

## **PRE-SERVICE TEACHERS' UNDERSTANDING AND USAGE OF SCIENTIFIC AND DAILY LIFE LANGUAGE\***

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### **ABSTRACT**

The purpose of this study is to investigate how pre-service teachers understand six selected dual meaning words (freezing, combustion, bond, organic, salt and stable) before and after traditional chemistry instruction. A qualitative study approach was used to answer the research questions. The study was carried out in a university on the north coast of Black Sea Region in Turkey. Participants were 29 freshmen pre-service teachers between 18-21 ages. As data collection tool, a questionnaire consisting 42 questions for 6 dual meaning words was prepared and administered as pre- and posttests. In data analysis, after reduction, similar answers were classified and code lists were created. Then, themes were formed according to the codes. After data analysis, it was found that pre-service teachers mostly constructed the meanings of dual meaning words in their daily lives. After learning the scientific meanings of the words, they continued to use both scientific and daily life meanings together. This may be associated with their inability to contextualize and a lack of conceptual understanding, or some combination of two.

**Key words:** scientific language, daily life language, learning chemistry, dual meaning words, chemistry education research

### **INTRODUCTION**

A key factor learning chemistry and predicting performance is language comprehension (Pyburn, Pazicni, Benassi & Tappin, 2013). Students' first requirement for understanding what they read in chemistry is to understand the language or vocabulary of the content within text and classroom instruction. Despite this fact, teachers do not always give sufficient thought to the precise words that they use in the classroom and how this use may affect students' understanding (Jasien, 2010). Furthermore, teaching vocabulary is not only allocated to the language teachers, but also allocated to the content-area teacher (Young, 2005). Content-area teachers make their greatest contribution to science literacy when they set up situations in which students actively write or speak about their science experiences.

A great challenge to students learning chemistry and to teachers teaching chemistry is the academic language in which chemistry is written. Academic language includes language of education, schooling, and science language (it is Turkish in Turkey) (Snow, 2010). Academic language varies from discipline to discipline. Specific terms in a discipline make the academic language more sophisticated and precise. Introducing a lot of words makes chemistry too difficult to understand and complicated, whereas developing understandings would make it possible for students to develop their vocabulary as they need new words (Miller, 2005). But sometimes the meanings of new words contradict everyday meanings. Because students primarily use the words' in the everyday meanings in the class (because it is known that students come to the class with pre-existing knowledge), they have difficulty in interpreting the scientific words' correct meanings (Itza-Ortiz, Rebello, Zollman & Rodriguez-Achach, 2003). As Michaels, Shouse and Schweingruber (2008) stated in their study unfortunately there are no native speakers of science; scientific language is foreign for all students. In this case, it is acceptable to make some interpretations to newly learned terms or concepts from daily life. For example teacher can use 'double talk' in his/her speeches to give more information about the words which appear both students' daily lives and science courses (Brown & Spang, 2008). In double talk, teacher provides a definition for students they assume is not familiar with an idea, the teacher may choose to offer two versions of the idea like, "a frog is an amphibian, it can live on water and on

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land,” provides students with multiple points of entry for understanding phenomena. In addition, one who uses such a mode of talk also gains insight into understanding the phenomenon in both vernacular and nonvernacular modes of talk. Therefore, double talk involves a subtext of attempting to provide multiple points of access.

To show the transition from daily life meanings to scientific meanings and contrasting two meanings of dual meaning words is necessary for a teacher (Song & Carheden, 2014) because students with their initial understandings -that are incorrect scientifically- may have difficulty at learning the scientific meanings and it may cause the formation of some alternative conceptions or misconceptions. In science education, it is quite well-known that it is hard to change students' initial understandings which may include alternative conceptions or misconceptions (Guzzetti, Williams, Skeels & Wu, 1997; Ültay, 2012). Once students have alternative conceptions or misconceptions, traditional instruction is become useless in eliminating them (Harrison & Treagust, 2001; Hewson & Hewson, 2003; Palmer, 2003; Ültay, 2015; Ültay & Ültay, 2014). However, it is quite difficult to learn academic terms and concepts in science courses. In addition, there are some words causing dilemmas for students because of difference between the word's daily life meaning and scientific meaning (Ünsal, 2010). There is a set of science vocabulary that needs special attention; they are called dual meaning vocabulary by Song and Carheden (2014). Dual meaning vocabulary includes words which are used in both daily life and scientific contexts. Work, energy, salt, organic, elastic, reaction, infrared, neutral, sugar, etc., can have been counted as dual meaning words in different studies (Jasien, 2010; Kızılcık, 2013; Song & Carheden, 2014). Specifically for Turkish language, salt, stable, organic, bond, freezing, combustion, and some other words have dual meaning because of their using both in chemistry and daily life. Students faced these words in their daily lives before formal teaching experience. For example, many of students may have been asked to pass the salt to put in food by their mother or father for many times. It is expected that students know that salt is something to put the food making it more delicious. Thus, when students were asked to define the salt, they explained it as “salt that you put on your food”. When students were asked to define “organic”, they explained it “something healthier because I think of organic food and because they talk about it all the time on television” (Song & Carheden, 2014). Thus, students' everyday ideas and ways of knowing and talking are largely different from and incompatible with those of science (Warren, Ballenger, Ogonowski, Rosebery & Hudicourt-Barnes, 2001). In many studies, this conceptualization is called misconception which is defined as students' everyday ideas are strongly held, may interfere with learning, and need to be replaced with correct conceptions (Clement, 1982; McDermott, Rosenquist & van Zee, 1987). And so, everyday experience is viewed as a principal source of the educational problem (Warren et al., 2001). For this reason, in recent years, researchers have focused on what students have misconceptions or alternative conceptions, how misconceptions or alternative conceptions can be remedied, how learning can be improved, how conceptual learning and development can be provided. Although the language of science has great importance on learning, there are limited numbers of studies arguing the effect of language in chemistry learning. According to Song and Carheden (2014) and Pyburn et al. (2013), research on language in science education has been mainly conducted at the pre-college level and too little attention was paid to the role of language in chemistry teaching. Nevertheless, it was found that there was a strong relationship between understanding and right usage of language and the success of general chemistry course (Pyburn et al., 2013). In this case, the purpose of this study is to investigate how pre-service teachers understand six selected dual meaning words (freezing, combustion, bond, organic, salt and stable) before and after traditional chemistry instruction.

### **Research questions**

The following research questions guided this study:

- (1) What are the pre-service teachers' initial understandings of dual meaning words before being introduced the scientific meanings?
- (2) What are the pre-service teachers' final understandings of dual meaning words after instruction?

