Introduction of PBL in the First Year of Traditional Medical Curriculum

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GOOD PRACTICES

Introduction of PBL in the First Year of Traditional Medical Curriculum

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Abstract

Purpose: Problem-Based Learning (PBL) is one of the more prominent student-centred approaches introduced in medical education to enhance the effectiveness of traditional lectures that have not always succeeded in preparing medical students for problem-solving in clinical settings. We conducted a study that introduced a short PBL case in a traditional curriculum of first-year medical students and investigated students’ overall experience.

Method: Participants were first-year medical students of a 6-year undergraduate medical programme (MD6) with varying levels of prior exposure to PBL, ranging from none to minor or some experience. All participants completed a questionnaire on their experience following completion of the PBL tutorial. Qualitative analysis of student comments allowed us to gain valuable insights, while quantitative analysis of their responses enabled us to assess their satisfaction with PBL in comparison to traditional lecture-based learning.

Results: Analysis of the questionnaires revealed an overwhelmingly positive response from students towards the PBL approach, indicating a strong desire for more PBL-styled classes throughout their medical studies.

Discussion: We have shown that the introduction of PBL in the first year of studies of a traditional lecture-based medical curriculum was well received by students, with the majority of them reporting that PBL was more interesting and more engaging than traditional lecture-based learning.

Keywords: Medical education, Problem-based learning, Traditional medical curriculum

1. Introduction

The clinical demand on doctors is continuously growing and medical educational methods have been adapted to meet these challenges. Over the last few decades there has been a movement away from the teacher-centred format to a more student-centred approach. A student-centred approach will provide students with opportunities to solve problems in a collaborative environment, create their own models for learning and form self-directed learning habits [1–4].

The McMaster Medical School in Canada was the first to adopt a Problem-Based Learning (PBL) format to address the needs for student-centred learning [5]. The core philosophy of this type of student-centred approach is to construct ideas through social interaction and self-directed learning [6]. In a PBL facilitator-led setting, students work in small groups to discuss, analyse, and present their findings on a particular clinical case. This approach aims to create an environment of active learning and encourage deeper understanding. Furthermore, PBL aims to prepare students for the clinical setting by developing problem solving, critical thinking and interpersonal skills [5,7–9]. PBL can also increase a student’s ability to retain knowledge through a deeper understanding of the material [10]. Moreover, Aldayel et al. [11] reported that students had a better ability to integrate basic science and clinical knowledge. PBL is also credited with improving student teamwork and interpersonal skills [7,9,10]. Students have also been found to spend more time in the library and are more motivated to undertake self-learning activities than in a traditional curriculum [7,12,13]. Studies have illustrated that PBL-based curriculums are not inferior to traditional lecture-based curriculums in terms of achievement on standardized tests, and may be associated with

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improved scores on these tests [8,10,12–16]. Furthermore, studies have demonstrated that many students perceive PBL to be more enjoyable, more interesting and more nurturing than traditional lecture-based learning [7,9,10,12–14,16,17]. Therefore, students have reported greater satisfaction with a curriculum that includes PBL than with a traditional curriculum [18]. However, the praise for PBL has not been unanimous. Some research has indicated that some students find PBL to be excessively time consuming [17]. Other studies have indicated that the experience students get out of PBL, is partly correlated with the level of experience and training of the tutors guiding these sessions [9,17,19–21]. In addition, some early research on the effectiveness of PBL indicated that students may perform slightly worse in basic sciences as compared to traditional curriculum students [12].

The aim of our study was to investigate the effect of the introduction of PBL into the first year of a traditional undergraduate medical curriculum and evaluate how it was perceived by students.

2. Method

2.1. Participants

Based on the aforementioned advantages of PBL as an educational methodology, we embarked on a comprehensive large-scale study involving 254 participants. The study received ethical approval from Cyprus National Bioethics Committee and the participants were students from four consecutive first-year cohorts of a 6-year undergraduate medical programme (MD6) delivered at the University of Nicosia, Cyprus.

