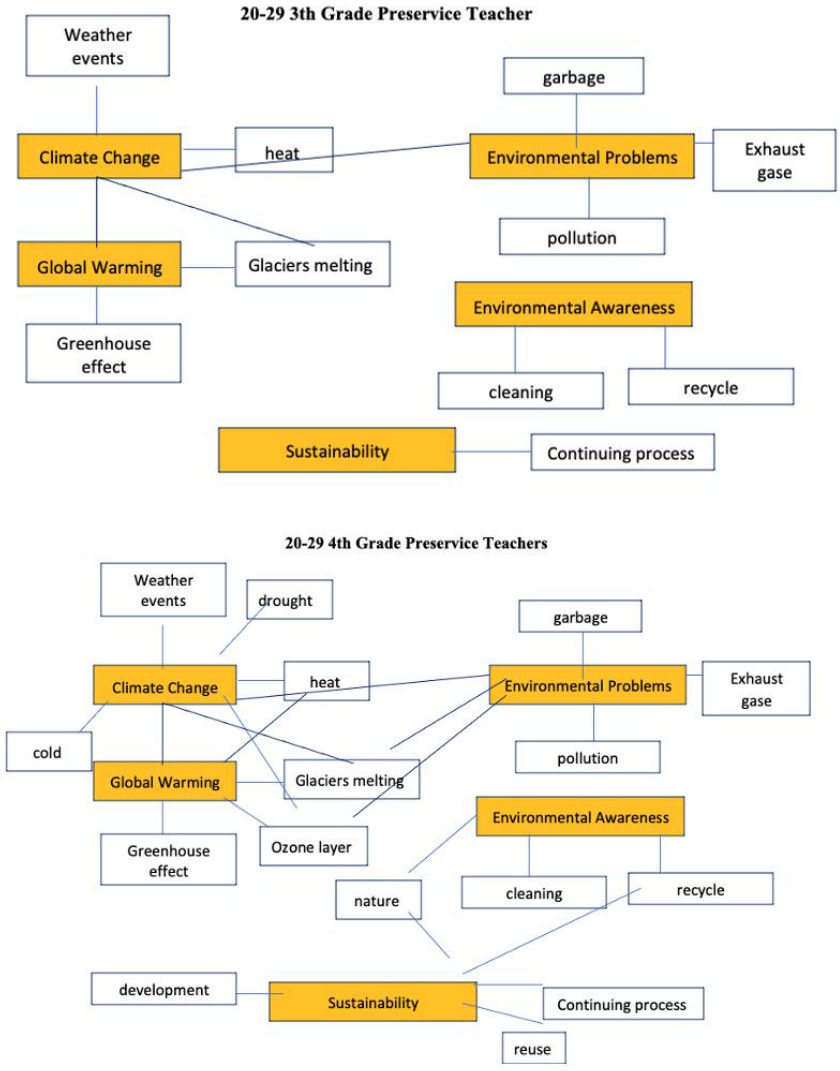
As a result of the analysis of the word association test; the concepts given to the words and the findings regarding the concept network developed through the keywords are presented below.