## **METHODOLOGY**

### **Research Design and Sample**

A qualitative study approach was used to answer the research questions. Qualitative studies are used when something is more important than the numbers. While quantitative studies focus on how much the students learn or know the research questions or the information about something, qualitative studies focus on the process of learning and a more detailed whole picture of the research. This study is aimed to show the whole picture of what the pre-service teachers know about the dual meaning words and how their knowledge is affected by the instruction.

The study was carried out in a university on the north coast of Black Sea Region in Turkey. Participants were 29 freshmen pre-service science teachers between 18-21 ages and 18 of them were females and 11 of them were males. Pre-service teachers had learned chemistry from the first year of the high school and in the first year of the university education they learned chemistry by General Chemistry Course four hours in a week and General Chemistry Laboratory Course two hours in a week in the first semester. Pretest was administered at the beginning of the semester and the posttest was administered at the end of the semester during one class period (40 minutes).

Before the pretest, pre-service teachers were asked if they wanted to participate in such a study and three pre-service teachers in the sample did not want to participate in the study, so they were excluded from the study and their data were not used. The rest of pre-service teachers willingly participated in the study. Pre-service teachers in the sample did not participate such a research design before. The researcher asked pre-service teachers about their willingness to participate in the study. She assured pre-service teachers that they were not obliged to participate in the study and that they would not be awarded extra points for their participation. The consent of the participants was requested before their responses in the questionnaire were shared with the reader. Also, the participants were informed about sharing some demographic information and their consent was requested beforehand. Before and after the test, some of the dialogue between the researchers and the participants were not reflected in the study and remained between the two because of the principles of privacy and confidentiality.

### **Data collection tools**

In the study, firstly some dual meaning words were determined by the help of the chemistry textbook. Selected dual meaning words were freezing, combustion, bond, organic, salt and stable because pre-service teachers were accustomed to hear these words in their daily lives and the school and because the study was implemented in the first semester of the academic year (fall semester) so the words students faced in the content of their chemistry textbooks (for example Petrucci, Harwoon and Haring, 2008). Then, after the literature review (reviewing the well-known databases (i.e. Academic Search Complete, Education Research Complete, ERIC, Springer LINK Contemporary) and Google Scholar with the keywords of “language of science”, “dual meaning”), the questions asking about these dual meaning words were prepared. The questionnaire included 42 questions for 6 words and each word had 7 questions. The questionnaire was administered two times, at the beginning of the first semester and at the end of the first semester. There were 13 weeks between the pre- and posttests. An example for one dual meaning word in the questionnaire which was administered as pre- and posttest is given in the following:

**Table 1: Questions for “freezing” word in the questionnaire**

“Freezing” in the pretest	“Freezing” in the posttest
1. What firstly comes to your mind when you hear “freezing”? If helps, you can draw a picture.	1. What firstly comes to your mind when you hear “freezing”? If helps, you can draw a picture.
2. How did you learn the meaning of that word? Does it have significance to you? Please explain.	2. Has the meaning of the word changed after learning in the lesson? Please explain.
3. How often do you use that word when writing or reading? Please explain.	3. How often do you use that word when writing or reading? Please explain.
4. When you hear that word in a scientific context, does the meaning of the word change for you? If so, what is that meaning?	4. When you hear that word in a scientific context, does the meaning of the word change for you? If so, what is that meaning?
5. Which meaning comes to your mind firstly, when you hear that word in the class? Please explain.	5. Which meaning comes to your mind firstly, when you hear that word in the class? Please explain.
6. If the meaning of daily use came to your mind, why was it hard to retain the scientific meaning of the word? Please explain.	6. Has the lesson been effective to learn the meaning of the word for you? Please explain.
7. Please use that word in a sentence.	7. Please use that word in a sentence.

Some example students responses are given in the following for the pre and posttests. Because the study was carried out in Turkey and in Turkish, it is added their translations to English.

2. Bu kelimenin anlamını nasıl öğrendiniz? Nasıl öğrendiğinizin sizin için bir önemi var mı? Açıklayınız.  
 Bu kelimeyi sanırım ilk ailede öğrendim. Fakat bu kelimeyi derste öğrendiysem iyi anlamam açısından nasıl öğrendiğimin önemi vardır.

Figure 1. 8 number of pre-service teacher’s response for the pretest

2. Bu kelimenin anlamını nasıl öğrendiniz? Nasıl öğrendiğinizin sizin için bir önemi var mı? Açıklayınız.  
 Çocukluğumda öğrendim fakat genel bir bilgiydi. Asıl olarak ilk okul 4. sınıfta Fen Bilgisi dersinde öğrendim. Benim için bir önemi yok.

Figure 2. 10 number of pre-service teacher’s response for the pretest

In Figure 1, the question was “How did you learn the meaning of that word? Does it have significance to you? Please explain”. The pre-service teacher answered this question as “I guess I learned this concept in my family, but it makes difference how I learned this concept for good understanding”. The same question was responded 10 number of pre-service teacher in Figure 2 in that way “I learned it in my childhood but it was a general knowledge. The real learning was in a science course in the 4<sup>th</sup> grade of primary school. It does not make difference how I learned it”.

2. Bu kelimeyi bir cümle içinde kullanınız?  
 Suyu donması için buzluga koydum.

Figure 3. 2 number of pre-service teacher’s response for the posttest

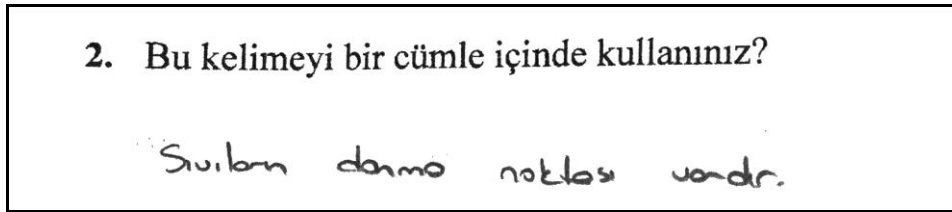


Figure 4. 1 number of pre-service teacher's response for the posttest

In Figure 3, the question was “Please use that word in a sentence”, the answer of 2 number of pre-service teacher was “I put the water to the freezer to freeze”, and in Figure 4, 1 number of pre-service teacher responded it as “Liquids have a freezing point”.

The same questions with the other selected dual meaning words were asked to pre-service teachers. In the study, pre-service teachers took the questionnaires and wrote their answers for each word. They completed to write the answers in approximately 40 minutes.

### **Validity and Reliability**

The validity and reliability in qualitative researches have not been thought separately (Golafshani, 2003). To be more specific with the term of reliability in qualitative research, Lincoln and Guba (1985, p. 300) use “dependability”, in qualitative research which closely corresponds to the notion of “reliability” in quantitative research. They further emphasize “inquiry audit” (p. 317) as one measure which might enhance the dependability of qualitative research.

