Perceived difficulty of chemistry units in Std IX for students in Kerala stream Calls for further innovations

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Full text

for

UGC sponsored national seminar
On

Innovations in pedagogy and curriculum: from theory to practice

at

GCTE Thalassery, Kerala

(10 & 11, April 2013)

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Introduction

Chemistry involves in all facets of our lives. Yet, it is cursed as much as it is praised. The mission of any high school chemistry teacher is to sell chemistry as an intellectual pursuit, as a creative science. Unfortunately, many students experience the chemistry curriculum as abstract, difficult to learn and unrelated to the world they live in (De Vos, Bulte & Pilot, 2002; Osborne & Collins, 2001). Chemistry is widely perceived as difficult because of its specialized language, mathematical and abstract conceptual nature, and the amount of content to be learned (Gabel, 1999; Moore, 1989). For the past decade, chemistry scholars and researchers have been trying to explain how students should be helped to understand chemistry better (Ben-Zvi et al. 1986; Gabel 1998; Kozma and Russell 1997; Wu et al. 2001). Mirroring the global pattern, in Kerala secondary school education scenario too, learning chemistry is found difficult for students, as compared to other subjects. This trend is evident in class X board exam results in recent years. The purpose of this investigation is to identify the units in chemistry that the majority of pupils in Kerala find difficult in standard 9.

Students are facing difficulty in understanding chemistry concepts due to the abstract, unobservable, particulate basis of chemistry. This difficulty is magnified, especially in chemistry learning, due the need for rapid transfer among the macroscopic, submicroscopic and symbolic levels of thought (Johnstone 1999). Conceptual understanding in chemistry is related to the ability to explain chemical phenomena through the use of *macroscopic*, *molecular* and *symbolic* levels of representation (Gabel, Samuel & Hunn, 1987; Johnstone, 1993; Gabel & Bunce, 1994; Wu, Krajcik & Soloway, 2001). It is known that when relationships are formed between these three levels of representation, students understand and learn more in chemistry (Sanger, Phelps & Fienhold, 2000).

At the macroscopic or phenomenal level properties can be seen and measured. At the submicroscopic level, molecular structures of the particles cannot be seen, whereas the symbolic level is the way a substance is represented by its chemical formula. While chemists and chemical educators operate across the various levels quickly and easily, students have difficulties

in creating links across these levels. Researchers have been arguing the necessity of learning at macroscopic, microscopic and symbolic levels (Gabel 1998; Johnstone 1993).

Need and significance of the study

Occurring on a molecular level in many chemical phenomena makes learning chemistry difficult (Ben-Zvi, Eylon & Silberstein, 1987; Gabel, Samuel & Hunn, 1987). This is because an understanding of chemistry is based on assigning meaning to the unseen and the intangible (Kozma & Russell, 1997). Many researches abroad have identified that, students in secondary school and in the universities to have many difficulties in understanding chemistry (Ross & Munby, 1991; Griffiths & Preston, 1992; Nakhleh, 1992; Schmidt, 1995; Sanger & Greenbowe, 1997; Stavridou & Solomonidou, 1998; Pınarbaşı & Canpolat, 2003; Sepet, Yılmaz & Morgil, 2004; Agung & Schwartz, 2007; Othman, Treagust & Chandrasegaran, 2008). For this reason, students develop scientifically unacceptable conceptions about many subjects or concepts in chemistry. Their knowledge of chemistry is therefore incomplete and incoherent (Kozma & Russell, 1997). Many students, in fact, merely memorize chemistry concepts without actually learning them (Haidar, 1997; Niaz & Rodriguez, 2000). This situation is an indication of why some students never come to like chemistry.

Research shows that there is a lack of evidence that traditional lectures as well as traditional laboratory activities (Tobin, 1990; Lazarowitz & Tamir, 1994; Hofstein & Lunetta, 2004) in chemistry lessons contribute to promoting meaningful learning. Innovative learning strategies could be used by teachers at all levels of chemistry education to enhance the students' motivation to learn chemistry (Hanson & Wolfskill, 2000; Eybe & Schmidt, 2004). Different strategies can be applied to chemistry teaching with the aim of encouraging students to learn chemistry at the macro, sub micro and symbolic levels.