2.2. Procedure

Our study focused on the integration of a concise PBL case within an Organic Chemistry Course, which took place during the Spring Semester. All enrolled students actively participated in the PBL session, and upon its conclusion, they were asked to provide feedback by completing a brief questionnaire. The questionnaire was made available to them in either hard copy format or online through SurveyMonkey.

2.3. Analysis

2.3.1. Choice of statistical tests

To investigate associations between students wanting to have more classes with PBL structure and the rest of our independent variables the asymptotic Somers’ D was chosen instead of the chi-squared test for independence. Somers’ D is an asymmetric measure of association between two ordinal variables and was preferred over conducting Goodman and Kruskal’s gamma since it distinguishes between a dependent and independent variable [22]. Somers’ D test is similar to the chi-squared test for independence, but it is more appropriate for ordinal variables because it considers the ordering of the levels of the variables. Since both our independent and dependent variables are ordinal, the choice to use the asymptotic Somers’ D test was more appropriate.

3. Results

3.1. Descriptive/frequencies results

Since there are very few observations in one or more categories of our ordinal items (Appendix), we decided it would be appropriate to collapse those categories in order to increase the sample size and improve the statistical power of the analysis. Since there is a clear order to the categories (Strongly Disagree, Disagree, Undecided, Agree, Strongly Agree), we collapsed the response as follows: “Strongly Disagree” and “Disagree” were combined into a single “Disagree” category, and “Agree” and “Strongly Agree” were combined into a single “Agree” category. The response “Undecided” remained as a category.

We believe collapsing this 5-point ordinal Likert scale into the aforementioned 3-point ordinal Likert scale still maintains the ordinal nature of the data while effectively reducing the number of categories. Overall, 254 first-year medical students completed the questionnaire. However, due to the nature of its optional answering, not all 254 students responded to every question. About half the students reported that they had some previous experience with PBL (125/244) followed by those who reported that they didn’t have any previous experience with this format (73/244) and those who had reported having extensive experience (45/244). Regarding the questions relating to the Independent Learning (IL) component of the PBL structure, overwhelmingly, most students reported that they agreed that the IL process made learning more interesting (241/253), was more engaging, compared to the traditional lectures (238/251) and that it motivated them to learn the subject in more depth (222/253). Moreover, regarding the case structure providing in the PBL sessions, most students (121/133) agreed that the case was well structured and that the Learning Objectives (LOBs) naturally came out. Furthermore,
regarding the PBL tutor, most students (245/253) reported that the tutor encouraged them to use clinical reasoning and that the tutor motivated them to research information (232/252). Finally, the vast majority of the students reported that they would like to have more classes with the PBL structure format (233/253) (Table 1).

3.2. Somers’ D results

The study’s application of Somers’ D test revealed significant positive correlations between students’ preference for more Problem-Based Learning (PBL) classes and several aspects of their PBL experience. A strong, positive correlation was identified between students’ preference for more PBL classes (where higher scores indicate greater agreement) and their perception of the Independent Learning (IL) process as more interesting (r = .593, p = 0.007) and more engaging compared to traditional lectures (r = .659, p = 0.002). There was also a significant, moderate positive correlation with the IL process motivating deeper learning (r = .467, p < 0.001).

The structure of the PBL cases, including case organization and the emergence of learning objectives, did not show a significant association with students’ preference for more PBL classes (r = .207, p = 0.136). However, aspects related to the tutor were strongly positively correlated: students’ preference for more PBL classes was significantly associated with tutors encouraging clinical reasoning (r = .702, p = 0.013) and motivating research (r = .546, p < 0.001).

Interestingly, a small negative association was noted between students’ prior experience with PBL (with lower scores indicating more experience) and their preference for more PBL classes (r = -.109, p < 0.005). This suggests that students with some or extensive prior experience with PBL were slightly more inclined to agree with wanting more PBL classes, indicating a positive reception of PBL among students familiar with the format.