To ensure reliability in qualitative research, examination of trustworthiness is crucial. Seale (1999), while establishing good quality studies through reliability and validity in qualitative research, states that the “trustworthiness of a research report lies at the heart of issues conventionally discussed as validity and reliability” (p. 266).

To improve the analysis and understanding of construction of others, triangulation is a step taken by researchers to involve several investigators or peer researchers' interpretation of the data at different time or location (Johnson, 1997). The reliability of the measurement results, two chemistry education experts read pre-service teachers' answers and each of them created their own codes and themes. Then the researcher checked and compared the codes and themes with her own codes and themes. The interrater reliability coefficient (Cohen's Kappa) between the experts and the researcher was calculated as 0.90. After that, the researcher used her own codes and themes while evaluating the data.

The chemistry education experts ensured the appearance (the page setup, the font size, etc), readability and content validity. Also, six pre-service teachers apart from the participants were read the items and they let the researcher about any unclear or not understandable points. After that, some minor changes were made to the items in the questionnaire.

### **Data Analysis**

In data analysis, all data were firstly written as a paragraph concept by concept. After reduction, similar answers were classified and code lists were created. Then, themes were formed according to the codes. The same process was repeated for the posttest. Because some questions were different in pre- and posttests, different codes and themes were appeared in pre- and posttests.

Because data were written as a paragraph, the common answers were outstanding. Almost all pre-service teachers had started to answer with a definition of the concept, although the first question was asking a different thing. In the first question, it was asked that “what firstly comes to your mind when you hear ‘freezing’? If helps, you can draw a picture.” Because pre-service teachers defined ‘freezing’, thus, from these answers the first theme was formed: definition of the concept. Then in the second

question, students explained how they learned the meaning of the concept but they did not explain whether it had significance to them. So, from these answers the second theme was formed: learning. Thus, all themes were created in this way for pre- and posttests apart from the questions but depending on the pre-service teachers' responses.

## RESULTS AND DISCUSSION

To answer the research questions the results and discussion from the questionnaire are presented in this section.

### 'Freezing' Concept

Pre-service teachers' initial and final understandings of 'freezing' concept are shown in Figure 5 and 6.

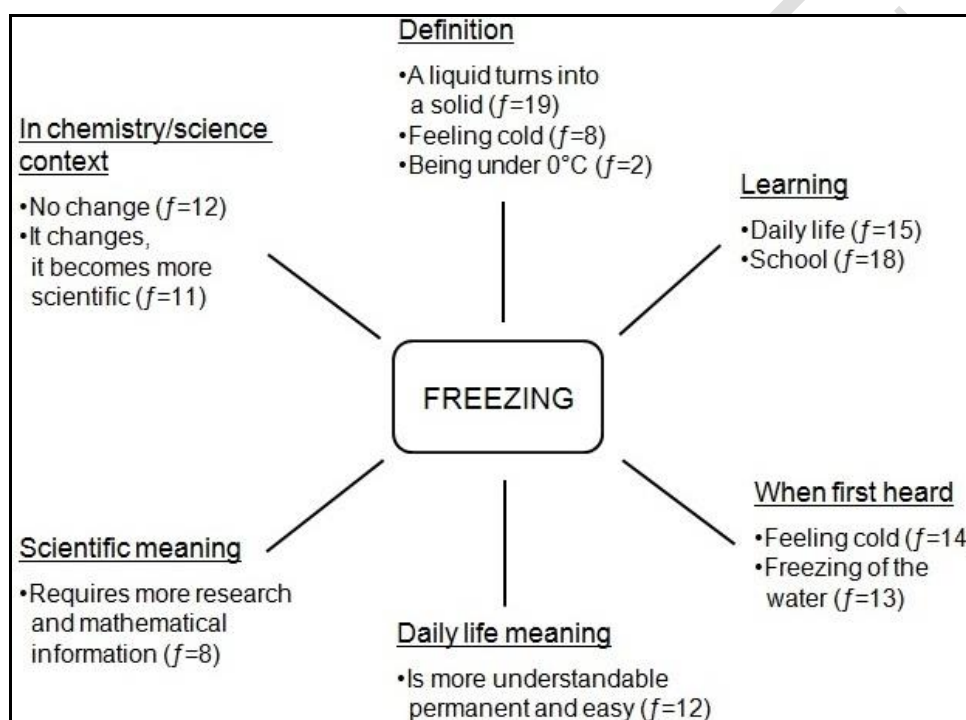


Figure 5. Pre-service teachers' initial understandings of 'freezing' concept

According to Figure 5, pre-service teachers defined 'freezing' as a liquid turned into a solid ( $f=19$ ), feeling cold ( $f=8$ ) and being under  $0^{\circ}\text{C}$  ( $f=2$ ). Pre-service teachers mostly learned this concept in school ( $f=18$ ) and daily life ( $f=15$ ).

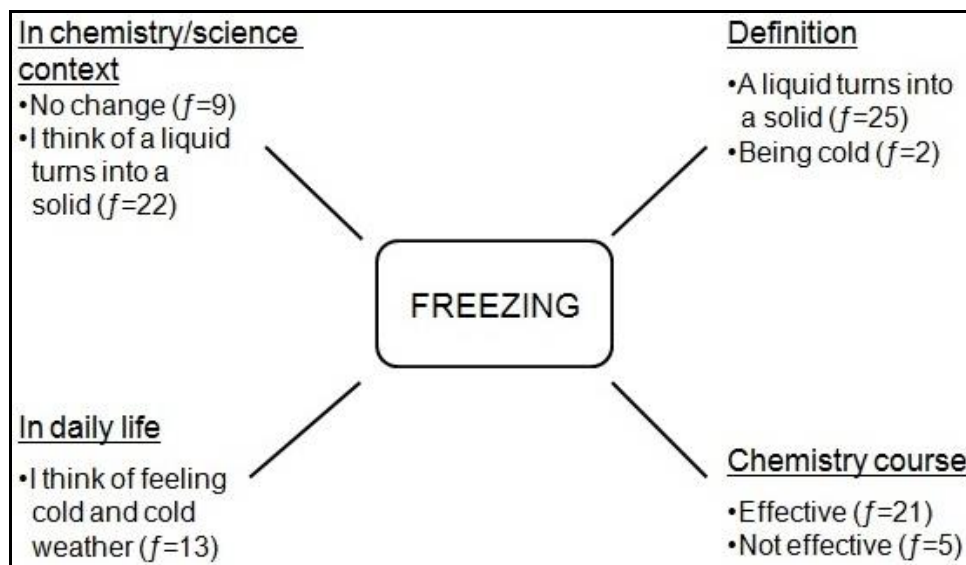


Figure 6. Pre-service teachers' final understandings of 'freezing' concept

As can be seen in Figure 6, in posttest, pre-service teachers mostly defined the 'freezing' concept as a liquid turned into a solid ( $f=25$ ). On the other hand, some of them kept relating 'freezing' and 'cold' ( $f=2$ ).

