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Current Literature Summary

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Athletic training faculty and preceptors are expected to prepare students for autonomous professional practice. Problem-based learning (PBL) is a teaching approach that may facilitate development of entry-level clinicians. Research suggests that PBL encourages self-directed learning, develops critical-thinking, problem-solving, and teamwork skills as well as promotes life-long learning behaviors. We will provide brief synopses of current research on PBL and discuss possible applications to athletic training.

Applin H, Williams B, Day R, Buro, K. A comparison of competencies between problem-based learning and non-problem-based graduate nurses. *Nurs Educ Today*. 2011;31(2):129-134.

Reviewed by Robert Ryan and Steven Ross Murray, Colorado Mesa University and Robert W. Pettitt, Minnesota State University, Mankato

Summary of research context and methods: Nurses are expected to be competent and provide safe, ethical, and legal nursing practices. The faculty members in nursing-education programs incorporate a variety of teaching techniques to ensure their graduates competently apply classroom theory to professional practice. One teaching technique that is used is problem-based learning (PBL). Applin et al. investigated the self-reported competencies between the graduates of PBL and non-PBL (NPBL) nursing programs by surveying 121 nurses who had been practicing nursing for a minimum of 6 months. Data were gathered using a questionnaire of 50 forced-choice items, answered with a 5-point Likert scale, and 2 open-ended questions. The forced-choice questions addressed the 4 standards of practice - professional responsibility, knowledge-based practice, ethical practice, and provision of service to the public - as identified by the representative professional association. The two open-ended questions were as follows: *How did your nursing program prepare you to meet the competencies listed above?* and, *What suggestions would you give your program to better prepare you to meet the above competencies?* Means of the Likert-scale responses were calculated for each standard and two-sample t-tests were used to compare PBL and NPBL nursing graduates.

Summary of research findings: No statistically significant difference was observed for the PBL and NPBL nursing graduates with respect to their perceived ability to meet the entry-to-practice competencies. With respect to the open-ended questions, the PBL graduates thought that "the structure and process" of their program helped them to develop competence. Further, the PBL graduates indicated that "their abilities to think critically and engage in self-directed evidence-based practice was key to enabling them to meet the competencies." Graduates from both styles of programs reported that more clinical time would have been helpful.

Implications for athletic training education/research: The didactic, practical/laboratory, and clinical experience model of athletic training is strikingly similar to nursing and other health professions. In athletic training education, we specifically delineate and establish competencies before proficiencies. In the case of therapeutic modalities, for instance, certain safety and precautionary issues preclude the effective use of PBL as an exclusive pedagogical strategy. Conversely, the PBL model may facilitate better proficiency development than traditional lecture and enhance each student's effectiveness in clinical experiences. The use of PBL also may have a place in the athletic training curriculum as an adjunct to developing the critical thinking skills required to be a successful athletic trainer. Athletic training students commonly experience a synchronous clinical education model (ie, clinical experiences occurring concurrently with didactic courses). The Applin et al. study was on a sample of students who completed an asynchronous clinical experience model. Specifically, these nursing students were taught formally with PBL then asked how well they applied lessons learned in a subsequent clinical experience. The effectiveness of PBL within a synchronous clinical model remains unstudied. We would encourage athletic training education researchers to explore the

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viability of PBL to augment the development of athletic training clinical proficiencies and critical-thinking skills.

McHarg J, Kay EF, and Coombes LR. Students' engagement with their group in a problem-based learning curriculum. *Eur J Dent Educ*; 2012;16:106-110.

Reviewed by Debbie I. Craig, Northern Arizona University

Summary of research context and methods: Problem-based learning (PBL) is defined as a method of collaborative learning through which knowledge is attained through facilitated small groups of students who work both together and independently to solve a problem or series of related problems provided by the instructor. Some medical and allied health education programs run solely on PBL curriculums. One of the greatest problems with PBL occurs when groups are poor-functioning due to individual participant characteristics. In this study, the authors investigated whether randomly assigned member groups or purposefully assigned member groups functioned better and/or gained more knowledge. To pursue these research questions, the authors utilized the Belbin method of team membership to form their purposefully assigned member groups. The Belbin method requires giving an inventory to define each participant's preferred group role (8 roles: completer-finisher, coordinator, implementer, monitor-evaluator, plant—planted on the team to be highly creative, resource-investigator, shaper, teamworker) and then creating heterogeneous groups with one participant for each Belbin role.

