[P8] Student-centred problem-based group exercises in molecular biology

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Keywords: molecular biology, problem-based learning, blended learning, experimental design

One challenge when teaching molecular biology is to effectively link the theoretical and practical aspects so that students can gain the skills of experimental design. In these exercises, students work together in groups to design an experimental strategy to solve a particular problem. They work independently from the tutor, who undertakes the role of facilitator for several groups at the same time. Sessions have been run with one tutor facilitating up to eight groups of eight students. This is an added benefit of the exercises; small group teaching in large groups! Students are given a 'real' problem to solve which relates the application of practical techniques to actual situations encountered in industry, medicine or academic science.

Examples include:

> *'How would you use recombinant DNA techniques to produce therapeutic quantities of a medically important protein?'*
>
> *'How would you develop a test to be used in genetic screening for a single gene disorder'*
>
> *'How would you clone a gene involved in the control of the eukaryotic cell cycle'*

Students are presented with an extensive set of researched options at each stage in the experimental design. The sets of researched options are presented as packs of cards. Some of the cards are decision-making and some provide information. Right and wrong decisions can be taken and there is more than one solution to the problem. At the end of the sessions the groups present their final strategies to each other and the tutor facilitates discussions about the approaches chosen. Therefore these exercises not only give students an opportunity to develop their awareness of practical molecular genetics, but also develop interpersonal, analytical and presentation skills. This approach has been used and adapted for all levels of undergraduate and taught postgraduate programmes as well as Adult Education short courses.

In questionnaire feedback both students and staff seemed to enjoy the exercise *'I found the tutorial really helpful. For the first time I really understand gene cloning'* (2nd year Medical Genetics student) *'We need more of these types of sessions'*(student from the MSc in Molecular Genetics programme) *'I had effective small group teaching but with 40 students*' (2nd year module convenor).

In addition to the hard copy packs of cards, we are developing electronic versions which

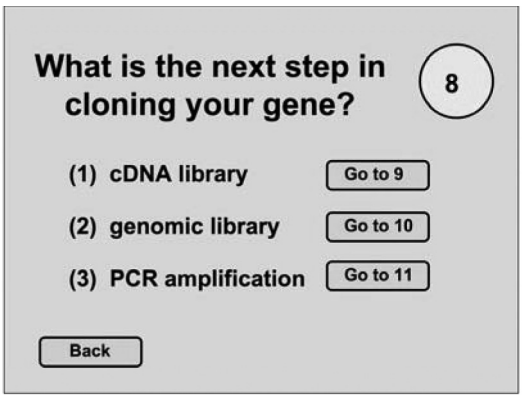

Figure 1: Example of a decision-making card. When students have made their decision they can use the buttons which will give them some brief information before guiding them to the next 'card'.

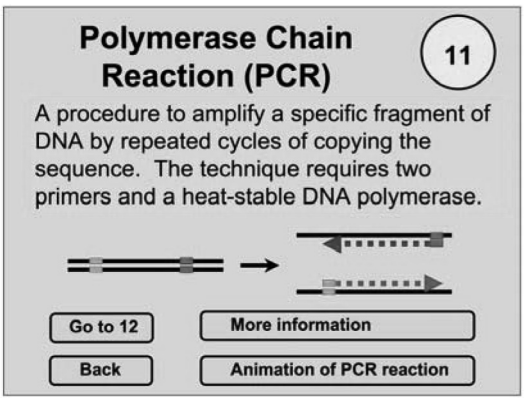

Figure 2: Example of an information card. Taking the example of PCR, in the on-line version there are possibilities for more detailed information or viewing an animation of the reaction before moving to the next 'card'.

enable the students to work on-line through the exercises. Examples of the 'cards' in the electronic versions are shown in **figures 1 and 2**. The on-line versions are good revision aids but can also be used as an alternative approach to presenting the exercises.

We are comparing the effectiveness of the two approaches in improving the students' ability to answer factual questions and to write a short summary of their final experimental strategy. In a pilot study a group of 36 students were split and half the students used the exercises on-line and half worked in groups with the hard copy packs of cards. We gave formative tests to the students before and after carrying out the exercises. On each occasion the students had to answer a series of multiple choice questions and write a brief summary of the experimental design which was marked to set criteria. The students who had worked on-line showed a marked improvement in their scores for the MCQs but little or no improvement in their ability to describe the experimental strategy. The opposite was observed for the students who worked in groups.

The on-line versions do contain more possible options for gaining information and, in interviews with the students, it was interesting to note that more than half the students that were carrying out the exercise on-line had used the internet as a source of information in addition to the information given within the exercise itself. The students using the hard copy versions did not have all of this information available but this approach did seem to be better at helping them to produce a coherent experimental strategy. We are carrying out the same tests with larger cohorts of both biological sciences and medical students to further compare the impact of the two approaches on the student learning experience.