Being a Scientist: Educating for Ethical Conduct

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This project is predicated on a reflective way of life for being a scientist as the epistemological foundation for educating health professions students in the ethical conduct essential for scientific integrity and progress. Thus, being a scientist exemplifies a reflective way of life; and educating health professions students for ethical conduct embodies the reflective practitioner epistemology explicated by Schon in his books, *The Reflective Practitioner* and *Educating the Reflective Practitioner* (1, 2). Schon (1) challenges traditional professional curricula and educators that continue to implement course content based on the positivist, technical-rational epistemology of the nineteenth and twentieth centuries. The reflection-in-action epistemology Schon (2) pioneered offers health professions educators and practitioners a theoretical system of knowledge for helping faculty in science-based professions education update curricula.

The thesis of this project is that a transitional problem-based learning (PBL) curriculum in the allied health professions provides an excellent framework for education of reflective practitioners. Reflective practitioners are problem solvers and ethical scientists. Faculties who are themselves exemplary reflective researchers and teachers can teach ethics through successful PBL experiences that guide health professions students in development of ethical conduct as the foundation for their way of life as science-based, reflective practitioners.

A transitional PBL curriculum in the health professions is structured to guide students from acquisition of new information and knowledge through application of that knowledge in solving clinically-based problems to reflection-in-action as practitioners. Put another way, the transitional PBL curriculum helps health professions students progress from information gathering and knowledge warehousing to practitioners who know through reflection-in-action and are therefore wise clinicians rather than master technicians.

Faculties, who are science-based, reflective practitioners and instructors, integrate scientific research, scholarship, and teaching. Successful implementation of reflection-in-action epistemology in health professions curricula depends in large measure on the participation of wise, dedicated faculty whose ethical conduct as scholars and as teachers is manifested in their successful participation in those reflective dimensions of problem-based learning experiences.

Introduction

Keith-Spiegel, et al., (3) report that scientific misconduct is socialized during undergraduate years

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with students believing that significant results will earn them better grades. Recent research by Davidson, et al., (4) lends additional support to these findings. One also can speculate that scientific misconduct reflects the attitudes of society. Dishonesty and misrepresentations have become commonplace and acceptable in the absence of social sanctions against these behaviors and also as a result of increased professional competition and increased pressure to produce. Since the 1940's the incidence of self-reported academic misconduct by college students has risen 55-78 percent (5). Other examples of misconduct include medical school faculty applicants misrepresenting research citations, (6) ethics committees endorsing unnecessary research, (7) peer-reviewed journals editors misappropriating authorship, (8) and researchers faking data in experiments or failing to report unfavorable results (9). Some researchers suggest that there has been a "reorientation away from traditional values," especially in scientific inquiry (10). Others speculate that fraud and dishonesty in scientific research are the inception rather than the rule (11).

Regardless, scientists and institutions must maintain quality and integrity in scientific research if progress and public support are to be sustained. To promote responsible research, college and university faculties must sensitize future scientists to the critical issues in research ethics and guidelines. Also, the National Institutes of Health requirements mandate all institutions participating in training grants show they provide instructions to faculty and students in the principles of scientific integrity (12). Additionally, the final report of the Commission on Research Integrity noted the importance of providing "formal and informal educational opportunities to sensitize both junior and senior scientists to critical issues in research ethics and their institution's guidelines" (13, p. 16). Although expecting college and university faculties to single-handedly prevent research misconduct is unrealistic, faculties can create informal learning environments to promote high standards by engaging students in open discussions of ethical and unethical research practices, carefully supervising and mentoring student research, encouraging responsible data management, and modeling ethical behaviors. Faculties also can create formal methods for integrating the study of scientific values and responsible conduct in the academic courses.

This project presents informal and formal methodologies to encourage health professions graduate students to develop reflection-in-action skills and values that foster ethical practice in health professions services and clinical research. The ultimate goal is to describe a curriculum for promoting active student learning throughout a series of scientific research courses.

