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Drawing a Turkish Concept Map: Numbering Method

Yılmaz SAĞLAM*

ABSTRACT. The objective of this study was to investigate the perception of Turkish middle school students about three methods of drawing concept maps. The methods were: (1) writing relationships between concepts on lines as a complete sentence, (2) writing relationships as a paragraph below the concept map, and (3) the numbering method- connecting concepts using numbers and explaining relationships next to each number below the concept map. A total of 53 students, whose ages ranged from 14 to 15 years old, participated in the study. The results indicated that the numbering method allowed the students to construct a clear map and with this method the information was conveyed in a more organized manner. However, the study also indicated that with numbering method the information was presented indirectly.

Key Words: Concept map, perception, Turkish language, numbering method

SUMMARY

Purpose and Significance: This study examined the students' perception of three methods of drawing concept maps. The methods were: (1) writing relationships between concepts on lines as a complete sentence, (2) writing relationships as a paragraph below the concept map, and (3) the numbering method- connecting concepts using numbers and explaining relationships next to each number below the concept map. In particular, the study aimed to find out whether the new method called 'Numbering Method' would be welcomed by the middle school students and how this method is perceived by them. If students find this method appropriate to construct concept maps, Numbering Method (1) allows students to construct a clear map and (2) permit the researcher or teacher to figure out a great deal about students' understanding of science concepts.

Method: A total of 53 students, whose ages ranged from 14 to 15 years old, participated in the study. First, three concept maps were first given to the students. The concept maps contained the same concepts with the same relationships. However, the maps were drawn with different methods. The students were asked to examine each map and draw a concept map using the method they liked most. At the end, the students were asked to explain the reasons for the selection of the specific method used for their maps.

Results: The result of the study indicated that the students evenly selected each method to draw their concept maps. Each method was selected for different reasons. For the students, the first method was chosen because the relationships and concepts were at the same context, which made the map easy to follow and easy to understand. The second method was selected because it was easy to construct the map and writing a paragraph about the relationships were more informative compared to other methods. Finally, the numbering method was selected because it allowed the students to construct a clear map and the information was conveyed in a more organized manner, thereby making the topic easy to remember. However, the students also stated that with this method the information was presented indirectly.

Discussion and Conclusions: The results indicated that although the numbering method had some limitations, it was welcomed by the students and can be a good drawing method for educators and researchers in probing students' understanding of science concepts.

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Türkçe Kavram Haritası Çiziminde Numaralandırma Yöntemi

Yılmaz SAĞLAM*

ÖZ. Bu araştırmanın amacı ilköğretim 2. kademe Türk öğrencilerinin üç farklı kavram haritası çizme metodu ile ilgili algılarını incelemektir. Bu metotlar: (1) kavramlar arasındaki ilişkilerin tam bir cümle ile oklar üzerinde gösterilmesi, (2) ilişkilerin paragraf halinde haritanın alt kısmında gösterilmesi ve (3) numaralandırma metodu: kavramlar arasındaki ilişkilerin numaralandırılması ve haritanın alt kısmında her bir numaranın karşısına kavramlar arasında ne türden bir ilişkinin olduğunun açıklanması. Araştırmaya 14 ve 15 yaş grubu 53 öğrenci katıldı. Araştırma sonuçlarına göre numaralandırma metodu öğrencilerin sahip oldukları bilgiyi daha açık ve anlaşılır bir şekilde sunmalarına olanak sağlamasına rağmen, öğrenciler bu yöntemde bilginin dolaylı yolla sunulduğuna inanmaktadır.

Anahtar Sözcükler: Kavram haritası, algı, Türk dili, numaralandırma yöntemi

ÖZET

Amaç ve Önemi: Araştırmanın amacı ilköğretim öğrencilerinin, üç farklı kavram haritası çizme metodu ile ilgili algılarını incelemektir. Bu metotlar: (1) kavramlar arasındaki ilişkilerin tam bir cümle ile oklar üzerinde gösterilmesi, (2) ilişkilerin paragraf halinde haritanın alt kısmında gösterilmesi ve (3) numaralandırma metodu: kavramlar arasındaki ilişkilerin numaralandırılması ve haritanın alt kısmında her bir numaranın karşısına kavramlar arasında ne türden bir ilişkinin olduğunun açıklanması. Spesifik olarak, bu araştırma Numaralandırma yönteminin öğrenciler tarafından nasıl karşılandığı ve nasıl algılandığını incelemiştir. Bu yöntemin birkaç faydası olabilir. Birincisi, bu yöntemde öğrenci kavramlar arasındaki ilişkiyi numaralar ile gösterdiğinden dolayı, bu yöntem öğrencinin açık ve anlaşılır haritalar çizmesine olanak sağlamaktadır. İkinci olarak, bu haritalarda kavramlar arasındaki ilişkiler haritanın alt kısmında açıkça ifade edildiğinden, bu yöntem haritayı inceleyen öğretmen ya da araştırmacının öğrencinin fen bilimleri ile ilgili kavramsal bilgisi hakkında kapsamlı bilgiye sahip olmasını sağlamaktadır.

Yöntem: Araştırmaya 14 ve 15 yaş grubu toplam 53 öğrenci katılmıştır. Öğrencilere incelemeleri için 3 adet kavram haritası verilmiştir. Bu haritalar içerdikleri kavramların türü ve aralarındaki ilişkiler açısından birbirlerinin aynısı iken, çizilme yöntemleri bakımından birbirlerinden farklıdırlar. Daha sonra, öğrencilerden bu haritalardan en iyi yöntemle çizilmiş olan haritayı seçmeleri ve bu seçtikleri haritada kullanılan yönteme uygun olarak bir harita çizmeleri istenmiştir. Öğrencilerin haritayı çizerken kullanmaları gereken kavramlar ise daha öncesinden onlara verilmiştir. Haritalar çizildikten sonra, öğrencilere kullandıkları metodu neden seçtikleri ile ilgili açıklamalarda bulunmaları istenmiştir.

