

Problem-based learning (PBL): A novel and effective approach for teaching research skills by addressing contemporary research problems in physiology

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The biomedical science degree at Adelaide is oriented to research graduates, so we introduced a new unit in Physiology III. A unique component of that unit is a PBL course, the aims of which are to expose students to the science of addressing unresolved research issues, thereby developing their skills of scientific thinking and hypothesis setting and testing.

We base the full-year course on a series of 7-8 contemporary research questions, ranging from basic cellular physiology to medicine. Students are also challenged to address ethical issues incorporated into the PBL research cases. Students work together in small-groups on assignments, researching literature, and participate in regular group discussions. Assessment in this course tests the process of scientific thinking and teamwork, as well as content knowledge.

The PBL course prepares students for a research career by providing as much of a real research team experience as can be engineered into a single component of the year 3 curriculum. Students learn to appreciate the value in advancing science of teamwork, brainstorming in groups to produce thought-provoking discussions and other virtues normally acquired only in laboratory-based research training schemes. PBL cases begin with the introduction of a contemporary research issue by having the students interpret a series of key observations or results. Subsequent discussion is directed at achieving a basic level of background understanding through marshalling the students' own knowledge and on-the-spot research of relevant literature. Subsequently, students do further literature research, identify gaps and discrepancies in the current understanding of the scientific problem and frame hypotheses and design strategies to address the gaps/discrepancies. The students discuss matters as though members of a research team, and individuals report to the PBL group on material in which they develop specific expertise.

We assessed the impact of the PBL course by determining the extent to which attitudes toward research-oriented skills are changed. In 2001-2004, students were asked at the beginning and end of Physiology III to rate the importance of individual aspects of the course on a scale from 0 to 10 (least to most). Surveys were anonymous, but coded to match individuals' responses. Students had no access to their earlier responses when completing the second survey. The familiar and conventional educational category, *Importance of Informational Content and Facts*, was considered as a standard aspect of all courses, whereas the others are more related to the PBL course; these were:

- A. stimulation of new thoughts through discussion (8.28±1.39 beginning; 8.96±0.98 end)
- B. capacity to provoke new thoughts by others (7.55±1.65; 8.38±1.23)
- C. introduction of new ideas (8.29±1.2; 8.29±1.03)
- D. experience working in teams (8.37±1.53; 8.52±1.25)
- E. discussion of current questions in science (8.31±1.44; 8.70±1.28)
- F. discussion of ethical issues in science (7.77±1.70; 7.84±1.66)
- G. self-directed learning in research. (7.77±1.70; 7.84±1.66)

48 students completed the survey. Responses were analysed by paired T-test and two-way ANOVA and Tukey's test, as appropriate.

Aspects A, B, E and G were significantly more important aspects to the students at the end of the year than at the beginning. There was also a significant effect of the year's experience. At the beginning of the year, there was no significant difference among the importance attached to the various aspects. By the end of the year, the students considered A, D, E, and G more important than *informational content and facts* (8.00±1.58 beginning; 7.68±1.38 end).

In summary, we introduced a novel PBL system for educating students in the science of research through discussion of contemporary research issues. The program apparently has been effective in shaping the students' thinking about physiology in terms of research.