3.3. Qualitative analysis results

The qualitative data obtained from the questionnaires was mostly positive. A total of 106/254 students responded in the comments section. When reading the comments, a number of key observations could be made. Firstly, most comments highlighted how engaging the class was. Furthermore, students found the material interesting when delivered in the IL format. Another key point expressed by students was the enjoyable nature of the session.

Students enjoyed the integrated clinical reasoning and critical thinking in the IL format. When reviewing the negative comments a few were unsure how this could be implemented with other subjects (N = 1/106) and a few students provided feedback that the session was long and could be more concise (N = 1/106). Overall, the negative comments were few and the overwhelming majority of comments were positive and focused around “engaging” (N = 14/106), “interesting” (N = 19/106) and “enjoyable” (N = 15/106) descriptors. Some phrases to support the positive review of the material include:

- “Session model was highly engaging, interesting and overall, a unique experience that joins together critical thinking with an ability to test our preliminary knowledge”

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Table 1. Table showcasing number of responses as well as mean, standard deviation and median response values of how first-year medical students of the University of Nicosia Medical School responded to the PBL quantitative questionnaire after collapsing the 5-point Likert scale (Strongly Disagree to Strongly Agree) to a 3-point Likert scale (Disagree, Undecided, Agree) for questions numbered 2–8. Question 1 was not collapsed as from its inception it was structured to be answered using a 3-point Likert scale (1 = None, 2 = Some, 3 = Extensive).

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean (SD)</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you had previous experience with problem-based learning (n = 244)?</td>
<td>1.89 (.687)</td>
<td>2</td>
</tr>
<tr>
<td>2. The IL process made learning more interesting (n = 253).</td>
<td>2.93 (.338)</td>
<td>3</td>
</tr>
<tr>
<td>3. The IL process was more engaging, compared to the traditional lectures (n = 251).</td>
<td>2.92 (.344)</td>
<td>3</td>
</tr>
<tr>
<td>4. IL motivated me to learn the subject in more depth (n = 253).</td>
<td>2.86 (.382)</td>
<td>3</td>
</tr>
<tr>
<td>5. The case was well structured and the LOBs naturally came out (n = 133).</td>
<td>2.89 (.382)</td>
<td>3</td>
</tr>
<tr>
<td>6. Our tutor encouraged us to use clinical reasoning (n = 253).</td>
<td>2.96 (.206)</td>
<td>3</td>
</tr>
<tr>
<td>7. Our tutor motivated us to research information (n = 252).</td>
<td>2.88 (.417)</td>
<td>3</td>
</tr>
<tr>
<td>8. I would like to have more classes with this structure (n = 253).</td>
<td>2.91 (.343)</td>
<td>3</td>
</tr>
</tbody>
</table>

a IL: Interactive Learning.

b LOBs: Learning Objectives.
• “This was fantastic! Very enjoyable and engaging”
• “The tutor was able to engage and encourage all students during the class and was able to teach in a manner that prompted students to use medical reasoning and previous knowledge to diagnose the case”
• “It was very fun and encouraged critical thinking”
• “This session was very hands on and engaging and I thoroughly enjoyed it”
• “It was more engaging than lectures which made it easier for me to understand and learn”
• “By far the most interesting entertaining session we have received all year. I feel like I learned a lot, helped develop my critical thinking and skills that will definitely be required in the future. We should have more lectures like this in the future.”
• “Thank you for this session, it was really interesting. I would love to have more of these in the future.”
• “It’s an excellent approach because we actually use our critical thinking skills in different given scenarios.”
• “It was very interesting and allowed us to think critically”
• “I really enjoyed it because it made me feel I am actually studying medicine”
• “This was very interactive and engaging. It was fun!”

The few phrases to support the negative view of the IL session include:

• “I think for a clinical scenario this is a very good method. However, I can’t see it working for other subject tutorials such as physics.”
• “It was a really good lesson, however sometimes I get mixed up between a student's reasoning and a teacher's so for me personally I would rather go to the old format of focusing on the teacher and the lecture.”
• “Was too long of a session, went over the same thing over too many times. Make it more concise.”