There were two research questions investigated: (1) Would using Belbin teams optimize group functionality? and (2) What is the relationship between student engagement and the PBL group learning process (using a group engagement measure and individuals' results on knowledge-based assessments as the outcome measures)? Participants (n=63) took the Belbin self-perception inventory to define their group role, which allowed for purposeful group assignment. The participants were divided into 8 groups of 8 members, with one group only having 7 members. Four of the groups were designated as the Belbin groups (experimental groups) while the other four groups (control groups) had members randomly assigned irrespective of their Belbin scores. Through the length of the investigation (31 weeks), neither the students nor facilitators knew which groups were Belbin or control. Functionality of each group was measured by the Macgowan Group Engagement Measure (GEM), which was completed by the facilitators evaluating each student. Four different knowledge-based assessments were given periodically throughout the investigation. Relationships were investigated between the group mean GEM scores and the Belbin or non-Belbin groups, and, between individual GEM scores and knowledge-based scores.

Summary of research findings: There was no correlation between the experimental (Belbin) groups and the mean GEM scores. Similarly, t-tests showed no statistically significant results between the Belbin group individual GEM scores and the knowledge-based scores. No groups were considered "dysfunctional" regarding level of learning. The only statistically significant result was between the individual student GEM scores and the average (of 4 assessments) knowledge-based assessment score. The author's concluded that using the Belbin model made no difference in the PBL group performance. However, students with higher GEM scores - meaning those who engaged the most with the PBL process - performed significantly better on the knowledge-based assessments.

Implications for athletic training education/research: This study supports the theory that collaborative learning through PBL processes results in higher knowledge achievement. The implication for using PBL in athletic training didactic and clinical courses is that it has the potential to improve knowledge above more traditional forms of teaching.

A positive outcome from research examining the efficacy of PBL is the notion that our brains learn best by solving problems and discovering knowledge, rather than having knowledge listed in a PowerPoint presentation. One of the difficulties in transitioning to PBL is letting go of our need to be the presenters of all knowledge in our classrooms. This is how we learned coming through school and is thus how we instinctively assume we should teach. When the plethora of evidence regarding PBL outcomes is reviewed, however, it becomes apparent that we need to take a step back and let our students discover the knowledge they need to be successful as practicing athletic trainers. To do this, our learner-centered classrooms need to be active, problem-solving environments. Teachers need to become facilitators of learning rather than presenters. In essence, our role as teachers is to present a clinical problem to a small group and facilitate or guide them through discovering the knowledge they need to solve that problem. Once they do this, the learning achieved is higher and more permanent than being told everything they need to know through lecture.

Castro-Sánchez AM, Aguilar-Ferrándiz ME, Matarán-Peñarrocha GA, Iglesias-Alonso AA, Fernández-Fernández MJ, Moreno-Lorenzo CC. Problem based learning approaches to the technology education of physical therapy students. *Med Teach.* 2012;34(1):e29-e45.

Reviewed by Kelly Fiala, Salisbury University

Summary of research context and methods: Problem-based learning (PBL) has been defined as a whole-curriculum concept. If it cannot be infused throughout the entire curriculum, it is suggested that implementers still utilize PBL as a learning modality. It is designed to promote self-direct learning (SDL) in a collaborative environment where students develop competency, skills, and attitudes that foster the learning process. Some researchers question whether SDL can automatically be achieved by utilizing PBL.

The purpose of this study was to compare learning preferences and strategies of physical therapy students taught by PBL and those taught by conventional lectures. Physical therapy students at three universities who were enrolled in massage therapy, trauma physical therapy or electrotherapy, hydrotherapy and thermotherapy courses participated in the study. The researchers utilized a quasi-experimental design in which students taught by conventional lectures during the 2008-2009 academic year were compared to students taught by PBL during the 2009-2010 academic year. The Approach to Study Skills Inventory for Students (ASSIST) was used to determine learning preferences related to three categories: superficial learning, strategic learning, and deep learning. The Canfield Learning Styles Inventory (CLSI) was used to determine learning strategies related to two categories: (1) learning conditions and (2) modes of learning.

Students completed both surveys during the first week (pre-test) and last week (post-test) of the academic year.

Summary of research findings: A total of 182 students participated in the conventional learning group while 176 students participated in PBL the following year. There were no significant differences in pre-test ASSIST or CLSI scores between the two groups. In addition, there were no significant differences between the pre-test and post-test ASSIST or CLSI scores of the conventional group. Significant differences were observed between pre-test and post-test ASSIST and CLSI scores for the PBL group. Results reported on the ASSIST showed students enrolled in PBL reported improvements in strategic learning (study organization and academic achievement) and deep learning (relationship of ideas and interest in the subject) coupled with a reduction in superficial learning (lack of purpose, memorizing without relating, the law of minimum effort, and fear of failure). For the CLSI learning conditions, PBL students developed a greater preference for organization and valued a good relationship with teachers. In terms of the CLSI learning mode, PBL students developed a greater preference for learning by reading, viewing images, and participating in direct, hands-on experiences.

