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Original Article

Online Problem-Based Learning (PBL) during COVID-19 Pandemic: Trial at the Libyan International Medical University

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Abstract

Background   Online courses that utilize problem-based learning (PBL) are widely recognized as an effective educational method that blends self-directed learning with collaborative problem-solving.

Aim   The aim of this study was to evaluate the satisfaction of students from the Faculty of Basic Medical Sciences (BMS) at Libyan International Medical University (LIMU) with an online PBL course during the coronavirus disease 2019 (COVID-19) pandemic in 2020.

Method   This is a cross-sectional study performed during the COVID-19 pandemic in 2020, involving a total of 293 students from four different classes of Faculty of BMS. Each online PBL session ran for 2 hours and was arranged independently for each year group. Students had access to a seven-closed-question questionnaire for a few hours after the end of the session. The questions were of three different categories. The first category was related to the online organization of the session, tutor control, and instructions provided in the applied Modular Object-Oriented Dynamic Learning Environment (Moodle). The second category involves questions related to online communication problems, the facility of the Google Hangouts application used, and the time allocated for the session. The third category was the cooperation of the PBL group. The student was asked to answer agree or disagree for each question. If the student did not choose one of the answers, his response was recorded as (no response). The scores of (agree), (disagree), or (no response) for each student were transferred to a Microsoft Office (2021) Excel file and were displayed as frequency and percentages. A two-way analysis of variance without replication was performed to analyze the differences in student responses across various groups using Excel statistics. The proportion test was utilized to determine whether the proportion of positive responses (agree) in any group significantly differed from a specified level of 0.75 (75%). The acceptable proportion of no response was set at 0.2 (20%). The significant level was set at p-value less than 0.05.

Keywords
► online PBL
► online learning
► COVID-19
► medical education
► basic medical sciences

Results   For the first category, the highest level of student satisfaction (79.9%) was associated with Moodle instructions, followed by tutor control (79.5%), and online organization (72%). However, students in the third year of medicine demonstrated significantly lower satisfaction with online organizations compared with other groups (62.3%, $p < 0.05$). For the second category, all groups, except first-year medicine students, reported significantly low satisfaction with online access (58% $p < 0.05$). All groups expressed satisfaction with the time allotted for the session (74%) and the online Google Hangouts application used (71%), except for third-year medicine students, who exhibited a notable level of dissatisfaction with the use of online Google Hangouts application (7%, $p < 0.05$). Lastly, the third category focused on group cooperation and reflected an overall student satisfaction rate of 80%.

Conclusion   BMS students responded positively regarding their first online PBL session during the COVID-19 pandemic. The study displayed that the availability of online communication, the clarity of instructions, good session organization, and control are important factors that will determine the effectiveness of online PBL.

ملخص المقال باللغة العربية

رضا طلاب الجامعة الليبية الدولية للعلوم الطبية عن الدراسة القائمة على حل المشكلات عبر الإنترنت أثناء جائحة كوفيد-19: دراسة مقطعية بخلفية نظرية

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الخلفية: تعتبر الدراسة عبر الإنترنت التي تستخدم التعلم القائم على حل المشكلات (PBL) معروفة على نطاق واسع باعتبارها طريقة تعليمية فعالة تمزج بين التعلم الموجه ذاتياً وحل المشاكل الجماعي. الهدف: تقييم مدى رضا طلاب كلية العلوم الطبية الأساسية في الجامعة الليبية الدولية للعلوم الطبية عن الدراسة القائمة على حل المشكلات عبر الإنترنت خلال جائحة كوفيد-19 في عام 2020. الطريقة: هذه دراسة مقطعية تم إجراؤها خلال جائحة فيروس كورونا في عام 2020، وتضمنت 293 طالبًا من أربع فئات مختلفة من طلبة كلية العلوم الطبية الأساسية . استمرت كل جلسة عبر الإنترنت لمدة ساعتين وتم ترتيبها بشكل مستقل لكل مجموعة. بعد ذلك قام الطلاب بعد نهاية الجلسة بملء استبيان مكون من سبعة أسئلة مغلقة. قسمت الأسئلة إلى 3 فئات مختلفة. كانت الفئة الأولى تتعلق بتنظيم الجلسة عبر الإنترنت، ومراقبة المعلم للجلسة، والتعليمات المقدمة في بيئة التعلم الديناميكية النموذجية الموجهة. وتضمنت الفئة الثانية أسئلة تتعلق بمشاكل الاتصال عبر الإنترنت، وسهولة استخدام تطبيق جلسات جوجل، والوقت المخصص للجلسة. أما الفئة الثالثة من الأسئلة فكانت حول تعاون مجموعة الطلاب فيما بينهم خلال الجلسة. طلب من الطلاب الإجابة بالموافقة أو عدم الموافقة على كل سؤال. إذا لم يختر الطالب إحدى الإجابات يتم تسجيل إجابته بـ (لا استجابة). تم نقل نتائج (أوافق) أو (غير موافق) أو (لا استجابة) لكل طالب إلى ملف أكسل ميكروسوفت أوفيس وتم عرض النتائج كتكرار وكنسب مئوية. تم استخدام التباين الثنائي الاتجاه (أنوفا) لتحليل الاختلافات في استجابات الطلاب عبر المجموعات المختلفة. كما تم استخدام اختبار النسبة لتحديد ما إذا كانت نسبة الاستجابات الإيجابية (موافق) في أي مجموعة تختلف بشكل كبير عن مستوى محدد قدره 0.75 (75٪). تم تحديد النسبة المقبولة لعدم الاستجابة عند 0.2 (20٪). تم تحديد الدلالة الإحصائية عند0.05> P