4. Discussion

The purpose of the study was to examine, over the course of four consecutive academic years, the effect of the introduction of PBL into the first year of an undergraduate medical curriculum and how PBL would be perceived by students. To investigate this, students were provided with questions pertaining to the independent learning (IL) aspect of PBL, questions relating to the clarity of the case structure, as well as teaching style related questions. The vast majority of students reported that they found the IL process engaging and that it made the learning more interesting and motivating. The vast majority of students also reported that they found the structure of the case clear and that perceived the PBL tutor as motivating and encouraging to research information and to use clinical reasoning. Overall, students responded favourably to the integration of PBL into the first year of an undergraduate medical curriculum.

We were also interested in determining what influences students’ desire to have additional PBL-format sessions in the future. This was significantly associated with all questions pertaining to the IL process of PBL as well as tutor-specific components of the PBL course, according to the study’s findings.

In terms of the independent learning process of PBL, the results indicate that students who found the IL process made learning more interesting (compared to traditional lectures) and engaging, as well as motivated them to learn the subject in more depth, were more likely to want more classes with PBL format. This confirms that the individual learning process is a crucial component of PBL [4] that might result in students finding the course more interesting and motivating.

In addition, the data indicate that students who thought the tutor prompted them to utilize clinical reasoning and inspired them to conduct informational research were more likely to desire additional PBL-format tutorials. This shows that specific characteristics of the PBL tutor’s teaching style, such as encouraging the use of clinical reasoning and the drive to investigate material, play a significant role in determining whether or not students intend to take more PBL-format classes. These findings are consistent with prior studies indicating that active learning strategies, such as PBL, can increase student engagement and motivation to learn [7,10,12,13,17].

Notable is the conclusion that students with at least some prior experience with the PBL format are more likely to desire additional PBL-style classes than students with no prior PBL experience. This shows that prior exposure to the PBL format can improve the likelihood that students desire additional PBL-style courses. There could be a number of reasons why students with prior PBL experience were more likely to desire more PBL-style courses than those with no prior PBL experience. Students having past PBL experience may be more comfortable with the structure and consequently find it more engaging and inspiring than those with no
prior experience. Familiarity with the format may also assist students in comprehending the goals and objectives of PBL, which may result in a more favourable attitude toward this format. Since PBL is an active learning strategy that stresses self-directed learning, students with prior experience with PBL may be more comfortable with the concept of taking charge of their own education. Therefore, students with prior PBL experience may find PBL more intriguing than those who are unfamiliar with this method of instruction. In addition, because PBL is a format that requires students to use critical thinking and problem solving skills, students with prior experience with PBL may have developed these skills to some degree and therefore may find PBL more challenging and rewarding than students who are unfamiliar with this format. It is also likely that students with prior PBL experience may have had a favourable experience with the format in the past, leading to a more positive attitude towards PBL in general. This favourable experience may help improve their desire to study and participation in the course. In addition, prior experience with PBL may boost students’ interest in the course, as they will be more familiar with the format and understand how to approach the course material. This increased engagement may result in a more favourable view of PBL and a desire for additional PBL-style courses. Finally, this finding suggests that providing a more thorough and informative educational segment about the benefits of PBL at the beginning of the course may be necessary. It is possible that those who completed PBL for the first time may not have fully experienced the benefits of the format yet, and a better understanding of its advantages could improve their perception of PBL. It is crucial to note that the reasons stated above are not exhaustive, that these explanations may differ between students, and that other circumstances may have also influenced student responses.

In conclusion, the quantitative data outcomes of this study suggest that the independent learning process and tutor-specific characteristics of PBL courses have a significant influence in determining students’ desire for future PBL-format lectures. In addition, the finding that students with prior experience with the PBL format are more likely to desire additional PBL-based classes implies that prior experience with PBL can enhance students’ engagement and drive to learn using the PBL format.

