PROBLEM BASED MOBILE LEARNING IN BIOCHEMISTRY: AN INTERVENTIONAL STUDY IN PHASE I MBBS STUDENTS

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ABSTRACT

Objectives: The objectives of the study were (1) to compare the effectiveness of problem-based learning (PBL) in classroom and problem-based mobile learning (PBML) using a mobile application and (2) to study the perception of students to PBML and PBL in classroom.

Methods: After getting clearance from institutional ethics committee, an interventional study was conducted for a period of 2 months among 250 Phase IMBBS students of Government Medical College Kozhikode, Kerala. Students who gave consent for the study were divided into two groups, namely, R-1 and R-2, and analyzed for the effectiveness of PBML as a teaching learning method in comparison with PBL in classroom. Perception of students toward use of PBML and PBL as teaching learning method was collected using validated questionnaire.

Results: It was observed from the study that in all the sessions post-test mean scores were significantly higher than pre-test scores in both PBL and PBML. Before the intervention there was no significant difference in the pre-test mean scores in topics done by PBL and PBML. After intervention the only the post-test mean scores significantly improved. When the total post score scores of PBL and PBML compared, it was found that PBML mean score is significantly higher than PBL mean score. In the student's perception analysis, it was found that both methods are effective in concept building, stimulating, helpful in passing exams, and development of problem-learning skills.

Conclusion: From the study finding, we can conclude that both PBL and PBML are effective modes of teaching applied biochemistry for Phase I MBBS students. PBML is more effective than PBL in teaching applied biochemistry in Phase I MBBS students. Perception analysis shows that interaction with the students and doubt clearance is more effectuated with PBL than PBML.

Keywords: M-learning, PBL, Teaching learning method, Medical education, Biochemistry.

INTRODUCTION

Handheld devices have revolutionized communication and education in the last decade. Consequently, mobile learning has become popular among medical students[1]. The physical presence of the teacher is important in traditional teaching process. In a medical college, the time they get to gather this information is limited. At present, COVID-19 pandemic has suspended all classroom-based learning but in a medical institution where mobile learning is already in practice, the course duration and content are not at all affected. In the present context use of mobile learning (M-learning) is extremely relevant. M-learning is a form of learning where the knowledge is dispersed using portable electronic devices such as mobile phones and tablet PC. With widespread adoption of technology, M-learning is already prevalent among the medical students [2-4].

New competency based medical education implemented in India, shifts the focus from conventional discipline-based learning to an integrated pattern from phase I onward. In the current pattern problem-based learning (PBL) is significant. There are very few studies to demonstrate the effectiveness of learning using mobile application in phase IMBBS subjects. The present study aims to compare the PBL in classroom and PBL with the help of a newly developed mobile application problem-based mobile learning (PBML) which can be used in android based mobile phones.

METHODS

It was an educational intervention study conducted in Department of Biochemistry, Calicut Medical College. Phase I MBBS students of Government Medical College, Kozhikode, Kerala were considered for the study for the period of 2 months (January–February 2020). Phase I MBBS students who gave consent for the study were included in the study. Around 250 students were included in the study.

Method of intervention

Consent for including in the study was obtained from all the participants, following which students who gave consent were randomly divided into two groups, that is, group R-1 (n-125) and group R-2 (n=125) by lot method. After conducting meeting of faculties in the department eight clinically correlated topics of equal weightage are selected.

4 topics (designated T-1, T-3, T-5, and T-7) selected for problem-based teaching in the classroom (PBL).4 topics (designated as T-2, T-4, T-6, and T-8) selected for PBL using a newly created mobile application (PBML) which can be downloaded free only to those students allocated. A mobile learning application which can be accessed free using a coupon code which is valid for 48 h in android and IOS system was created for the topics T-2, T-4, T-6, and T-8 with the help of a technical team in Bangalore. This application contains the video lectures of the above-mentioned topics were taken by the author. The PBL in the classroom (PBL) were conducted by the author.

Lesson plan made for all topics. Structured MCQ of same difficulty level prepared for each topic prepared with the help of faculties in the Department of Biochemistry, GMC Kozhikode. Pre-test and post-test were conducted online with the help of Google forms. A validated questionnaire was also made in Google forms.