النتائج: بالنسبة للفئة الأولى، ارتبط أعلى مستوى من رضا الطلاب (79.9٪) بتعليمات بيئة التعلم الديناميكية النموذجية الموجهة، تليها مراقبة المعلم (79.5٪)، والتنظيم عبر الإنترنت (72٪). ومع ذلك، أظهر الطلاب في السنة الثالثة من الطب رضا أقل بكثير عن التنظيم عبر الإنترنت مقارنة بالمجموعات الأخرى (62.3٪، P<0.05). بالنسبة للفئة الثانية، قررت جميع المجموعات، باستثناء طلاب الطب في السنة الأولى، عن مستوى كبير بعدم الرضا للوصول إلى الإنترنت (58٪، P<0.05). أبدت جميع المجموعات رضاها عن الوقت المخصص للجلسة (74٪) واستخدام تطبيق جلسات جوجل عبر الإنترنت (71٪)، باستثناء طلاب الطب في السنة الثالثة، الذين أبدوا مستوى ملحوظاً بعدم الرضا عن استخدام تطبيق جلسات جوجل عبر الإنترنت (7٪، P<0.05). وأخيرا، ركزت الفئة الثالثة على التعاون الجماعي وعكست معدل رضا عال للطلاب بنسبة 80٪.

الخلاصة: استجاب طلاب كلية العلوم الطبية الأساسية بشكل إيجابي لجلسات التعلم القائم على حل المشكلات عبر الإنترنت الخاصة بهم خلال جائحة كوفيد-19. وأظهرت الدراسة أن توفر الاتصال عبر الإنترنت، ووضوح التعليمات، والتنظيم الجيد للجلسة والتحكم فيها، جميعها عوامل ستحدد فعالية التعلم القائم على حل المشكلات عبر الإنترنت.

الكلمات المفتاحية: التعلم القائم على حل المشكلات عبر الإنترنت، التعلم عبر الإنترنت، كوفيد-19، التعليم الطبي، العلوم الطبية الأساسية.

Introduction

Online learning has long been used in higher education institutions in general and medical education in particular.[1] There are two approaches to online learning: synchronous and asynchronous. The former describes real-time learning that involves online face-to-face interaction among students and teachers via live chat or video calls. Asynchronous online learning, on the other hand, has no real-time interaction, but it relies on students having open access to course material, allowing flexibility in learning.[2,3] Technological resources such as the Learning Management System (LMS) are used in online learning approaches. Modular Object-Oriented Dynamic Learning Environment (Moodle) is the most frequently used LMS platform. Moodle is an open-source and customizable Virtual Learning Environment, which provides learning services such as forums, blogs, chats, wikis, glossaries, texts, books, and quizzes.[4] The Libyan International Medical University (LIMU) was the first Libyan university to adopt Moodle in its teaching strategy that has shown considerable positive impact on the learning experience since it was first used by the university in 2009.