Figure 1. Concept Network for >30



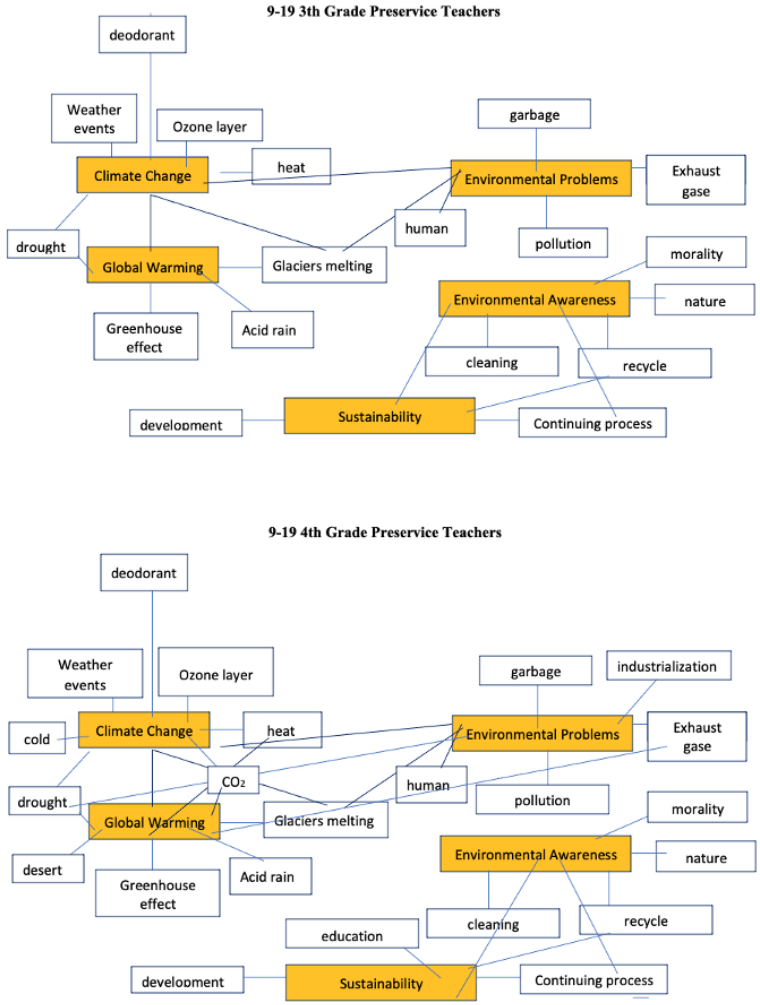
Comparison of 3rd and 4th grade preservice science teachers' conceptualizations of more than 30 words revealed that there are more connection lines in 4th grade students. While 3rd grade preservice science teachers had a total of 5 concepts for four words, 4th grade preservice science teachers had 6 words for five words. In addition to that, there is no sustainability concept in 3rd grade concept network.

Figure 2. Concept Network for 20-29



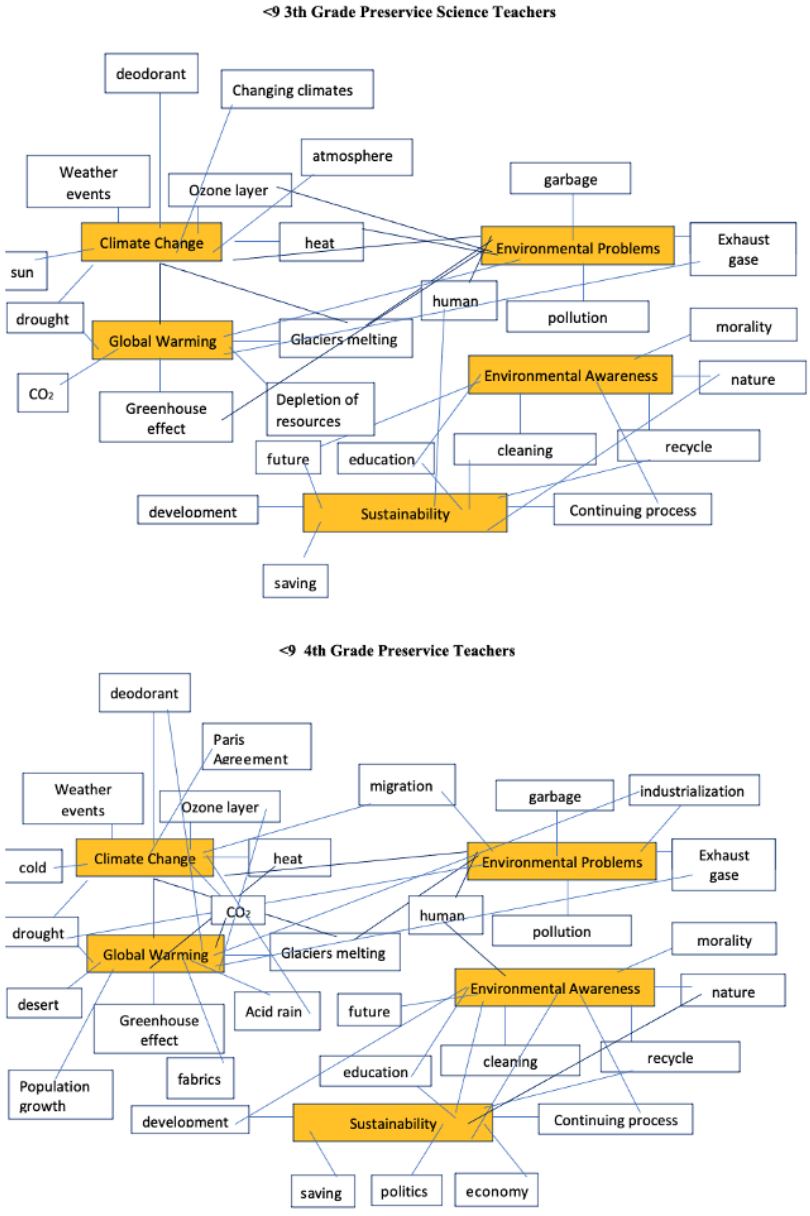
Comparison of 3rd grade and 4th grade preservice science teachers' conceptualizations between 20-29 concepts revealed that 4th grade preservice science teachers had more connection lines among concepts. 4th grade preservice science teachers connected these words and concepts more than 3rd grade preservice science teachers. More specifically, while 3rd grade preservice science teachers had 10 concepts for five words, 4th grade preservice science teachers had 16 concepts for five words.