When pre-service teachers' understandings are considered, it is seen that their understanding of 'freezing' concept is highly based on their daily life experiences. Furthermore, some pre-service teachers used 'freezing' concept instead of feeling cold especially in winter days. While some of them defined 'freezing' as a liquid turned into a solid, they gave examples of turning water to ice from daily life. When pre-service teachers heard 'freezing', they instantly maybe unconsciously related water and ice. The reason of this may be that most teachers used daily life experiences that students were more familiar (Çalık, 2005). It may cause a contextual difficulty with the freezing concept associated with pre-service teachers lack of experience with different substances (Jasien, 2013). Students sometimes try to use ideas from daily life to explain scientific conceptions, but they may not have a deep understanding of the scientific view which leads them to make inappropriate applications of daily life experiences and terminology to scientific matters (Ültay, Durukan & Ültay, 2015). After chemistry course, although pre-service teachers changed their understandings about 'freezing' and they gained more scientific point of view, there are still some pre-service teachers stated that they thought feeling cold. Their wrong perception about 'freezing' may prevent their scientific understanding because in the literature some studies have revealed the wrong perception of some terms and these kind of wrong perceptions and thoughts are get into the language as term misconceptions (Kızılcık, 2013; Ünsal, 2010). Nevertheless it is claimed that coldness is a misconception (Vosniadou, 2013). It would be quite difficult to change the alternative conceptions and misconceptions with the scientifically understandings. In recent years, conceptual learning and overcoming alternative conceptions and misconceptions have been the most popular research areas in science education (Ültay & Çalık, 2016). Besides applying different techniques and methods to remedying alternative conceptions and misconceptions, it should be noted that language comprehension is the key factor (Pyburn et al., 2013).

### 'Combustion' Concept

Pre-service teachers' initial and final understandings of 'combustion' concept is shown in Figure 7 and 8.

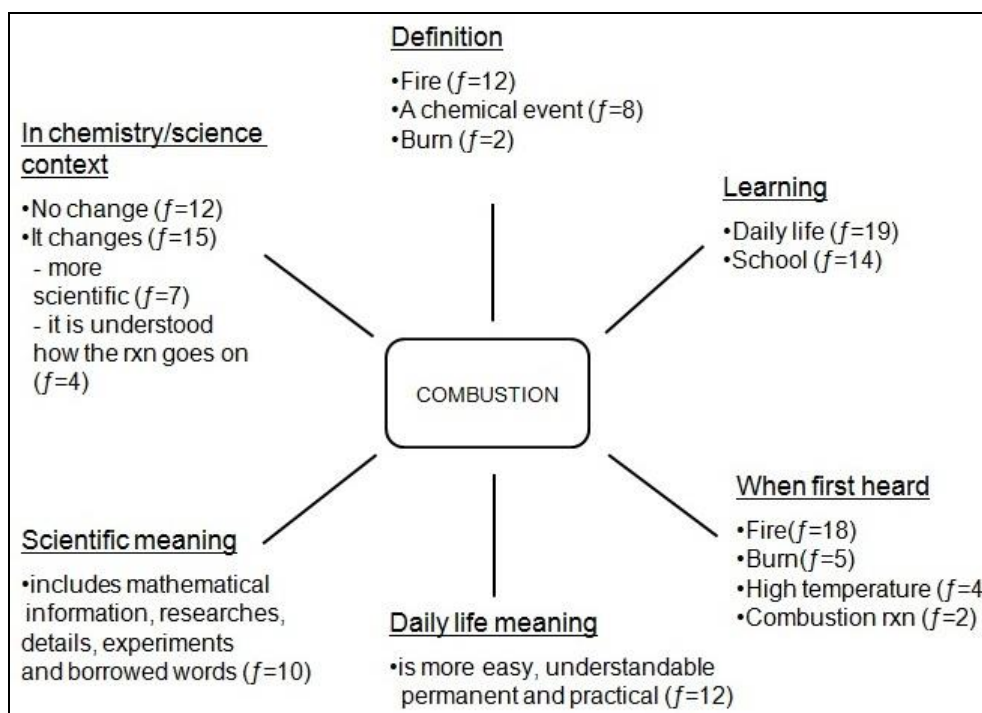


Figure 7. Pre-service teachers' initial understandings of 'combustion' concept

According to Figure 7, pre-service teachers defined 'combustion' as a fire ( $f=12$ ), a chemical event ( $f=8$ ) and burn ( $f=2$ ) in pretest. Pre-service teachers mostly learned this concept in daily life ( $f=19$ ) and in school ( $f=14$ ). In addition, they thought that the daily life meaning was more easy, understandable, permanent and practical ( $f=12$ ).

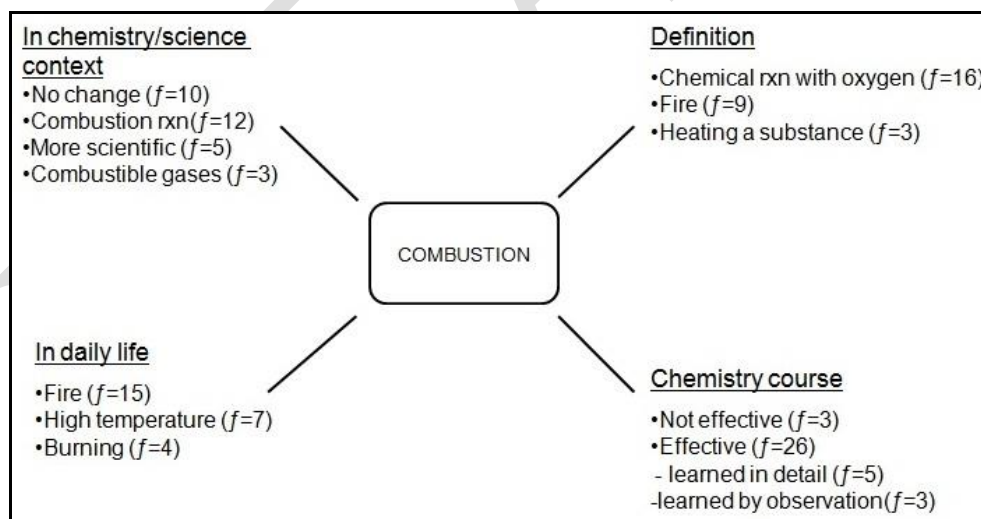


Figure 8. Pre-service teachers' final understandings of 'combustion' concept

As can be seen in Figure 8, in posttest, pre-service teachers mostly defined the 'combustion' as a chemical reaction with oxygen ( $f=16$ ), a fire ( $f=9$ ) and heating a substance ( $f=3$ ). Most of pre-service teachers found the course effective in learning the 'combustion' ( $f=26$ ) because learning was provided in detail ( $f=5$ ) and by observation ( $f=3$ ), but a few of them found the course ineffective ( $f=3$ ).

