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Problem-Based Learning (PBL) Model in Teaching Medical Laboratory Science at University of Hawai'i

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The Medical School Hotline of the University of Hawai'i John A. Burns School of Medicine was founded in 1993 by Satoru Izutsu PhD (former vice-dean UH JABSOM). It is a regularly scheduled column and is edited by Kathleen Kihmm Connolly PhD, HJH&SW Contributing Editor.

Introduction

The Medical Technology (MT) Program at the John A. Burns School of Medicine (JABSOM) uses the Problem-Based Learning (PBL) model approach. PBL addresses many theories of learning, including collaborative and social learning theory and information processing.[1] PBL improves students' abilities to think critically, enhance problem-solving capabilities, teamwork, and knowledge transfer.[2] Integration of these skills promotes restructuring of students' coherence that helps them to make sense of the issues.[3] PBL discourages memorization but promotes the construction of knowledge, fosters attitudes, ethics, and improves research skills.[4] These skills are critical to meeting the demands of a professional Medical Technologist or Medical Laboratory Scientist (MLS) within a dynamic global economy.

PBL theory became popular in the 1970s as a learning model in medical schools.[2] PBL was introduced in 1969 at McMaster University in Canada as an innovative instructional strategy and has since proliferated and been adopted by other institutions around the world.[4] The strategy is based on the principles of cognitive learning theory. PBL encourages self-directed learning, congruent with modern principles of learning. It consists of carefully designed scenarios that require students to use a range of skills. PBL relies on presenting students with ill-structured (messy), open-ended, and real-life problems with possible answers.[5] The parameters of the problem are not well-defined, just like the real world, and students work through the ambiguity and uncertainty to find a solution.

PBL is group-dependent, encourages collaboration among group members, and promotes working toward finding a consensus. The groupwork challenges students to explain their reasoning from different viewpoints. Grouping ensures that students actively involve themselves in their education.[6] The approach allows students to control how fast they learn, as they can ask questions and get immediate feedback. All educational levels can use the PBL method to promote noteworthy discussions within the group. The most appropriate instructional strategy for PBL is to clearly define the learning objectives. Clear and concise instructions help students understand expectations, which allows them to mold their behaviors to meet the goal.[7]

PBL and the JABSOM Medical Technology Program

The PBL theory is the learning approach of choice for the MT Program at JABSOM. The learning theory advances the idea that learning starts by identifying problems that need solutions. In the MT program at JABSOM, the teaching method is influenced by investigation through laboratory testing to help physicians make diagnoses and manage patient health. MLSs are analytical people. Since the PBL teaching method was introduced more than ten years ago, graduates' critical thinking skills and collaborative work have improved. Reports from laboratory partners suggest that graduates are now better prepared to meet the laboratory demands from the first day. The American Society for Clinical Pathology Board of Certification (ASCP-BOC) examination pass rates have stayed above 90%, exceeding the 75% passing rate benchmark required by the accreditation agency, National Accrediting Agency for Clinical Laboratory Science (NAACLS). JABSOM's MT curriculum challenges students to solve problems, both in the classroom and in clinical training. It uses different learning methods in the classroom to promote the PBL theory.

Case Studies

Case studies are used extensively in the MT program. Case studies present a given scenario, usually the patient's age and sex, and the presenting symptoms. The program includes laboratory test results followed by a series of questions. The case studies challenge students to review, analyze, and synthesize the data to answer the relevant questions. Students are challenged to see beyond the obvious. The students must use the interpretation and application cognitive skills to correlate laboratory results to disorders or diseases. Basic case studies involve presenting students with laboratory results from a single laboratory section.

As an example, students are provided with several hematology and chemistry parameters from a laboratory test. Even though many of the testing parameters may be within normal reference range, students must recognize abnormal results. The following represents an example of abnormal results: an increase in Mean Corpuscular Volume (macrocytosis), low vitamin B12 and folate, reticulocytopenia, elevated homocysteine, and elevated methylmalonic acid. The students should be able to interpret these results as potential megaloblastic anemia. As the students progress in the program, case studies become more complex, with lab results from multiple laboratory sections such as hematology,

chemistry, and/or urinalysis. A typical case study is shown below.

Peer Learning

Peer learning has its roots in the social constructivist theory. Vygotsky (1978) argued that peer learning enriches students' social and cognitive learning processes. These learning processes become more dynamic as students explore diverse perceptions and viewpoints via firsthand experiences. The MT faculty provides prompts that require assigned students to explore the topic extensively and present it in class. The presenter becomes the subject-matter expert who must share the knowledge with the other students. The audience asks the presenter questions about the topic. The students use Socratic questioning techniques to stimulate critical thinking and invoke discussions. Below is an example of a prompt that may be assigned to a student.

> Describe the etiology of the major disease states associated with the adrenal glands. Provide an overview of the gland, including morphology and functions. Include types of hormones and their functions. Discuss causes, symptoms, and steps in the diagnosis of Cushing's disease. Discuss Addison's disease. Differentiate primary and secondary Cushing's Syndrome and Addison's disease, using laboratory data and symptoms. Discuss the mechanism of action and the physical and chemical properties of the hormones regulated.

This in-depth question provides a framework that allows the student to invest time in learning about Cushing's and Addison's diseases. The assigned student addresses all parts of the question, which in turn generates questions from the audience.

Group Assignments

Group work promotes collaboration and critical thinking among learners. Learning groups provide students with opportunities to express their opinions as they search for practical solutions to problems. When students work in groups, they too become teachers. Group work forces students to explain their reasoning from different perspectives. Grouping maximizes students' opportunities to be actively involved in their own learning.[6] The approach gives students control of their pace of learning, as students can ask questions and get immediate feedback. The MT students at JABSOM are challenged to write standard operating procedures. Each group is assigned a topic based on the hands-on laboratory exercises completed in class. One group may be assigned to write a procedure to perform a manual erythrocyte sedimentation rate (ESR) test or a manual coagulation test. These group tasks build character by promoting the collaboration needed to solve a problem.

Clinical Rotation Projects

Upon completion of the didactic part of the MT program at JABSOM, the MT students complete a clinical training regimen at one of the following laboratories. The MT program assigns students to Adventist Health at Castle, Clinical Laboratories of Hawaii (CLH), Diagnostic Laboratory Services (DLS), Kaiser Healthcare, Kuakini Medical Center, and Tripler Army Medical Center. During the training cycle, the students may get individual and/or group assignments based on the PBL model. Assignments may include a parallel investigation to solve a problem encountered in the training laboratory. As a case in point, students are expected to identify a problem encountered during routine testing, such as finding a missing specimen. The student must document the process involved, from how and when the discovery was made to how the issue was resolved. The MT program expects students to utilize recalled knowledge to interpret or apply written, numeric, or visual data encountered in the situation. The program provides an opportunity for students to share the results with other students. The goal is to transfer knowledge gained in the program into real-life contexts.

Conclusion

The PBL methodology is an appropriate mode for teaching courses in MT. MLSs are problem-solvers. Problems begin from the preanalytical phase, through the analytical phase, to the postanalytical phase of the testing process. PBL promotes deeper learning, collaboration, critical thinking, problem solving, communication, and teamwork, which are essential in operating a clinical laboratory. The development of these skills, through a PBL approach, provides students with a competitive advantage in the job market while leading to better content knowledge and increased student motivation.

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