

Effect of problem based approach on medical students' learning satisfaction and understanding in the histology course topics

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Abstract

Background and purpose: Problem-based learning (PBL) is a term used within education for a range of teaching approaches that encourage students to learn through the structured exploration of a problem. Histology comes early in the curriculum and the medical students seem unable to see the value of the content, they don't appear to be motivated to learn the content. This project used PBL to help the students make the connection between the content and clinical aspects.

Methods: Thirty six undergraduate medical students, 22 female and 14 male, enrolled in the histology course during the spring semester of 2008. A survey which collected information relative to gender, course load, and workload and study time was used. The subjects were accessory glands of digestive system histology. The course is designed into four units: three units of salivary glands, pancreas and gall bladder histology, were presented in a traditional lecture format; the fourth unit, liver was presented in a problem-based format that used clinical practice. Assessment focused on three issues of a. student engagement, b. lesson assessment in terms of clarity, interest and usefulness and c. student understanding.

Results: Student comments collected during PBL class periods indicate engagement in the topic. In PBL method of teaching most of responses were consistent with the aim of teaching but in traditional classes few responses relate to the objectives at hand. Students had more active partnership in PBL class. Students found PBL class more useful, interesting and clear in terms of subject material than traditional method.

Conclusions: In this project student comments collected during PBL class periods indicated more engagement in the topic. Students' understanding of material were significantly higher and students' partnership in PBL class was more than traditional classes.

Keywords: PBL, HISTOLOGY, STUDENT PARTICIPATION

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Introduction

PBL is a recognized teaching and learning strategy popularized during the 1960s as a result of research and used to engage

students in deep rather than surface learning. It is also viewed as a successful strategy to align university courses with the real life professional work students are expected to undertake on graduation. PBL represents a major and widespread change in educational practice within higher education and has been introduced into all of the health sciences, engineering, business, science and education. Both 'pure' and 'hybrid' approaches have been adopted in tertiary institutions (1,2).

As faculty, we understand that our medical students' lives have become more complicated and the more successful students have become

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masters at integrating their studies with the other aspects of their lives. In this disorganize background it becomes more and more difficult to employ the students. Less frequently do we see the student with a true appetite for the subject and students who desire to learn for learning's respect. Students focus on learning for the test and often ask what they need to know to pass the test. What is absent and how do we as educators keep our students interested or motivated?

Wlodowski offers that establishing inclusion, offering choice, making subject matter relevant and generate competence will enhance the meaning of the material and enhance students' motivation (3). Don pronounces that learning cooperatively as well as building good teacher student relationships also enhances motivation (4). Medical students are no different than their peers.

It seems that our medical students are often unable to use information learned in didactic courses to make clinical decisions. It appears that, due to the pure volume of material, the students often rely on routine memorization. In the case of Histology, the students don't seem to connect the histological ideas with clinical practice. Histology comes early in the curriculum and the students seem unable to see the value of the content, they don't appear to be motivated to learn the content. Problem Based Learning help to the students make the connection between the content and clinical decision making by actively connecting Histology to practical clinical problems. In problem based learning (PBL), students work in small groups, asking questions to arrive at possible solutions; they collaborate in investigation and description, with teachers as guides. The problems serve to develop clinical problem solving skills; and new knowledge is acquired through self-directed learning (2). In PBL, topics are presented using problems based in clinical practice rather than straight lecture, and students will interact to solve the problem presented. Students are actively involved in their learning because they are not given the

material but discover answers through investigation by working with peers (3).

This project used problem based learning to help the students make the connection between the content and clinical aspect of histology. PBL actively connects Histology to practical clinical problems. The question examined was: Will using a problem based approach which uses questioning, inquiry learning and group work both enhance students' understanding of the topic and increase the student's motivation to learn the subject?

Methods

Thirteen six undergraduate medical students, 22 female and 14 male, enrolled in the histology course in the study during the spring semester of 2008. Students Credit in the current course and the study time of them was assessed.

Design and procedure of this study was according to the modified PBL teaching of histology for dentist student (5). A demographic survey which collected information relative to gender, credit hours, and study time was used. A three-question evaluation form with a 5-point Likert's scale that gathered information from the students as to the clarity, interest and usefulness of the units was designed(5) (Appendix 1).

Design and procedure of this study was according to Sweeney's' study about the modified PBL teaching of histology for dentist student (5).

The course examined was accessory glands of digestive system histology. The course is designed into four sections.

