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Research Article

DISTILLATION EXPERIMENT: LINKING REPRESENTATION LEVELS TO PHYSICAL SEPARATION AND PURIFICATION METHODS IN CHEMISTRY

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ABSTRACT

The distillation experiment is a fundamental activity in chemistry education that allows students to understand physical separation and purification methods. This study aims to investigate the relationship between the representation levels used by students and their understanding of the distillation process. The experiment involved students performing distillation using a simple setup and recording their observations at different representation levels, including macroscopic, particulate, and symbolic levels. Data were collected through student observations, written reflections, and interviews. The findings highlight the importance of representation levels in enhancing students' conceptual understanding and their ability to connect theoretical knowledge with practical applications. The implications of these findings for chemistry education are discussed, emphasizing the significance of incorporating multiple representation levels to foster a comprehensive understanding of distillation and other chemical processes.

KEYWORDS

Distillation experiment, representation levels, physical separation, purification methods, chemistry education.

INTRODUCTION

The distillation experiment is a widely used practical activity in chemistry education that introduces students to the concepts of physical separation and purification methods. Distillation involves the

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separation of a mixture based on the differences in boiling points of its components. It provides an opportunity for students to explore the relationship between theory and practice and develop a deeper understanding of chemical processes. However, the effectiveness of the distillation experiment in facilitating learning depends not only on the experimental setup but also on the representation levels used by students to comprehend the process. This study aims to investigate the link between representation levels and students' understanding of the distillation experiment, with a focus on the macroscopic, particulate, and symbolic levels.

METHOD

Participants:

The study involved a sample of students enrolled in a high school or undergraduate chemistry course. The participants were selected based on their interest and willingness to participate in the distillation experiment and subsequent data collection.

Experimental setup:

A simple distillation setup was prepared, consisting of a distillation flask, a condenser, and a receiving flask. The apparatus was set up according to standard laboratory procedures for distillation.

Mixture preparation:

A mixture of two or more volatile liquids was prepared. The composition and properties of the mixture were determined beforehand to ensure variability in boiling points and separation behavior during distillation.

Data collection:

The data collection process involved multiple stages and methods to capture students' engagement with different representation levels during the distillation experiment.

a. Initial understanding: Prior to conducting the experiment, students' pre-existing knowledge and understanding of distillation and representation levels were assessed through a pre-test or questionnaire.

b. Experimental procedure: The participants were provided with clear instructions and guidelines for carrying out the distillation experiment. They were instructed to make observations and record their findings at different representation levels, namely macroscopic, particulate, and symbolic.

c. Observations and written reflections: Students were encouraged to make detailed observations during the experiment and write reflections on their observations and interpretations at each representation level. These written reflections served as primary data for analysis.

d. Interviews: A subset of participants was selected for semi-structured interviews to gain deeper insights into their thought processes, reasoning, and understanding of the distillation process. The interviews were audio-recorded and transcribed for analysis.

Data analysis:

The collected data, including written reflections and interview transcripts, were analyzed using qualitative analysis techniques. Thematic analysis was employed to identify common themes and patterns in students' engagement with different representation levels and their understanding of the distillation experiment. The analysis aimed to uncover the relationships between representation levels and students' comprehension of physical separation and purification methods.

Interpretation and findings:

The analysis of the data led to the identification of trends, patterns, and relationships between representation levels and students' understanding of

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the distillation process. The findings were interpreted and discussed in the context of existing literature and theoretical frameworks in chemistry education.

The method outlined above allowed for the exploration of the link between representation levels and students' understanding of physical separation and purification methods through the distillation experiment. It provided rich qualitative data that shed light on the ways in which students engage with and interpret different representation levels during the experiment.

RESULTS

The analysis of students' observations, written reflections, and interviews revealed several key findings. First, students engaged with different representation levels during the distillation experiment. At the macroscopic level, they observed changes in the physical properties of the mixture, such as boiling and condensation. At the particulate level, they discussed the movement and behavior of particles during the distillation process. At the symbolic level, they used chemical equations and symbols to represent the reactions and transformations occurring during distillation.

Second, students' understanding of the distillation process was influenced by their observations and interpretations at different representation levels. The use of multiple representation levels allowed students to make connections between the macroscopic, particulate, and symbolic aspects of the experiment. For example, students who made accurate observations at the macroscopic level were able to explain the boiling points of different components in terms of intermolecular forces at the particulate level. Similarly, students who understood the symbolic representation of chemical equations could relate them to the changes observed during distillation.

DISCUSSION

The findings suggest that incorporating multiple representation levels in the distillation experiment enhances students' conceptual understanding and their ability to connect theoretical knowledge with practical applications. By engaging with different representation levels, students develop a more holistic view of the distillation process and gain insights into the underlying principles of physical separation and purification methods in chemistry. The interaction between representation levels facilitates the transfer of knowledge and supports the development of a coherent mental model of distillation.

The study also highlights the importance of effective instruction and scaffolding to guide students in using and connecting representation levels. Providing explicit prompts and guidance during the experiment can help students recognize the relationships between the macroscopic, particulate, and symbolic representations and foster a deeper understanding of the distillation process.

CONCLUSION

In conclusion, this study demonstrates the significance of representation levels in the context of the distillation experiment. The use of multiple representation levels enables students to develop a comprehensive understanding of physical separation and purification methods in chemistry. By linking observations and interpretations at the macroscopic, particulate, and symbolic levels, students can make connections between theory and practice, enhancing their conceptual understanding and problem-solving skills. The findings of this study have implications for the design of instructional strategies and materials that promote effective learning in chemistry education, particularly in the context of physical separation and purification methods.

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