Bulgular: Araştırma sonuçlarına göre her üç yöntem de yaklaşık eşit sayıda öğrenci tarafından tercih edilmiş, fakat tercih sebepleri birbirinden farklı olmuştur. Öğrenciler birinci yöntemde kavramlar ve kavramlar arasındaki ilişkiler harita üzerinde bir arada gösterildiğinden dolayı, bu yöntemle çizilmiş haritanın daha açık ve anlaşılır olduğunu ifade etmişler. Öğrenciler ikinci yöntemi çizimi kolay olduğu ve konu hakkında paragraf yazmanın daha bilgilendirici olduğuna inandıkları için seçtiklerini belirtmişler. Üçüncü yöntem ile ilgili olarak ise, bu yöntem öğrencilerin sahip oldukları bilgiyi daha açık ve anlaşılır bir şekilde sunmalarına olanak sağlamıştır. Fakat yine aynı öğrenciler, bu yöntemde bilginin dolaylı yolla sunulduğunu ifade etmişlerdir.

Tartışma ve Sonuç: Sonuç olarak numaralandırma yöntemi bazı sınırlılıkları olmasına rağmen, öğrenciler tarafından kullanılabilir ve araştırmacı ya da öğretmenlerce öğrencilerin sahip oldukları fen bilgisi kavramlarını değerlendirme açısından bir ölçme aracı olarak kullanılabilir.

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THEORETICAL PERSPECTIVE

The idea of concept mapping is derived from Ausubel's Assimilation Learning Theory (Lindesay & Irvine, 1995). This constructivist theory defined the learning process as the integration of new information into existing knowledge structures. To Ausubel, learning is only meaningful if one actively incorporates new information into the relevant knowledge structures that one already possesses. According to Ausubel (Novak, 1995 pp. 230-232; 1998 pp. 31, 51), meaningful learning takes place only if: (1) the learner has some relevant knowledge, (2) the material to be taught is introduced to students using clear language and real life examples that allow students to relate their previous knowledge to new experiences, and (3) the learner is active in learning the material. In this respect, concept maps can be very helpful for teachers to identify students' prior knowledge and to design instruction accordingly. Concept maps could also be good tools for encouraging students to relate their previous knowledge to new experiences and to be active in the learning process.

The Origin of Concept Maps

The Ausubel's learning theory inspired Novak and Gowin (1970s) and led to the construction of the first concept map. Novak (1998 p. 27) stated that during the early 1970s, a research program conducted by him faced the challenge of preparing records about what children know on a domain before and after instruction. Although trying every form of paper and pencil tests, Novak's group could not get adequate data about the patterns and development of students' knowledge. Interviews with students indicated the fact that students chose the right answers for the wrong reasons. Novak's group was also faced with numerous audiotapes. It was difficult to transcribe those tapes and try to draw a meaningful picture of students' understanding out of pages and pages of transcripts.

Fortunately, inspired by Ausubels' Assimilation Learning Theory, the group came up with the idea of turning those students' transcripts into the representation of their understanding. They used concepts and propositions to create the representation of each student's knowledge and called this web of concepts and propositions a 'concept map' (Novak, 1998). The concept map allowed them to condense a 20-30 pages long transcript to a one-page concept map. They found concept maps to be remarkable tools in representing student prior- and post-instruction knowledge. They also found concept maps to be valuable tools for teachers to negotiate meaning with students and organize their instruction. Moreover, they asserted that concept mapping helped students learn how to learn.

The Views on the Concept Map

It is believed that concept maps take the advantage of human visual perception system and benefits of visual knowledge representation (Kommers & Lanzing, 1997). A concept map provides a visual network, which involves a set of inter-relationships of events, objects, and ideas that display one's understanding of a topic (Nakhleh & Saglam, 2005). Each map includes figures, lines, arrows, and spatial configurations to show relationships between concepts (Guastello, Beasley, & Sinatra, 2000; Kommers & Lanzing, 1997; Novak, 1995, 2004; Taber, 1994).

A typical concept map is mainly composed of three components: concepts (nodes or terms), lines (usually a unidirectional arrow), and labels (a word or a symbol) (Francisco, Nakhleh, Nurrenbern, & Miller, 2002; Nakhleh & Saglam, 2005; Yin & Shavelson, 2004; Yin, Vanides, Ruiz-Primo, Ayala & Shavelson, 2004). A 'concept' can be defined as a perceived regularity or pattern in objects or phenomena. It is usually enclosed in circle or box of some sort, which is called a 'node'. Nodes are interconnected by a 'line'. Each line has an arrowhead on one end in order to indicate directionality of the relationship between nodes. Short phrases or labels

are written on the lines to indicate the nature of the relationship between connected nodes. The 'label' can be a word or a symbol. The two connected nodes make a 'proposition'. Figure 1 illustrates a typical statement on a concept map.

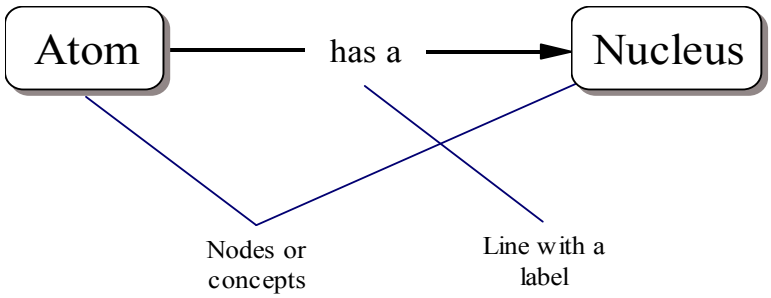


Figure 1. A typical statement on an English concept map includes two nodes, which are connected with a line and the line is labeled with a short phrase.