Figure 3. Concept Network for 10-19



Comparison of 3rd grade and 4th grade preservice science teachers' conceptualizations between 9-19 concepts revealed that 4th grade preservice science teachers had more connection lines among concepts. 4th grade preservice science teachers connected these words and concepts more than 3rd grade preservice science teachers. More specifically, while 3rd grade preservice science teachers had 17 concepts for five words, 4th grade preservice science teachers had 23 concepts for five words.

Figure 4. Concept Network for <9



Comparison of 3rd grade and 4th grade preservice science teachers' conceptualizations less than 9 concepts revealed that 4th grade preservice science teachers had more connection lines among concepts. 4th grade preservice science teachers connected these words and concepts more than 3rd grade preservice science teachers. More specifically, while 3rd grade preservice science teachers had 25 concepts for five words, 4th grade preservice science teachers had 32 concepts for five words.

On the one hand, in all the concept network it can be deduced that 4th grade preservice science teachers stated more concepts compared to 3rd grade preservice teachers for each word. On the other hand, while preservice science teachers had more conceptualizations for the words climate change, global warming for both grades; there is less conceptualizations in the concept of sustainability.

DISCUSSION

This present study aimed to determine preservice science teachers' conceptualizations related to the environmental words of global warming, climate change, environmental problems, environmental awareness, and sustainability by using word association test. A total of 104 preservice science teachers participated and stated reminded concepts in order to create concept network related to the environmental topics. Comparison of 3rd and 4th grade preservice science teachers' conceptualizations, it was found that 4th grade preservice science teachers did not only have more concepts but also connected these words into each other. However, for both group of pre-service science teachers, it can be reported that there was not a whole network among concepts and words. Therefore, it can be said that neither 3rd grade nor 4th grade pre-service science teachers have high cognitive structures or conceptualizations about environmental concepts. This result is also supported by previous research studies which claimed that pre-service and in-service teachers' conceptualizations about the environment is low (Arık & Yılmaz, 2020) Bahar, 2000; Özdemir, 2007).

Among selected environmental words, preservice science teachers have more conceptualizations related to global warming and climate change. These concepts are related to some scientific concepts such as ozone layer or greenhouse effect, acid rain or radiation pollution and to non-scientific ones such as heat, cold, and sun. Similar to this finding, Berkes and Kışlaoğlu (1993) reported that all people have both scientific and daily perceptions about the environment. Accordingly, 4th grade pre-service science teachers have more scientific conceptions than their 3rd grade peers. Other two words in the word association test were environmental awareness and environmental problems. Preservice science teachers' conceptualizations of these two concepts are lower. This finding is also supported by Şen and colleagues' (2009) findings that teachers have low conceptualizations among environmental problems such as pollution. The last but not least finding was that sustainability concept is newer than other words (Michelsen & Fischer, 2017). Not surprisingly, pre-service science teachers' conceptualizations of sustainability were low. Also, pre-service teachers' conceptualizations were less connected to sustainability than the other environmental terms. Özdemir (2010) stated that sustainability is significant for both education and environment. For this reason, there should be more emphasis on sustainability concepts in environmental education.

