Learning Chemistry Using Analogies

M.M. Jamila[1] and S. Karunaratne[2*]

[1]Postgraduate Institute of Science, [2]Faculty of Science, University of Peradeniya

Introduction

In Sri Lankan schools, students in the GCE advanced level science classes study chemistry as a subject. They generally consider chemistry as a difficult subject to learn because of its abstract nature of the concepts. The content of chemistry deals with chemical processes and entities that are submicroscopic, which make the subject difficult for students who do not readily visualize or think at abstract levels. In the normal classrooms, teachers generally do not use audio visual aids or other teaching techniques to make the content easier to understand. Frieedal *et al.*, (1990) found that the use of analogies in teaching chemistry at secondary level enabled to help students in their learning process. The aim of this study was to use analogies in teaching chemistry at GCE advanced level to promote learning without encountering problems.

Methodology

The study was conducted in three phases. In the first phase, one classroom was observed in an urban school when teaching chemistry lessons on the sub-topic, "Chemical Equilibrium" of the twelfth unit of the GCE advanced level chemistry syllabus in order to understand the problems faced by teachers and students in the classroom. After studying several research reports on analogies, lessons with activities based on analogies were developed in the second phase of the study to provide visualization of the abstract nature of concepts relating to real world applications and to encourage the teachers to consider students' prior knowledge. Some of the analogies used were a boy and an escalator, a man swimming against the current, ants and a meter ruler, and a sailor and a boat, to build up the concept of dynamic equilibrium. As a part of the teaching/learning process, assessment activities were also developed using new analogies for which the students were not familiar in the class. This enabled the researchers to gauge the level of understanding of students. Further discussions were also made with teachers who were going to implement the planned lessons in order to get a clear understanding of analogies.

In the third phase of the study, four classrooms were selected from four other urban schools. Two classrooms were treated as the control group (n=45) and the other two classrooms were treated as the experimental group (n=45). A pre-test was administered to all classes in both control and experimental groups. The two teachers in the control group classrooms used their own teaching method. Developed lessons were tried out by the two teachers in the classrooms of the experimental group. They also used the same number of periods used by the teachers in the control group. The classrooms were observed while implementing the prepared lessons to identify how analogical strategies help students in learning. A post-test was administered to all four classes after the completion of teaching the unit. Data were analyzed using the results of the pre-test and the post-test using the two sample t-test.

Results and discussion

It was found out that most of the time, the students in the control group classrooms only listened to their teacher passively with no questioning or without doing any activity in the learning process. They were conscious in taking down notes given by the teacher. Discussions with the teachers on developed lessons revealed that they were enthusiastic in using analogies. They enjoyed practicing the analogies in their teaching and expressed that they wanted to try analogies for some other units too. Teachers were also able to give some other analogies with the practice for individual students who indicated lack of understanding. According to the teachers, analogies helped them to explain easily the difficult or challenging ideas and to present abstract nature of concepts in a simple way. Student interviews revealed that they felt comfortable in learning chemistry as analogies helped them to understand and remember the lesson more easily than they would be without the analogies. For example one student said, "*I like the analogies. They break up the class. We do not want just to look at the blackboard and take down notes. They help me learn difficult ideas easily. It's really fun.*" Another student

said, "*I think it's really important to give an analogy without explaining more and more when we get confused.*" Pictorial analogies seemed to clear up confusion about the analogue concept that teachers were using. The students also thought that analogies would be useful to explain or describe objects or processes that are too small that they cannot be seen with the naked eye. One student said, "*Whenever the concepts that the teacher teaches at a level that we actually cannot see what's going on, it's good to use analogies.*" At the end of the lessons some students were able to make some analogies based on concepts relating to their real world experiences.

Analysis of the pre-test results showed that there was no difference between mean values of control (49.2) and experimental groups (49.0). Standard deviations were 12.8 and 14.4, respectively. Using the two sample t-test, it was found that there was no significant difference at p=0.05 between the control group and the experimental group of the pre-test results. Analysis of the post-test results showed that there was a difference between mean values of the control (32.29) and experimental groups (83.07). Standard deviations were 10.48 and 9.43, respectively. Using the two sample t-test, it was found that there was a significant difference at p=0.05 between the control group and the experimental group.

Conclusions

Analogies had a motivational impact on the students. Students could be made interested to learn abstract concepts in chemistry by using analogies in classroom teaching. Analogies not only help to explain or introduce difficult concepts in chemical equilibrium but also to make students attentive and actively involved in the lessons. In addition, use of analogies enables to have high interaction between the teacher and students, and among students. It is recommended that teachers need to develop a personal set of useful analogies in their teaching. It is necessary to select appropriate analogies that could be related to students own experience without misleading or confusing them. Otherwise they may lead to misconceptions. Therefore, teachers should pay more attention in selecting analogies for their explanations.

References

Frieedal, A.W., Gabel, D.L. and Samuel, J. (1990) Using analogies for chemistry solving: Does it increase understanding? *School Science and Mathematics,* 90, 674-682.