Every concept map (Nakhleh & Saglam, 2005) usually has a central concept and other concepts are included by spiraling out from the central concept. Every concept node on the map should have a traceable line back to the central idea. Concepts are organized in a hierarchical way, in which most general concepts are at the top and more specific concepts are arranged below. However, in some disciplines such as chemistry, concepts are not necessarily linked in a hierarchical way. Usually, the ideas are linked in a more horizontal way.

Currently, concept maps are utilized in several ways: (1) as an interviewing and communication tool (Freeman & Jessup, 2004), (2) as an instructional tool (Guastello, Beasley, & Sinatra, 2000; Kennedy & McNaught, 1997; Kommers & Lanzing, 1997; Nakhleh & Saglam, 2005; Novak, 1998 pp 27, 63) (3) as an assessment tool (Jonassen, Reeves, Hong, Harvey, & Peters, 1997; Markham, Mintzes & Jones, 1994; Nicoll, Francisco & Nakhleh, 2001; Rice, Ryan, and Samson, 1998; Ruiz-Primo & Shavelson, 1996; Rye & Rubba, 2002; Shavelson & Ruiz-Primo, 1998; Taber, 1994), and (4) as a learning tool (Guastello, Beasley, & Sinatra, 2000; Huai, 1997; Kommers & Lanzing, 1997; Nakhleh & Saglam, 2005; Francisco, Nakhleh, Nurrenbern & Miller, 2002; Nicoll, Francisco, & Nakhleh, 2001; Novak, 1998).

STATEMENT OF THE PROBLEM

How do Language and Culture Create a Difference in the Construction of Concept Maps?

In 2003, Bagci Kilic investigated the adaptation of concept maps into Turkish language. She stated that Turkish and English language has two basic differences: (1) word order and (2) the ways of attaching suffixes to words. She maintained that these differences create a problem of drawing Turkish concept maps in an English manner.

First of all, in English language, a typical statement is established by the order of subject-verb-object (SVO), whereas in Turkish the order of the words in a typical proposition is subject-object-verb (SOV) (Bagci Kilic, 2003). While drawing a concept map in English, one connects two concepts with a label similar to a statement like 'matter (concept 1) - is made of (label) - atoms (concept2)'. As seen, the statement also follows the order of subject-verb-object, therefore creating a meaningful sentence in English. This linguistic property enables an English speaker to review the concept map easily by first reading the concept (subject), and the label (verb) on the connecting line, and the succeeding concept (object). However, the same sentence in Turkish would be 'madde (matter) atomlardan (atoms) oluşur (is made of)', the order of which

is subject-object-verb, which is not appropriate for drawing concept map because as drawing a concept map, one needs to write a label (verb) on connecting line between two concepts (subject and object). If you place the verb after the subject on a Turkish map, the sentence will be 'madde (matter) oluşur (is made of) atomlardan (atoms)'. Even though this statement seems to be complete, it will not be meaningful to a Turkish speaker. Figure 2, 3, and 4 point out this issue.

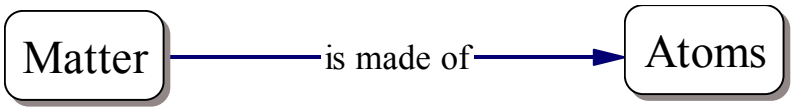


Figure 2. A typical proposition on an English concept map is drawn by connecting two concepts along with a label, which at the same time creates a meaningful statement in English language.

Figure 3. A meaningful statement in Turkish language is established by the order of subject-object-verb, which however creates a problem of connecting two concepts with a label.

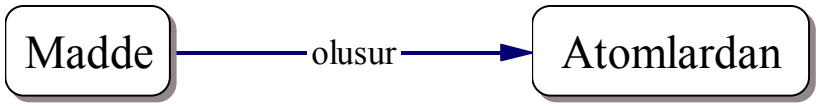


Figure 4. The two concepts are connected with a label, which is however not a meaningful statement in Turkish language.

The second difference is that unlike English, in Turkish a meaningful sentence includes postpositions and suffixes rather than prepositions (Bagci Kilic, 2003), which creates a difficulty of relating two subjects to the same object. When you relate two subjects to one object, you might have to add more than one suffix to the end of the object. However, if you add two suffixes to the end of the object at the same time, the new word would have no meaning in Turkish.

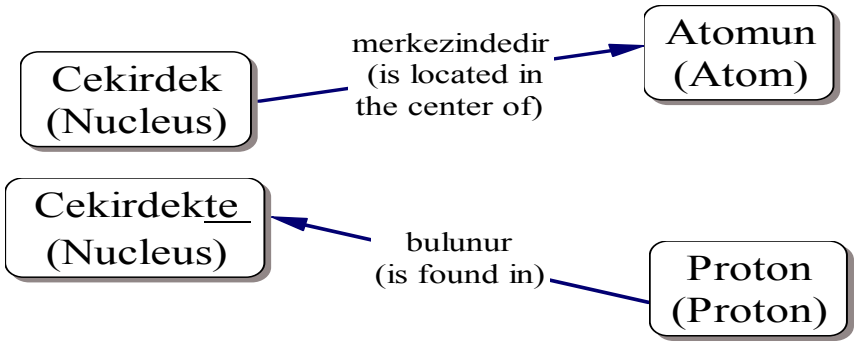


Figure 5. When the same concept is connected to two other concepts, one needs to add the postposition, 'te', to the end of the object, 'cekirdek', which however require the repetition of the same concept in order to create meaningful statements.