CONCLUSION AND RECOMMENDATIONS

In short, the aim of this study was to reveal preservice science teachers' conceptualizations related to environment by using word association test. Word association test is easy to apply and an effective strategy for determining concepts and their relationships. Preservice science teachers' cognitive structures related to the environmental concepts was investigated. By considering the findings of this study, two recommendations can be made. Firstly, environment education is an important idea for future science teachers. Therefore, preservice teacher education programs should focus more on environment education in order to increase students' conceptualizations related to the environment. Secondly, preservice science teachers have less conceptualizations related to some concepts including environmental awareness, environmental pollution and sustainability. Environment education lessons can focus more on these topics.

REFERENCES

Arık, S., & Yılmaz, M. (2020). Çevre akademik başarısı ve çevreye yönelik tutumla ilgili deneysel çalışmaların sistematik alanyazın incelemesi. *Cumhuriyet Uluslararası Eğitim Dergisi, 9*(2), 494-535.

Bahar, M. (2000, November 1-2). *Üniversite öğrencilerinin çevre eğitimi konularındaki ön bilgi düzeyi, kavram yanılgıları* [Paper presentation]. V. Uluslararası Ekoloji ve Çevre Sorunları Sempozyumu, TÜBİTAK, Ankara.

Bahar, M., Johnstone, A. H., & Sutcliffe, R. G. (1999). Investigation of students' cognitive structure in elementary genetics through word association tests. *Journal of biological education*, *33*(3), 134-141.

Bahar, M., & Özatlı, N. S. (2003). Kelime iletişim test yöntemi ile lise 1. sınıf öğrencilerinin canlıların temel bileşenleri konusundaki bilişsel yapılarının araştırılması. *Balıkesir Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *5*(2), 75-85.

Berkes, F., & Kışlalıolu, M. (1993). *Ekoloji ve çevre bilimleri.* Çevre Sorunları Vakfı Yayınları.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Flyvbjerg, B. (2011). Case study. *The Sage handbook of qualitative research*, *4*, 301-316.

Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *The Journal of environmental education*, *18*(2), 1-8.

Keleş, R. (1997). *İnsan, çevre, toplum*. Imge Kitapevi.

Kola-Olusanya, A. (2017). Young adults' contextualization of environmental and sustainability issues: a critical issue for environmental education intervention. *Journal of Education in Black Sea Region, 3*(1), 2-17.

Michelsen, G., & Fischer, D. (2017). Sustainability and education 1. In *Sustainable development policy* (pp. 135-158). Routledge.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.

Powers, A. L. (2004). Teacher preparation for environmental education: Faculty perspectives on the infusion of environmental education into preservice methods courses. *Journal of Environmental Education*, *35*, 3-18.

Sato, M. & James, P. (1999). "Nature" and "Environment" as perceived by university students and their supervisors. *International Journal of Environmental Education and Information, 18*(2), 165-172.

Özdemir, O. (2007). Yeni bir çevre eğitimi perspektifi: "Sürdürülebilir gelişme amaçlı eğitim". *Education and Science*, *32*(45), 23-39.

Özcan, H., & Demirel, R. (2019). Ortaokul öğrencilerinin çevre sorunlarına yönelik bilişsel yapılarının çizimleri aracılığıyla incelenmesi. *Başkent University Journal of Education, 6*(1), 68-83.

Özsoy, S. (2012). A survey of Turkish pre-service science teachers' attitudes toward the environment. *Eurasian Journal of Educational Research*, *46*, 121-140.

Şahin, H.G., & Doğu, S. (2018). Okul öncesi öğretmen adaylarının çevre sorunlarına ilişkin tutum ve davranışlarının incelenmesi. *Elementary Education Online, 17*(3), 1402-1416.

Şen, Ş., Varoğlu, L., & Yılmaz, A. (2019). Examination of undergraduates' cognitive structures on reaction rates and chemical equilibrium. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, (45)*, 335-352.