When 'combustion' concept is considered, it is seen that much more pre-service teachers defined combustion as a fire in pretest than it was in posttest. It reveals that the chemistry course was effective



at teaching this concept because most of pre-service teachers defined combustion as a chemical reaction with oxygen. In addition, pre-service teachers stated that they had learned in detail and they got the opportunity to make experiments in the chemistry laboratories. Therefore, learning was become more meaningful and permanent by the chemistry laboratories (Domin, 1999; Hofstein, 2004). Some chemistry concepts such as dual meaning words often assign strange meanings to well-known colloquial words and present a special problem when chemists require an exact meaning in a given context (Jasien, 2011). For instance, while pre-service teachers could have defined combustion in a scientific way in scientific context, they tended to use 'fire' or 'burn' in daily life context. Because of this reason, in today's society, it is becoming important to have an understanding of the concepts and processes of science, as well as a grasp of the language of science, to be an informed citizen (Holbrook & Rannikmae, 2007; Miller, 2005). An understanding of science and the processes of science is essential to full participation in life. Despite the centrality of science to our life and to the progress of our society, many students fail to acquire scientific knowledge, understanding, and abilities (Fang, 2004).

### 'Bond' Concept

Pre-service teachers' initial and final understandings of 'bond' concept are shown in Figure 9 and 10.

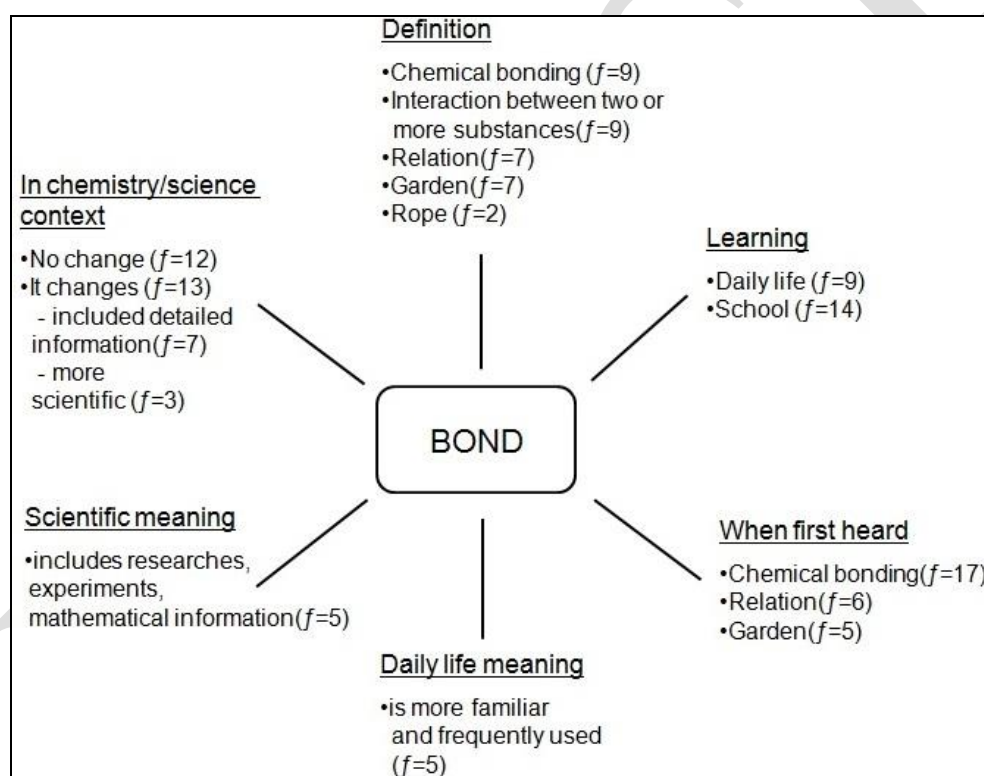


Figure 9. Pre-service teachers' initial understandings of 'bond' concept

In Figure 9, pre-service teachers' initial understandings of 'bond' concept are seen. Pre-service teachers related 'bond' with 'chemical bonding' ( $f=9$ ), relation ( $f=7$ ), garden ( $f=7$ ), rope ( $f=2$ ) and they defined it as an interaction between two or more substances ( $f=9$ ). Pre-service teachers mostly learned this concept in school ( $f=14$ ), and some of them learned this concept in daily life ( $f=9$ ).

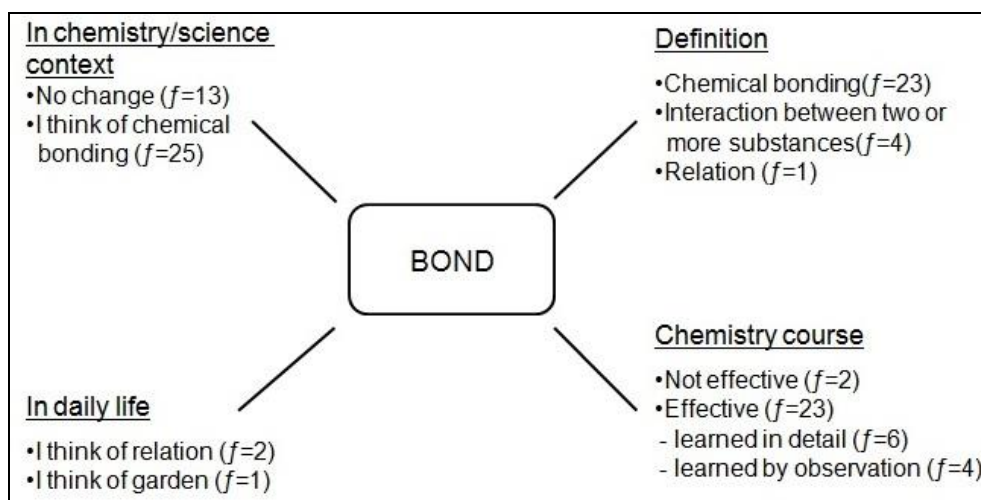


Figure 10. Pre-service teachers' final understandings of 'bond' concept

As can be seen in Figure 10, pre-service teachers related 'bond' concept with chemical bonding ( $f=23$ ) and relation ( $f=1$ ), and defined it as an interaction between two or more substances ( $f=4$ ). Most of pre-service teachers found the chemistry course effective at understanding the meaning of the 'bond' concept ( $f=23$ ) because they stated that they learned in detail ( $f=6$ ) and by observation in the course ( $f=4$ ).