For example, in an English sentence, such as ‘matter is made of atoms’, the preposition, ‘of’, comes before the object without attaching to it. That way, you can relate as many concepts as to the same object, ‘atoms’. On the other hand, in a Turkish statement like ‘madde atomlardan oluşur’, the postposition, ‘dan’, is attached to the end of the object, ‘atomlardan’. If you relate another subject to the same object, you might need to add a new postposition to it, which makes the word meaningless. Accordingly, it seems impossible to relate one concept to several other concepts on a Turkish concept map. Figure 5 and 6 illustrate this problem.

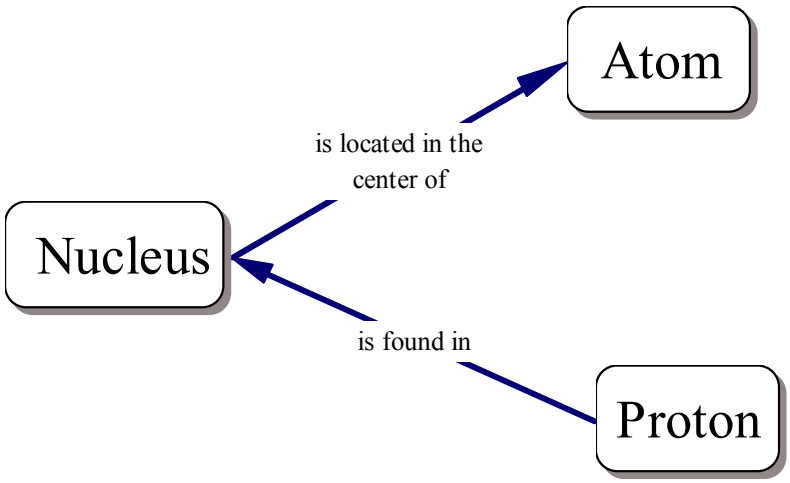


Figure 6. In English language the preposition, ‘in’ come before the object, thereby allowing one to relate a concept to two other concepts.

Bagci Kilic (2003) investigated students’ spontaneous tendencies in drawing Turkish concept maps. She studied with undergraduate elementary education majors, who were registered for a science methods course. Although she provided the steps of developing a concept map to the students, she did not instruct the students how to show the relationships between concepts. In addition, she disregarded the concept maps of the students who had prior knowledge about concept maps.

The results of the study (Bagci Kilic, 2003) indicated that the students tended to construct concept maps in three different ways: (1) writing relationships between concepts on lines as a complete sentence, (2) writing relationships as a paragraph below the concept map, and (3) expressing relationships orally rather than writing them.

THE SIGNIFICANCE OF THE STUDY

Comparison of Turkish Maps to English Maps

Although all three methods seemed to be satisfying to the students, Turkish maps drawn with these methods might have some limitations when compared to English maps.

In the first method, the students used complete sentences to relate concepts. These lengthy labels seem to require a lot of space and make the map unclear and disorganized. This happens especially when a quite number of concepts are connected. In the second method, relationships are stated as a paragraph and lines are not labeled. This method seems to not allow one to examine specific relationships and therefore assess the map based on the quantity and quality of each link. Finally, because the third method has concepts connected with lines without labels, the map seems to not provide any information concerning the nature of the relationships.

In contrast, the English concept maps have two significant properties: (1) lines are labeled so that a reviewer can examine the relationships between concepts; (2) labels are short enough that allows the construction of a clear map. Based on these two criteria, a drawing method for Turkish maps called 'Numbering Method' was developed, which is basically a combination of method 1 and 2 (Bagci Kilic, 2003). In this method, students give a number to each connecting line on a concept map and write the relationship next to each number below the concept map. If students find this method appropriate to construct concept maps, Numbering Method seems to have two advantages: it (1) allows the construction of a clear and large map by assigning number as a label and (2) allows researcher or educator to examine the relationships between concepts. Because of these advantages, Numbering Method can be an important research tool in Turkey. Researchers and educators can use this method in order to reveal a great deal about students' understanding of science concepts.

RESEARCH QUESTIONS

The following research questions provided a focus for this study, (1) how do students perceive three methods of drawing concept maps? And (2) what method of concept mapping is most favorable from the perspective of middle school students? The methods were: (1) writing relationships between concepts on lines as a complete sentence, (2) writing relationships as a paragraph below the concept map, and (3) the numbering method- connecting concepts using numbers and explaining relationships next to each number below the concept map. Exemplary concept maps for each method are provided in the subsequent part of the paper.

DESIGN AND PROCEDURES

Sample Description

The present study was conducted with middle school students in Izmir, Turkey. A total of 53 students volunteered to participate in the study. The students were 8th grade from a private school. The students' ages ranged from 14 to 15 years old. The socioeconomic status of the school was slightly higher than regular public schools in the area. In Turkey, the regular schools are supported by the government so these schools are generally free of charge. On the other hand, the private schools are at cost and students attending these types of schools have to pay some amount of tuition.

Methodology

Three concept maps were first given to the students. The concept maps contained exactly the same information. All three maps had the same concepts with the same relationships. However, the maps were drawn with differing methods. Figure 7, 8, and 9 show the example concept maps respectively.