Plan of sessions

Sessions	Topic taken and Method of intervention			
	PBL	Group	PBML	Group
I	Jaundice (T-1)	R-1	Iron deficiency anemia (T-2)	R-2
II	Homocystinuria (T-3)	R-2	Phenylketonuria (T-4)	R-1
III	Diabetic Ketoacidosis (T-5)	R-1	Glucose Tolerance Test (T-6)	R-2
IV	Scurvy (T-7)	R-2	Rickets (T-8)	R-1

First session with two topics (T1 and T2) of equal weightage

- Pre-test conducted to R-1 and R-2
- To R-1, one topic taken as PBL to the other group R-2, T-2 taken as PBML
- Post-test conducted to R-1

Second session, with T3 and T-4 of equal weightage

- R-1 and R-2 are crossed over
- Pre-test conducted to R-1 and R-2
- Now to R-2 topic T-3 taken as PBL. To R-1 topic T-4 taken as PBML
- Post-test conducted.

Third session with two topics T-5 and T-6 of equal weightage

- The groups in second session is crossed over
- Pretest conducted to R-1 and R-2 for the topics assigned
- To R-1 topic T5 taken as PBL and R-2 topic T6 taken as PBML
- Post-test conducted.

Fourth session with topics T7 and T8 of equal weightage

- The groups R-1 and R-2 are again crossed over
- Pretest conducted for both groups in assigned topic
- To R-2 topic T-7 taken as PBL and to R-1 as PBML
- Post-test was conducted.

Furthermore, a perception analysis from the students about both methods of learning taken by peer-validated questionnaire with Likert scale after completion of four sessions.

Question-1	I am interested to participate in this TL method
Question-2	This TL method is stimulating
Question-3	It helped to develop my problem-solving skills in future practice
Question-4	The teaching time is put to good use
Question-5	The teacher over emphasize the factual learning
Question-6	The teacher had good interaction with us
Question-7	This TL method is useful for me
Question-8	I feel confident to pass if more problem-solving sessions
Question-9	Enjoyment in the sessions outweighs the stress of studying
Question-10	I can clear doubts with the teacher
Question-11	This TL method motivated me as a lifelong learner

Mobile application, Google forms to do pre-test and post-test and collect student's perception about two methods, Google docs to collect informed written consent. As the two groups are crossing over both groups are getting equal exposure to both methods of teaching. The study was cleared by Institutional ethics committee. IRC Ref No: IRC/2019/Protocol/184.IEC Ref No: GMCKKD/RP2019/IEC/275.

Statistical analysis

The collected data were analyzed by using descriptive statistics like mean, standard deviation and inferential statistics such as paired t-test and student t-test. Student's perception was assessed using Likert scale.

RESULTS

From Table 1, Graph 1 and Graph 2 of the 250 students participated in the study, 125 students were part of Group R-1 and 125 students were part of

Table 1: Comparison of pre-test and post-test scores of PBL and PBML in different sessions

Session	TL-method	Mean±SD	p value Paired t-test
I	PBL	5.65±1.80	0.0001
	PBML	6.06±1.45	0.0001
II	PBL	4.51±2.26	0.0001
	PBML	5.65±1.72	0.0001
III	PBL	5.51±2.42	0.0001
	PBML	6.35±1.67	0.0001
IV	PBL	5.45±2.19	0.0001
	PBML	5.78±2.14	0.0001

Table 2: Comparison of pre-test and post-test scores between PBL and PBML in different sessions

Session	Test score	TL method	Mean±SD	p value Student t-test
I	Pre-test score	PBL	2.86±1.30	0.404
		PBML	2.72±1.27	
	Post-test scores	PBL	8.50±1.20	0.036
		PBML	8.78±0.88	
II	Pre-test score	PBL	2.95±1.22	0.247
		PBML	2.77±1.28	
	Post-test score	PBL	7.46±1.85	0.001
		PBML	8.70±1.12	
III	Pre-test score	PBL	2.75±1.15	0.052
		PBML	2.48±1.05	
	Post-test score	PBL	8.26±1.80	0.004
		PBML	8.83±1.22	
IV	Pre-test score	PBL	2.83±1.33	0.443
		PBML	2.70±1.30	
	Post-test score	PBL	8.28±1.72	0.337
		PBML	8.49±1.70	