In pretest, because pre-service teachers mostly learned the meaning of 'bond' at school, they defined it by using 'chemical bonding' and 'interaction between two or more substances' instead of daily life meanings. But still, some of them related 'bonding' concept with relation, garden and rope. In Turkish language, 'bonding' have different meanings such as relationship between friends or family members, garden in which fruits are growing and rope which was used to tie something. Science terms are used with very specific meanings, yet because many of these terms have different meaning in everyday life, students can become confused (Jasien, 2010; Haider & Abraham, 1991). Nevertheless, when most of pre-service teachers first heard 'bonding', they thought of 'chemical bonding'. In the former dual meaning words, pre-service teachers found the scientific meaning was difficult because of mathematical information and including researches, they found the daily life meaning was more familiar. In posttest, surprisingly, almost all pre-service teachers defined 'bonding' scientifically except one person. They found the chemistry course was effective at learning the concept and they tended to think scientific meaning almost all the time.

### 'Organic' Concept

Pre-service teachers' initial and final understandings of 'organic' concept are shown in Figure 11 and 12.

According to Figure 11, all pre-service teachers related 'organic' concept with natural and pure ( $f=30$ ) and organic fruits and vegetables ( $f=3$ ). A few of pre-service teachers defined 'organic' as a substance containing C, H and O elements ( $f=2$ ). Pre-service teachers mostly learned this concept in daily life ( $f=17$ ) and school ( $f=13$ ).

As can be seen in Figure 12, pre-service teachers related 'organic' concept with natural and pure ( $f=16$ ) and they defined it as a substance containing C, H and O elements ( $f=11$ ). A few of pre-service teachers related 'organic' with organic fruits and vegetables ( $f=3$ ). Most of pre-service teachers found the chemistry course effective at understanding the meaning of the 'organic' concept ( $f=15$ ) because they stated that they learned in detail ( $f=5$ ) and by observation in the course ( $f=1$ ).

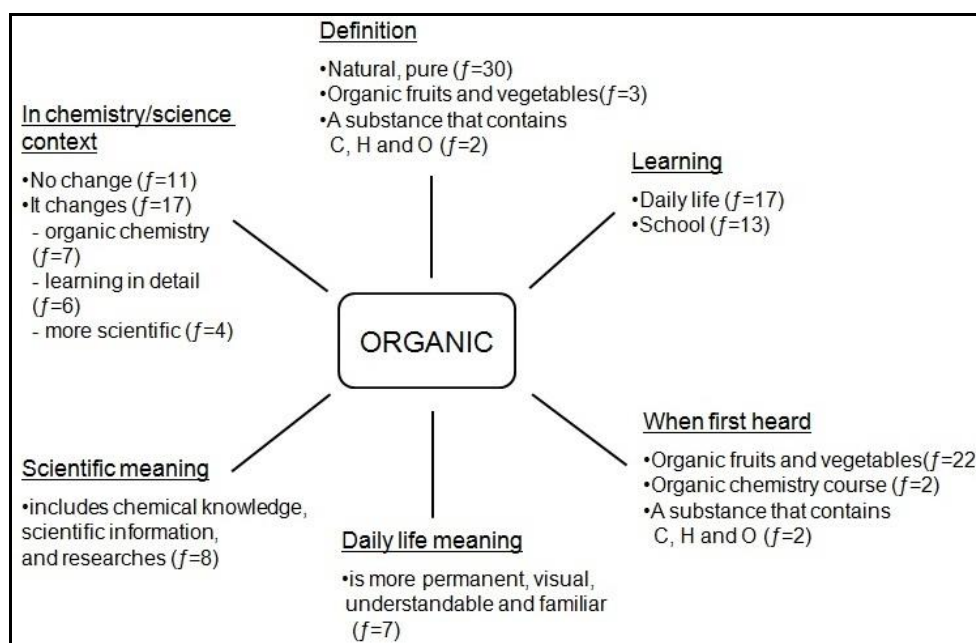


Figure 11. Pre-service teachers' initial understandings of 'organic' concept

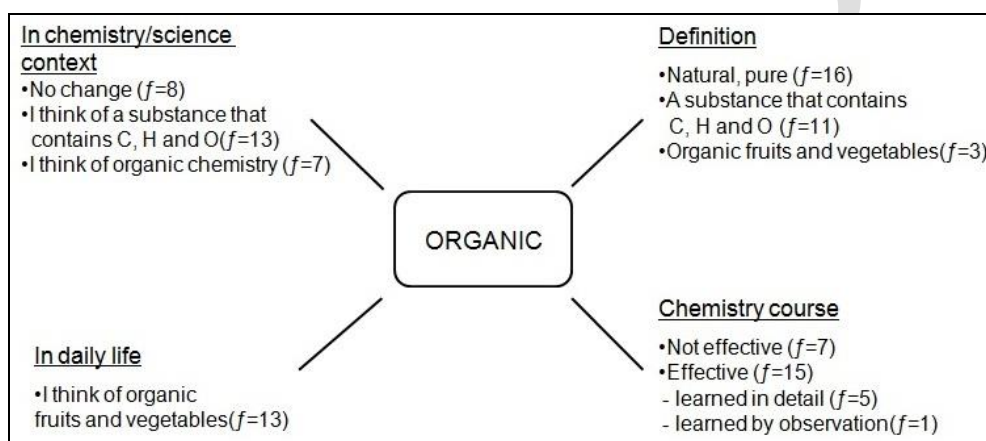


Figure 12. Pre-service teachers' final understandings of 'organic' concept

Before the instruction, pre-service teachers often defined the 'organic' concept by its everyday meaning. The reason of this may be pre-service teachers did not have many opportunities to use them in scientific contexts (Song & Carheden, 2014). Pre-service teachers mostly related 'organic' concept with natural and pure because they often saw some news about a fruit or vegetable was organic if it was grown naturally. It was also understood that pre-service teachers' knowledge about 'organic' was limited with organic fruits and vegetables and being natural. A few pre-service teachers related 'organic' concept with a substance containing carbon, hydrogen and oxygen atoms. After the instruction, most of pre-service teachers kept using 'natural and pure' to define 'organic' concept. It shows that the everyday meanings of 'organic' concept were rooted in pre-service teachers' thinking after instruction so that they struggled with retaining the scientific meanings of it (Song & Carheden, 2014). In addition, some pre-service teachers learned the scientific meaning of 'organic' and used it in their responses. On the other hand, they still continued to think organic fruits and vegetables in daily life context. This shows us that pre-service teachers' everyday meanings and ways of using language differed from those of science (Warren et al., 2001). According to Itza-Ortiz et al. (2003), students give different responses depending upon the context. For instance, they make a scientific explanation

if the teacher asks the question in a scientific context; they say the daily life meaning of the concept, if the question is asked in a daily life context.

### 'Salt' Concept

Pre-service teachers' initial and final understandings of 'salt' concept are shown in Figure 13 and 14.

