Re-thinking the teaching of Organic Chemistry in Harbin Institute of Technology

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Abstract

This paper considers the existing problems in the teaching of organic chemistry at the Harbin Institute of Technology and suggests the introduction of contemporary teaching strategies to improve the student learning experience. Modern theories of teaching and learning are considered, e.g., constructivism, and the introduction of teaching strategies for organic chemistry such as problem based learning (PBL), concept mapping and case studies is described.

Introduction

The author participated in *Teaching Science in English*, a professional development course for Chinese University science teachers, a joint project between The University of Sydney and China Scholarship Council. The project supported the need for bilingual (Chinese and English) teaching and exposed the participants to a variety of teaching strategies that encourage active learning.

Studying science is not very popular in many countries. One reason is considered to be that scientific knowledge is taught with an approach that is too content driven and which emphasises the systematic treatment of science too strongly. Therefore, science lessons and science itself do not seem to be relevant to the students, because the content is not taught in a real world context. This perceived lack of relevance leads to low motivation and a lack of interest in science and science learning. (Eilks 2002)

Organic chemistry is one of the most important courses for second year undergraduate students majoring in applied chemistry, polymer chemistry, material chemistry, chemical engineering, life science, and environmental engineering and science in Harbin Institute of Technology (HIT). The main objective of organic chemistry is to provide a basic understanding of its principles, introduce the characteristic of some kinds of organic compounds, learn how to design and synthesise important active compounds and solve some real-life problems.

Organic chemistry teaching at HIT is generally teacher-centred: the teacher organises the content of the teaching and decides on all the activities in the classroom; generally the teacher stands in front of the whole class, demonstrates and explains the lesson. In the so-called 'problem-oriented phrases' the problem given by the teacher is seldom authentic; further, the process of problem solving is often strongly guided by the teacher. It is necessary to rethink the teaching process and make changes.

Modern teaching approach

From a conventional teaching point of view, students are seen to possess little, if any, prior knowledge of the concepts that they are required to learn, particularly with abstract scientific concepts. Constructivists, in contrast, attempt to foster active learning, guiding learners to create their own constructs using a process of peer and teacher-facilitated learning. Under constructivism, the teacher holds a totally different role; that of a facilitator rather than a transmitter of knowledge.

A change in how science is taught as well as what is taught has been the rallying cry behind a national call for education reform that has gained momentum throughout the past decade. The PBL approach uses complex, 'real world' problems to engage student curiosity, motivating them to identify and research the abstract concepts and principles they need to know in order to progress through the problems. Students work together in small groups, bringing together their skill at

acquiring, communicating, and integrating information in a process that resembles that of scientific inquiry.

The aim of instruction must be the training of independently acting and thinking individuals. Chemistry teachers need 'a better in-depth insight into students understanding, learning and difficulties'.

Strategies to introduce into *Organic Chemistry* teaching

Investigations show that people retain 90% of what they say as they do something but only 10% of what they read and only 50% of what they hear (Lagowski 1990). It is important to help students develop a deeper understanding of the discipline. It may be that a completely new curriculum that uses different teaching methods is needed.

Introduce philosophy of chemistry
The new developments in the philosophy of chemistry are beginning to have an impact on chemical educators (Erduran, 2002). The reason why this should be is rather obvious. If teachers want to teach more effectively the most productive approach for them to adopt, is to develop a deeper understanding of the subject matter that they claim to instruct others about. Without any input from philosophy of science, the views of explanations which chemical educators possess must remain tentative, intuitive and largely ill-formed. So, it is essential for chemistry educators to be familiar with the details of the many chemical theories, models and laws which they hope to teach, it is almost more important that they become aware of what theories, models and laws are in general and how they vary in nature within the basic science of chemistry.

Give students more seminar and tutorials
A potential way to improve students' motivation in science teaching may be to design lessons that include discussions about societal issues related to science and about the actual and potential industrial applications of science and technology. Such an approach may also improve students' attitude towards science, and through attitude, achievement. So, research staff and postgraduates should be encouraged to be involved in seminars, and students should have a greater opportunity for discussion and ask more relevant questions. This method will drive student to think more about what they are learning.

Create an active learning environment
Relatively small changes in the tools used to teach and the format of the curriculum may result in significant changes in the learning environment. For example, in large or small lecture theatres interactive lecture demonstrations, which are designed to be used in a traditional teaching context, can be used. Students can be actively engaged by the use of a learning cycle which includes a written prediction of the results of an actual organic chemistry lecture, small group discussion with their nearest neighbors, observation of the organic process in real time with certain tools, and comparison of observation with predictions without changing the lecture structure and the traditional nature of lecture instruction. If the students get the fundamental concepts right, they will have a better chance of understanding the rest of the subject. This can result in significant increase in understanding.

Use of *PowerPoint* and molecular modeling
The fast development of computer technology and software has allowed the field of molecular modeling to become a powerful tool in chemistry, especially in organic chemistry, including at an academic level. Molecular modeling provides a way to correlate theoretical concepts with experimental data. This approach provides students with additional skills for clarifying chemical and theoretical concepts by means of demonstrations in the classroom. Chemical concepts such as conformational analysis, stereochemistry, Infrared spectrometry, molecular and electronic properties, molecular orbitals, and chemical reactivity are emphasised through this approach. In this manner the impact of the active-learning and problem based learning process will be increased, and a student's interest and motivation will be greatly enhanced.

Use of PBL group activities
The most important single factor influencing learning is what the learner already knows (Ausubel, Novak and Hanesian 1978). Starting a lesson by gathering students' prior knowledge is considered to be extremely important. Accordingly, teaching organic chemistry by showing the students various compounds, which are commonly available as advertisements on television in China. The students could be asked to share what they already know and their previous experience with a certain topic. This will lead to high student activity and allows for differentiation among the students. Several groups were divided in the classroom, offering a variety of activities that focus on parts of the common task, in this way they are partially responsible for organising their work.

Use of concept mapping
Concept maps are diagrams in which various forms or lists of information are classified and their linkages are shown. They can be used at the start of a topic, part way through a topic or at the end of it.

Conclusion

Students should be actively involved in the learning process and this in turn will help to strengthen student acceptance and foster a more informed view of the importance of organic chemistry. This will help to increase the relevance of organic chemistry lessons from the students' point of view and help teachers to achieve their educational objectives in the fields of social and communicative skills and personal development.

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