



# Implementation and Evaluation of a Blended Integrated Course in a Problem-based Learning Program

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## **Authors' contributions**

*This work was carried out in collaboration between all authors. Author RAA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript.*

*Authors SEE and NH managed the analyses of the study. Authors MAH and WT managed the literature searches and reviewed the written manuscript. All authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/JESBS/2018/38657

### Editor(s):

(1) Durdane Bayram-Jacobs, Professor, Department of Science Education, Radboud University, The Netherlands.

### Reviewers:

(1) Berna Musal, Dokuz Eylül University, Turkey.

(2) Mehmet Şahin, Dokuz Eylül University, Turkey.

(3) Ang Chooi Kean, Institute of Teacher Education International Languages Campus, Malaysia.

(4) Fariza Khalid, Universiti Kebangsaan Malaysia, Malaysia.

Complete Peer review History: <http://www.sciencedomain.org/review-history/23385>

**Original Research Article**

**Received 5<sup>th</sup> December 2017**

**Accepted 15<sup>th</sup> February 2018**

**Published 28<sup>th</sup> February 2018**

## **ABSTRACT**

Most medical educators agreed that the Electronic Learning is a necessity nowadays and not a luxury shift. This study was conducted aiming at implementing and evaluating a blended educational course for third-year medical students at the Faculty of Medicine, Suez Canal University (FOMSCU). An interventional study was used, data collection tools included: Needs assessment questionnaire; E-learning experience questionnaire and a PBL Tutorial Assessment form.

Forty-seven percent (47%) were satisfied with overall quality of blended block materials and

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activities, 28% were not satisfied and 26% have a neutral response. When evaluating students' group dynamics and performance by tutors in Problem-based sessions were more positive in PBL sessions during the blended block compared to previous sessions. The study concluded that students were in a larger percent satisfied with the implemented blended course. Furthermore, E-learning has a positive effect on the PBL sessions.

*Keywords: Information communication technology (ICT); online learning; quality of e-learning; e-learning experience/ blended learning; PBL.*

## 1. INTRODUCTION

The transformation from the traditional Face to Face (FTF) classroom mode to new delivery methods and platforms (correspondence, Internet-online, one-way, two-way audio and video) collectively known as Distance Education (DE), led some experts to predict that the residential based model will disappear in the near future [1]. The number of higher education institutions offering distance learning programs is growing. Innovative forms of instruction, such as Internet-delivered courses, are substituting traditional classrooms; students can now obtain their education anytime and anywhere [2]. One frequently cited definition of blended instruction is the mix of traditional (FTF) and interactive forms of classroom instruction with learning technologies to support planned learning and foster subsequent learning outcomes [3]. Other researchers defined blended instruction as an integrated approach utilizing strategically planned instructional or non-instructional approaches for fostering learning and performance [4].

The Faculty of Medicine- Suez Canal University (FOM-SCU) was established in 1978 to become the first problem-based, community-oriented/based and student-centred school in the Middle East [5]. Problem-based learning (PBL) is a specific form of collaborative learning that has gained a widespread acceptance in undergraduate medical education. Presentation of clinical scenarios as the stimulus for learning enables students to understand the relevance of underlying scientific knowledge and principles in clinical practice [6]. The term PBL is employed to transfer different concepts with different meanings. It is preferred to think of PBL as the active learning process that can be stimulated by a clinical, community or scientific problem. The principal idea behind problem-based learning is that the starting point for learning should be a problem, a query or a puzzle that the learner needs to solve. Students work on the problem to

identify and search for the knowledge that they need to obtain in order to approach the problem. Students on presentation of the problem are required to fulfil two objectives :solution of the problem and learning related to the problem [7].

Generally, PBL is introduced in the context of a defined core curriculum with integration of basic and clinical sciences, often being used to deliver core material in non-clinical parts of the curriculum. Paper-based PBL scenarios form the basis of the core curriculum and ensure that all students are exposed to the same problems. Recently, modified PBL techniques have been introduced into clinical education, with 'real' patients being used as the stimulus for learning [8].