Implications for athletic training education/research: Although there were significant limitations, including the use of intact (non-randomized) groups of participants and the lack of post-graduation follow-up, this study demonstrated that using PBL can improve student perceptions towards SDL. Problem-based learning examines the ability of students to function in situations they have yet to encounter, enabling them to identify their learning needs and access appropriate resources. Although using this model means that the teacher is no longer the main source of initial information and has less influence on the early steps of the learning process, students taught using PBL report valuing cordial interaction with their professors. The professor is consulted by students on their SDL and is respected as a mentor and resource, rather than being seen solely as a disseminator of data. In addition, students taught by PBL report they enjoy collaborating with their peers throughout the learning process. The ability to work with others is a valuable trait that athletic training educators strive to cultivate in students. While it might not be possible to introduce PBL throughout the entire curriculum, utilizing it as a learning tool should be considered by athletic training education programs. Given that athletic trainers practice in an unpredictable environment with evolving resources, using PBL strategies in the educational setting prepares students to successfully implement evidence-based practice as professionals.

Klegeris A, Hurren H. Impact of problem-based learning in a large classroom setting: student perception and problem-solving skills. *Ad Physical Educ*. 2011;35:408-415.

Reviewed by Jennifer L. Doherty-Restrepo, Florida International University

Summary of research context and methods: Problem-based learning (PBL) is an effective learning strategy that encourages students to become self-directed learners and to develop critical-thinking skills, problem-solving skills, and teamwork skills. PBL typically involves learning in small groups, which are supervised by tutors. Research suggests the PBL in a small group setting positively effects student learning and skills, such as improved problem-solving skills and increased motivation. However, little research has examined the efficacy of PBL in a large classroom setting. Therefore, the purpose of this study was twofold: (1) to assess student perception of PBL as a teaching method implemented in a large class (45-85 students) setting, and, (2) to measure improvements in problem-solving skills due to exposure to a course delivered using PBL and standard lectures.

The teaching methodology used in this study was a hybrid class consisting of 75% lecture and 25% PBL. Over the course of two semesters, PBL cases were delivered by a single course instructor to large groups of up to 85 students enrolled in undergraduate biochemistry and biology courses. Each PBL case was presented over 3 class sessions spaced at least 1 week apart to allow sufficient independent study. The class was randomly assigned to groups of 7 to 9 students before that start of each PBL case. During class, the PBL case was presented and students worked in their assigned groups for 10-15 minutes to assess the presented information, list case-specific concerns/problems, hypothesize what might be happening, and identify learning issues that require further study. This group time was not supervised as there was only one instructor present. Following the small group discussion, the instructor facilitated open classroom discussion as each group briefly presented their hypotheses and reasoning regarding the PBL case. Once all groups presented, additional case information was provided. Students worked again in their assigned groups for 10-15 minutes to reassess their hypotheses and identify leaning issues requiring further study. Students were required to independently research identified issues and any other unknowns related to the case prior to the next class session. One week later, at the next class session, each group had 10-15 minutes to share their independent research on the pre-identified learning issues and propose a hypothesis based on the information they gathered. Open class discussion followed, facilitated by the instructor. Finally, information sufficient to solve the PBL case was revealed.

Data were collected to assess student perception and problem-solving skills. Student perception of PBL was assessed during both semesters. During the first semester, students were surveyed following exposure to two PBL cases to determine their desire to continue participating in PBL. During the second semester, students were surveyed to determine their perception of PBL compared to standard lectures. Student attendance in class was monitored throughout the study. Students' problem-solving skills were assessed at 3 points: (1) September (following exposure to two PBL cases), (2) December (the end of the fall semester), and (3) April (the end of the spring semester) by counting acceptable answers to problem questions. The same problem questions were used throughout data collection. A blind review of all responses was conducted by a teaching assistant and a third-party content expert. Acceptable answers were tallied for each time point for comparison.

Summary of research findings: Student attendance was significantly higher during PBL sessions (96% fall semester, 93% spring semester) compared to lecture sessions (78% fall semester, 67% spring semester) in both semesters. The majority (53%) of students indicated a desire to continue in PBL following exposure to two PBL cases during the fall semester. At the conclusion of the spring semester, students reported that their motivation to participate in class work, their communication skills, their comfort level with group work, and their retention of course material were improved as a result of PBL. With regards to students' problem-

solving skills, the number of acceptable answers to problem questions increased from 27% at the end of the fall semester to 58% at the end of the spring semester. If given the choice, most students (74%) would choose PBL over the lecture format of instruction.

Implications for athletic training education/research: This study had several limitations. The administration of the same PBL exercise repeatedly could have resulted in a learning effect. The hybrid format of the class makes it difficult to attribute the change in problem-solving skills to the PBL sessions as opposed to the lectures. Despite noted limitations, this study suggests that implementing PBL in a large class can improve students' motivation to attend and participate in class, their communication skills, their comfort level with group work, and their retention of knowledge. PBL encourages students to become self-directed learners who research possible solutions (independently or in collaboration with others) to a clinically-relevant problem. The use of PBL in athletic training curricula may facilitate evidence-based practice as graduates apply this approach of problem-solving in the ever changing environment of athletic training clinical practice.