Problem-based learning (PBL) is a modern teaching method that is based on constructive and critical thinking.[5] PBL is believed to be the keystone in science and medical education as the method enhances the application of problem-solving skills and acquired knowledge. This teaching strategy is well-established globally and is used as a vital educational tool in different educational institutions including information technology (IT), engineering, business, and medical schools. In Libya, teaching methods established in higher education are still mainly based on traditional lectures and traditional face-to-face teaching.[6] However, the first Libyan university to adopt PBL is the LIMU, where PBL has been integrated into the teaching system since 2009.[7]

The emergence of the coronavirus disease 2019 (COVID-19) led to the closure of many schools and universities around the world. Libyan universities were no exception as the rise of COVID-19 cases led to a full lockdown in late March 2020. History has proved that online learning is an effective approach during global and local crises. For example, during the influenza pandemic, the California Department of Health Services and the California Distance Learning Health Network used online learning to prepare public health nurses.[8] Online learning was also successfully utilized in the influenza pandemic in Australia.[9] Najran University in Saudi Arabia also benefited from online learning during the war between the Arab Coalition and Yemeni rebel groups.[10]

In fact, LIMU was in a similar situation during the civil war following the Libyan Revolution in 2011, as this also caused the shutdown of all educational institutions across different regions in the country. There were, however, several challenges facing the shift to online learning at the time. These ranged from the psychological and financial distress caused by the war to technical problems due to the community being generally very unfamiliar with the technologies needed for online learning. Therefore, the faculty has adopted alternative strategies to online education including transferring students to neighboring countries such as Egypt. In contrast, the shift to online education during the COVID-19 pandemic was easier due to the fact that over the past decade, the teaching strategies and technologies used by LIMU have developed significantly. This has significantly smoothened the shift to online education during the COVID-19 pandemic. In addition to conventional online teaching, Basic Medical Sciences (BMS) students were also encouraged to attend a trial online PBL during the COVID-19 pandemic.

Online PBL sessions have been previously established and are believed to have a positive effect on the learning experience of students, staff as well as the environment.[11] Because the teaching strategy at BMS relies heavily on PBL, and due to the faculty's belief that the skills developed in PBL are crucial for the students' development into competent graduates with good research skills. Thus, the faculty started an online PBL trial as well as online lectures during the COVID-19 crisis. The rationale for starting such a trial was to aid active involvement of students in the teaching process, and to assess the technical feasibility of such an online teaching plan given the expected technological challenges facing Libyan students in particular. A seven-closed-question questionnaire was used to gather feedback from students regarding the online organization of the session, tutor control, instructions provided in Moodle, online communication problems, applications used, time of the session, and cooperation within the PBL group.

Methods

The study was performed after obtaining ethical approval from the Scientific Research Deanship of the Libyan International Medical University

Preparation and Training

Students from different classes were first gradually introduced to online PBL sessions. This included year 1 medicine, year 2 medicine, year 3 medicine, and year 2 dentistry students who all undergo their basic medical sciences phase at the Faculty of BMS. First, all students were remotely taught and guided using video tutorials prepared by members of the faculty to familiarize the students with the rules and provide students with any required technical aid. After that, workshops were organized to prepare the tutors responsible for running the actual online PBL sessions. The majority of these workshops were done virtually, although some were organized in person following very strict social distancing rules. After all tutors were familiarized with the online PBL strategy, academic supervisors then organized virtual meetings with their students to ensure all students were comfortable with the new plan.

The Questionnaire and Data Collection

Participation in this study was voluntary and anonymous. Each online PBL session ran for two hours and was arranged independently for each class. Students had access to the questionnaire questions for a few hours after the end of the PBL session to make sure the feedback truly reflected their experience. The questionnaire contained seven closed-ended questions regarding the participant's first online PBL experience as shown in ►Table 1. The student was asked to answer

Table 1 The questionnaire's seven closed-ended questions

Questions	Agree	Disagree
1. Online PBL was organized		
2. The tutor was in control of the session		
3. The instructions provided in Moodle were clear.		
4. I had no Internet problems during the session.		
5. The online Google Hangouts application was easy to use.		
6. The time for the session was enough.		
7. The PBL group was cooperative.		

Abbreviation: PBL, problem-based learning

agree or disagree for each question. If the student did not choose one of the answers, his response is recorded as (no response). The scores of (agree), (disagree), or (no response) for each student were transferred to a Microsoft Office (2021) Excel file and were displayed as frequency and percentages. Then the questions were divided into three different categories. The first category included the first three questions related to the online organization of the session, tutor control, and instructions provided in Moodle. The second category involves questions 4, 5, and 6 related to online communication problems, the facility of the Google Hangouts application used, and the time of the session. The third category was the cooperation of the PBL group.