FOM SCU activities are conducted face to face. Faculty self-study recommended incorporating Computer-Assisted Learning (CAL) in different activities. So, this study can provide a useful basis for curriculum reform in FOM-SCU. Therefore, to cope with the new era innovation, this study was aiming at implementing an educational electronic course horizontally integrated and problem-based for undergraduate medical students. Evaluating the satisfaction and the performance of the students after the course was done. The 3rd Year students were selected to conduct this study, provided that this year (3rd year), is a transitional period between preclinical and clinical phases. Results will provide indicators for future investigation and more descriptive research concerning the development of online programs for undergraduate students.

## 2. METHODOLOGY

The study was an interventional study aiming at implementing and evaluating a blended educational course for 3rd-year medical students, at the Faculty of Medicine, Suez Canal University. The target population included the third year undergraduate students at the faculty of medicine, Suez Canal University, during the

academic year (2013-2014). A comprehensive sample was included (n=119). The design of the course was divided into two correlated and interconnected macro-phases: the course plan itself and the communication architecture for the development and management of the learning activities. Therefore, the following steps were followed: conducting needs assessment of targeted learners: students' experience in ICT was firstly explored prior to course implementation to ensure that they had the necessary knowledge and skills in personal computing. An informal interview was conducted with stakeholders (year and phase coordinators) and the endocrinology block was selected. Then, revisiting educational block aims and objectives was done. Communicating with staff for course adaptation to fit for online purpose. This phase was exhaustive as many staff was not convinced of this technology shift. However, Faculty administrative support has solved many problems. The research proposal has been approved by the faculty ethical committee. The final decision was that the staff prepared their educational course materials adapted to online context and then they checked the final version before implementation. Phase coordinators were also supportive and facilitated the implementation phase. Ten different specialities were included: anatomy, histology, genetics, biochemistry, family medicine, community medicine, pathology, physiology and pharmacology. The platform for implementation MOODLE learning management system was chosen for the ease of accessibility and connectivity. A website was reserved securing the host and domain for its maintenance. The course was three weeks duration divided into modules and modules are then subdivided into lessons. For each module, objectives are announced and for each lesson, related activities and downloadable resources are present. The main menu includes hyperlinks for peer to peer forum and online seminar. Selecting suitable educational strategies: A blended learning approach was favoured using a mixture of both electronic and face to face teaching. All through the blended course student-centered, PBL and integration approaches were used. Identifying course activities: electronic lectures, quizzes, handouts, online videos, online games, peer to peer forums and asynchronous online seminar were used between two face to face PBL sessions. Meanwhile, PBL tutorials and labs were conducted via face to face techniques. Communication architecture: Identifying ways of communication between staff and students and

students with their colleagues. Forums and chat rooms were mainly used for this purpose. Once the first draft of the course was designed, reviewed by staff till the final version was available on the website, the course was implemented. An orientation session was conducted explained to students how to use the website, frequently asked questions, common navigation problems. Also, the nature of online courses and ways of communication with staff and colleagues were also discussed. Moreover, a manual on how to be familiar with the course was explained with details and how to proceed in each section. Students' log in username and passwords were distributed prior to course implementation and any inaccessibility problem was checked and solved. Staff username and passwords and manual on how to log into the website were sent by email. A meeting was conducted with the staff of involved departments. They were informed that their role was to guide students all through the process, providing help, support and effective feedback.

## **2.1 Data Collection Tools Included**

- 1. A self-administrated questionnaire:** It was adapted from published literature [9]. It contained two sections:-The first section was relevant to students' perceptions of the computer, its programs and internet familiarity (its use in school, classrooms, at home, for educational purposes, etc). - The second section focused on students' perceptions of the online courses.
- 2. E-learning experience questionnaire (Annex 1):** It was used to assess students' perception regarding the implemented course. It consisted of 32 items with a 5 point Likert scale (1=Strongly Disagree, 2=Disagree, 3=Neutral,4= Agree and 5=Strongly Agree). E-learning experience questionnaire is an adaptation of the Student Course Experience Questionnaire (SCEQ) to be context specific for online learning [10].