Implementing Problem-Based Learning Curriculum in Scientific Research for Graduate Health Professions Students

First semester course content includes three case-based problems for students to study and discuss: university-specific guidelines for conduct of scientific research, how to construct a research project, and the virtues of ethical research. Second semester course content is focused on student implementation of the research project constructed during the first semester. In subsequent semesters, students reflectively examine with faculty mentors their completed student projects for ethical integrity.

Learning issues in the first case-based problem explored in semester one focused on defining scientific misconduct through differentiating negligence from deliberate dishonesty and examining institutional research policies, especially distinguishing human and non-human research, confidentiality, and the obligations of scientific researchers. Students complete an institutional review board proposal for their subsequent projects. The second problem progresses students to application of those skills and behaviors learned in the first case-based problem on the rudiments of responsible scientific conduct. Learning issues for this case include practicing ethical data management and examining the ethical content of published research studies. The third problem is structured to concentrate student learning on management of conflicting interests, determination of criteria for multiple authorship, reporting scientific misconduct, and the process by which research grants are awarded.

Second semester learning issues arise from reflection on students' performances as they begin to conduct their research projects, structured during the first semester. Throughout this course faculty and student reflection-in-action and faculty mentoring become critically important. Learning experiences during this semester are more informal than those structured

for the first course. Students complete their projects in subsequent semesters, varying from one to three. Equally critical throughout these times is informal student-faculty discussions, supervision, and reflection that occurs during regularly scheduled small group or individual meetings.

Benefits of Problem-Based Curriculum and Learning Experiencesfor Faculty and Students

Students and faculty alike are beneficiaries of PBL experiences and curricula. Students develop problem-solving skills through student-directed discussions and information gathering assignments. They also learn to become self-directed and independent learners, habits that equip them for lifelong learning in practice communities, even in those remote settings where colleagues and library resources may be scarce. As they become more independent learners, students begin to actively demonstrate increasingly critical, creative thinking.

Assessment of one's peers during PBL experience is an essential dimension of PBL that requires active participation of all students in a learning group. To that end, students must learn to assess themselves and their colleagues in honest, thorough, deep, and sincere ways. Learning to work critically in this manner helps students reach greater depths of understanding the importance of frequently and realistically evaluating their performance as team members and learners; they also become skilled in applying the same sensitivities to evaluating the participation and performance of their peers in learning groups. These assessment skills and values also relate to other aspects of PBL: information management, creation of measurable knowledge bases for solving problems, and assessing peers, social and ethical skills, communication effectiveness, and the ability to work effectively as a team member.

Finally, development of leadership skills is fostered through revolving, shared group leadership. For each problem-solving session, students select a group leader, facilitator, and recorder. All group members serve in each capacity throughout a semester.

If PBL is to be successful, faculties must become models and coaches, relinquishing their traditional roles as lecturers and purveyors of information. In this role, faculties develop skills that monitor student learning during a problem-solving session and throughout the curriculum. To properly monitor student learning, faculties must become proficient in classroom reflective behaviors that probe and challenge students' thinking conclusions and processes, keep students involved throughout exploration of the problem, adjust levels of challenge to students, and manage group dynamics so that processes move toward constructive resolution of the problem. Development of learning materials and writing comprehensive clinical problems that challenge students demand faculty creativity and planning that exceed those faculty demands imposed by a curriculum predicated on traditional technical-rational epistemology. Faculties relinquish the resident expert status to become guides for student learning that is independent and self-directed. Faculty expertise in asking rather than telling, planning and guiding rather than showing is essential for successful discussions and problem solving sessions.

Formal and Informal Methodology Designs

Problem-based learning methodologies presented here are designed to encourage first-semester health professions graduate students to develop reflection-in-action skills and values for ethical practice as clinicians and as researchers. The ultimate goal of the methodology is to promote active student learning in the education of future scientists who will consistently demonstrate ethical scientific research behaviors.