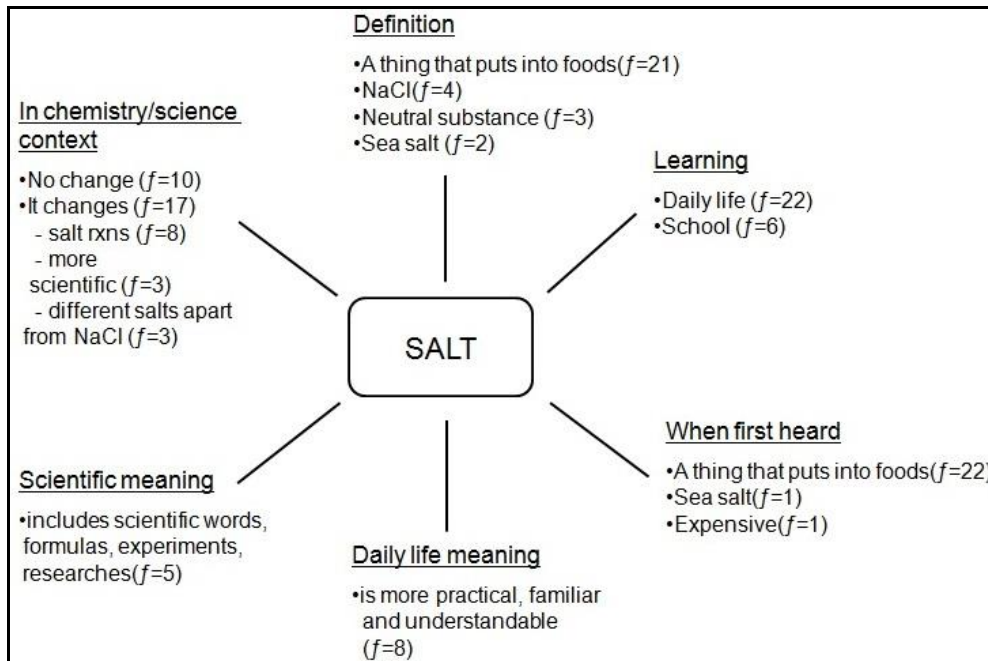


Figure 13. Pre-service teachers' initial understandings of 'salt' concept

In Figure 13, most of pre-service teachers defined 'salt' concept as a thing that can be put into foods ( $f=21$ ) in pretest. Some of them related 'salt' concept with NaCl ( $f=4$ ), neutral substance ( $f=3$ ) and sea salt ( $f=2$ ). Because 'salt' concept was frequently used in daily life, most of pre-service teachers stated that they had learned this concept in their daily lives during eating something ( $f=22$ ). A few of them stated that they learned the scientific meaning of the concept in school ( $f=6$ ), although they had heard in their daily lives before school. Because pre-service teacher found the daily life meaning was more practical, familiar and understandable ( $f=8$ ), 'a thing that can be put into foods' came in their minds ( $f=22$ ) when they firstly heard 'salt'.

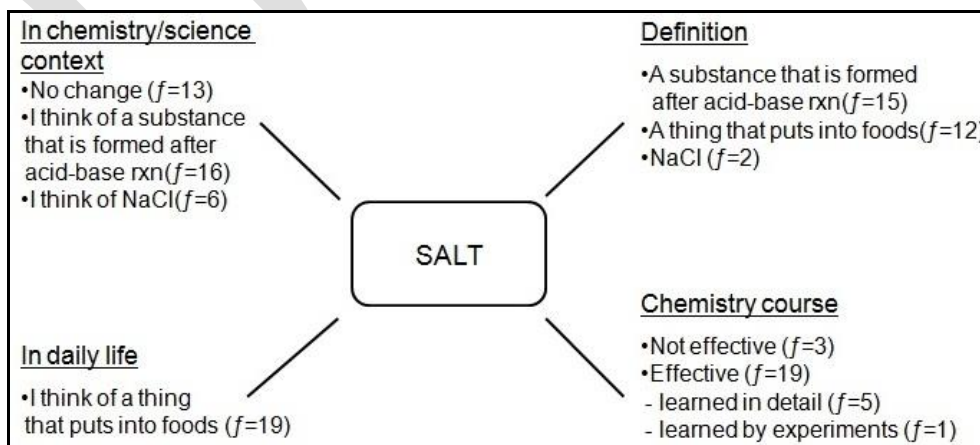


Figure 14. Pre-service teachers' final understandings of 'salt' concept

According to Figure 14, pre-service teachers defined 'salt' as a substance that was formed as a resultant of acid-base reaction ( $f=15$ ) in posttest. But many of pre-service teachers held the thought that 'salt' was a thing that can be put into foods ( $f=12$ ) and NaCl ( $f=2$ ).

Another dual meaning word was 'salt' which pre-service teachers faced much more time before school. Besides, most of them stated that they had learned this concept in their daily lives during eating. Pre-service teachers defined 'salt' as a thing that can be put into foods before the instruction. It was acceptable because 'salt' concept has different meanings from those in chemistry. After the instruction, half of the pre-service teachers could have explained 'salt' scientifically while anyone could not have explained in the pretest. It shows that the chemistry course was effective as seen in their responses about the course. But still, most of pre-service teachers insisted on thinking 'salt' as a thing that can be put into foods in daily life context. Even if they knew the scientific meaning of the word, they insisted on using everyday meaning (Itza-Ortiz et al., 2003). This confusion can be overcome by using 'double talk' (Brown & Spang, 2008). In double talk, teacher provides a definition for students they assume is not familiar with an idea, the teacher may choose to offer two versions of the idea like, "salt is a chemical compound, it is formed from the reaction between an acid and a base". Thus, pre-service teachers hear the scientific definition with the dual meaning word and they do not imagine the daily life meaning all the time when they hear the word.

### 'Stable' Concept

Pre-service teachers' initial and final understandings of 'stable' concept are shown in Figure 15 and 16.