### **The questionnaire includes eight Scales:**

1. Good E-Teaching scale includes 7 items (3, 4, 5, 9, 12, 15, and 28).
2. Good E-Resources scale includes 4 items (8, 17, 20, and, 23).
3. Clarity of goals and standards scale includes 3 items (13, 19, and, 29).
4. Appropriate Workload scale includes 3 items (11, 14, and, 22).

5. Appropriate Assessment scale includes 3 items (1, 10, and, 26).
6. Interaction and engagement scale includes 4 items (7, 16, 18 and, 21).
7. Students Management scale includes 3 items (2, 6 and, 31).
8. Blended Learning scale includes 4 items (24, 25, 27, and, 30).

**3. PBL Tutorial Assessment form:** The tool was developed by University of Malaya for assessing student performance during PBL sessions. It was used in our context to evaluate students' group dynamics and performance by tutors in PBL sessions during blended course comparable to previous PBL sessions in other courses. Each tutor was required to rate or score students' performance (number of students in each class between 8 and 12) in 4 scales with 5 ratings for each (Participation and communication skills, Cooperation or team-building skills, Comprehension or reasoning skills and, Knowledge or information gathering skills. A 5-point grading system was used where ("1=unsatisfactory, 2=marginal, 3=satisfactory, 4=good or 5=outstanding performance) [11].

**2.2 Data Analysis**

Once the completed questionnaires were returned, they were entered onto an Excel Spreadsheet. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS version 21). According to the type of data, the followings were used: Descriptive analysis: Data was presented in the form of mean, percentage and standard deviation. Tables and graphs were used when appropriate. Paired T-Test was used for comparing means between males and females. Test for

normality was performed first. Pearson Product Moment correlation was used for correlations study.

**3. RESULTS**

One hundred and nineteen (119) students filled the pre-questionnaire. Regarding gender distribution in the study population, males were representing 25.7% while females were representing 74.3%. Twenty-six percent of participants received E-learning courses. Adding to this, 57% of students stated that they prefer to study by E-learning while 43% prefer face to face teaching.

Moreover, 42.8% of students agreed that their communication with staff will increase with the implemented blended course. While 51.3% of students agree that their communication with colleagues will increase with the implemented E-learning course. The results also showed the relationship between students' expectations of the implemented E-learning course effect on their communication with their colleagues and communication with staff and revealed statistically significant relationship (Table 1).

One hundred and five (105) students filled the E-learning experience questionnaire after implementation.

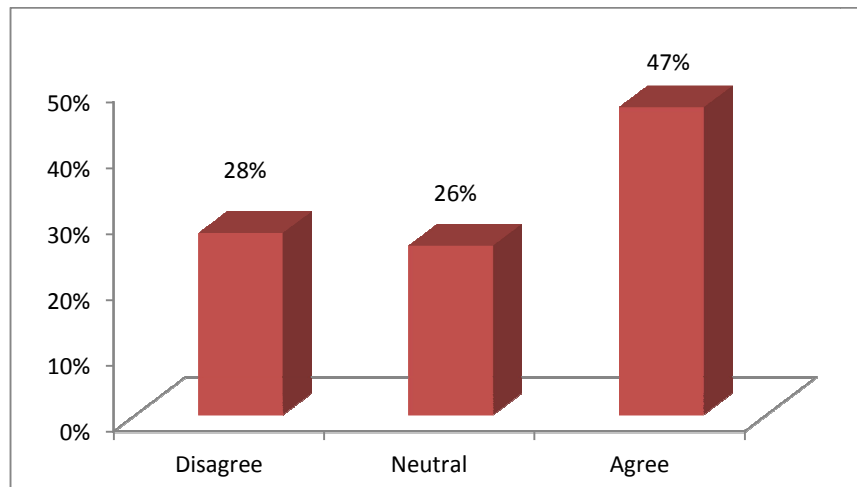
Fig. 1 shows that near half of students (47%) perceived the overall quality of E-learning block materials and activities positively while 28% were not satisfied.

Students' responses of the items related to students' interaction and engagement revealed that 29.8% of students agreed that they have benefited from other students' online submission and interacted with it (Table 2).

