Problem-Based Learning: Can it Enhance Cognitive Thinking, Motivation, and Small Group Learning in a Physical Education Course?

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Abstract
Past courses in PE 150 (Fundamentals of Physical Fitness) have been taught with the traditional lecture technique. Problem-Based Learning (PBL) was used to enhance cognitive thinking while learning to develop physical fitness programs. The level of cognitive thinking increased throughout class participation as well as the motivation for learning more about physical education. PBL also provided gains for small group learning, as the students were able to gain confidence in their own work as well as the team work required to handle the challenges. Over the course of 19 lessons cadet’s were approached with problem solving strategies and skills required to meet the objectives and the final results showed many positive outcomes as well as a first time event for any PE 150.

Keywords: Problem-Based Learning, Cognitive Learning, Surface Learning, PE 150, Work Capacity, Traditional Lectures

Introduction
Most physical education courses involve kinesthetic and visual learning. Since these classes are different from other courses it was my intent to apply cognitive thinking to examine four domains (nutrition, body composition, cardiorespiratory endurance, and muscular strength and endurance aspects) from real situations whether they be incomplete, wrong, or confusing. In correspondence with enhancing cognitive thinking should be the increase in motivation for learning about physical fitness. Lastly, I required many small group activities using PBL to see if the students gained confidence in working with others and confidence in their team/group members.

With new equipment and publicity of workout programs it is essential that each student is able to make educated decisions based on their ability to think critically. If a student is accustomed to cognitive thinking when they assess new equipment and/or programs the feedback they conclude on will allow them to preview the benefits or hindrances prior to instilling them into their program avoiding an increased chance of risk for themselves or those individuals they train.

The student’s attitudes and behaviors changed over the 19 lessons and showed an increase in the desire to learn and understand the four domains in PE 150. From lesson 1 to lesson 18 the discussion increased across the board as all 16 students made contributions or statements in the last two lessons. This was a big increase from the five who contributed during the first two lessons. The students often
mentioned the fact that they enjoyed learning about practical situations and how they felt they were actually learning what they could apply to their life and training.

The small group project was used to evaluate how each student was able to contribute to their team as well as give them another tool for learning. The small group setting was to get the students to see that they can always seek assistance from other educated individuals in the same field/profession. We don’t have all the right answers but when we merge ideas greater results can be seen and more experience can be applied.

I have seen that physical fitness can best be applied when we are able to breakdown a program from final results into understanding each element. As a facilitator I no longer wish to allow students to set their goals on “surface learning”, instead I wish to allow each student to find their place within the physical education field and hold themselves accountable for what they learn and submit. After teaching the course 6 times prior I felt that using traditional lectures was not meeting the standard and therefore there was a need to change up the way the information was presented. The results were either neutral or greater than expected.

**Problem-Based Learning**

Reaching higher levels of cognitive thinking should be a part of every student’s goals and an expectation of every instructor. Many methods of teaching can get us to increase cognitive thinking and one that I believe will benefit most courses is Problem-Based Learning. PBL is a curriculum development and instructional system that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems. (Finkle and Torp, 1995) Hmelo-Silver in 2004 described PBL as an instructional method in which students learn through facilitated problem solving that centers on a complex problem that does not have a single correct answer. She noted that students work in collaborative groups to identify what they need to learn in order to solve a problem, engage in self-directed learning, apply their new knowledge to the problem, and reflect on what they learned and the effectiveness of the strategies employed.

Characteristics of PBL include:

- Make the students accountable for their own learning
- The questions or problems being solved must be either incorrect or incomplete to allow free inquiry
- Collaboration of the group and facilitators must be established
- What the students learn during their self directed learning must be applied back to the problem with reanalysis and resolution
- A discussion of the concepts and/or principles that have been learned is essential
- Self and peer assessments should be carried out at the end of each problem
- Student exams must measure student progress

(Savery 2006)
**a. History/Past Research**

PBL was initially adopted in medical schools to prepare students for patient care. Many students were having difficulty transitioning lecture material into functional medical care. A meta-analysis of 20 years of PBL evaluation studies was conducted by Albanese and Mitchell (1993), and also by Vernon and Blake (1993), and concluded that a problem-based approach to instruction was equal to traditional approaches in terms of conventional tests of knowledge (i.e., scores on medical board examinations), and that students who studied using PBL exhibited better clinical problem-solving skills. A smaller study of graduates of a physical therapy program that utilized PBL (Denton, Adams, Blatt, & Lorish, 2000) showed that graduates of the program performed equally well with PBL or traditional approaches but students reported a preference for the problem-centered approach. Anecdotal reports from PBL practitioners suggest that students are more engaged in learning the expected content (Torp & Sage, 2002).