Tree sections of salivary glands, pancreas and gall bladder histology, were presented in a traditional lecture format. The fourth section, liver was presented in a problem-based format that used clinical practice as an organizing concept as follows:

- 1) A three-stage problem which focused on the liver was developed
- 2) Classroom Activities; session 1
 - a) The 36 students were randomly assigned to six groups: six groups of six. Roles of Reader,

Recorder, Moderator and Reporter were taken in each group. (15 minutes)

b) Stage one of problem was distributed to the groups and students worked through the problem while the teacher circulated to clarify points and field questions. (35 minutes)

c) The entire class came together and presented the conclusions reached. Ideas and possible solutions were brainstormed. (20 minutes)

d) The teacher presented a mini- lecture to clarify questions that arose (20 minutes)

e) Stage two of problem was distributed to existing groups. Students worked in groups on the second part of the problem for the remaining class time. (20 minutes)

3) Classroom Activities; session 2

a) Students met in a different classroom equipped with computers.

b) Students continued discussion of Stage 2 (20 minutes)

c) Stage 3 was distributed to students who were reassigned to jigsaw or expert groups.

Appendix 2 illustrates the make up of these groups. These expert groups were made up of students from each of the original groups. The assignment for these expert groups was to collect information, become "expert" on that information and share this information when they returned to their original group. The expert or jigsaw groups researched the following topics: liver lobule, liver sinusoids, space of disse, portal lobule, hepatic acinus's of rapaport, and blood and bile flow. In these new expert groups students conducted a web search on topics. (60 minutes)

d) Students exchange information and continue solving problem. (40 minutes)

4) Classroom Activities; session 3

a) Stage four of problem was distributed to main groups and students worked through the problem while the teacher circulated to clarify points and field questions. (50 minutes)

b) The entire class came together and presented the conclusions reached and ideas and possible solutions were brainstormed.

(40 minutes)

c) At the end of the unit the teacher fielded questions and presented a mini lecture to clarify questions and unit content.

(30 minutes).

In this study the effective lecture that named as the traditional lecture format, was present for students in the definite topics as following steps:

Establish the purpose of the lecture

Consider the logistics of the lecture

Plan a variety of approaches (use of questioning)

Prepare a set of lecture notes

The purposes of the lecture subjects, logistic of presentation & various approaches planning are defined in Appendix 3.

Assessment

Assessment focused on three issues: 1) Student engagement, 2) Unit assessment of clarity, interest and usefulness and 3) Student understanding (5).

1. Class session feedback on student engagement:

An envelope was circulated through both the traditional classroom session and the problem-based one that asked the question:

What were you doing right before this envelope reached you?

Each student completed a card and inserted it into the envelope as it reached them. Responses were categorized as specific to unit concept, related to the class and not relevant to class. Responses were considered "specific to unit concepts" if the response indicated discussion or thinking around the concept being discussed which indicated the student was actively engaged in the material being covered. Responses were considered "pertaining to class" if the comment indicated engagement in the class such as thinking, taking notes, listening but with no specific topic was indicated. Responses were considered "not pertaining to class" if the response had no relationship to the class or concepts discussed.

2. Unit assessment:

At the end of the problem-based units and the traditional units, a brief survey was distributed that addressed the clarity of the unit, the degree of interest of the unit, and the usefulness of the unit, (Appendix 1).

3. Students were evaluated on objective questions in a comprehensive final examination results for the PBL unit and Traditional units

Results

Student passed credit hours (The credit hours that students passed till this course) collected according to the answering oneself during this study period. Our results showed that most of the students took 12-17 credits (91.66%) and 52.77% of students took 15 or more credit (Table 1).

Table 1. Frequency distribution of students by their credit hours

Number of credit	<12	12-14	15-17	17 <	Total
Number of student	3	14	16	3	36

Note most of the student took 12-17 credit hours.

Student stated the studies time. Most students spent 3-9 hours for study each week (80.5%), (Table 2).

Student comments collected during PBL class periods indicated engagement in the topic (Table 3); their answers to this question What were you doing right before this envelope reached you? – showed that twenty-one out of 36 comments listed information on specific concepts of the unit. In contrast, comments from the traditional unit nine out of 36 that indicate less focused so in PBL method of teaching most of the responses discussing about the unit according to the aim of teaching, (Table4).

Our results about the student answering about usefulness, interesting and clearness of material during PBL in contrast to traditional class periods showed that all of the usefulness, interest and clearness in PBL

methods significantly higher than the traditional method (Table 5).

The students' understanding was evaluated on objective questions in a comprehensive final examination & our results showed that student grade in PBL methods significantly higher than traditional method, (Table 6)

Discussion

Our results showed the clarity, interest and usefulness of the units using a problem-based method enhanced significantly compare to traditional method.

The students' understanding was evaluated on objective questions in a comprehensive final examination. Our results showed that the student understanding using a problem-based method enhanced significantly compare to traditional method.

Specifically, this finding support the question explored whether using a problem-based method would enhance students' understanding of the topics and increase students' motivation to learn. Light notes that active learning leads to increased understanding and retention (6). Bergin investigated students' achievement in mastery and competitive conditions. He found that students' enjoyment and understanding in learning conditions that do not emphasize grade competition can lead to increased achievement for both low and high ability students and more enjoyment for most students(7). It seems that PBL bring increased achievement to all students.