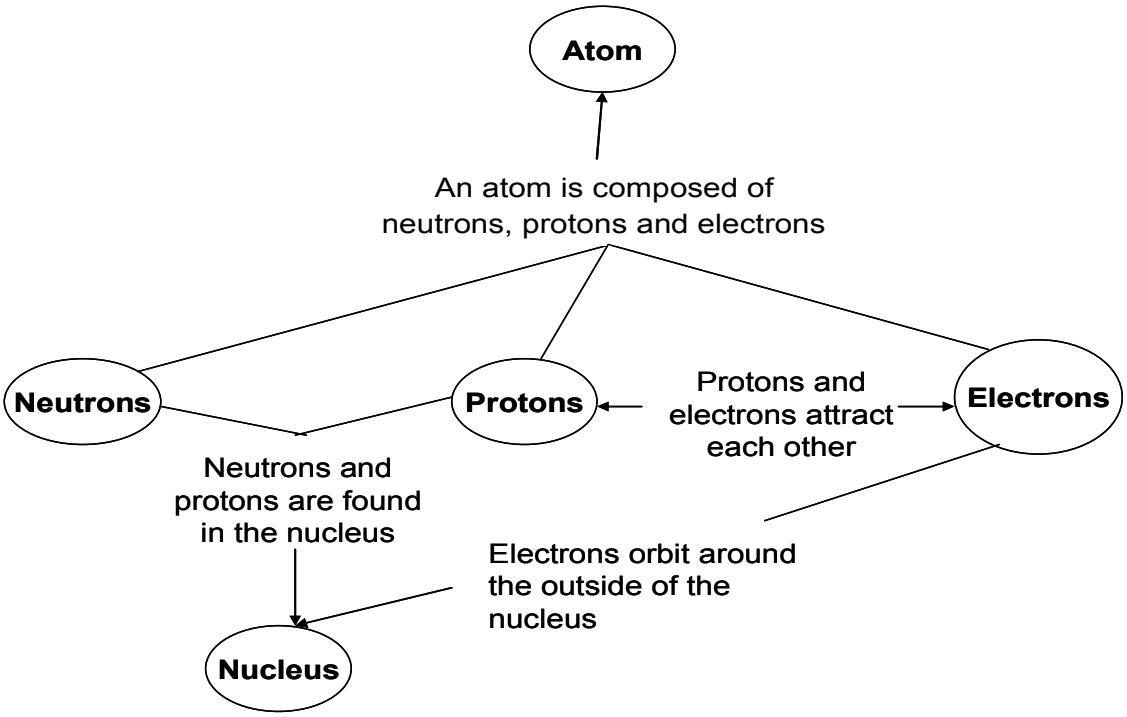
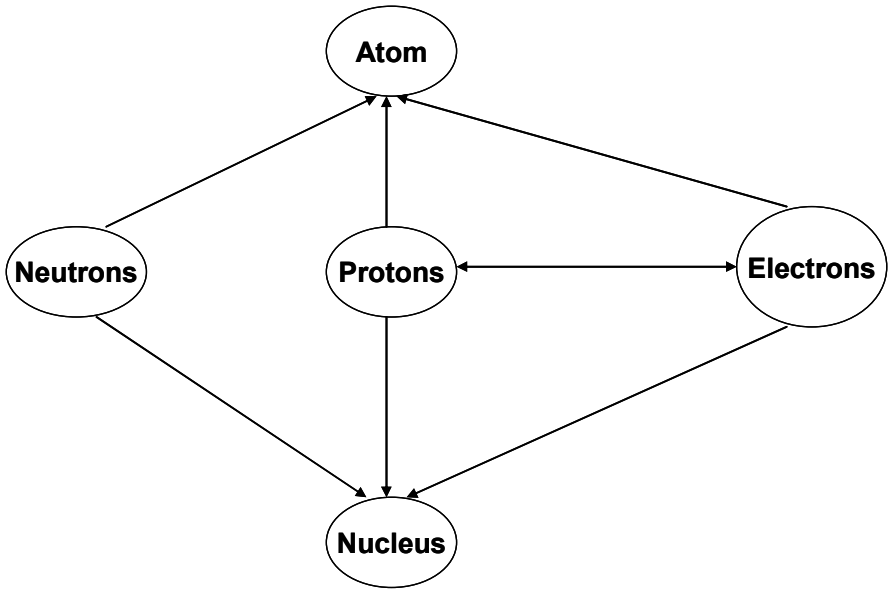
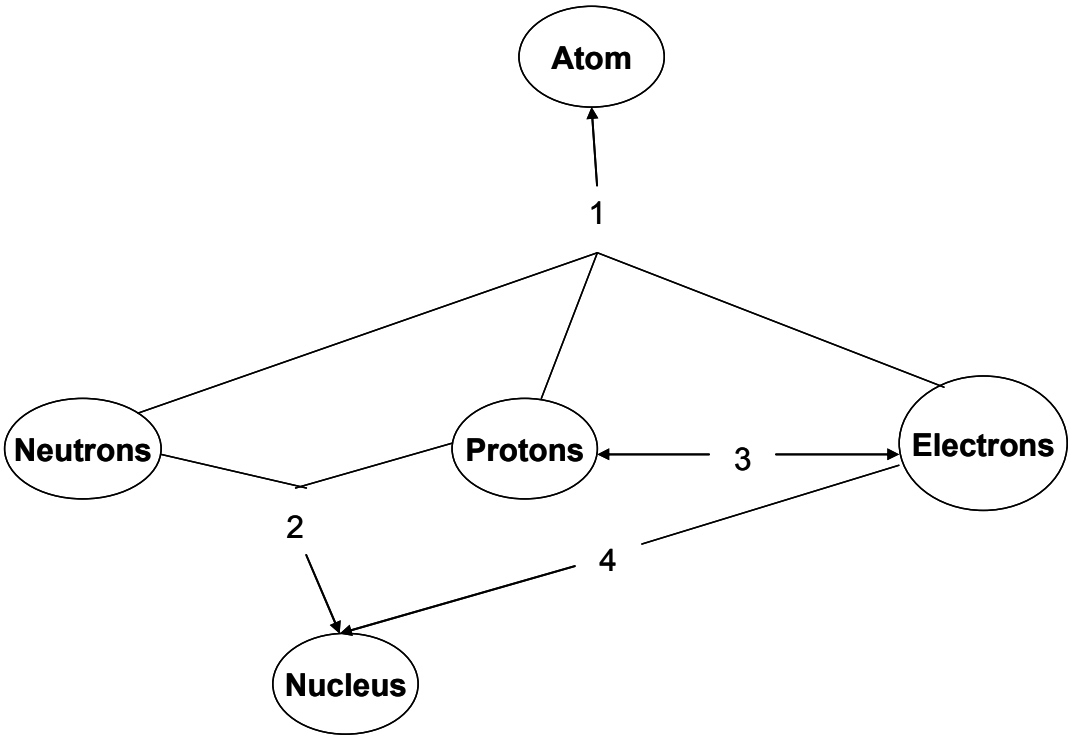


Figure 7. The concepts were connected with complete sentences (Adapted from Bagci Kilic, 2005).