A lack of well-designed studies posed a challenge to this research analysis, and an article on the same topic by Sanson-Fisher and Lynagh (2005) concluded that “Available evidence, although methodologically flawed, offers little support for the superiority of PBL over traditional curricula” (p. 260). This gap in the research on the short-term and long-term effectiveness of using a PBL approach with a range of learner populations definitely indicates a need for further study.

**Implementation and Assessment of PBL**

PE 150 consists of 19 lessons and is broken into four domains: body composition, nutrition, cardiovascular endurance and muscular strength and endurance. Each domain was assessed using various evaluation tools to include a pre and post survey, minute papers, quizzes, lab reports, muddiest points, application cards, problem solutions, term end exam, and course feedback.

**a. Body Composition**

Body composition is important in assessing recommended body weight. It consists of the fat and non-fat components of the human body. (Hoeger 2010) Our objectives for this domain include understanding the concept of body composition, learning and applying methods used to assess body composition measurements and understanding general percent body fat values. My expectation is for each student to understand body composition and the various ways to measure body fat percentages and then identify how this can apply to current and future physical fitness training. In the past I would use presentations to cover my objectives, instead I made the presentations available but I created problems and divided the class into groups of 3-4.

Scenarios were created to require each student to look at all aspects of body composition without directly giving them the answer. I used the following for body composition, a healthy soldier comes to you telling you about how their weight is constantly fluctuating and that they notice changes in physical performance based on their fluctuation. I wait for the students to respond to the scenario, do they ask questions, do they give experiences, do they respond at all or do they start brainstorming to find out how to solve the case. Initially I have three students out of 16 who attempt to respond by stating that the soldier needs to increase their workouts and the soldier may have bad eating habits. So to provide a little direction I ask the students what they can do to determine whether it is the workouts or eating
habits that are creating the issue and how can this be measured. It is at this point that two students start discussing body fat percentage, which then leads into body composition with some guidance.

Being the first domain and the first time using PBL I was not surprised by the small response from the class. As the class moves on I expect to see greater responses from the majority of the class. In order to assess if the PBL had any effect I compared lab reports from this class to the previous class which was taught by the traditional lecture. Also administered were a body composition quiz and a muddiest point’s paper, the results can be found under the statics analysis section.

b. Nutrition
Nutrition is a valuable science that studies the relationship of foods to optimal health and performance. (Hoeger 2010) It is incorporated into PE 150 so that students understand basic nutrition, energy demand, how and why to apply recommendations for performance eating, and assessing their dietary habits over three days. My expectation is for each student to identify the healthy and unhealthy eating habits they have and discover food sources that can compliment or enhance their physical/mental performance. The class was divided into groups of 3-4. Groups were required to research and discuss nutritional topics to answer the scenarios.

The nutrition scenario used was, you notice that you are fatigued more than usual. It affects your workouts, academic work, and your daily activities. You are also getting ready to take boxing and you want to make sure you are ready for the increase in physical activity. The response from students should be to assess nutritional behavior by looking at macronutrients, as well as energy utilizing micronutrients such as iron, magnesium, potassium and sodium. The discussion is more productive today as contribution is made from each group with 8 students doing the majority of the discussion. The class is allowed to use their textbook and internet to assist in answering the scenarios and questions discussed. Guidance is required by me to make sure we stay on task and to make sure all areas of nutrition are mentioned. The nutritional domain was assessed using the lab report, quiz, muddiest point, and small group assignment.

c. Cardiorespiratory Endurance
Cardiorespiratory endurance (CRE) focuses on the ability of the lungs, heart, and blood vessels to deliver adequate amounts of oxygen to the cells to meet the demands of prolonged physical activity. (Hoeger 2010) In PE 150 we focus our objectives on understanding the cardiorespiratory concepts such as energy systems, compare/contrast high and low intensity work capacity, muscle fiber types, heart rate, rating of perceived exertion, and lactate threshold. My expectation is for each student to first know proper technique and biomechanics associated with CRE and to decrease risk of chronic injuries. Second I want each student to be able to identify positive and negatives in constructing a cardio program from scratch or pre-made workouts. The students will be expected to design and implement a cardio program around their primary goals and use their own progression to enhance performance levels.

