Prospective Chemistry Teachers' Understanding of Boiling: A Phenomenological Study

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Abstract

This study investigates chemistry prospective teachers' views regarding boiling phenomenon, and provides a concept analysis on the nature of boiling together with suggestions on how to teach boiling phenomenon in the light of literature and findings of this study. The sample of this study consists of 18 senior prospective chemistry teachers who attend chemistry teacher training program. Data were collected by discussions with the participants. The discussions were specifically focused on prospective teachers' understanding of "internal pressure" and "vapor pressure" concepts which are often used in defining boiling point. The results showed that students have serious misconceptions on boiling phenomena. Finally, to remediate those misconceptions and to lead conceptual learning, a concept analysis and suggestions for teaching were presented in the light of the findings of this study and the literature.

Keywords: boiling, misconception, phenomenology, concept analysis

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Extended Summary

Purpose

Studies aiming to determine students' understanding of boiling indicates that students do not realize the phenomenon conceptually and they hold some misconceptions. This is agree with our findings obtained through both informal interviews with students and teaching experiences in class. However, these studies do not provide a content that can be puroposed for teaching the concept for deep understanding. They only focuss on determining the students' difficulties in understanding of boiling. The same is also correct for textbooks giving only definition of boiling point without a conceptual content. So, this study intended to investigate chemistry prospective teachers' views regarding boiling phenomenon, and to provide a concept analysis on the nature of boiling together with suggestions on how to teach boiling phenomenon in the light of literature and findings of this study.

Method

This study consists of concept analysis including probing students' deep understanding, determining their learning level and possible misconceptions, and some suggestions to be able to remediate or able to prevent misconceptions about boiling phenomenon. Therefore, doing only qualitative description of current case and the nature of boiling is being discussed. The sample of this study consists of 18 senior prospective chemistry teachers who attended chemistry teacher training program. Data were collected by discussions with the participants. The discussions were specifically focused on prospective teachers' understanding of "internal pressure" and "vapor pressure" concepts which are often used in defining boiling point. All discussions were video recorded. The analysis of findings were done by transcribing students' responses in the records.

Results

The students' responses about the definition of boiling are as follows: *the temperature in which internal pressure of liquid is equal to atmospheric pressure, the temperature in which vapor pressure of liquid is equal to atmospheric pressure.*

Some of the students' responses relating to meaning of internal pressure is as follows: *liquid's own pressure, the pressure on container walls by liquid molecules in motion, the pressure in equilibrium in container, the pressure exerted by surface molecules to evaporate.* Above responses show that the students have inadequte understanding of internal pressure. Secondly, the students are required to answer what vapor pressure is and some responses is here: *the pressure exerted on liquid surface by evaporated molecules, the pressure after vapor above liquid come to equilibrium, the pressure of liquid molecules, the pressure in the balloon, the pressure of molecules just under liquid surface.* These responses indicate that students could not make any connection between pressure within bubbles and vapor or internal pressure stated in the definition.

Discussion

The findings of the study showed that even undergraduate students do not have sufficient conceptual understanding of boiling concept. The participant prospective students successfully state boiling point as "the temperature in which internal pressure of liquid is equal to atmospheric pressure" or "the temperature in which vapor pressure of liquid is equal to atmospheric pressure" as placed in many textbooks. But many of them could not go any further and do not display acceptable conceptual understanding of boiling. They remained at the level of "knowledge" according to Bloom's Taxonomy. Moreover, they had some important misconceptions.

Conclusion

Both this study and others in literacy display the necessity of using different strategies in teaching the subject of boiling in textbooks and during insruction. Mostly, it is acceptable to simply give definition of boiling point and it is thought that there is no need to go any further of the definition or to make any explanation about the concept. It is appear that only giving definitions is not enough in developing a conceptual understanding. So, it can be said that the nature of boiling should be probed deeply by taking into account the followings: *how to decide boiling is taking place, how bubbles occur in water, what vapor or internal pressure in the definition of boiling mean, whether bubbles occur or not in water before boiling, the stability mechanism of bubbles in boiling water, how vapor pressure is equal to atmospheric pressure, and the misconceptions held by students.*

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