An atom is composed of neutrons, protons and electrons. Neutrons and protons are found in the nucleus. Electrons orbit around the outside of the nucleus. Protons and electrons attract each other.

Figure 8. The concepts connected with lines and the relationships between concepts were shown as a paragraph below the concept map (Adapted from Bagci Kilic, 2005).



1. An atom is composed of neutrons, protons and electrons,
2. Neutrons and protons are found in the nucleus,
3. Protons and electrons attract each other
4. Electrons orbit around the outside of the nucleus.

Figure 9. The numbers were assigned to the relationships and the explanations for the nature of the relationships were indicated next to each number below the concept map.

Following that, the students were asked to examine three exemplary maps, select one they found the best, and draw one concept map accordingly. The students were provided with such terms and symbols as 'molecular compound' (moleküler bileşikler), 'ionic compound' (iyonik bileşikler), 'periodic table' (periyodik cetvel), 'element' (element), 'compound' (bilesik), 'positive' (pozitif), 'negative' (negatif), 'neutral' (nötral), 'nonmetal' (ametal), 'metal' (metal), 'cation' (katyon), 'anion' (anyon), 'ion' (iyon) , N_2O_4, Mg^{2+}, 'atom' (atom), 'electron' (elektron), Ag(s), Na_2SO_4. The terms were already introduced to the students so it is presumed that the students had adequate knowledge about these terms. The students were also told that they could use concepts and symbols outside of the list.

The students individually drew the maps. After that, they were asked to write down the particular reasons for selecting the specific method they have chosen and the reasons for not selecting others.

DATA ANALYSIS AND RESULTS

The Students' Perceptions about the most Favorable Maps

The maps (53 maps) were first divided into groups based on the way they were drawn. 11 students used the first method, 10 students used the second method and another 11 students used

the third method in drawing their concept maps. However, it was seen that 21 students tended to draw their maps without using any one of three methods. They drew the maps by connecting concepts without showing relationships. The maps did not have any information concerning the nature of the relationships between concepts so that their maps were excluded from the analysis. Yet, in their comments, seven students stated that they liked the third method. Five students liked the second method and one student liked the first method. However, the rest of the students did not indicate which method they liked most.

The Reasons for the Selection of Specific Method

When asked to give reasons for the method used for drawing concept maps, the students selecting the first method invoked a number of reasons for their selection. They generally stated that the maps drawn with this method became easy to follow and easy to understand because the concepts and relationships were depicted together on the map. However, in the second and third method, the relationships were shown indirectly. In other words, the relationships were taken apart from the concepts, which thereby made the map more difficult to follow. The following excerpt, which is translated into English, illustrates this view. The excerpt is taken from the written explanations made by student #37.

> 'I used Figure 1 because with this method concepts and explanations [relationships] are together. This made the topic easy to understand. In other figures, there were separations between concepts and explanations. It was difficult to follow the concepts and explanations that were separate from each other'

Figure 10 illustrates an exemplary map drawn with the first method.

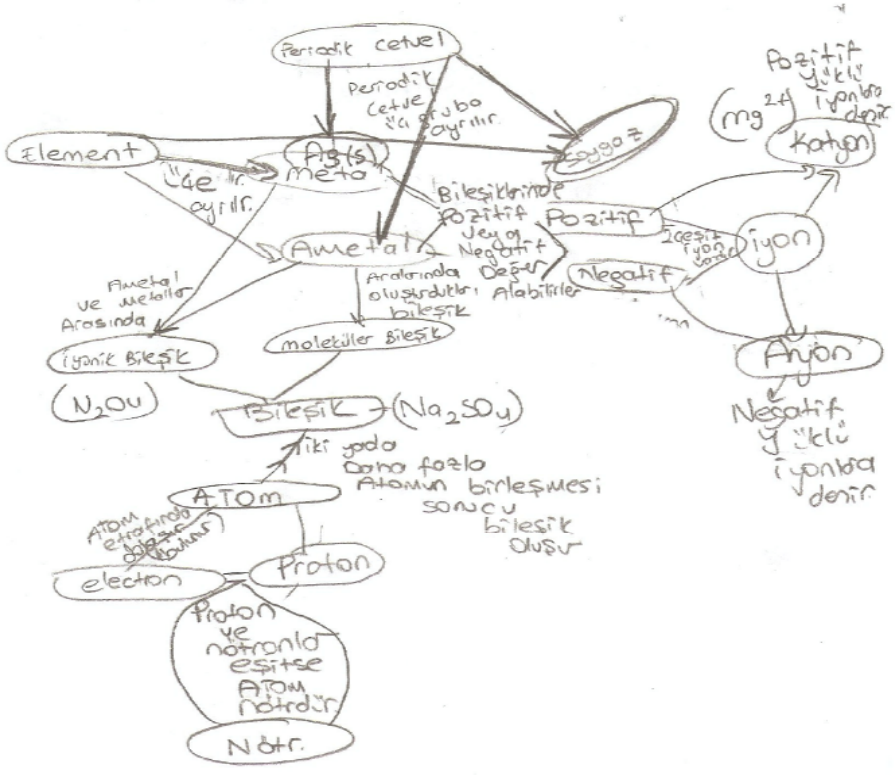


Figure 10. An exemplary concept map drawn with the first method.