There were two CRE scenario used and the first one was, as a PL you notice a plateau in cardio performance for the majority of your soldiers and you start to see an increase in chronic lower leg
injuries. The second was, you are preparing for a sandhurst competition, your training program consists of 6 days of running, 4 days of lifting, and the running consists of anywhere from 3-10 miles of running. If you are planning to be successful as a team what corrections should be made to the running program and why? With the first scenario the students should first identify the safety factors and determine why there is an increase injuries and what can be done to correct this. The students should also be able to brainstorm and come up with a reason as to why the unit is unable to make improvements in their performance. For the second scenario, the students must understand the sandhurst competition and ways to provide variety as well as workouts that will improve training other than traditional running. The class was allowed to use their textbook, class slides, and internet resources to come up with an answer for the scenarios. Discussion from the class increases to 13 students for the CRE domain and the students are beginning to use personal experiences to address the issues. Less guidance is required when compared to the first two domains, but is necessary to assist the students in overcoming sticking points in the running program. The CRE domain was assessed using a quiz, application card, and lab report.

\[d. \text{Muscular Strength and Endurance}\]

Muscular strength and endurance (MSE) refers to improving muscular strength and/or endurance through a series of progressive resistance training exercises that overload the muscle system and cause physiological development. (Hoeger 2010) Our goal in PE 150 is for each student to understand the types of muscle contractions, identify the major muscles that control human movement such as location and function, identify joint movements and apply them in specific and functional activities. My expectation first and foremost is using proper technique on every lift or movement. This is to focus on the safety of each student and gain the maximum benefits from each lift. I want each student to view the whole athlete and then be able to break down functional steps that will allow them to build specific and functional programs.

Two scenarios were used for the MSE domain. The first was, after a leg workout you hear your buddy talk about how he lifted 10 different leg exercises with reps ranging from 10-50. He/she mentions that they are on the inline roller hockey team and have a game in two days, yet they have pain in their knees and low back. What issues does your buddy have to be concerned with? The second is your friend comes to you talking about this new program called cross fit and how it can be a great way to get into shape. Your friend tells you about some of the workouts that include doing 100 pull-ups, performing 50 kettle bell swings, 20 minute abs workout and 100 squats. What should be considered before moving forward into this program or any new program? The class was allowed to use their textbook and internet references. The entire class contributes to either the first, second, or both scenarios. Most of the talk covers ideas or theories from the students based on experience. The discussion crosses multiple topics within MSE which is great as the students are able to visualize a bigger picture of what they should know and understand. The MSE domain was assessed using a lab report and a minute paper.
Additional assessments addressing the entire course include a pre and post survey, the term end exam, and the course end feedback from the students. Each of these gives subjective and quantitative measurements to determine if cognitive thinking, motivation, and small group learning have improved.

**Statistical Analysis**
The goal was to use various assessment tools to gain insight on PBL. Comparisons were made with the Spring 2010 class and a previous Fall 2009 class that was taught using traditional lectures. Assessments were made in each domain to identify if the students’ scores, responses, and grades reflect improvements and note significant results.

*a. Body Composition*
Three assessments were given for this domain to include a quiz, one sentence summary, and the lab report. The first of the assessments was a quiz which was administered upon completion of the body composition lessons. It consisted of five multiple choice questions; each question was worth one point. The students had five minutes to complete the quiz. The quiz was taken without use of notes or educational materials. The scores and quiz are below:

<table>
<thead>
<tr>
<th>Points Possible</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Scores</td>
<td>0</td>
<td>7 (44%)</td>
<td>5 (31%)</td>
<td>4 (25%)</td>
<td>0</td>
</tr>
</tbody>
</table>

I was not surprised by the results of the quiz, especially because there wasn’t participation from many of the students regarding this domain. Overall I was glad to see that 75% scored a 3 or higher on the first time through. The class was allowed to correct missed questions on their own and resend them to me by e-mail, this is not reflected in the results. The mean for the quiz was a 64%. Upon completion of the quiz we discussed each answer and I facilitated discussions on how each question is viable and imperative to understanding body composition.