Statistical and Data Analysis

The data was presented in the form of frequencies and percentages. A two-way analysis of variance (ANOVA) without replication was performed to analyze the differences in student responses across various groups using Excel statistics. Additionally, the proportion test was utilized to determine whether the proportion of positive responses (agree) in any group significantly differed from a specified level of 0.75 (75%). We set the acceptable proportions of no response to 0.2 (20%). The significant level was set at p-value less than 0.05.

Results

Out of the 437 students, approximately 67% (293 students) returned the questionnaire. The majority of students that participated in this questionnaire were first-year medical students, as these accounted for 45% ($n = 131$) of the overall responses, second-year medical students accounted for 20% ($n = 59$) of the overall responses, second-year dental students accounted for 14% ($n = 42$) of the overall responses, and third-year medical students accounted for 21% ($n = 61$) of the overall responses.
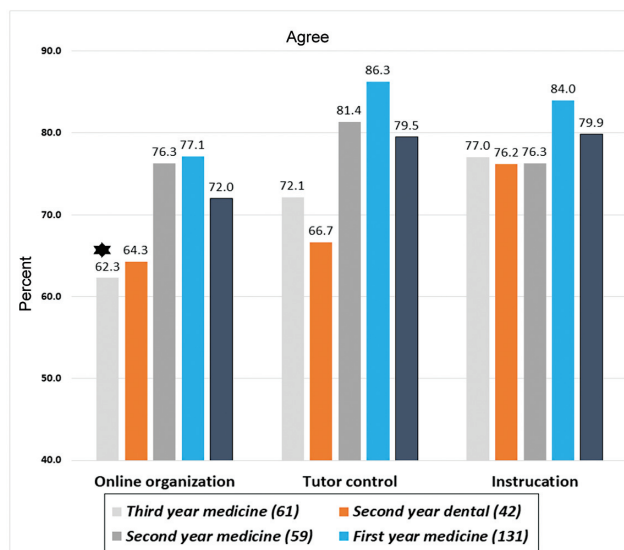
The distribution of the sample data according to the questions related to the first category stated in the questionnaire is illustrated in ►**Fig. 1**, showing that for all classes the highest percentage of student satisfaction (79.9%) was seen with Moodle instructions, followed by tutor control (79.5%), and the online organization (72%). Two-way ANOVA produced no significant differences between the different classes regarding their responses to the different questions ($p > 0.05$). However, third-year medicine showed significantly lower satisfaction than other groups in the question related to online organization (62%, $p < 0.05$). Otherwise, all other obtained responses were set within the chosen criteria (null hypothesis value at 75%), which reflect a general satisfaction with the online PBL experience (i.e., responding "agree" to the questionnaire elements).

When examining the no response in the first category, it was observed that the no-response rate for all students fell within the range of 9.9 to 14.7% (►**Fig. 2**). The highest rates were observed among second-year dental students (21.4%) in relation to Moodle instructions, and third-year medicine students (21.3%) in relation to online organization. Nevertheless, these differences were not statistically significant when the null hypothesis value was set at 20% (0.2).

In the second category concerning online communication factors, varying levels of satisfaction were observed among the different student groups. All groups, except first-year medicine students, reported significantly lower satisfaction with online access ($p < 0.05$; ►**Fig. 3**). On the other hand, all students expressed satisfaction with the time allocated for the session, with a highly positive response regarding the use of the online Google Hangouts application (80%). However, third-year medicine students stood out with a significant
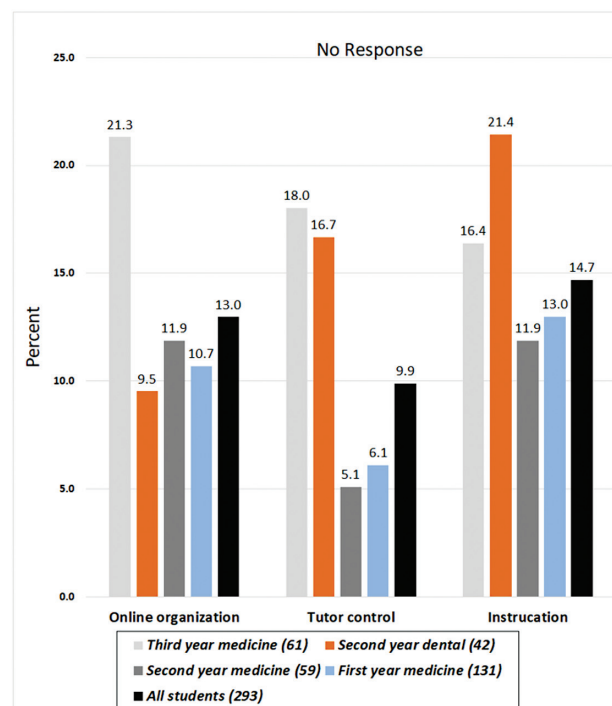