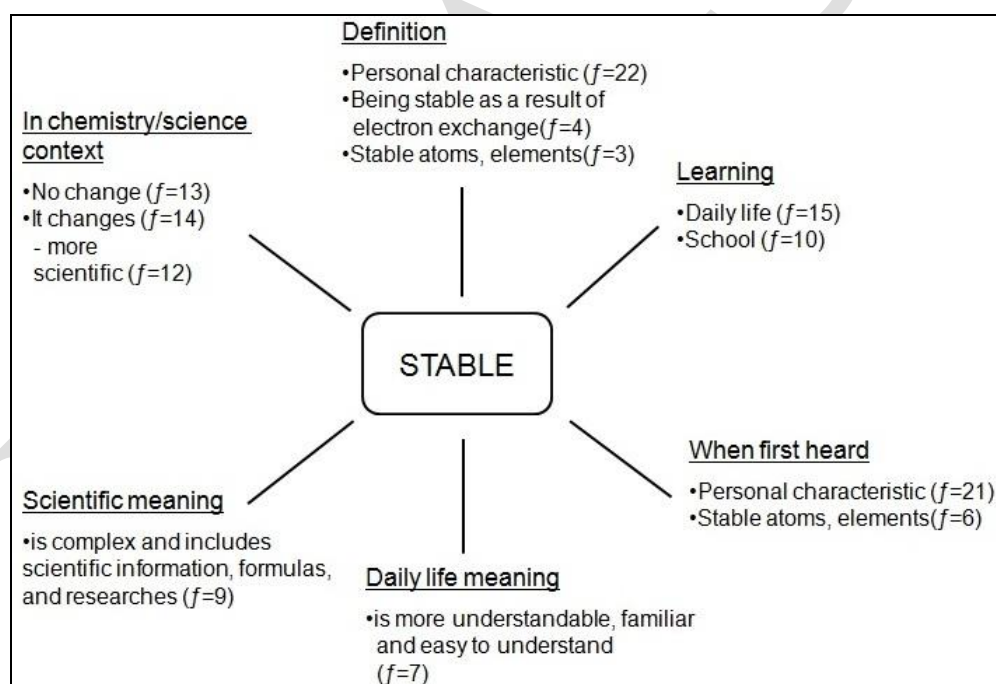


Figure 15. Pre-service teachers' initial understandings of 'stable' concept

As can be seen in Figure 15, most of pre-service teachers related 'stable' concept with personal characteristic ( $f=22$ ) and stable atoms and elements ( $f=3$ ). Some of them defined 'stable' as a result of electron exchange ( $f=4$ ). Most of pre-service teachers learned this concept in their daily lives ( $f=15$ ), while some learned in school ( $f=10$ ). Pre-service teachers found the scientific meaning was difficult because it was complex and included scientific information, formulas and researches ( $f=9$ ).

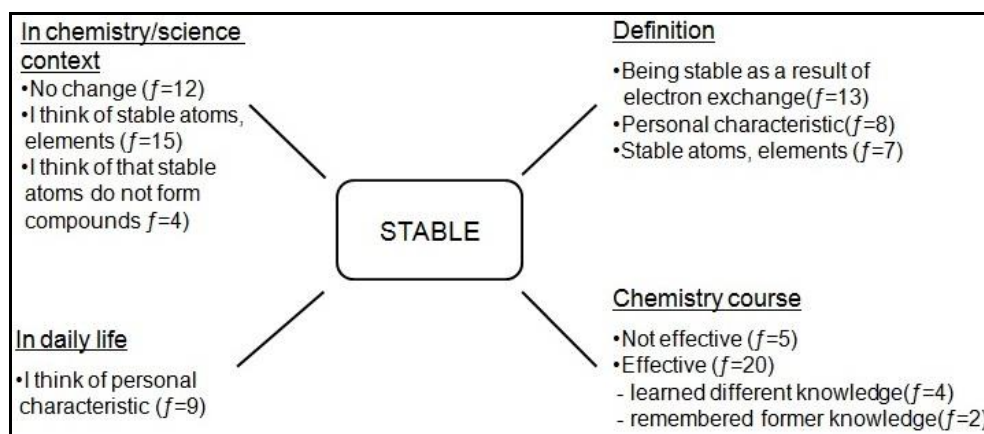


Figure 16. Pre-service teachers' final understandings of 'stable' concept

According to Figure 16, pre-service teachers defined 'stable' as a result of electron exchange ( $f=13$ ). Some of pre-service teachers related 'stable' with personal characteristic ( $f=8$ ) and stable atoms and elements ( $f=7$ ). Most of pre-service teachers found the chemistry course effective ( $f=20$ ) at learning the meaning of the concept because they stated that they learned different knowledge ( $f=4$ ) and remembered former knowledge in the course ( $f=2$ ).

When pre-service teachers' understandings of 'stable' concept, it was seen that they related it with a personal characteristic which meant 'self-confident' in English. Because the dual meaning word 'stable' had many different meanings in scientific and daily life contexts, pre-service teachers preferred to remind the daily life meanings as happened in the other dual meaning words. After the instruction, most of pre-service teachers defined 'stable' as a state of happened after electron exchange. In these scientific explanations, traditional chemistry teaching was effective but some pre-service teachers still held the idea of 'self-confident' as a personal characteristic. The results of the questionnaire indicated that, although the majority of students were able to "correctly" contextualize the meaning of stable, significant confusion still remained. This problem may be associated with an inability to contextualize, a lack of conceptual understanding, or some combination of the two (Jasien, 2010).

## CONCLUSIONS

The research findings reported here suggest that pre-service teachers mostly constructed the dual meaning words in their daily lives in this study because they met them before formal education. So, it was quite difficult to change their understandings. When these pre-service teachers learned the dual meaning words scientifically, they continued to use both scientific and daily life meanings together. The reason of this was explained by pre-service teachers as being more familiar to daily life meanings of dual meaning words. This can be overcome by providing much more opportunities to use dual meaning words in scientific contexts (Song & Carheden, 2014). For instance, pre-service teachers should be given some opportunities to make experiments in chemistry laboratories because it is well-known that learning becomes meaningful and permanent by hands-on activities (Domin, 1999).

As Jasien (2011) reported in his study, some dual meaning chemistry concepts often assign strange meanings to well-known colloquial words and present a special problem when chemists require an exact meaning in a given context. In this research, all concepts have different meanings from their daily life meanings. After the instruction, majority of pre-service teachers learned the scientific meanings, they used scientific meanings in a scientific context, and they continued to use daily life meanings in a daily life context as found in other studies in the literature (Itza-Ortiz et al., 2003; Jasien, 2011; Warren et al., 2001). This may be associated with their inability to contextualize and a lack of conceptual understanding (Jasien, 2010). It can be suggested that to use context-based learning approach may provide students the needed context to understand the concepts in their scientific

contexts. Context-based learning approach provides the relevant contexts that contribute positively to the learning of the concepts (Ültay, 2017). In this sense, it is expressed that an effective learning takes place if students can relate a concept and its practices to the real world that includes their own culture, family or friends (Tekbiyik, 2010; Yam, 2005).

In developing world, to be an informed citizen, it is becoming important to have an understanding of the science and processes of science (Holbrook & Rannikmae, 2007; Miller, 2005). This can be provided as follows: Teachers can support their speeches by using 'double talk' (Brown & Spang, 2008). For example the teacher may provide two versions of the meaning (scientific and daily life). Pre-service teachers hear the scientific definition with the dual meaning word and they do not imagine the daily life meaning all the time when they hear the word. If pre-service teachers' first understandings including alternative conceptions or misconceptions are not taken into account, in following stages of learning, it will be impossible to change their hard-core understandings (Lakatos, 1970).

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