A one sentence summary was completed after the first lesson of discussion on body composition. This technique requires students to summarize the information within the grammatical constraints of a single sentence. (Angelo, Cross 1993) I wanted to identify what the students could recall about body composition and its importance in physical fitness. As a majority most students recalled specific topics such as body fat percentage, and methods for measuring. A few of the students had great responses such as “Body composition is beneficial in allowing individuals to set reachable goals and use measurements to determine if progress is made toward these goals.” And another was “Body composition allows us to use quantitative measurements for achieving goals, as well as make our goals more desirable and specific.” These two cases exemplify a bigger picture which I was trying to achieve and that is body composition should be used with in accordance with goals and can be retested over a course of time to determine if the physical fitness plan each student is using is effective and producing positive results.
The lab report is a required graded document which contains lab measurements such as the Army tape test, skin folds, height and weight, body mass index, and bioelectrical impedance analysis. The measurements were taken during the class period. The rest of the lab contained six short answer questions that asked for definitions, purposes and ways to apply this in to each student’s current fitness program. Below are the following grades achieved from the lab.

The Lab was worth 50 points and three students had earned that mark while others were between 40 and 50 with one outlier at 24. The average was 91% as a class compared to the 90% from the fall class. Although there was a 1% increase from the class, it is difficult to say if PBL was the main factor for improving the scores, but what I can say is that the students responded equally as well to the PBL lessons as they did to the traditional lectures for this specific domain.

b. Nutrition

The assessments used for the nutrition domain include: quiz, muddiest point, small group assignment and a lab report. The quiz consisted of five multiple choice questions and each question was worth one point. The class was given five minutes to complete the quiz. The quiz was taken without use of notes or educational materials. The scores are below:

<table>
<thead>
<tr>
<th>Points Possible</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Scores</td>
<td>0</td>
<td>8 (50%)</td>
<td>6 (38%)</td>
<td>2 (12%)</td>
<td>0</td>
</tr>
</tbody>
</table>

The nutrition quiz had an improvement with 50% of the class scoring 4/5 points. Overall I contribute the increase due to the rise in class participation as more students were discussing nutrition and the subtopics within its domain. The mean for the quiz was a 68%. Upon completion of the quiz we discussed each answer and I facilitated discussions on how each question is viable and imperative to understanding and correcting nutrition and dieting behaviors.
A muddiest point paper was completed after the first lesson of nutrition. The Muddiest Point technique provides information on what students find least clear or most confusing about a particular lesson or topic. (Angelo, Cross 1993) I used this technique to determine if the scenarios had covered the main objectives of nutrition as well as find out what concepts seemed difficult to interpret. The feedback I received was that the students were confused about micronutrients such as vitamins and minerals. The students wanted to know specifics but because we cover four domains in 19 lessons we were unable to touch in detail the amounts and benefits of each. This is beneficial because hopefully this will get students to do more research outside of class in order to answer their questions. There were two responses that stood out: 1) What are the best ways to manage nutrition for others, such as your troops in the future? 2) The amount of calories to consume in one day and how the calories should vary based on activity levels. Both question one and two require an application process which is what I want the students to achieve from PBL.

The small group assignments were created to allow students to answer a problem solution in groups of 3-4. The small group assignment is a tool used to identify the student’s ability to communicate, contribute, and discuss the topics or lessons. It allows the students to use their peers as a source of information in order to answer problem solutions. The direction given was to answer the problem solution as detailed as possible. The groups were randomly formed. The results showed that within each of the four groups the responses to the problem solution was basic information with very little detail. All the groups had very little discussion occurring and usually only one to two group members contributed. Two groups had some specifics by including some food sources and micronutrients to answer the problem. I was concerned initially that not everybody would contribute and that the answers would not involve cognitive thinking, but as they are adjusting to PBL I believe changes will be made for the remaining two domains.

The body composition lab report is a required graded document which contains 3 reports for each day a dietary analysis was completed over three days for a total of 9 reports. The rest of the lab contained four short answer questions that asked for the functions, comparisons, contrasts, and critical thinking in regards to dietary behavior and nutrition. Below are the following grades achieved from the lab.
The Lab was worth 100 points, 7 students earned that mark while others were between 66 and 98. The average was 93% as a class compared to the 90% from the fall class. There was a 3% increase in this class, when compared to the fall. This 3% increase is an improvement and one question that had more correct responses in this class then the previous classes was the question below:

**Micronutrients Analysis (12 points):**

1. What four micronutrients are you most concerned with due to your over or under consumption? Utilize the textbook and additional resources to discuss the effects (positive and negative) of over/under consuming these specific micronutrients.