Fig. 1 Students satisfaction with the online managements.
* Significantly different from the specified level of 0.75 (75%).

Fig. 2 Students no-response related to online managements.

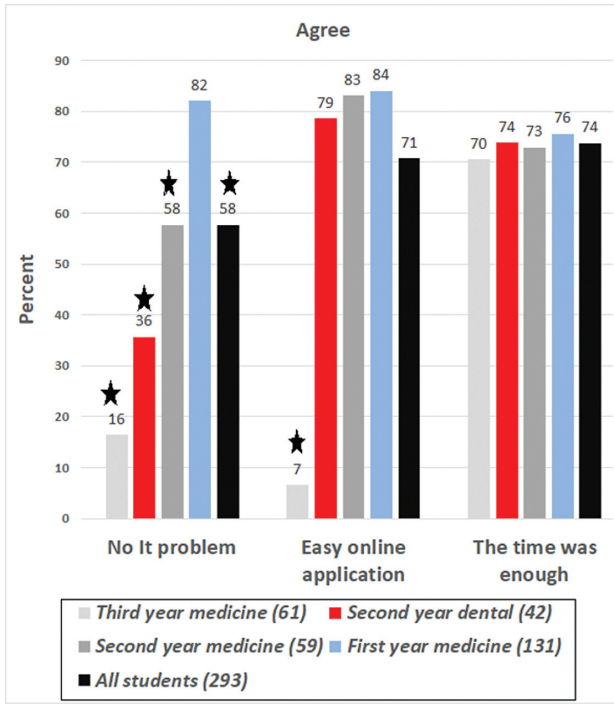**Fig. 3** Students satisfaction with the online communication.
* Significantly different from the specified level of 0.75 (75%).

Fig. 4 Students no-response related to online communications.
* Significantly different from the specified level of 0.20 (25%).