Regarding the qualitative data obtained, the results of the study revealed that the great majority of comments were positive, with the majority of students describing the session as engaging, fascinating, and entertaining. Numerous students also emphasized the value of integrating clinical reasoning and critical thinking into the autonomous learning format. It is important to note that qualitative data, such as open-ended comments, can provide a more in-depth understanding of students’ perceptions and attitudes towards the PBL course. The positive comments from students such as “Session model was highly engaging, interesting and overall, a unique experience that joins together critical thinking with an ability to test our preliminary knowledge” and “This was fantastic! Very enjoyable and engaging” are indicative of the session’s success and provide insight into how students felt about the PBL session and how it impacted their learning.

When reviewing the negative comments, only a few students expressed uncertainty about how this format could be implemented with other subjects, and a few provided feedback that the session was too long and could be more concise. One student also commented that they experienced difficulty in distinguishing between the reasoning of other students and that of the teacher. Therefore, it could be beneficial for the teacher to provide more scaffolding and guidance on how to participate in class discussions and independent learning activities. However, overall, these negative comments were very few and the overwhelming majority of comments were very positive.

In conclusion, the qualitative data provides a more in-depth understanding of students’ attitudes towards PBL and highlights the benefits of the independent learning format. However, it is also important to consider the limitations of the study and the comments provided by students in order to improve the PBL session in the future.

4.1. Limitations and future directions

Although our study provides valuable insights, it is important to note that the results are based on self-reported data, which may be subject to bias, such as social desirability bias. Additionally, the generalizability of the findings may be limited as the study was conducted in a specific medical school with a particular PBL course design and student population. Future research could explore PBL in different medical schools or educational settings to determine if the findings can be replicated and generalized. The study also focused on a limited set of quantitative and qualitative questions, and there may be other factors that could influence students’ perceptions of PBL that were not considered. For example, individual personality characteristics and demographics may play a role.
Previous research has examined the impact of PBL on student learning styles, as well as the association between learning styles and academic performance in PBL. Various surveys have been used to assess learning styles, including the VARK Questionnaire Approaches [23] and Study Skills Inventory for Students [10], Kolb Learning Style Model [24], Felder’s Learning Style Inventory Questionnaire [25,26], Lancaster Inventory of Learning Styles [27], Study Process Questionnaire (SPQ) [28], and Shortened Study Process Questionnaire [8]. While results from these studies have been mixed, with some finding no significant differences in learning style following PBL [8,25] and others reporting shifts in learning approach [28], it is clear that understanding the impact of PBL on learning styles and academic performance is an important area of research. For example, McParland et al. [8] found no significant differences in learning style following PBL using the Shortened Study Process Questionnaire, while Groves [28] reported shifts from a “surface” to a “deep” learning approach using the Study Process Questionnaire. Additionally, Alghanem [25] found no significant difference in academic performance between students with an “active learning style” and a “passive learning style” using the Felder’s Learning Style Inventory Questionnaire. Despite the research on PBL’s impact on learning styles, it is important to note that there is a lack of research investigating whether certain learning styles find PBL-format classes more favourable than others. Thus, it remains unclear whether certain learning styles are better suited to PBL than others. Further research is needed to explore this relationship and to determine whether tailoring PBL courses to specific learning styles could enhance the effectiveness of this educational approach. Furthermore, future research could delve deeper into the teaching style of PBL tutors and its impact on students’ perceptions and attitudes towards PBL classes. Previous studies have investigated the impact of the tutor on students’ academic achievement and broader outcomes, including their role in groups and satisfaction with PBL. According to Williams and Paltridge [29], an effective PBL tutor is someone who facilitates learning, has a strong understanding of the subject matter, allows time and space for students to explore problems, can make appropriate decisions about when to intervene and help students without taking over the learning process, encourages the acquisition of knowledge and development of sound learning skills, is reflective of their own practice, and encourages students to reflect on what and how they learned. Tutors who possess these qualities are likely to have a positive impact on students’ PBL perception, how well they perform in the PBL learning process and the outcomes they achieve. However, there is still a lack of research on the beliefs and philosophies that underpin and shape PBL tutors’ approaches, strategies, and styles, as well as how their behaviours and beliefs may change and adapt over time.

