Evaluation of second and fourth year undergraduate medical students' perception and acceptance of the problem-based learning process

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ABSTRACT

الأهداف: دراسة مستوى قبول و إدراك طلبة كلية الطب لنظام ومنهج التعليم المبني على حل المشاكل، والمقارنة بين مستوى قبول الطلبة الجدد الذين عُرضت عليهم الناحية النظرية للتعليم المبني على حل المشاكل والطلبة الذين لديهم سنتين من الخبرة العملية مع هذا المنهج، ودراسة مدى تأثير ذلك المنهج على الأداء الوظيفي.

الطريقة: أجريت هذه الدراسة المقطعية في كلية الطب بجامعة الملك عبد العزيز، جدة، المملكة العربية السعودية، واستمرت خلال الفترة من نوفمبر 2008 م إلى مايو 2009م. لقد قمنا بتوزيع استبيان منظم وذاتي التعبئة على مجموعتين من الطلبة. تمثلت المجموعة الأولى في طلاب السنة الثانية الذين حضروا دورة تأسيسية في نظام التعليم المبني على حل المشاكل فقط، وليس لديهم أي خبرة تطبيقية في هذا المجال، أما المجموعة الثانية فتمثلت في طلبة السنة الرابعة الذين أكملوا ثماني وحدات عملية في التعليم المبني على حل المشاكل، وقد كانوا المجموعة الأولى التي بدأت المنهج الجديد في الجامعة. ولقد قمنا باستخدام اختبار تي من أجل المقارنة بين المجموعتين.

النتائج: اشترك في هذا البحث 506 طالب و طالبة من كلية الطب والذين يمثلون نسبة (60%) من دفعة السنة الثانية (250) والرابعة (256) في عام 2009. لقد وصل عدد الذكور المشاركين في الدراسة إلى 284 طالباً (56%)، فيما كان عدد الإناث 222 طالبة (44%). وأشارت نتائج الدراسة إلى أن متوسط درجات طلاب المجموعتين قد كان إيجابياً وعالياً في كل أسئلة الاستبيان التي تخص نظام و منهج التعليم المبني على حل المشاكل، وبالرغم من التقبل الإيجابي لطلاب السنة الثانية لهذا المنهج إلا أن متوسط درجاتهم قد كان أقل مستوى من درجات الطلاب في السنة الرابعة.

خاتمة: تعطي هذه الدراسة بيانات أساسية عن تصور الطلاب للمناهج الجديدة ومحتوي التعليم المبني على حل المشاكل، كما أوضحت مواطن القوة والضعف الموجودة حالياً، ويتضح من النتائج بأن تقبل الطلاب للمنهج يعتمد على التغيير الدوري لهذه المناهج.

Objectives: To investigate medical students' perception of problem based learning (PBL), to compare the acceptance level of new students who were introduced to PBL theoretically with those who had 2 years experience, and to study the effect of PBL on the academic performance.

Methods: This cross-sectional study was conducted on medical students at King Abdul-Aziz University (KAU), Jeddah, Saudi Arabia between November 2008 and May 2009. A self-administered structured questionnaire was used to collect data from 2 groups of undergraduate medical students who volunteered to participate. Student t-test was used for comparison between the groups.

Results: Out of the 450 fourth-year, and 400 second-year medical students at KAU in 2009, 506 (60%) chose to participate in this study and represented the study population (250 second year, and 256 fourth year students). There were 284 (56%) males and 222 (44%) females. A positive and higher mean score was found in all statements of the questionnaire among fourth year medical students. Although second year students perceived all domains of the PBL process positively, their mean scores were lower than the fourth year students.

Conclusion: This study provides baseline data on the students' perception of PBL in the new curriculum. The study identified the strengths and weaknesses of PBL at KAU. Satisfaction was significantly perceived with the curricular change as indicated by students' perception of a positive learning environment.

