THE ROYAL
SOCIETY OF
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Using the problems

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General

The problems are designed to improve problem solving skills and to encourage cooperative working in small groups. A brief introduction by the teacher is required so that students know the objectives of the learning experience and realise what is expected of them.

Format of the problems

For flexibility of use each problem is set out as both a statement of the problem and as a teacher's guide (including a suggested approach).

Each of the problems starts on a new page. When the problems were trialled the statement of the problem and the suggested approach were photocopied and given to students; this approach worked well and is recommended to teachers. However, teachers are encouraged to modify the problems to suit their particular circumstances. It is unlikely that the suggested approaches will suit all circumstances, and the extended discussion may not always be necessary.

The practical work in some of the practical problems labelled P is small and could be carried out in advance if access to a laboratory is not possible for the main problem solving session; and some of the non-practical problems have extensions which do involve laboratory work and could be incorporated into the main problem solving session.

Objectives

During the trials it was very important to explain the objectives of the learning experience to the students before they attempted the problems. These include:

▼ to improve students' ability to work and communicate with others,[1] and to develop an awareness and control over their own thinking processes;

▼ to give students the opportunity to develop their problem solving skills (see introduction); and

▼ to show students that science is more than 'getting the right answer', and that it does involve using one's judgement, being creative and using lateral or divergent thinking (appendix 1).

Students should know that these skills are not only important in themselves but are highly regarded by employers and the community.

The chemistry underpinning many of the problems is relevant to senior school courses and they can be readily integrated into class teaching.[2] In addition, during trialling it was found that group discussions to find solutions, and the preparation of a presentation to the peer group, helped to clarify concepts, deepened understanding and correct misconceptions.

Student groupings and duration of problems

During the trialling of these problems discussions within groups of students were found to be extremely effective. The size of the class will determine how many groups there are and how many different problems are in use at one time. For classes of about 20, two or perhaps three different problems might be used; whilst for classes of twelve or less one or two different problems would be more suitable. To allow more time for discussion it may be better to give one problem to two groups of

students rather than increasing the number of problems beyond the number recommended.

Each group should make a presentation to the rest of the class and then answer questions and discuss their findings with the rest of the class (see Discussion groups).

It is not possible to give definitive time allocations for each problem, as this depends upon many factors including:

▼ the problem itself;

▼ the number of students;

▼ the ability of the students and their previous experience of these problems; and

▼ the importance the teacher attaches to different parts of the problem (tackling the problem, its presentation and the discussion following the presentation). In practice, the reverse may apply – the time available dictates the number of stages tackled.

When the lesson lasts for about 100 minutes or more it is possible to complete some of the problems along with the presentation and discussion in one day; otherwise the presentation and discussion has to be left until later. The presentation and associated discussion is sufficiently important to warrant the extra time.

An overhead projector with an acetate transparency per group speeds up the presentations because every group can prepare their presentation at the same time; otherwise several groups compete for the use of the blackboard.

Teacher 's role

The teacher's role during the problems is to provide sufficient support to ensure that the students are at least partially successful. Students should be allowed to make mistakes and explore blind alleys provided that this does not take up so much time that it jeopardises success. They should be made to think but given sufficient help, not by giving them answers but by encouragement ('that sounds like a good idea'), by asking appropriate questions or by pointing them in the direction of a suitable textbook. In some of the problems an old inorganic textbook (Parkes and Mellor) proved more useful than an up-to-date book like Cotton and Wilkinson.

After presentation of the problems the group is asked to consider how well they accomplished the task, and discussion becomes more reflective.

Notes

1. 'Communication and interpersonal skills ... are considered to need the greatest development at the commencement of ... employment' from CASupdate no. 1, published by the Careers and Appointments Service of the University of Technology, Sydney, Australia.

2. Some projects have been used for examination revision. Here too, much useful learning took place during discussion. On occasion a misconception would persist through to the presentation, where further discussion, with teacher input as required, could remedy the problem.