

THE IMPLEMENTATION OF SUB-MICRO IMAGERY ON TEACHING OF ELECTROLYTIC DISSOCIATION

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The role of visualization and sub-microscopic imagery in contemporary education and research is becoming increasingly significant, particularly within the context of science education. Numerous cognitive studies indicate that the human brain processes visual information more rapidly and efficiently than textual data, which enhances comprehension, conceptual integration, and long-term retention. In disciplines such as chemistry, biology, and physics, where many processes occur at the atomic or molecular level and are not directly observable, sub-microscopic representations serve as an essential pedagogical bridge between abstract theory and conceptual understanding. By enabling students to visualize particles, ions, and molecular interactions, these tools contribute to the formation of scientifically accurate mental models.

Sub-micro imagery, defined as highly detailed visual representations of structures and processes at the atomic and molecular scale, facilitates the clarification of complex phenomena. In chemistry education, for example, the visualization of ionic dissociation, molecular geometry, and intermolecular interactions allows learners to move beyond rote memorization toward mechanistic and analytical reasoning. The integration of visualization technologies—such as digital simulations, animated diagrams, and particle-level models—stimulates students' cognitive engagement and supports the development of higher-order thinking skills.

The present research was conducted with 8th-grade secondary school students to examine the impact of sub-micro imagery and visualization tools on analytical thinking, memory retention, and problem-solving skills. The chemistry topic “Electrolytic Dissociation” was selected due to its abstract nature and reliance on particle-level understanding. A total of 20 students participated in the study and were divided into two groups: an experimental group and a control group, each consisting of 10 students. In the experimental group, instructional content was delivered using sub-microscopic visualizations illustrating the dissociation of sodium chloride (NaCl) in water (Fig.1), whereas the control group received instruction through traditional, lecture-based methods.

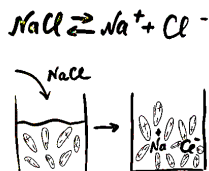


Fig. 1. Submicroscopic imagery of dissociation of sodium chloride

To ensure methodological rigor, data were collected using pre-tests and post-tests designed to assess analytical reasoning, memory, and problem-solving ability. In addition, structured classroom observations and semi-structured student interviews were conducted to obtain qualitative insights into students' engagement and attitudes. Statistical comparison of pre- and post-test results revealed substantial differences between the two groups.

The findings demonstrated that analytical thinking ability improved by 60 % in the experimental group, compared to a 20 % increase in the control group. Memory retention and comprehension scores increased by 70 % in the experimental group, while the control group exhibited a 20 % improvement. Problem-solving skills showed the most pronounced growth, with an 80 % increase in the experimental group versus a 30 % increase in the control group. Furthermore, 90 % of students in the experimental group reported heightened interest and motivation during lessons, compared to 40 % in the control group.

In conclusion, the integration of sub-micro imagery and visualization technologies significantly enhances students' cognitive development and academic performance. These tools promote deeper conceptual understanding, strengthen analytical reasoning, and foster sustained engagement. The findings suggest that incorporating structured visual representations into science instruction can substantially improve the effectiveness and productivity of the learning process.