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Medical schools today aim to send their graduates out to the professional world with not only an extensive store of knowledge, but also with the means to keep that knowledge up to date, solve problems, and function as part of a team. According to Armbruster et al,[1] learning takes place when students are given the opportunity to develop a more interactive relationship with the subject of a course, encouraging them to generate knowledge. Problem based learning (PBL) is a teaching method featuring "interactive student-centered exploration of real life situations."[2] According to Dolmans et al,[3] PBL develops cognitive effects on student learning. These effects increase the retention of knowledge, enhancement of integration of basic science concepts into clinical problems, the development of self-directed learning skills, and the enhancement of students' intrinsic interest in the subject matter. The Faculty of Medicine at King Abdul-Aziz University (FOM-KAU) in Jeddah, Saudi Arabia, realized that learning is a product of both cognitive and social interactions in a student centered learning environment. They introduced PBL as part of an integrated curriculum in 2007. All faculty members were required to rethink their teaching methods to include some that positively utilize student centered learning. The term PBL was made known on campus when elements of PBL process were explained to students during the foundation course in 2008. This course is offered in the first semester of the second year, and it introduced the students theoretically to the elements of PBL. In order to prepare faculty members for their role in new curriculum implementation, PBL facilitation workshops were conducted. Undergraduate medical students at KAU are exposed to PBL for the first time through 5 modules in their second year: musculoskeletal, cardiovascular, immune, blood and lymphatic system, respiratory and urinary modules; and 3 in their third year: gastrointestinal module, nervous system and special senses, endocrine and reproductive modules. Each of these modules includes one PBL case that covers new material excluded from their lectures. During the module, students are grouped (10 students in each group and each is led by a certified PBL facilitator) to solve a constructed problem in 4 sessions. The sessions continue for 2 weeks during which contextual learning, integration of knowledge, and development of skills takes place. Normally, a case is used as a trigger to initiate learning. These cases describe events in a context or situation that promotes active learning. Cases are written as problems that provide the student with history or background of a patient. The main idea is that their learning starts with this problem. To be solved rather than simply given the exposition of disciplinary knowledge, students take responsibility for their learning. Discussing the problem in small groups stimulates independent and active learning.[4] Recently, researchers have emphasized the benefits of soliciting student perception regarding effective small group teaching.[5] This perception has been measured either by interviewing students, discussion in focus groups, or by use of questionnaires.[6] However, little research is present with respect to perceptions amongst students engaged in PBL pedagogy. Therefore, the aim of our study was to evaluate from a student perspective, through a cross-sectional survey, student perceptions of their PBL experience. Two years after introducing PBL at FOM-KAU as part of the new integrated curriculum, this study was conceived with the following objectives: 1. To investigate student perceptions of PBL. 2. To compare the acceptance level of new students who were introduced to PBL theoretically with those who had 2 years experience. 3. To study the effect of PBL on academic performance.

Methods.

The present cross-sectional study was conducted between November 2008 and May 2009 at FOM-KAU, Jeddah, Saudi Arabia. A self-administered structured questionnaire was used to collect data from 2 groups of undergraduate medical students (**Appendix 1**). It was distributed and collected at the end of the foundation course for second year students, and at end of the academic year for fourth year students. Participation in this study was optional. Ethical approval was granted from the Biomedical Ethics Research Committee at KAU.

Foundation course. All students attend a lecture as part of the foundation course that describes PBL, strengths and weaknesses of PBL, and explains the process at KAU. The lecture also defines their role as students and responsibilities during PBL sessions. The role and responsibilities of the tutor is also made clear.

Subjects. The study subjects consisted of 2 groups of undergraduate students at FOM-KAU. The first group was second year students who were introduced to PBL though the foundation course only, and did not attend any PBL sessions. These students served as a control group since they had no exposure to PBL in practice. The second group was fourth year under-graduate medical students who experienced PBL through 8 modules in 2008 and 2009, they were the first group that started PBL at FOM-KAU. Students who volunteered to participate filled out the questionnaire and returned it through their group leaders. Students who did not answer all 13 questions were excluded from the study.

