EXTENDED SUMMARY

It can be try to determine pre-service science teachers’ understandings at physical (change of state of matter) and chemical changing (chemical reaction of CH₄ with O₂) of the particulate nature of matter topic in this research.

METHOD

In this research it was used survey method in order to determine pre-service science teachers’ understandings of the particulate nature of matter topic at micro level.

The sample of research was consisted of 57 pre-service science teachers who studied in the third level undergraduate of science teacher education program.

For collecting data it was used The Particulate Nature of Matter Test (PNMT) which contains two open-ended questions. It was applied to expert views for validity. In order to analyze data, it was formed categories from answers of pre-service teachers and done descriptive statistics.

Pre-service science teachers’ drawings related to topic was classified at three categories as “true scientific drawings”, “drawings contain misconceptions” and “false drawings/free”.

RESULTS & DISCUSSION

According to the first question of the PNMT, it was seen that most of the pre-service science teachers knew that solid state of matter and its properties like intermolecular distances are too few. According to their drawings, pre-service science teachers have some misconceptions related to the liquid and gas states of matter and phase changing points. Adadan (2014a), Griffiths and Preston (1992) and Meseci et al. (2013) determined that students drew the state of liquid phase as false at the most, similarly. According to these results it can be inferred that most of the pre-service science teachers did not drew their views about the state of matter. Similarly, most of the pre-service science teachers cannot understood liquid-gas and gas states of matter at micro level. However, Canbazoglu et al. (2010) found that pre-service science teachers knew intermolecular forces of different phases of matter in their research.

Pre-service science teachers who drew correctly of the particles’ position of during the change of state of matter as scientifically know the decrease the amount of matter at an opening pot during the heating process, intermolecular distances are too few at solids, in liquids intermolecular distances are a little more than solids and intermolecular distances gases are the highest. But, only Pre-service Science Teacher 8 (PST₈) expressed “evaporation occurs each temperature” and showed this in his drawing. According to pre-service science teachers’ expressions and drawings, it can be inferred that these pre-service science teachers ignored or not to know evaporation occurs at each temperature because they expressed that it is decreased the amount of matter at an opening pot during the heating process. According to this, it can be said that most of them know the state of matter but they cannot draw at micro level. Students tend to explain events at macro level, they do not consider particles and thus micro level. This situation determined in several researches like Adadan, (2014a), Martín Del Pozo and Porlán (2001), Ozmen (2011) and Stavridou and Solomonidou (1998).

Also, some of the pre-service science teachers thought that during the changing state of matter a physical changing is occurred and the particulate nature of matter is changed. These results was existed in literature (Ahtee & Varjola, 1998; Boujouda, 1992; Demircioglu et al., 2012; Kabapinar & Adik, 2005; Novak & Musonda, 1991; Solsona & De Jong, 2003; Stavridou & Solomonidou, 1998), too.

According to the second question of the PNMT, most of the pre-service science teachers cannot showed the particulate nature of matter in a chemical reaction as correctly. Pre-service science teachers who drew correctly as scientifically showed molecular geometry of reactants and products in a chemical reaction correctly and paid attention number of moles in the reaction.

According to drawings contain misconceptions, some pre-service science teachers ignored the amount of reactants and products, they showed intermolecular forces as false, did not know molecular geometry of compounds exactly, and drew molecules as atomic state. Similarly, it was determined students did not explain events at micro level in Abraham et al. (1994), Callik et al. (2006) and Demircioglu et al. (2012) studies.
CONCLUSION & IMPLEMENTATION

According to drawings of the first question, most of the pre-service science teachers have some misconceptions related to liquid and gas phases of matter. Some of the pre-service science teachers knew that intermolecular forces as true, however, it was seen that most of the pre-service science teachers cannot drew their views related to the state of matter on their drawings. Another important result of this study was that pre-service science teachers ignore evaporation occurs each temperature. Although some of them know evaporation that occurs each temperature, they ignored a decrease of matter amount in an opening pot at micro level. This situation can be originate from not to be careful their drawing by pre-service science teachers. Because they expressed in their explaining matter amount will decrease with time.

Some of the pre-service science teachers like PST3 showed H2O particles different symbols at solid, liquid and gas state during the change of state. According to this situation, it can be said that they think that particles’ structure is changing during the change of state. Griffiths and Preston (1992) found students thought that atoms’ size, shape and weight are changing during the change of state. In some of the drawings which contain misconceptions, pre-service science teachers showed particles as molecular shape but they ignored intermolecular forces among particles. With reference to this, it can be said that pre-service science teachers like PST3 do not know illustration of intermolecular forces exactly.

According to drawings of the second question, most of the pre-service teachers attended to research cannot show correctly of illustration of reactants and products of a chemical reaction at micro level. According to true scientifically drawings, pre-service science teachers took care of matter amount and molecular geometry of reactants and products during the reaction process. It was seen that some pre-service science teachers did not know exactly molecular geometry of molecules in a chemical reaction, ignored the amount of matter at reactants and products of reaction, showed intermolecular bonds as false and showed molecules as atoms. On the basis of showing intermolecular bonds as false, it can be effective that they have lacking knowledge related to topic, do not know elements’ valence in compounds, do not know which element want to give electron or which element want to take electron in its compound in a molecule. With regard to these results, it can be concluded that most of the pre-service science teachers cannot understand matters at micro level which are reactants and products of a chemical reaction.

With respect to a lot of researches in chemistry contains several conceptions at micro level and seem as a difficult subject so, it is not understood effectively by students (Acar & Tarhan, 2008; Adadan, 2012; Demircioglu, et al., 2012; Haigh et al., 2011; Kalin & Arikil, 2010; Ultay & Calik, 2012; Wheeldon et al., 2012). The particulate nature of matter topic is one of the misunderstand topic of chemistry because of containing abstract concepts. It was determined that relating correctly of macroscopic, microscopic, and symbolic level of chemical concepts facilitates understanding of chemistry (Gabel & Bunce, 1994; Pekdag & Le Maréchal, 2010; Sanger et al., 2000). From this point of view, it is needed different techniques or methods like animations and models which keep in view among three level, are focused on students and provide to attending of students on studies actively in order to provide to understand chemical concepts correctly and exactly.

If it thought that pre-service science teachers will be a science teacher in future, for not to fall into misconceptions of students, firstly it must be determined of pre-service science teachers’ misconceptions in which point of subject and what their problems are related to subject. In addition, it should be need new researches related to topic and it should be provide to vitalize the topic at micro level in their mind as correctly.