I believe this was partly due to the fact that the student’s responses from the muddiest point discussed how they were confused on the specifics of micronutrients and I take this into account as the students were required to do more studying on their own to answer this. This is a positive in PBL as the students may have been motivated to learn more about nutrition.

c. **Cardiorespiratory Endurance**

The CRE domain was assessed using a quiz, application card, and lab report. The first of the assessments was a quiz which was administered upon completion of the body composition lessons. It consisted of five multiple choice questions; each question was worth one point. The students had five minutes to complete the quiz. The quiz was taken without use of notes or educational materials. The scores are below:

Cardiorespiratory Endurance Quiz Results

<table>
<thead>
<tr>
<th>Points Possible</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Scores</td>
<td>6 (38%)</td>
<td>8 (50%)</td>
<td>2 (12%)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

As the participation in class increases and the students begin to understand how to use PBL they have made significant improvements in their quiz scores. For the first time a 5/5 was achieved and it was achieved by six students and zero students scored a two. The mean for the quiz was an 87.5%, a big increase when compared to the previous two domains. Upon completion of the quiz we discussed each
answer and I facilitated discussions on how each question is viable and imperative to understanding body composition.

An application card was used to discuss periodization and its purpose in CRE. This technique prompts students to think about possible applications and, as a consequence, to connect newly learned concepts with prior knowledge. As the students respond to the technique they see more clearly the possible relevance of what they are learning. (Angelo, Cross 1993) Periodization is defined as a training approach that divides the season into cycles using a systematic variation in intensity and volume of training to enhance fitness and performance. (Hoeger 2010) I was looking for the students to use their own words and definitions and I was surprised as 13 out of 16 had a response that would suffice as periodization to include the following two. 1) Periodization is a set workout routine for a certain period of time to maximize results to fit according to the activity (i.e. pre-season, season, post season.) 2) A workout regimen that applies principles to achieve the maximum effectiveness without overtraining. The students from this class have stepped outside of the box and started to form their own opinions to apply cognitive thinking when compared to past classes taught by traditional lectures.

The cardiorespiratory lab report is a required graded document which contains results from four cardio tests performed over two lessons. The rest of the lab contained four short answer questions that required the students to apply cardiorespiratory principles to current and future scenarios. Below are the following grades achieved from the lab.

The Lab was worth 100 points, nobody achieved a 100% but two cadets earned a 99%. The lowest score was a 56.50 and this score was low because he did not turn in his test results. The average was an 89% as a class compared to the 87% from the fall class. This gives the class a 2% improvement and had the one score of 56.50 had its test results the score would have been an 81.50 and would have changed the average to a 91%. I believe the continuation for improvement is due to PBL when compared to the past class.

d. Muscular Strength and Endurance
The MSE domain was assessed using a minute paper and lab report. The minute paper provides manageable amounts of timely and useful feedback for the most significant things they are learning. (Angelo, Cross 1993) The minute papers gave me great insight into what the students had lacked prior to this course as well as what seemed to interest them. Many of the papers discussed variety and learning new lifts, implementing new training methods and understanding major muscles and most of them for the first time. Here are two responses: 1) I understand the difference between concentric and eccentric exercises and the fact that eccentric can be beneficial if used correctly. 2) Recovery time and use of recovery lifts are necessary for muscle repair and increasing performance. PBL has allowed these students to state more than I learned how to lift or I know where the hamstring muscle group is located, they are forming principles from detailed information and implementing them into their own life.

The muscular lab report is a required graded document. It consists of 25 fill in the blank sentences and a strength training program. The MSE lab allows the students not only to recall MSE terminology but also allows them to develop a strength program that is specific, detailed and incorporates information discussed from scenarios covered in class. Below are the following grades achieved from the lab.

<table>
<thead>
<tr>
<th>Grades for MSE Lab Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17</td>
</tr>
<tr>
<td>0  20  40  60  80  100  120</td>
</tr>
</tbody>
</table>

The Lab was worth 100 points, nobody achieved a 100% but two students earned a 96%. The lowest score was a 31 and this score was low because he turned in his lab two days late. The average was a 77.78%.

Pre-Post Survey Results
This survey was established to identify pre and post knowledge on the students to assist in determining their behavior in regards to physical education, group learning, motivation, and problem solving abilities. The pre-survey was administered on lesson prior to facilitating the first lesson and the post-survey was administered at the end of lesson 18.