Instrument. Based on the available literature on student perception, a questionnaire was developed to address several areas of students experience with PBL at KAU. Since PBL did not replace the existing curricula at KAU and was only integrated though additional

modules, a specific questionnaire had to be developed to evaluate the current situation. The questionnaire consisted of a demographic section and 13 statements regarding students' perception on PBL. These included questions on PBL process, communication skills, PBL cases, resources, and tutors. The students were asked to indicate agreement on a 5 point Likert scale where 5 was strongly agree with the statement, and one was strongly disagree with the statement. The questionnaire was first designed in English and then translated into Arabic. To ensure validity, a double translation was also carried out. The Arabic version was used to collect data from both groups.

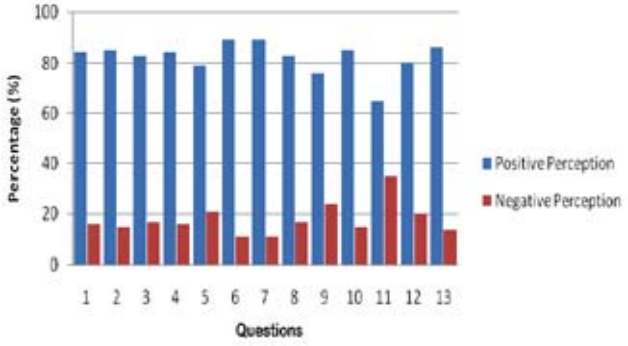

Figure 1 - Response of the study population to the 13 questionnaire statements. Data represents the percentage of students responding to each question.

Statistical analysis. Data entry and analysis was carried out using the Statistical Package for Social Science version 19 (SPSS Inc., Chicago, IL, USA). The quantitative data were presented in the forms of means and standard deviations. Student t-test was used for comparison between 2 groups (second and fourth year). Pearson's correlation coefficient was carried out to study correlation between variables; significance was considered at *p*-value less than 0.05. A score was given for each questionnaire statement. The mean score reflecting students' perception on each item of the PBL process ranged between 2.78 to 3.89 out of 5. Items with a mean score of 3 and above were considered

Table 1 - Second and fourth year student scores on each of the 13 questions.

No.	Statement	2nd Year Students		4th Year Students		*P*-value
		Mean score ± SD	95% CI of mean	Mean score ± SD	95% CI of mean	
1	PBL emphasized regular attendance	3.22±1.07	(3.09 - 3.35)	3.89±0.96	(3.77 - 4.01)	0.00*
2	PBL helped integration from different disciplines (anatomy, physiology, pathology, etc..)	3.48±1.02	(3.35 - 3.61)	3.87±0.93	(3.76 - 3.98)	0.002*
3	PBL allowed you to ask questions more regularly	3.34±0.98	(3.22 - 3.46)	3.59±1.07	(3.46 - 3.72)	0.044*
4	PBL allowed collaborating productively in groups	3.56±1.11	(3.51 - 3.79)	3.67±1.04	(3.54 - 3.80)	0.411
5	PBL has trained you to become independent in your learning	3.29±1.02	(3.16 - 3.42)	3.71±0.96	(3.59 - 3.83)	0.440
6	PBL trained you to think first rather than ask questions	3.57±0.90	(3.46 - 3.68)	3.71±0.96	(3.59 - 3.83)	0.252
7	PBL gave you more confidence to speak-up and explain your ideas/knowledge	3.57±1.05	(3.44 - 3.70)	3.86±0.94	(3.74 - 3.98)	0.021*
8	PBL helped you understand underlying mechanism of problems better than if it had been lectured in the conventional way	3.44±1.15	(3.30 - 3.58)	3.78±1.06	(3.65 - 3.91)	0.013*
9	Assessment during PBL sessions influenced corrective actions on your performance	3.06±1.10	(2.92 - 3.20)	3.30±1.11	(3.16 - 3.44)	0.087
10	PBL consumed a lot of preparation time in between sessions	3.44±1.06	(3.31 - 3.57)	3.53±1.18	(3.39 - 3.67)	0.521
11	PBL resources were available and easy to access via library	2.78±0.98	(2.66 - 2.90)	2.85±1.08	(2.72 - 2.98)	0.603
12	PBL resources are available and easy to access via internet	3.06±1.01	(2.93 - 3.19)	3.49±1.12	(3.35 - 3.63)	0.002*
13	The PBL tutor affected the success of the session/module	3.21±0.92	(3.09 - 3.32)	3.61±1.20	(3.46 - 3.76)	0.002*

PBL - problem based learning, SD - score represented by mean and standard deviation, CI - confidence interval of the mean, *indicated a statistical difference

positive, and items with a mean score of 2 and below were considered as negative student perception.