Cabrera defines critical thinking as an evaluative activity that reaches a conclusion and reasoned judgment is made about information. This skill is necessary for clinical decision-making and is modelled in PBL. By covering material in traditional lecturing we may be doing the students a disservice by predigesting the material and putting it in neat packages for them to give back to us. Using PBL may be a road to

Table 2. Frequency distribution of students study time per week .

Number of study time for histology (h/w)	<3h	3-4.9 h	5-6.9h	7-9 h	9< h	Total
Number of student	4	10	12	7	3	36
Percent of student	11.1	27.77	33.33	19.44	8.33	100

Table3 Engagement Envelope Responses

Type of response	PBL unit	Traditional unit
Specific to unit concepts	Discussing liver circulatory system (2) Drawing the portal area(2) Discuss about liver sinusoid(2) Answering a question (2) Discussing with group(3) Discussing liver lobules(3) Discussing diss space(2) Discussing hepatocyte morphology (2) Discussing, function and characters of hepatocyte(3)	Thinking about unit(1) Looking at slide(1) Taking notes(1) Taking notes and listening(1) Listening(1) Writing and highlighting(1) What is important in this unit(1) How I can pass this unit(1) Trying to listening , learning and taking notes(1)
Concept related to class	Discussing hepatocyte subculture(1) Discussing fatty liver(3) Discussing liver fibrosis(2) Discussing jaundice (2) Discussing liver regeneration(2) Discussing hepatocyte apoptosis (2)	Talking to another student in the class(2) Thinking about lecturer (2) Eating (2) brows the slides from teacher(2) Waiting for break(2) Thinking about anatomy(2) I am bored (1) Must to complete notes(3) Thinking about next class(2) Buying the histology text book(1)
Not related to class	This unit is so important(1) Have a good feel(1)	How can I passes the exam(2) Thinking about way to solve my economic problem(1) I haven't enough time for studying(1) Thinking about my recorder(1) Thinking about weekend(1) Reading mobile message (2) Purchasing a laptop (1)

Student's responses to "were you doing right before this envelope reached you?" in PBL and Traditional method classified as Specific to unit concepts and not related to class.

Table 4: Student engagement comments (Class session feedback on student engagement)

Unit	Specific to unit	concept related to class	Not relevant to class	Total
PBL(percent)	21(58.3%)	13(36.1%)	2(5.6%)	36(100%)
Traditional(percent)	9(25%)	18(50%)	9(25%)	36(100%)

P-value: 0.007 (df: 2) - Tested by Chi-Square test

getting the students to understand the material by peers through involving them and thus increasing their intrinsic motivation to learn (8).

In this project student understanding during PBL class periods indicate engagement in the topic. The most of the comments listed information on specific concepts of the unit. In contrast, comments from the traditional unit were less focused. Although 18 comments were related to the class, 9 specific concepts were listed that related to the unit, and 9 comments were not relevant to the class. The mean of students' ratings of clarity, interest and usefulness for the PBL unit were significantly higher than those for the traditional units. These findings are similar to White's study that found an increased level of interest and superior performance in classes using team based learning and small group discussions (9). Students' understanding was evaluated on objective questions in a comprehensive final examination. Our results showed student grade in PBL methods significantly higher than traditional method these findings are similar to Pileggi that found an increased level of grade in classes using team based learning. He notes that improved TBL diagnostic skills with the final examination.

Table 5. Unit assessment based on a 5-Point Likert's scale type survey by student

Assessment Items	Salivary glands (lecture)	Pancreas (Traditional method)	Gall bladder (Traditional method)	Liver (PBL method)
Clarity *	2.88	2.92	2.94	3.66
Interest **	2.83	2.77	2.66	3.44
Usefulness ***	2.80	2.92	2.83	3.72

* P-value: 0.001 (Z: -3.259) - Between two methods.

Tested by nonparametric Mann-Whitney Test.

** P-value: 0.001 (Z: -3.281) - Between two methods.

Tested by nonparametric Mann-Whitney Test.

*** P-value: 0.002 (Z: -3.046) - Between two methods.

Tested by nonparametric Mann-Whitney Test

He found that students' attitudinal survey indicated an 80 percent agreement that TBL

enhanced their powers of critical analysis (10).

Nieder et al have used the TBL method for teaching gross anatomy and embryology at the Wright State University School of Medicine, Dayton, Ohio. Their first experience with this method was positive. The faculty felt that this method ensured a closer interaction between them and the students. Other studies have shown that knowledge acquisition with the TBL method compared favourably with more traditional methods such as lectures (11-14).