Question 1: I enjoy learning about physical fitness
Question 2: I enjoy learning about nutrition
Question 3: I enjoy learning about cardiorespiratory endurance.

Question 4: I enjoy learning about muscular strength and endurance

Question 5: I enjoy working in small groups (3-4)

Question 6: I learn best when working in small groups

Question 7: I communicate well in group settings

Question 8: I learn best when working on my own

Question 9: I enjoy spending time outside of class reading about physical fitness
Question 10: I would rate my current knowledge of physical fitness as:

![Bar chart showing changes in knowledge of physical fitness](chart1)

Question 11: I would classify myself as a:

<table>
<thead>
<tr>
<th>Learner</th>
<th>Visual</th>
<th>Auditory</th>
<th>Kinesthetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results</td>
<td>11</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

Question 12: I enjoy problem solving

Question 13: I prefer to work through problems individually

Question 14: I read the required text for each class

![Bar chart showing responses to reading text](chart2)

Question 15: I read the required text for each class

Question 16: I achieve higher grades when I participate in discussions

Question 17: I have good short term memory

![Bar chart showing memory responses](chart3)

Question 18: I have good long term memory

Question 19: My current physical fitness is above average for my age and gender

Question 20: I am motivated by group learning
**Term End Exam (TEE)**

Each class is required to take a final consisting of 50 questions. The questions are multiple choice and true or false and cover all four domains: body composition, nutrition, cardiorespiratory endurance, and muscular strength and endurance. The TEE is created by the course director. Below are the results for the Fall 2009 and Spring 2010 classes.

For the first time ever all the students passed the TEE and there was only one D at 68%. Average classes have 2-3 failures with multiple D’s. This was a significant improvement over past courses and should be recognized that it could be contributed to the PBL training received.

**Course End Feedback**

The course end feedback is completed on-line; it consists of 4 sections for a total of 29 questions. The responses remain anonymous and provide valuable feedback for future lessons. A 5 is Strongly Agree, 4 is Agree, 3 is Neutral, 2 is Disagree and 1 is Strongly Disagree. PE 150 (TL) refers to traditional lectures, Academy refers to all academic courses taught at USMA and DPE is all courses taught within the department of physical education.

Section A

A1. This instructor encouraged students to be responsible for their own learning.
A2. This instructor used effective techniques for learning, both in class and for out-of-class assignments.
A3. My instructor cared about my learning in this course.
A4. My instructor demonstrated respect for cadets as individuals.
A5. My fellow students contributed to my learning in this course.
A6. My motivation to learn and to continue learning has increased because of this course.

Section B
B1. My knowledge, skills and abilities to promote and maintain my personal fitness or the fitness of my soldiers was enhanced by this course.
B2. This course enhanced the moral-ethical attributes essential for effective leadership.
B3. My physical and mental courage to accomplish challenging tasks and ability persevere in adverse conditions was enhanced because of my experiences this course.
B4. I am more committed to participate in sports and physical activity throughout my military career because of my experiences in this course.
B5. Additional instruction was available.
B6. Additional work outside of class was needed to perform well.
B7. My Instructor(s) was knowledgeable about the course subject matter.
B8. The grading in this course accurately reflected my level of learning.
B9. What did your instructor(s) do well?
B10. What suggestions do you have to improve this course?

Section C
C1. This course was physically challenging.
C2. This course was psychologically challenging.
C3. The instructor/team's demonstrations facilitated learning.
C4. The instructor/team's presentations facilitated learning.
C5. The instructor/team's feedback facilitated learning.
C6. The instructor/team was concerned about safety throughout the course.

Section D
D1. The knowledge gained in this course will enable me to develop a scientifically sound exercise program.
D2. The nutrition project increased my knowledge of my dietary strengths and weaknesses.
D3. The CFC increased my knowledge of my physical fitness strengths and weaknesses.
D4. The muscular strength and endurance labs were valuable experiences.
D5. The cardiorespiratory labs were valuable experiences.
D6. The body composition lab was a valuable experience.
D7. The high intensity motor performance lab increased my knowledge of my high intensity strengths and weaknesses.
D8. Which lecture lesson(s) were the most beneficial to you?

Conclusion
The final results confirmed that in this research there were several significant factors that supported problem-based learning well others showed similar results to past classes using traditional lectures. The supportive findings came from many areas, such as the lab reports, surveys, term end exam, course end feedback and quick assessment techniques. The most significant findings occurred during the TEE and course end feedback, although there were
minuscule findings from the lab reports, pre and post surveys, and the quick assessment techniques to support PBL.