Finally, the current study is a longitudinal study that collected data from medical students in their first year throughout a four-year period. While this design permits the evaluation of changes in the attitudes and perceptions of first-year medical students over time, it would be interesting to examine these across the course of their whole medical education.

Furthermore, to complement the quantitative data, a more in-depth qualitative study such as focus group discussions or interviews would provide a more in-depth understanding of students’ perceptions and attitudes towards PBL.

5. Conclusion

The purpose of this study was to identify the elements that influence a PBL participant’s desire for additional classes with this format. Our findings revealed strong favourable relationships between students’ desire for more PBL-format classes and all questions pertaining to the IL process of PBL and tutor-specific components of the PBL course. In addition, it was discovered that students having prior experience with the PBL format are more likely to desire additional PBL-based courses. Thus, providing a more thorough educational segment about the benefits of PBL at the beginning of the course may improve students’ perceptions of the format, particularly for those with no prior experience.

When interpreting the results, it is important to acknowledge the study’s limitations, including self-reported data, cross-sectional data, limited independent variables, and generalizability. Future research should seek to address these limitations and explore the impact of different learning styles on the perception of PBL. Furthermore, future studies could investigate changes in students’ attitudes and perceptions of PBL over the course of their entire medical degree and consider a more comprehensive set of factors that may influence their views of PBL. Qualitative research methods, such as focus group discussions or interviews, could
also provide a deeper insight into students’ perceptions and attitudes towards PBL. Overall, this study gives valuable information for the design and execution of PBL courses in medical education in order to better suit students’ requirements and preferences. When creating and implementing PBL courses in medical education, it is vital to consider

the independent learning process, lecturer-specific characteristics of PBL courses, and students’ prior experience with the PBL format.

Ethical approval
The study received ethical approval from Cyprus National Bioethics Committee and the participants were students from four consecutive first-year cohorts of a 6-year undergraduate medical programme (MD6) delivered at the University of Nicosia, Cyprus.

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Other disclosure
None.

Conflicts of interest
The authors report no conflicts of interest associated with this article.

Acknowledgments
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References
Appendix

Appendix. Table displays the mean, standard deviation (SD) and median responses of the 254 students to seven 5-point Likert scale (Strongly disagree = 1, Disagree = 2, Undecided = 3, Agree = 4, Strongly agree = 5) questions about their perception of the PBL course at the University of Nicosia Medical School.

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean (SD)</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>The IL(^a) process made learning more interesting (n = 253)</td>
<td>4.64 (.70)</td>
<td>5</td>
</tr>
<tr>
<td>The IL(^a) process was more engaging, compared to the traditional lectures (n = 251)</td>
<td>4.63 (.71)</td>
<td>5</td>
</tr>
<tr>
<td>IL motivated me to learn the subject in more depth (n = 253)</td>
<td>4.43 (.79)</td>
<td>5</td>
</tr>
<tr>
<td>The case was well structured and the LOBs(^b) naturally came out (n = 133)</td>
<td>4.41 (.78)</td>
<td>5</td>
</tr>
<tr>
<td>Our tutor encouraged us to use clinical reasoning (n = 253)</td>
<td>4.72 (.55)</td>
<td>5</td>
</tr>
<tr>
<td>Our tutor motivated us to research information (n = 252)</td>
<td>4.43 (.77)</td>
<td>5</td>
</tr>
<tr>
<td>I would like to have more classes with this structure (n = 253)</td>
<td>4.57 (.73)</td>
<td>5</td>
</tr>
</tbody>
</table>

\(^a\) IL: Interactive Learning.
\(^b\) LOBs: Learning Objectives.