Results. Out of the 450 fourth-year, and 400 second-year medical students at KAU in 2009, 506 (60%) chose to participate in this study and represented the study population (250 second year, and 256 fourth year students). The male and female distribution was 284 (56%) and 222 (44%). Among the 506 students who participated in the study, 424 (84%) opined that PBL improved their attendance. The responses also indicated that PBL sessions helped them integrate information from different disciplines (85%), and helped them understand the underlying mechanism of problems better than if it had been lectured in the conventional way (83%). Participants also felt that PBL contributed to their communication skills by indicating that it allowed them to ask questions regularly (83%), and gave them more continence to speak up and explain their ideas (89%). While 85% of them found that PBL requires a lot of preparation work, and 35% found difficulty accessing resources from the library (**Figure 1**).

Control group. The control group perceived all domains of the PBL process positively; however, their mean scores were lower than those of the second group (fourth year students). The mean score of the control group ranged from 2.78-3.57 compared to those of fourth year students, which ranged from 2.85-3.89.

Fourth year students. When comparing fourth year students with the control group, the means in scores reflecting students' perception of the 13 questionnaire statements are as shown in **Table 1**. A positive and higher mean score was found in all statements of the questionnaire among fourth year medical students. A statistically significant difference was found in questions 1, 2, 3, 7, 8, 12, and 13 (**Figure 2**). The overall academic performance of the 250 participants from fourth year was as follows: 178 very good to excellent, 70 good, and only 8 students had poor to acceptable overall academic performance. Among the 178 high achievers, we found a correlation between their positive perception of PBL, and their grade in all questionnaire statements except for questions 5, 9, 11, and 12 (**Figure 3**).

Discussion. The current educational reform is swinging away from traditional approaches and towards PBL with such momentum that adaptation of PBL for many schools seems inevitable.[7] The FOM, at KAU introduced and started implementation of PBL in the academic year 2008/9 to gradually replace a traditional medical lecture based curriculum. It was important for the planners at the Medical Education Department (MED) and administrators of the new curriculum to assess the perceptions of students not only to get a feel of the student experience, but also to inform us and flag problems that need to be addressed with existing and future students.

This study demonstrated that both second and fourth year medical students, with mean score ranging from 2.77-3.57 and 2.85-3.89, favored PBL. Fourth-year students had higher positive perception regarding the PBL process. This finding could be due to the fact that fourth year students had ample time, 2 academic years, to experience the PBL process rather than being just theoretically introduced to it.

In PBL, students are encouraged to take responsibility for their own learning experience. Nevertheless, from the comparison of their mean scores, both second and fourth year students, with mean scores of 3.44±1.06 and 3.53±1.18, agreed and/or strongly agreed that PBL consumed a lot of preparation time between the sessions. These findings agree with those reported by Yuan et al[8] where students complained of the time-consumption and stressful nature of PBL, as well as the work overload. This could be attributed to the fact that students at

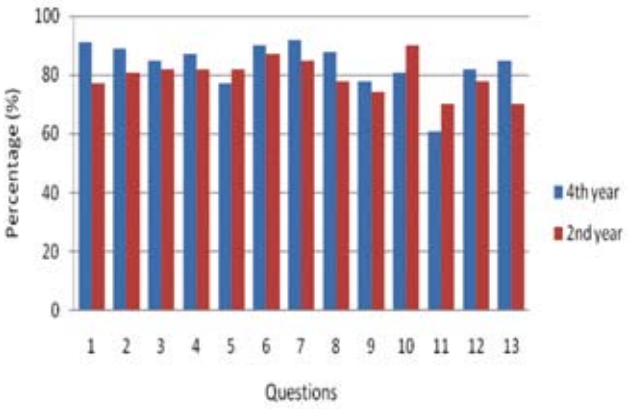

Figure 2 - Positive perception of second and fourth year students on the 13 questions. Data represents the percentage of students responding to each question.

