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# EXAMINATION 8TH GRADE STUDENTS' COGNITIVE STRUCTURES ABOUT PHYSICAL AND CHEMICAL CHANGES THROUGH WORD ASSOCIATION TEST

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**Abstract**: In this study it is aimed to investigate middle school students' cognitive structures of physical and chemical changes through word association test (WAT). The data were collected from 126 eight grade students. The WAT was used as data a data collection instrument developed by the researcher in her previous study. At the beginning of the study, the physical and chemical change topic placed in the middle school science curriculum was examined and also the opinions of the two science teachers were asked to establish the content validity of the stimulus words of WAT. The same WAT comprised of eight total stimulus words was decided to use without modification. The response frequency mapping method was used to examine students' cognitive structure which was developed by the researcher. At the end of the study, it was found that all stimulus words appeared and were added to the map at the frequency range $16 \leq f \leq 20$ as five separate islands. Besides, it was concluded that the eight grade students, like ninth and tenth grade students, could not associate with the concept of energy with other concepts of the subject.

***Keywords*:** Eight school students, cognitive structures, physical and chemical changes, WAT

## Introduction

There is an interaction between the students' new knowledge thought in class and their existing knowledge. For this reason what the students have learned in their previous class and how this knowledge in their cognitive structure have constructed are very important to subsequent learning. The cognitive structure comprises learners' existing experiences and knowledge that will lead to their reconstruction and information processing of the incoming stimuli (Nakiboğlu, 2008). The researchers use different terms to describe cognitive structure, such as, structural knowledge (Jonassen et al., 1993 cited in Tsai and Huang, 2002) or knowledge structure (Champagne, Klopfer, Desena and Squires, 1981). The knowledge students acquire in science classrooms is stored in long-term memory in a hierarchically organized form, and can be represented as a cognitive structure in their memory (Tsai, 2001; Kalyuga, 2006). Proping students' cognitive structure is important to discover what students learn and how their knowledge may change during the learning process (Tsai and Huang, 2002). Therefore, knowing students' prior knowledge can guide teachers to design appropriate teaching strategies in their classless.

In this study, it was focused on students' cognitive structures of the physical and chemical changes. The subject of the physical and chemical changes is one of the basic and essential issues of both middle school science curriculum and the high school chemistry curriculum. This subject is also related to daily life. On the other hand, it was found that students had learning difficulties and misconceptions concerning the identification of the physical and chemical changes. So many studies of specific learning problems and students' misconceptions concerning the physical and chemical changes have been reported in the literature. Since there was not known about students' cognitive structure of the physical and chemical changes, the high school students' cognitive structures of the physical and chemical changes through word association test (WAT) were investigated in the previous study by Nakiboğlu (2016). Nakiboğlu (2016) compared the results of ninth and tenth grades students' cognitive structures concerning the physical and chemical changes. The comparison of the students' cognitive structures showed that all stimulus words appeared and were added to the map at the frequency range $16 \leq f \leq 20$ as three separate islands in the ninth grade students' cognitive structures, not all stimulus words appeared at the



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same frequency range of the tenth grades'. In the case of 9th grade that before teaching the physical and chemical changes topic there were more disconnected ideas in the students' minds. She concluded that there were differences between these two grades and the instruction has an influence on students' cognitive structure about the physical and chemical changes (Nakiboğlu, 2016). From this departure point, it was aimed to find out eight grade students' cognitive structures of the physical and chemical changes firstly, and to compare the results with results of high school students'.

## Methods

Data were collected 126 eight grade students from two middle schools. All students were taught the unit "The particulate nature of matter/Matter and change (in 6th, 7th and 8th grades) before data were collected. The WAT was used as a data collection instrument developed by the researcher in her previous study. At the beginning of the study, the physical and chemical change topic placed in the middle school science curriculum was examined and also the opinions of the two science teachers were asked to establish the content validity of the stimulus words of WAT (Gay and Airasion, 2000, p. 163). The same WAT comprised of eight total stimulus words was decided to use without modification. The students were provided with a booklet, each page containing each page of which contained one of the eight stimulus words.

### Analysis of Data

There are several ways of scoring the data provided by a WAT. The response frequencies method developed by Nakiboğlu (2008) was used to mapping of students' cognitive structures in this study. This mapping method is an integrated method which is based on Gussarsky and Gorodetsky' (1988) relatedness coefficient method and Bahar et al. (1999) response frequencies' mapping method. The number of responses to each stimulus word was tabulated for 8th grade firstly and then maps were drawn taking into account these tables. While drawing the tables, when a stimulus word was obtained from students as a response word, it was enclosed in a frame to the map. When a response word was obtained as a new word, it was added to the map without frames.

## Results and Findings

The map of students' cognitive structures was drawn from the frequency tables. In Figure 1, a part of map concerning cognitive structure of students at frequency 20 was presented.

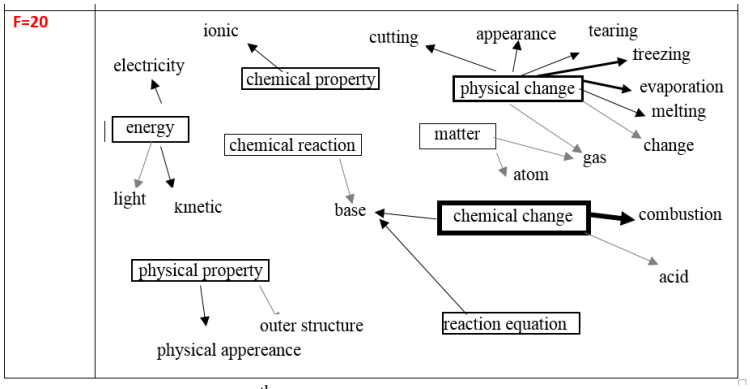


Figure1. The 8th grade students' cognitive structure

It was seen that from Figure 1, the first and strongest relationship is between chemical change and combustion. This result is very similar to the results obtained from the 9th and 10th grade students. It is also seen that there are no connections between concepts and that the concepts are clustered into separate islands. On the other hand, the relations placed in the cognitive structures of 9th and 10th grade students were better than the map placed in Figure 1.

## Conclusion

In this study, the word association test (WAT) was applied successfully for identifying conceptual organization of the cognitive structure of middle school. It was concluded that the chemical change, chemical properties and reaction equation concepts are correlated with one another in the eight grade students' cognitive structures. It is interesting finding is that the relationships between concepts are constructed based on the "base" concept. On the other hand, in the secondary students'cognitive structures the concepts were mostly constructed based on the concept of "atom". This may be related to the fact that the concept of the atom is too abstract for 8th grade students. Another interesting result is that the concept of energy has emerged as a separate island like in the high school students' cognitive structures.

## Recommendations

The first general recommendation of this study is that the teachers should gain information about their students' prior knowledge before the instruction that so they can find to chance to reconsider their teaching strategies. To gain students' cognitive structures can use so many techniques such as concept map and flow map. The WAT technique can also be suggested using before the instruction to gain the students' prior concepts in students' conceptual structure and after the instruction to see how changes the students' cognitive structures. Finally it can be recommended that the abstract concepts like the atom concept should be explained more carefully for the middle school students.

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