level of dissatisfaction (7%) about the use of online Google Hangouts application in comparison to students in other academic years ($p < 0.05$, ►**Fig. 3**). On the other hand, the no response in this category remained within the planned range of 20%, except for third-year medicine, which exhibited a significantly high proportion of nonresponses for questions related to IT communication problems (31%) and the ease of online Google Hangouts application (75%; ►**Fig. 4**).
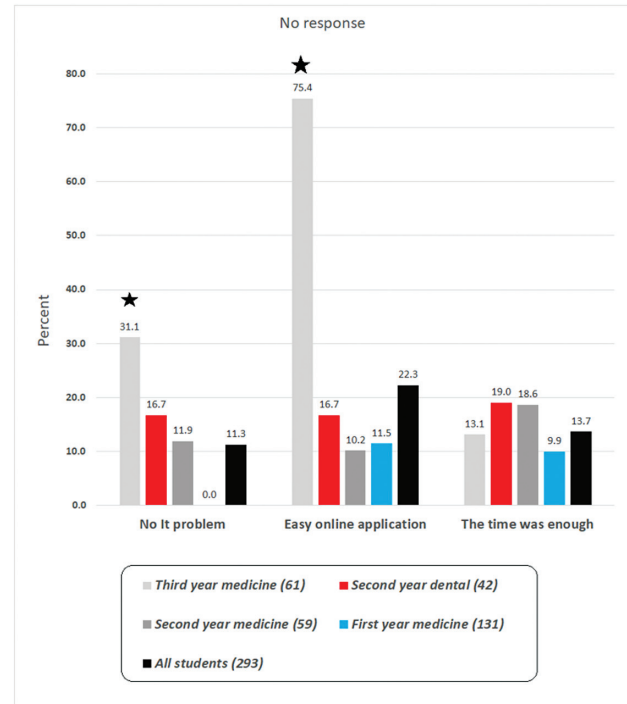
The third category, shown in ►**Fig. 5**, refers to group cooperation and demonstrates a general student satisfaction rate of 80%. The highest satisfaction rate was observed for second-year medicine students at 92%, followed by first-year medicine students at 78%, third-year medicine students at 77%, and lastly second-year dental students at 67%. The no-response score fell within the expected range, and there was no statistically significant effect on the
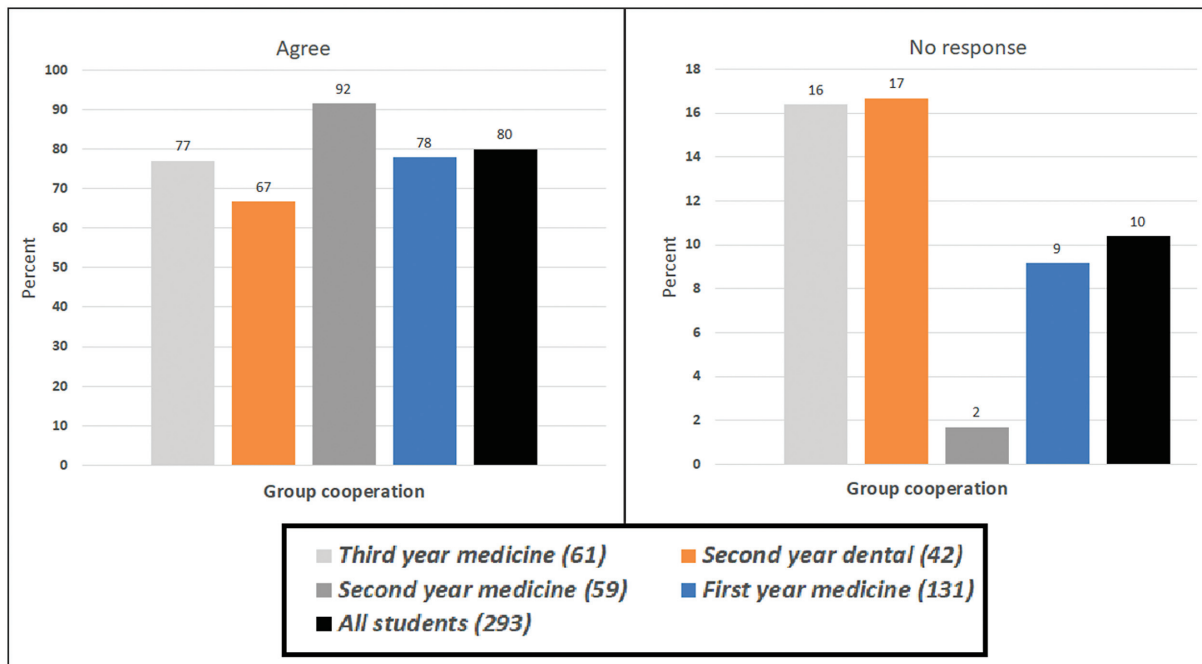

Fig. 5 Students satisfaction and no-response related to team work.

proportions of no response when the null hypothesis value was set at 20% (0.2).

The two-way ANOVA without replication revealed that there were no significant differences between the proportions of responses to all the questions in the questionnaire across the different groups of students.

Discussion

The lockdown resulting from the COVID-19 pandemic has urged universities around the world to shift to online teaching. The LIMU was the first Libyan educational institution to adopt an online teaching strategy during the pandemic period. Because students have their PBL sessions as a crucial element of their studies at the Faculty of BMS, the online PBL strategy was gradually introduced and integrated into the online teaching strategy during the COVID-19 pandemic.

The questionnaire responses indicate several key findings regarding student satisfaction with different aspects of the online course, as well as notable differences between student groups.