Table 6. Students' understanding was evaluated on objective questions in a comprehensive final examination.

Unit	Mean score	Of items
Salivary gland	15.6	20
Pancreas	15.3	20
Liver	16.8	20
Gall bladder	15.7	20

Conclusion

We find a few reports of PBL application in Medical basic sciences. This study was a systematic investigation into the effectiveness of linking clinic to classroom by using Problem Based Learning. Our results showed support advantages to this method. Specifically, the question explored whether using a problem-based method would enhance students' understanding of the topics and increase students' motivation to learn. Was the problem-solving ability and critical thinking of all students enhanced as evidenced by performance on objective tests and problem sets and does the problem based method increase the perceived clarity, interest and usefulness of the topic as well as increase student engagement in the unit? Although gathered evidence illustrated only a slight advantage interested class, comments from clinical instructors provide evidence that students were bringing the didactic content to clinic. It appears that using PBL fulfilled some of the conditions that Wlodlowski notes as essential motivational conditions (inclusion, positive attitude

towards learning through personal relevance, enhancing meaning) (15). All students were involved in the process of learning through collaborative problem solving, and students expressed increased interest and usefulness for the PBL unit. Overall, using PBL appeared to enhance students' learning and increase the connection of Histology to clinical activities while increasing students' motivation to learn the subject.

Lessons learned from this project range from simple logistics to larger organizational and assessment issues. They are as follows: Mixing three traditional units with one PBL unit led to confusion among the students. Early in the semester a class protocol is generally established which leads to a smooth class time. Problem Based Learning has a different classroom structure as it is discussion oriented and takes place in groups. Much time was taken up with organizing the classroom and the students for the different approaches. If a protocol was established for class early on, discussion could commence as soon as the students arrived in class. All units should be delivered via PBL with mini-lectures. As the class is not instructor led but driven by the student's inquiry, a clear structure needs to be described and explained to the students.

Students expressed confusion about using jigsaw/expert groups. Clear guidelines and instructions need to be designed and distributed to students at start of problem. Changing locations caused confusion. The PBL unit used web resources and the class was moved to the library in an adjacent building which had web access. Schedules should be distributed along with problem guidelines.

Disparity of computer capabilities among students caused difficulties with searching. Conducting a web search orientation at the beginning of the course may be helpful.

Random groups led to inequities in the skills of the group. Instructor should assign groups according computer skills and medical experience to equalize the groups.

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Appendix 1: A three-question evaluation form with a 5-point Likert's scale on clarity, interest and usefulness of the classes

1. How clear was the material in this unit?					
totally unclear	some what unclear	mostly clear	very clear	extremely clear	
1	2	3	4	5	
2. How interesting did you find the material in this unit?					
totally boring	mostly boring	somewhat interesting	very interesting	extremely interesting	
1	2	3	4	5	
3. How useful were the classroom sessions in helping you learn the material?					
Useless	not very useful	somewhat useful	very useful	extremely useful	
1	2	3	4	5	

Appendix 2: Groups composition

Main groups					
Group1	Group2	Group3	Group4	Group5	Group6
6member	6member	6member	6member	6member	6member
Expert or Jigsaw groups topic					
Portal areas	Liver sinusoids	Space of disse	Hepatic lobules	Hepatocyte morphology	Blood and bile flow
6members each coming from a different groups	6members each coming from a different groups	6members each coming from a different groups	6members each coming from a different groups	6members each coming from a different groups	6members each coming from a different groups
Aims: Explain and discuss about liver circulation	Aims: Explain the and discuss about liver sinusoid Component	Aims: Explain the and discuss about space of Disse and clinical aspect of fat storage in ITO cells	Aims: Explain the and discuss about hepatic lobules and clinical aspects of these lobules classification	Aims: Explain the and discuss about hepatocyte morphology according to arrangement in liver lobules	Aims: Explain the and discuss about bile formation in hepatocyte and clinical aspects of this activity

Appendix 3- The purposes of the lecture subjects, logistic of presentation and various approaches planning in the traditional lecture format.

Lecture Topics	Histology of salivary glands	Histology of pancreas	Histology of gall bladder
Purpose	Students should be identify the histology of salivary acini and ducts , types of salivary glands and functions of the saliva.	Students should be identify the histology of pancreas exocrine (acini and duct)and endocrine units , exocrine and endocrine secretion and functions of the pancreatic enzymes and hormones	Students should be identify the histology of gall bladder. Communication between gall bladder and liver.
Logistic	In this study the time of lectures presented by use of computer-based projections. Lecture times were 90 minutes , including approximately 10 minutes devoted to audience break , 10 minutes to interaction and 10 minutes to questions according to our experiences		
Plan a variety of approaches	use of questioning: Educator asks questions, which students answer. Students ask some questions. There is limited discussion among students.		