As with the previously discussed benefits of PBL for students and faculty alike, effective PBL methodology design occurs only when faculties and students participate successfully in the process. At a minimum, faculties must openly discuss with students during learning group sessions those ethical and unethical behaviors in scientific research reported in the literature and in the faculty member's experience as a scholar-researcher. Faculties also must carefully and continuously supervise student research activities while mentoring student development as novice researchers. To be credible leaders for development of ethical behaviors in students, faculties must be personally engaged in ongoing and successful scientific research and scholarship.

Student involvement in design of PBL methodology requires full participation of all group members in researching the literature

available on ethical and unethical practices in scientific research. Students also must learn to engage faculty and student peers in reflective discussions throughout the problem solving group experiences.

Finally, students must demonstrate learned ethical behaviors in their own student research projects completed after their first semester.

Formal faculty and student responsibilities for methodology design and successful implementation are focused on scientifically rigorous planning and participation guidelines. Faculties are charged with responsibility for developing curriculum materials that include a series of complex, real world, "ill-structured" problems to stimulate learning, integration and organization of learned information that ensure application of past learning to future problems. Curricular materials include learning objectives for each PBL problem, definition of PBL techniques, appointment of small groups of 5-7 student learners, identification and instruction of tutors, guidelines for student leadership process and responsibilities during group learning sessions, and development of assessment tools. Beyond these process design matters, the essential faculty responsibility is creating multiple cases that form the bases for student learning. Without solid, reality-based clinical cases, the process cannot proceed as a valid or effective learning experience. As stated earlier, faculty also must model the values promoted as ethical conduct for scientists. They must consistently demonstrate their ability to reflect-in-action as they participate in the group learning experiences.

Students likewise have many formal responsibilities for achieving successful PBL. Students must learn to formulate hypotheses as individuals and as learning team members. They must learn to participate effectively and responsibly as group members for many outcomes, including designing a plan to solve the problem, researching available and pertinent information, justifying individual and group decisions and conclusions, recognizing multiple acceptable solutions to a given problem, evaluating the performance of themselves, their peers, and their tutors, and demonstrating novice reflection-in-action skills and values.

Discussion and Conclusion

Problem-based learning, based on small group discussion and clinically-based problems, encourages independent learning during which students develop depth of understanding of content (14). Through PBL students become more involved in and responsible for their own learning. The objectives of PBL are to assist the process of active learning by students as they develop effective clinical reasoning skills, such as critical appraisal, decision making, collaboration, and self-directed learning habits in order to participate effectively and actively in the small group discussions during the problem solving of cases (15, 16). Each problem should be designed to provoke critical inquiry, to encourage independent access to multiple and diverse learning resources, and to generate lively, focused, and pertinent small group discussions. Reflection-in-action during and after completion of a problem promotes transfer of learning as well as generation of new concepts (16). Recent research findings suggest PBL curricula are effective methods of learning and that students successfully transfer knowledge and skills in timely and meaningful ways (17, 18, 19).

Researchers have shown PBL promotes higher order thinking skills (16). PBL is a curriculum approach that places students in the active role of problem solver during the process of constructing meaning from case-based problems that mirror real-world situations. Throughout the process students develop problem-solving and information gathering strategies, reflection skills, and discipline-specific knowledge bases. In the absence of actual clinical experiences during problem solving discussions, students learn to make judgments based on facts, information, logic, and rationalization alone, they must use higher thinking orders to justify decisions based on application of learned principles. Nevertheless, the defining measurement of learning during an academic course is the quality of research produced by the student, an outcome that may not be evident throughout the span of the course. Therefore, continued supervision and mentoring of a student's future research activities beyond the first semester is essential for facilitating ethical development. The authors believe that through PBL students will exhibit reflection-in-experiment skills that will culminate ultimately in reflection-in-action skills1 as they complete their student research projects and move toward mastery as scientific researchers.

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