The first category included Online Organization, Tutor Control, and Moodle instructions. The highest level of student satisfaction (79.9%) was associated with Moodle instructions, indicating that students were generally satisfied with the instructions provided through the Moodle platform. Moodle is widely used in educational settings, to deliver online courses and facilitate blended learning experiences. Key features of Moodle include the ability to create customized courses, manage assessments and assignments, facilitate communication and collaboration among learners, and track learner progress.[4]

Tutor control also received high satisfaction (79.5%), suggesting that students felt positively about the guidance and direction provided by the tutors. Good tutoring in online courses plays a crucial role in engaging students and providing them with the support they need to succeed academically. Tutoring can help students stay motivated, address their questions and concerns, and guide them through the learning process.[11]

Online organizations had a satisfaction rate of 72%, with students in the third year of medicine demonstrating significantly lower satisfaction compared with other groups (62.3%, $p < 0.05$). This finding suggests that third-year medicine students were less satisfied with the online organization aspect of the course. Overall, effective online organization contributes to a positive learning environment, enhances student engagement, and supports the success of online courses by creating a structured and accessible learning experience for students.

As for the second category which deals with Online Access, Time Allotted, and Online Google Hangouts application used, all groups, except first-year medicine students, reported significantly low satisfaction with online communication access (58%, $p < 0.05$). Similar results were reported in Erickson et al[12,] where students were unhappy with the audio and video quality at some parts of the online session due to poor Internet connection. Globally, one of the main difficulties facing online education is technological problems and Internet connectivity.[13] All groups expressed satisfaction with the time allotted for the session (74%), suggesting that the duration of the sessions was generally well-received by the students and that students had enough time to understand and elaborate on the given scientific material.

Furthermore, this online PBL trial used Google Hangouts as a live chat online application as it offers several features including slide share, which enables students to share illustrative media during PBL sessions, and a chat box for live text messages. The majority of the participants were generally satisfied with the use of the Google Hangouts application for their online PBL trial (71%). This is consistent with the results from a similar study which showed that 70% agreed that the session objectives were met when discussion took place using Google Hangouts.[11] However, third-year medicine students demonstrated a significant level of dissatisfaction with the use of Google Hangouts application (7%, $p < 0.05$). These results highlight another area of dissatisfaction among third-year medicine students, in addition to their dissatisfaction with online management in comparison to other groups. Furthermore, third-year medicine students exhibit the highest significant no-response rate concerning IT communication problems (31%) and the usability of online Google Hangouts application (75%). This finding could have several potential explanations, including elevated expectations regarding the online organization, disparities in the course structure, and/or challenges related to accessing materials, navigating the online platform, or other technical issues.

The most important finding was the high satisfaction among all students about group cooperation (80%). Teamwork in PBL online fosters collaborative learning, allowing students to work together to solve complex problems, share knowledge, and learn from each other's perspectives. Moreover, working in teams in an online PBL setting enhances students' communication skills, including written communication, virtual collaboration, and the ability to express and defend their ideas.

When analyzing the results of any questionnaire, it is crucial to take into account the proportion of nonresponses. This refers to the percentage of respondents who choose not to answer a specific question. A high proportion of nonresponses can introduce bias into the results and hinder the ability to draw accurate conclusions. Consistently high proportions of nonresponses for certain questions may suggest that those questions are confusing, sensitive, or irrelevant to the participants. In our case, we observed no significant effect on the proportion of nonresponses when the null hypothesis value was set at 20% (0.2). This indicates that the nonresponses did not have a significant impact on the validity of our data. However, it is important to remain vigilant about the potential impact of nonresponses and consider strategies for minimizing their occurrence in any future surveys.

There are various benefits of online PBL. For example, it offers flexibility in some logistical difficulties, such as travel time. This ensures that students are engaged in academic activities regardless of factors such as geographical location.[12] Additionally, in this online PBL trial, students were

offered the opportunity to enhance their IT skills. This adds an important benefit to BMS students particularly as the use of such IT technology is still compromised in the region. Also, because this trial was introduced during a time of considerable psychological and financial stress resulting from the lockdown, online PBL sessions promoted an enthusiastic environment because students and tutors were able to actively interact and discuss thoughts and knowledge that decreased the social isolation impact during the lockdown period.

Additionally, training of the academic staff to monitor online classes was advised by various health and educational organizations.[14] Therefore, as part of the preparation strategy, the Faculty of BMS performed a series of preparation workshops before the start of the online program. This was done to guarantee that tutors can control the sessions and ensure that the objectives are achieved. Other workshops aimed to introduce Google Hangouts. Similarly, the students were provided with multiple video tutorials to provide them with the support needed, familiarize them with the technologies, and encourage active participation during the session. The efforts in preparing the academic staff and students for the online sessions were effective as reflected by the high score obtained for clarity of information.