The students who used the second method invoked that with the second method it was easy to draw the map. They found more difficult to draw the map using the other methods. They also believed that explaining the relationships with a paragraph made the topic easy to understand. The following quote taken from student #52 depicts this view.

> 'I selected Figure 2 because it was easy to draw the map with this method. Compared to others, it was clearer and more informative. I did not select the others because it was more difficult to construct the map with other methods and to me the other figures were conveying the information indirectly. The other figures were more complicated. However, figure 2 was more informative and easier to build'

Figure 11 illustrates an exemplary map drawn with the second method.

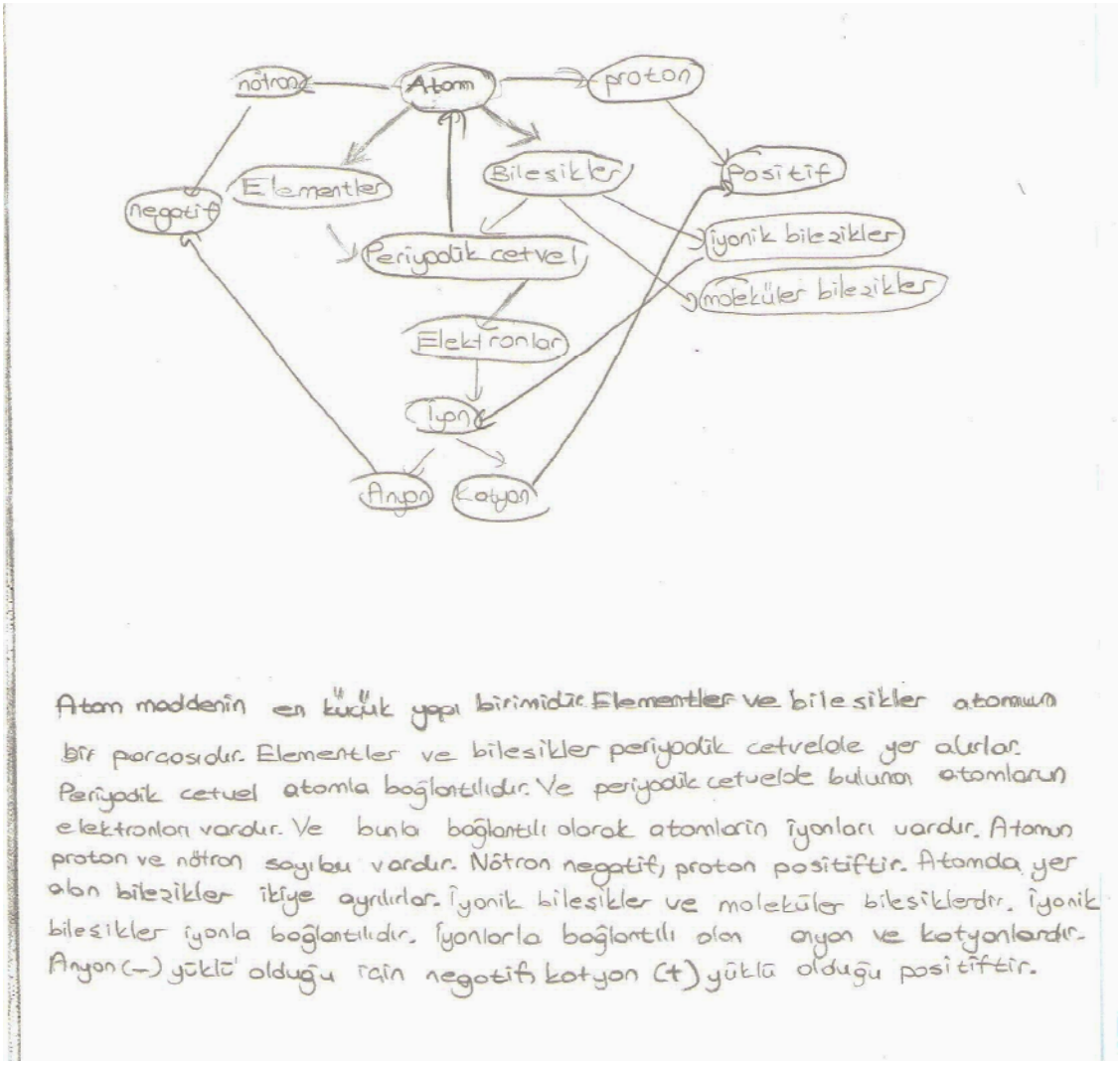


Figure 11. An exemplary concept map drawn with the second method.

The students who selected the third method (Numbering Method) provided several reasons for their selection. First, the students stated that the concept maps drawn with numbering method looked clearer compared to the first method. Unlike the first method, in which labels were complete sentences, in Numbering Method labels were numbers, which therefore made the

map look clearer and more organized. The following quote taken from student #15 illustrates this view.

> 'I selected Figure 3 because Figure 3 makes the topic easy to understand and the possibility that concepts and relationships are mixed up is low. Figure 2 and Figure 1 are not appropriate in connecting such high number of concepts'

Figure 12 illustrates an exemplary map drawn with the Numbering Method.