**Table 1. Students' expectations of the implemented E-learning course effect on their communication with their colleagues and their staff**

Item	Mean	SD	Likert scale (%)			P value
			Disagree	Don't know	Agree	
Expectation of increased communication with staff as a result of e-learning course	3.24	1.091	21.8	34.5	42.8	0.511
Expectation of increased communication with colleagues as a result of e-learning course	3.33	1.206	26.9	21	51.3	.000*

*(Statistically significant at p<0.01)*



**Fig. 1. Frequency distribution of students' (n=105) perception of the E-learning block**

**Table 2. Descriptive statistics of students' responses to items representing students' interaction and engagement (Items 7, 16, 18 and, 21).**

N	Item	Mean	SD	Likert scale (%)		
				Disagree	Neutral	Agree
7	Reading other students' on-line submissions clarified some of my own ideas	2.88	1.188	41.9	27.9	29.8
16	I interacted with students' on-line postings/submissions even if they weren't assessed	3.30	1.151	24.7	28.6	46.6
18	Other students' on-line submissions helped me understand my ideas from a new perspective	3.07	1.137	35.2	25.7	39.1
21	Other students' on-line submissions encouraged me to investigate further sources of knowledge	3.28	1.005	23.9	32.4	43.8

**Table 3. Descriptive statistics of students' responses to items representing quality of online resources (Items 8, 17, 20, and, 23).**

N	Item	Mean	SD	Likert scale (%)		
				Disagree	Neutral	Agree
8	The on-line teaching materials in this unit of study are extremely good at explaining things.	3.21	1.146	29.6	26	44.3
17	The on-line activities are designed to get the best out of students	3.20	1.180	25.7	35.2	39.1
20	The on-line teaching materials are designed to really try to make topics interesting to students.	3.10	1.119	31.5	32.4	36.2
23	The on-line learning materials helped me to learn during the face-to-face situations in this block	3.47	.971	15.2	30.5	54.3

Students' responses were positive concerning clear guidelines for online discussions (item 19: The guidelines for using on-line discussions were clear to me). Students' responses of the items

related to quality of online resources were positive, they agreed on the support of online materials to face-to-face situations (item 23). Also, 44.3% of the students were satisfied that

the on-line materials are relevant for explanation (item 8) (Table 3).

Students' responses of the items related to blended learning, how online learning support face to face activities were positive to a greater extent, as more than half of the students agreed that online activities support face to face ones all through the block (item 25). However, it was not clear for them the relationship of online modules to whole block (item 30) (Table 4).

Concerning the relationship between students' interaction scale includes 4 items (7, 16, 18 and, 21) and satisfaction (item 32), we have investigated this relationship using Pearson correlation coefficient. The results of the correlation analysis have revealed a strong, positive relationship between the two variables ( $r=0.61$ ,  $p<.001$ ) Comparison between males and females students' perception of E-learning experience revealed no statistically significant difference in their overall satisfaction as well as different components of E-learning. When evaluating students' group dynamics and performance by tutors in PB sessions, students' participation, cooperation, comprehension and reasoning skills, knowledge and information gathering skills, results were more positive in PBL sessions during the E-learning block compared to previous sessions. Data were analyzed by using Pearson Product moment-to-moment correlation coefficient) to test the relationships between scales. It shows statistically significant relationship in between students' participation and cooperation, students' participation and information gathering skills. Also, a statistically significant relationship between students' comprehension and reasoning skills with students' knowledge and information gathering (Table 5).

Considering all the study's findings, we arrived at the following overall assumptions students were in a larger percent satisfied of the designed Blended course. Having the necessary skills and experience in ICT tools with adequate teachers' support and feedback were main elements for this success.

#### **4. DISCUSSION**

Students' needs assessment was performed prior to course implementation. Results were guiding all through course design and directing towards any modification of course plan. In our study, 57% of students stated that they prefer to

study by E-learning in the pre-questionnaire. Therefore, a blended learning approach was used, by mixing technology-enhanced learning experiences with other, face to face learning experiences. Hence, course content was available via E-learning while labs and PBL sessions were conducted through face to face learning. Previous studies on blended learning effectiveness reported that it meets the educational needs of students such as satisfaction of learning, flexibility as well as developing critical thinking skills [12].