Learning is actually an interaction between the existing knowledge and new knowledge. The use of appropriate teaching strategies can relate the novel abstract chemistry concepts with the concrete existing chemistry knowledge. Chemistry teachers must make much effort to create an ideal environment for teaching and learning. Teaching needs to present ideas in ways that are authentic representations of the scientific concepts, yet simple enough to be meaningfully understood by the learners. This requires that, attempts be made to pinpoint areas of difficulty in the local contexts of teaching learning. If areas of difficulty are identified, that will encourage teachers to employ innovative strategies in a more economic and focused way to remedy student

difficulties in those areas. Identifying hard spots will encourage researches as well to ameliorate the situation. This study is but a first step in this direction.

Objectives

To identify the most difficult unit in ninth standard chemistry from student perspective and to make suggestion for improvement in the teaching –learning of those areas.

Methodology

A survey was employed to identify the chemistry units in ninth standard that are perceived as being difficult by students in Kerala state stream.

Sample

The sample of this study consists of 1382 standard X students, both males and females, from three high schools from that many revenue districts in Kerala.

Data collection Procedure

Standard IX chemistry text includes six chapters. They are Nature of substances, Separation of mixtures, Periodic table and chemical bonding, World of carbon, Some non-metals in our surroundings, and, Acids and alkalis. A chart listing these chapters was presented in classroom. Necessary instructions were given to students to opt any one unit that he/she thinks the most difficult.

Table.1 - Perceived difficulty in chemistry units in terms of percentage of students identifying the unit as difficult

Sl.No:	Unit name	No: of students	%
1	Periodic Table & Chemical Bonding	851	61.58
2	World of Carbon	213	15.41
3	Separation of mixtures	139	10.06
4	Nature of substances	70	5.07
5	Some Non-metals in our surroundings	70	5.07
6	Acids and Alkalis	39	2.82
	Total	1382	

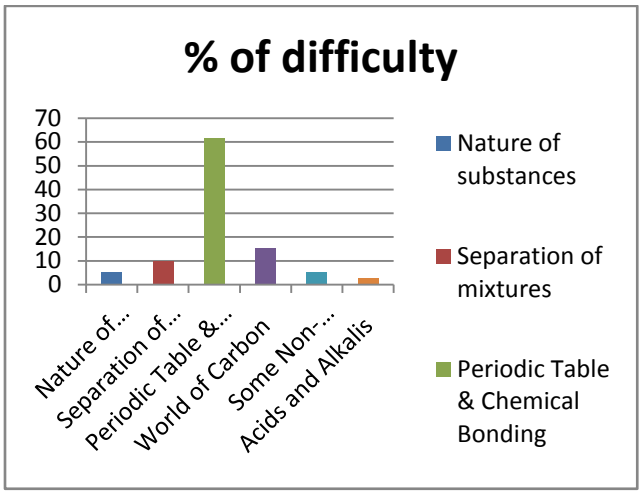

Figure 1. Bar diagram showing percentage of difficulty of different chemistry units. On X axis one unit corresponds to 10%

Findings

The result shows that majority of pupils (61%) faces difficulty in mainly in the unit on Periodic Table & Chemical Bonding. World of Carbon and separation of mixtures are the two other units that more than 10% students found difficult to learn. Units on Nature of substances, Some Non-metals in our surroundings and Acids and Alkalis were least difficult.

Conclusion and Suggestions

Many researchers found difficulties in chemistry in similar to the findings of this study. However, researches are not that agreeing in pinpointing reason for particular topics or units being difficult for students. Nor is there any consensus on ways to reduce student difficulties in chemistry. By analyzing many reasons researchers arrived at developing, implementing and evaluating new instructional strategies to tackle this issue. Innovation in science education can contribute to the favourable learning environment in schools. By adopting innovative

instructional strategies in accordance with the nature of the topic, a teacher can create a good and favourable environment in classroom, which in turn makes further learning easier for students.

For the unit Periodic table and chemical bonding the major process competencies mentioned in the teachers' handbook are listing, categorization, discussion, tabulation and using worksheets. After finding a difficulty in this unit it is clear that teachers should rethink the teaching strategies according to the student need. To learn periodic table easily, interactive periodic table, on line periodic table games and puzzles may be useful. For a better learning in chemical bonding and organic chemistry, worked examples can contribute a lot. Teachers can adopt innovative strategies as concept mapping, concept cartoons, analogies, worked examples too.

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