This online PBL trial at the Faculty of BMS shows that online PBL could provide an effective strategy as a replacement for traditional PBL during crises. The introductions and training sessions offered before the trial were helpful in familiarizing students with the online learning system in general. This is reflected by the consistently high percentage of students satisfied with online PBL trial.

Conclusions

The study illustrated that online PBL can be an effective replacement for traditional PBL, mainly during crises. Traditional face-to-face PBL remains the ideal situation as it is crucial in the development of interpersonal and communication skills. In this study, there was no question comparing online and traditional PBL and therefore direct inferences cannot be made.

References

1 O'Doherty D, Dromey M, Lougheed J, Hannigan A, Last J, McGrath D. Barriers and solutions to online learning in medical education - an integrative review. BMC Med Educ 2018;18(130):1–11 Available at https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-018-1240-0 Accessed December 01, 2020

2 Wittich CM, Agrawal A, Cook DA, et al. E-learning in graduate medical education: survey of residency program directors. BMC Med Educ 2017;17(01):114https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-017-0953-9 Accessed December 012020

3 Moore JL, Dickson-Deane C, Galyen K. e-Learning, online learning, and distance learning environments: are they the same? Internet High Educ 2018;14(02):129–135 Available at https://www.sciencedirect.com/science/article/abs/pii/S1096751610000886 Accessed December 02, 2020

4 Cole J, Foster H. Using Moodle: Teaching with the Popular Open Source Course Management System. 2nd ed. Sebastopol, California, USA: O'Reilly Media, Inc; 2007

5 Wood EJ. Problem-based learning. Acta Biochim Pol 2004;51(02):XXI–XXVIhttp://www.actabp.pl/pdf/2_2004/XXIs.pdf Accessed December052020

6 Rhema A, Miliszewska I The potential of E-learning in assisting post-crisis countries in re-building their higher education systems: The case of Libya. Issues Informing Sci. Inf. Technol. 2012; 9: 149–160. Available at: *https://vuir.vu.edu.au/22860/6/IISITv9p149-160Rhema033.pdf* Accessed December 05, 2020.

7 El-Mansoury A, El-Naas N. Libyan International Medical University the Libyan Pioneer in Problem Based Learning. Int J Adv Res (Indore) 2016;4:992–1000 Available at https://www.journalijar.com/article/9893/libyan-international-medical-university-the-libyan-pioneer-in-problem-based-learning./ Accessed December 07, 2020

8 Macario E, Benton LD, Yuen J, et al. Preparing public health nurses for pandemic influenza through distance learning. Public Health Nurs 2007;24(01):66–72https://onlinelibrary.wiley.com/doi/10.1111/j.1525-1446.2006.00609.x Accessed December072020

9 Van D, McLaws M-L, Crimmins J, MacIntyre CR, Seale H. University life and pandemic influenza: attitudes and intended behaviour of staff and students towards pandemic (H1N1) 2009. BMC Public Health 2010;10(130):130https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-10-130 Accessed December 092020

10 Rajab KD. The effectiveness and potential of e-learning in war zones: an empirical comparison of face-to-face and online education in Saudi Arabia. IEEE Access 2018;6:6783–6794 Available at https://ieeexplore.ieee.org/document/8276222 Accessed December 10, 2020

11 Hashim H, Chong DWK, Er HM, et al. Students' Perceptions of Live Online Virtual e-Problem Based Learning (LOVE-PBL) using Google Hangouts. J Res Educ Indian Med 2017;9(04):31–39 Available at https://eduimed.usm.my/EIMJ20170904/EIMJ 20170904_04.pdf Accessed December 10, 2020

12 Erickson S, Neilson C, O'Halloran R, Bruce C, McLaughlin E. 'I was quite surprised it worked so well': student and facilitator perspectives of synchronous online Problem Based Learning. Innov Educ Teach Int 2020;58(01):1–12 Accessed December 11, 2020 . Doi: 10.1080/14703297.2020.1752281

13 Song L, Singleton ES, Hill JR, Koh MH. Improving online learning: student perceptions of useful and challenging characteristics. Internet High Educ 2004;7(01):59–70 Accessed December 12, 2020 . Doi: 10.1016/j.iheduc.2003.11.003

14 Sahu P. Closure of universities due to coronavirus disease 2019 (COVID-19): impact on education and mental health of students and academic staff. Cureus 2020;12(04):e7541https://pubmed.ncbi.nlm.nih.gov/32377489/ Accessed December122020