Significant findings from the TEE showed a big increase in the average score from a 76% during the traditional lecture to an 84% during the PBL course for an improvement of 8%. Also for the first time in any class every student passed the TEE and there was only one D (68%) from the class. Average classes run 2-3 failures with multiple students earning a D. I was shocked and surprised by these results and they should be seen as a reflection of the benefits of PBL.

The course end feedback also showed some significant findings when compared to the other PE 150 courses taught this round that used traditional lectures. Possible answers for each question are as follows: 5- Strongly Agree, 4- Agree, 3-Neutral, 2-Disagree, 1-Strongly Disagree. Only questions that had a minimum of a .20 difference are discussed. Question A2: This instructor used effective techniques for learning both in class and out of class assignments. Responses showed that the PBL average was 4.29 which was higher than the average of the other traditional lecture (TL) courses with a 4.01. I believe this to be a reflection of PBL. Question A5: My fellow students contributed to my learning in this course. Results were 4.43 for PBL and 3.91 for the other TL courses for a difference of .52. This is in response to the small group learning that PBL provides giving each student the ability to learn from others. Question A6: My motivation to learn and to continue learning has increased because of this course. 4.07 for PBL and 3.75 for TL, showing that PBL can increase the motivation to learn and adapt to cognitive thinking lessons. Question B6: Additional work outside of class was needed to perform well. PBL had a 3.86 while TL had 4.43, a difference of .57 the biggest margin for any of the feedback responses. This response shows that the students had to do less work outside of class in order to do well, which means that the PBL allowed students to retain and cover more information so that the students did not need to spend any unnecessary time studying information that could have been discussed in class. PBL seems to have benefits in regards to conserving time. Question B8: The grading in this course accurately reflected my level of learning. PBL had a 4.36 and TL had a 3.63 for a difference of .73, the biggest margin for the feedback responses. This could be indicative of that the fact that the PBL was able to translate over on to the TEE as well as that the students were able to recall information longer than the TL courses. Question C2: This course was psychologically challenging. PBL had a 3.21 while TL had 3.43 indicating that PBL was possibly easier to understand and apply. Question C3: The instructor/team’s demonstrations facilitated learning. PBL had a 4.36 and TL had 4.15, concluding that the PBL demonstrations were beneficial to the students when compared to the TL lessons. Question D1: The knowledge gained in this course will enable me to develop a scientifically sound exercise program. TL had a response of 4.21 and PBL had a 4.43, declaring that PBL can increase cognitive thinking to develop physical fitness programs.

Class discussions showed an improvement, there were 3-5 students who contributed in the first two lessons and by the last two lessons all 16 students were actively involved in problem solving. Past PE 150 traditional lectures have had 5-8 students who contributed from a class size of 18. There were multiple lessons where the students voiced their appreciation for PBL by stating “we feel like we are being taught how to apply and use the four domains we have covered, while my buddies in other courses complain how much they hate going to class and don’t feel like they understand any of the information.” There were many conversations similar
to this, which was encouraging as a facilitator to hear that the way the information had been presented was effective and produced positive results.

After reviewing the lab reports, quizzes, and small assessment techniques PBL had some minimal gains over traditional lectures such as quiz scores improved, lab reports improved slightly, and the assessment techniques supported PBL being effective. Other results had PBL equally effective as traditional lectures, but at no time did PBL ever show to be a hindrance to the learning environment or below traditional lecture lessons. Past studies comparing PBL indicating that PBL did not lower scores and at minimum was equivalent to traditional lectures.

This research presented significant findings to indicate that PBL can improve cognitive thinking, motivation, and improve small group learning in a physical education course. Additional benefits of PBL included increasing the student’s confidence by increasing their knowledge of physical fitness. In regards to physical education courses PBL was beneficial and enhanced the student’s ability to learn when compared to traditional learning. PBL should be considered as a high priority teaching technique when instructing courses that involve practical skills. If PBL can benefit this PE 150 course I am sure it can benefit other courses.

The only other assessment that needs to be carried out is long term recall. If the same students were to take the TEE 3 months, 6 months, or 1 year after taking the course how well would they do when compared to students who had the traditional lecture technique? Would they be able to recall general and detailed information from each of the four domains? As of this point PBL is beneficial and can improve the students ability to apply cognitive thinking, increase motivation, and enhance small group learning when used in physical education courses.

References


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