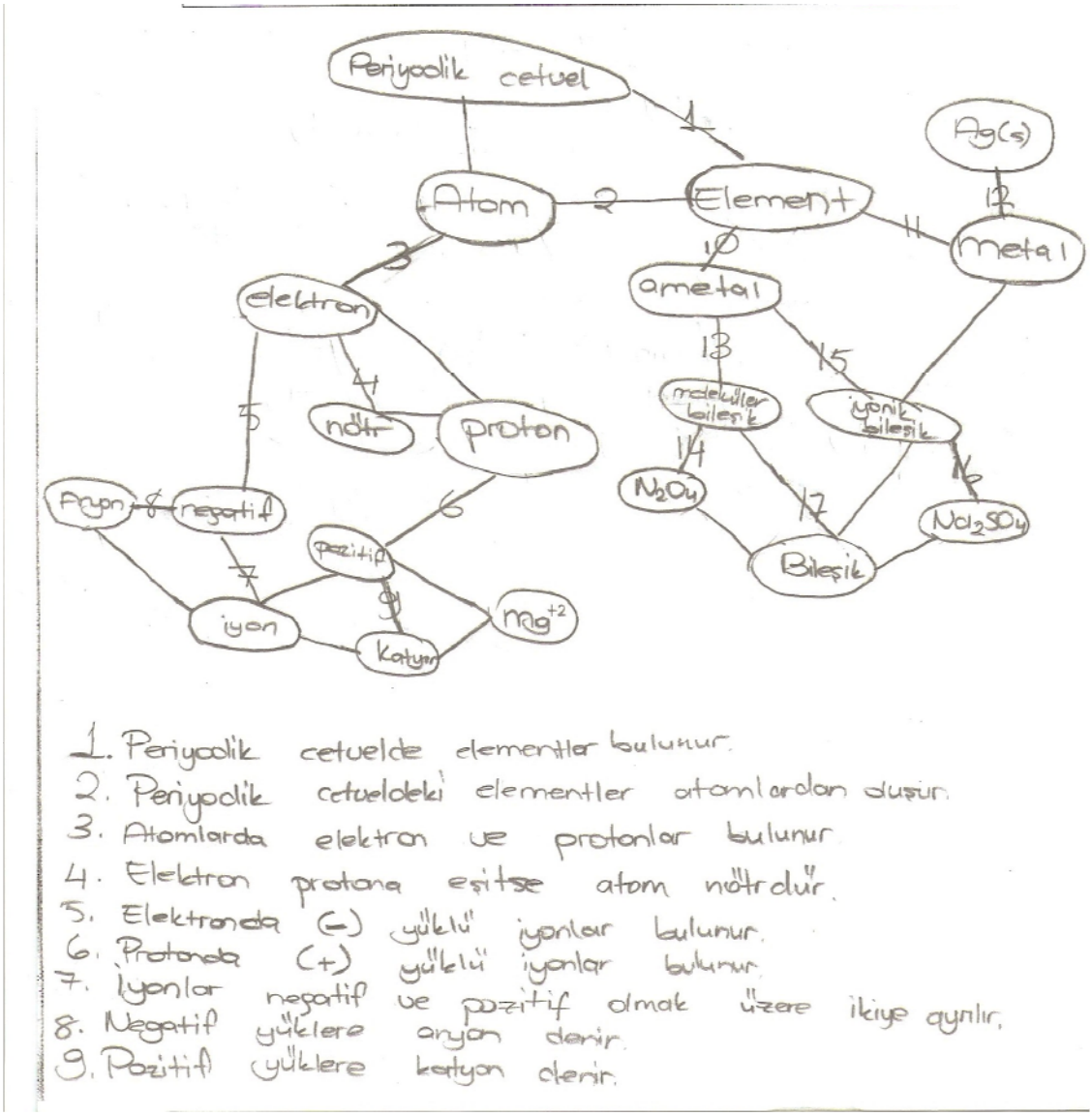


Figure 12. An exemplary concept map drawn with the Numbering Method.

Second, according to the students, because in Numbering Method they had to explain the relationships next to each number below the map, the method enabled them to convey the information in a more structured and organized manner. Furthermore, the students believed that this property allowed them to easily remember the information and thereby facilitated their learning. The following quote taken from student #4 illustrates this view.

'I selected Figure 3 because in numbering method, the information is conveyed in a more organized manner and this makes the topic easy to remember. Because the information is displayed in a more organized fashion, the information also stays organized in our mind. This method facilitates learning and the maps drawn with this method looks clear. I did not select the others because the map drawn with one of them [first method] will be unclear. We might mix up concepts with relationships'

DISCUSSION AND CONCLUSIONS

The result of the study indicated that the students evenly selected each method to draw their concept maps. Each method was selected for different reasons. For the students, the first method was chosen because the relationships and concepts were in the same context, which made the map easy to follow and easy to understand. The students using this method would like to see both concepts and relationships together in one context, which they believed made the map easy to follow and understand the relationships. The second method was selected because, to the students, it was easy to construct the map and writing a paragraph about the relationships were more informative compared to other methods. The students seemed to have difficulty in constructing maps with the first and third method. Accordingly, they may have preferred writing a paragraph about the concepts rather than depicting particular relationships on the map. Finally, the numbering method was selected because it allowed the students to construct a clear map and the information was conveyed in a more organized manner, thereby making the topic easy to remember. However, the students also stated that with this method the information was presented indirectly. To the students, because concepts and relationships were depicted separately, the maps drawn with this method was more difficult to follow.

In conclusion, the results highlighted the fact that even though the numbering method seems promising in permitting the construction of a clear and large map and allowing researchers or educators to easily examine students' constructed relationships amongst concepts, the property that the relationships amongst the concepts are separated from their context created a difficulty for students to follow the map and appreciate it. In other words, according to the students the numbering method has two advantages: it (1) allows the construction of a clear map, and (2) makes the information be more organized, which hence enables the students easily remember the information. However, to the students the use of this method causes the information to be presented indirectly, not allowing the reader to easily follow and appreciate the map.

This study also indicated that there might be no one to one correspondence among different languages. One cognitive method developed in a culture might not be applicable to another. In our example, it is emphasized that the method of drawing concept map in a Novakian way could not be exactly used in Turkish language. However, this does not mean that there is no way of drawing a Turkish diagram that reveals a student's knowledge framework. We could find a visual diagram like concept maps and can still demonstrate hierarchical nature of students' knowledge.

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