Concerning students' expectation of the extent to which communication will be affected by the designed Blended course, 42.8% agreed that their communication with staff will increase with the implemented Blended course while 51.3% agreed that their communication with colleagues will increase with the implemented course. Moreover, the relationship between students' expectations of the implemented Blended course positive effect on their communication with their colleagues and communication with staff revealed a statistically significant relationship. These expectations were taken into consideration during course design, as a peer/peer communication (online forum) was designed for better communication and an online seminar for regular communication with staff. Similar studies noted that student satisfaction with the overall learning experience depended on the perceived continuous interaction with staff and their involvement in course delivery [13].

Overall, 47% of students ( $n=105$ ) were satisfied with the quality of Blended course materials and activities while 28% were not satisfied and 26% have neutral opinion. A similar study on a blended two years course in a veterinary Science school in an Australian metropolitan university ( $n=127$ ) was conducted. Their students were satisfied by 45% while 21% were not satisfied. Their blended approach was to some extent similar to our study, as the orienting scenario for online resources was an authentic scenario. The online resources were used to help students to deal with the problem. However, their lectures were conducted through face to face and their courses were distributed all through years 3 and 4 [6].

Similarly, Akkoyunlu and Soylu when studying the viewpoints of students regarding blended learning, they reported positive students' attitudes. Also, studies revealed that the more

**Table 4. Descriptive statistics of students' responses to items representing blended learning (Items 24, 25, 27, and, 30)**

N	Item	Mean	SD	Likert scale (%)		
				Disagree	neutral	agree
24	It was clear if online resources were related to assessment.	3.00	1.065	29.5	39	31.4
25	The online activities helped me to understand the face-to face activities in this block	3.41	1.007	18.1	28.6	53.4
27	The relationship between the online resources and the whole block was clarified on the block's website.	2.99	1.096	34.3	32.4	33.4
30	It was clear to me how the website modules were related to the whole block	2.74	1.132	47.1	26.9	26

**Table 5. Evaluation of students' group dynamics and performance by tutors in PBL sessions**

Item (N=13)	Mean	Standard deviation	P value			
			Students participation	Students cooperation	Students reasoning skills	Students information gathering
Students Participation in classes	4.23	0.93	0.72	0.05	0.63	0.59
Students cooperation and team work in classes	3.77	0.83			0.84	0.04
Students comprehension and reasoning skills	3.4615	0.88			0.04	0.60
Students knowledge and information gathering	3.0769	1.04			0.89	0.03

students participated in the online discussion forums, the more they achieved and the more positive views they developed towards blended learning [14].

In our study, students' responses of the items related to students' interaction and engagement highlighted that they have benefited from other students' online submissions and interacted with them even though they are not assessed. We have used asynchronous online discussions (forums) as studies reported that they promote critical thinking. However, recent research suggested that levels of critical thinking in online discussions remain low [15] and further studies are required to analyze the quality of these online discussions.

Experts have been concerned with the level of interactions in online courses as teachers and students in online settings are not in the same physical place [16,17]. A path model conducted in similar study examining the relationship between factors affecting blended learning experience, self-regulated learning and academic achievement indicated that the e-Learning component of blended experience had a direct effect on peer learning, which consequently affected help-seeking, critical thinking, and metacognitive regulation [18]. Concerning the relationship between students' interaction and satisfaction, we have investigated this relationship using Pearson correlation coefficient. The results of the correlation analysis have revealed a strong, positive relationship between the two variables ( $r=0.61$ ,  $p<.001$ ). Although online courses may be labeled as artificial [16], however, acceptable levels of satisfaction have been reported with emphasis on the importance of interaction in virtual learning settings. Moreover, positive correlations between overall interaction and student satisfaction were noted; as Interaction levels went up, satisfaction and learning scores tended to go up as well [19,17]. Our findings are consistent with previous studies in the literature ( $r=0.55$ ,  $n=31$ ,  $p<.001$ ), [20,17], recommendations of the constructivist theories of learning [21] and with Salmon's Five-Step Teaching and Learning Online Model. Thus, these findings underlined the importance of promoting interaction in blended settings to reach higher levels of satisfaction and learning.