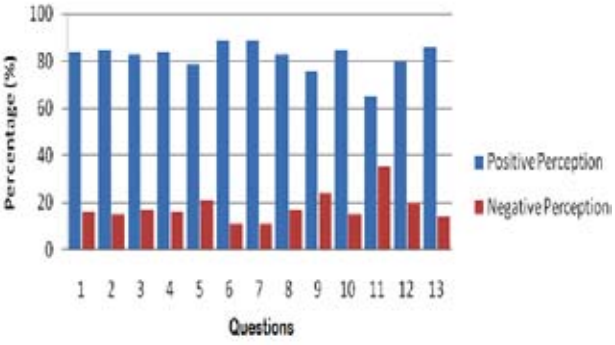

Figure 3 - Response of 178 students with high over all average to 13 questionnaire statements. Data represents the percentage of students responding to each question.

KAU are expected to spend extra hours for researching learning issues. They are responsible, during their own time out of sessions, to search in valid resources, to identify required information, and to be able to explain it in future sessions to their tutor and peers. On the other hand, second year students complaining of work overload was also foreseen. Since the majority of them were only taught using "teacher centered" methods of learning in their former education, difficulties to adjust are expected. Further research is needed to focus on how students, tutors, and administrators can be trained to help students regulate their time effectively.

Statistically significant differences were found between the 2 groups in several statements of the questionnaire. The ability to integrate information from different disciplines and understanding underlying mechanism was among those. The PBL seeks to engage students in an active process of individual and cooperative learning of interrelated themes.[9] The statistically significant difference (p=0.002) can be attributed to the fact that the fourth year students had experienced PBL cases that were built around an integrative theme where different disciplines were represented. Second year students, on the other hand, did not experience that.

The PBL emphasizing regular attendance was another area that showed a statically significant difference. Fourth-year students believed that PBL did indeed emphasize their regular attendance. There are 2 possible explanations for this finding: it could be because PBL cases at KAU are sequential and each session depends on the one before and/or students need to attend the 4 sessions to understand the case as a whole and maintain continuity. The second explanation could be related to the fact that students are graded for their attendance.

Among the 13 statements, improving communication skills was also among the highest overall mean score. The ability to ask questions regularly and the confidence to speak up findings were statistically significant for fourth year students. This might be explained by the fact that fourth year students had 2 years of experience with PBL and were able to recognize their own gain in communication skills from one PBL session to the other. This positive finding is a key ingredient for student centered learning. The PBL provides a more challenging and enjoyable approach to education.

Allowing students to ask questions was perceived positively among both groups, and there was a statistically significant difference (p=0.04) for the later. This might be attributed to the effect small-group work in PBL has on individuals, where they all have to be ready to construct collaborative explanations.

Both groups perceived the role of the tutor positively. Fourth year student findings were statistically significant (p=0.002). This was consistent with the literature, and an important implication that students realize the important role the tutor has on the successes of their PBL experience.[10]

The availability and ease of access of learning resources had the lowest mean scores among both second (2.78±0.98) and fourth (2.85±1.08) year students. Students did not agree that recourses were available and easy to access via the library. Similarly, lack of physical resources was one of the difficulties reported at the National University of Singapore when PBL was first introduced.[11]

At KAU, the introduction of PBL has highlighted the need to improve learning resources. In PBL, students are expected to spend a significant amount of their time searching for answers and explanations of the learning issues raised during each session. It is likely that, since the traditional curriculum was lecture based, the shortage in resources and reference materials was not visible at the implementation stage. This finding might have changed, as in 2010-2011 significant improvement was seen in the library resources as a direct cause of the preparation for the accreditation process.

Another objective in this study was to correlate student perception with their grades. Amongst the fourth year group, there was a correlation between their positive perception and their grades in most statements of the questionnaire. In a study by Nalesnik et al,[12] the effect of PBL method on student grade was investigated in the form of student and faculty satisfaction only. They reported that the mean student satisfaction responses were significantly higher for students who used the PBL method. They also found that the mean scores on the National Board of Medical Examiners were higher for subjects using PBL.