Finally, students' participation, cooperation, comprehension and reasoning skills, knowledge and information gathering skills, evaluated by the

tutors, are more positive in PBL sessions during the Blended course compared to previous PBL sessions in other courses.

A similar study was conducted in Hong Kong where a standard learning management system (LMS) was adapted to support self-directed learning within an integrated PBL curriculum for undergraduate Bachelor of Dental Surgery students. They stated that the integration of face to-face and virtual modalities through the use of interactive whiteboards within the tutorial was seamless and supported whole group engagement in the problem process [22]. These positive learning effects refer to the learning theories of constructivism on which PBL and Blended learning are both based and thus complement one another [23].

#### **4.1 Limitations of This Study**

A number of limitations should be acknowledged that if overcome could lead to better findings: first, small sample size hindered performing factor analysis. However, a trial of exploratory factory analysis was performed but was not conclusive with too much data reduction leading to elimination of major original subscales. Second, Generalizability of the results could not be achieved. So, replications to other institutions could not be done to determine if these findings extend over the current setting.

#### **5. CONCLUSION**

Considering all the study's findings, the study concluded that students were in a larger percent satisfied with the implemented blended course by PBL. Preparing a balanced blended recipe that meets students' educational needs was a point that should not be overlooked. Nevertheless, the study also revealed some unsatisfactory items concerning interactivity and stimulating online resources that should be studied. The study strongly recommends conducting the results to the relevant stakeholders to utilize them as basis for subsequent Blended courses planning. Results also should be used as guidance to institutional remedial action regarding students' indication of areas of concern.

#### **COMPETING INTERESTS**

Authors have declared that no competing interests exist.



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**E-learning experience questionnaire (Annex 1)**

<b>Question</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly agree</b>
1. To do well in the online quizzes all you really need is a good memory.					
2. The teacher used the online environment when appropriate to keep students informed about results					
3. I received too much feedback online from my teacher.					
4. The teacher's responses online motivated me to learn more deeply.					
5. The teacher helped to guide online discussions between students					
6. The teacher used the online environment to regularly update students about relevant block study information.					
7. Reading other students' on-line submissions clarified some of my own ideas					
8. The online teaching materials in this unit of study are extremely good at explaining things.					
9. The teacher's interaction with me online encouraged me to get the most out of my learning.					
10. Online quizzes helped me to learn effectively					
11. The workload for the online component of this block is too heavy					
12. The teacher's online responses motivated me to do more online learning than I would have done otherwise.					
13. Information needed to understand the purpose and contents of the block was integrated in one place online.					
14. I generally had enough time to understand the things I had to learn online.					
15. I didn't receive enough helpful online feedback from my teacher.					
16. I interacted with students' online postings/submissions even if they weren't assessed					
17. The online activities are designed to get the best out of students					
18. Other students' on-line submissions helped me understand my ideas from a new perspective					
19. The guidelines for using on-line discussions were clear to me.					

Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
20. The on-line teaching materials are designed to really try to make topics interesting to students.					
21. Other students' online submissions encouraged me to investigate further sources of knowledge					
22. The sheer volume of work for the online component of this block means it can't all be thoroughly comprehended.					
23. The online learning materials helped me to learn during the face-to-face situations in this block					
24. It was clear if online resources were related to assessment.					
25. The online activities helped me to understand the face-to face activities in this block					
26. The online materials supported some key assessment items in this block					
27. The relationship between the online resources and the whole block was clarified on the block's website.					
28. The teacher helped to focus online discussions between students					
29. Information needed for assignments was integrated in the one place online.					
30. It was clear to me how the website modules were related to the whole block					
31. The teacher ensured continuous access to the relevant online materials throughout the block					
32. Overall, I was satisfied with the quality of the on-line materials and activities of this block					

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*Peer-review history:*  
 The peer review history for this paper can be accessed here:  
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