The statements that were perceived negatively were related to students becoming more independent learners, realizing that PBL influenced corrective actions on their performance, and availability of resources either in the library or online. The first 2 statements might be attributed to the fact that students who are high achievers are also independent learners despite obtaining feedback during PBL sessions. The other areas that high achievers were not positive about were resources. Poor resources frustrate students, especially the ones that seek better grades. It is of great importance for the administration at FOM-KAU to consider this finding and attempt to seriously upgrade the available resources.

In conclusion, this study provides baseline data on students' perception of the educational environment in the new curriculum. The questionnaire identified the strengths and weaknesses of the newly introduced integrated curriculum at KAU. Satisfaction was significantly perceived with the curricular change as

indicated by students' perception of a positive learning environment. The findings of this study should be interpreted considering the following limitations. First, one of the inherent limitations of educational research using a questionnaire is the role of subjectivity. Secondly, it is very important to acknowledge that there are other related factors that affect the PBL experience: the quality of the cases, structure of PBL courses, the link with students' level of prior knowledge, and the functionality of tutorial groups.[13] Therefore, there may be other factors that contribute to student perception of the PBL process, and more research is needed to fully understand the effect of other variables.

Further research is needed to compare future students of the integrated curricula and this group of students. Also, it would be useful to investigate other aspects that have not been considered in this study, such as the correlation of student perceptions with the foundation course content.

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Illustrations, Figures, Photographs

Four copies of all figures or photographs should be included with the submitted manuscript. Figures submitted electronically should be in JPEG or TIFF format with a 300 dpi minimum resolution and in grayscale or CMYK (not RGB). Printed submissions should be on high-contrast glossy paper, and must be unmounted and untrimmed, with a preferred size between 4 x 5 inches and 5 x 7 inches (10 x 13 cm and 13 x 18 cm). The figure number, name of first author and an arrow indicating "top" should be typed on a gummed label and affixed to the back of each illustration. If arrows are used these should appear in a different color to the background color. Titles and detailed explanations belong in the legends, which should be submitted on a separate sheet, and not on the illustrations themselves. Written informed consent for publication must accompany any photograph in which the subject can be identified. Written copyright permission, from the publishers, must accompany any illustration that has been previously published. Photographs will be accepted at the discretion of the Editorial Board.

Appendix 1

Questionnaire

Thank you for taking the time to fill out this anonymous questionnaire. Your participation is optional but will help us to further improve future PBL modules at KAU.

Demographic Information:

1. **Gender:** Female ☐ Male
2. **Year:** ☐ 2nd ☐ 3rd ☐ 4th
3. **Overall average grade:** ☐ A ☐ B ☐ C ☐ D
4. **Number of cases covered in PBL:** ☐ 0 ☐ less than 2 ☐ 2-4 ☐ 4-6 ☐ more than 6

Your PBL Perception:

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
PBL emphasizes regular attendance	o	o	o	o	o
PBL helped integration from different disciplines (anatomy, physiology, pathology, etc…)	o	o	o	o	o
PBL allowed you to ask questions more regularly	o	o	o	o	o
PBL allowed collaborating productively in groups	o	o	o	o	o
PBL has trained you to become independent in your learning	o	o	o	o	o
PBL trained you to think first rather than ask questions	o	o	o	o	o
PBL gave you confidence to speak-up and explain your ideas/knowledge	o	o	o	o	o
PBL helped you understand the underlying mechanism of problems better than if it had been lectured in the conventional way	o	o	o	o	o
Assessment during PBL sessions influenced corrective actions on your performance	o	o	o	o	o
The PBL cases were well written and introduced new information	o	o	o	o	o
PBL consumed a lot of preparation time in between sessions	o	o	o	o	o
PBL resources were available and easy to access via the library	o	o	o	o	o
PBL resources are available and easy to access via the internet	o	o	o	o	o
The PBL tutor affected the success of the session/ module	o	o	o	o	o