Table 3: Comparison and total post-test scores of PBL and PBML

| Total score	Mean±SD	p value Paired t-test
PBL	32.52±4.20	0.0001
PBML	34.80±2.76	
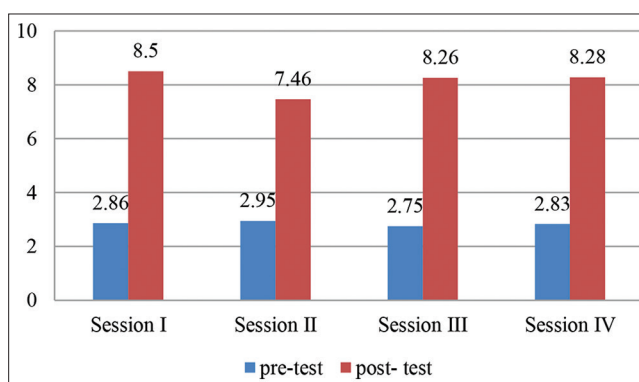
Graph 1: Comparison of mean of pre-test and post-test score of PBL

Group R-2. It is observed that post-test scores are significantly higher as compared to pre test scores in all four sessions of both PBL and PBML. This suggests that both methods are effective in teaching applied biochemistry.

From Table 2, the comparison of pre-test scores of PBL and PBML and post-test scores of PBL and PBML each session is shown. It is observed that before the intervention there is no significant difference in the pre-test scores between PBL and PBML. After intervention by the post-test

Table 4: Students perception about PBL and PBML

Likert scale	Strongly agree		Agree		Neutral		Disagree		Strongly disagree	
TL method	PBML (%)	PBL (%)	PBML (%)	PBL (%)	PBML (%)	PBL (%)	PBML (%)	PBL (%)	PBML (%)	PBL (%)
Q-1	33	22	58	58	6	15	3	4	Nil	2
Q-2	17	13	49	64	25	16	8	32	1	Nil
Q-3	19	17	49	54	27	17	Nil	24	Nil	2
Q-4	21	28	64	46	12	17	3	24	Nil	4
Q-5	Nil	4	4	2	16	12	38	37	42	41
Q-6	2	33	8	52	24	10	39	4	27	2
Q-7	27	26	57	49	13	20	3	2	Nil	2
Q-8	30	28	38	56	30	12	1	2	1	2
Q-9	5	9	52	47	33	29	10	12	Nil	3
Q-10	1	10	8	44	41	29	36	10	14	7
Q-11	17	11	54	51	22	28	3	9	4	2
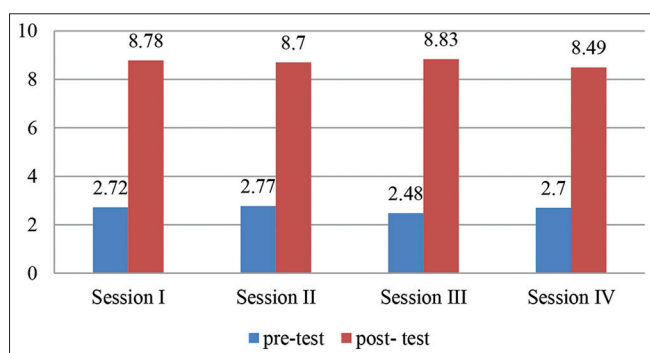
Graph 2: Comparison of mean of pre-test and post-test score of PBML

scores were significantly higher in the PBML subjects compared to PBL. This suggests that knowledge of the students significantly improved in the group receiving PBML as compared to PBL.

Table 3 is the comparison of summation post-test scores of PBL and PBML analyzed by paired t-test. The post-test score of PBML subjects was significantly higher than subjects intervened by PBL. This suggests that PBML is comprehensively better mode of teaching than PBL.

From Table 4, all feedback questions for perception of students toward PBL and PBML does not show much difference. However, in Likert question 6 about the teacher's interaction with the students, in PBL 52% agree and 33% strongly agree but PBML only 8% agree and 4% strongly agree. So this shows student's interaction with the teachers is more in PBL than in PBM. In Likert question 10 about clearing doubts with the teacher, in PBL 44% agree and 10% strongly agree but in PBML only 8% agree and 1% strongly agree. This difference shows that clearing doubts with the teacher is more in PBL than in PBML.

DISCUSSION

In the study conducted among 250 students divided in to two groups R-1 and R-2 with 125 students each in all the sessions post-test mean scores were significantly higher than pre-test scores in both PBL and PBML. Before the intervention, there was no significant difference in the pre-test mean scores in topics done by PBL and PBML. After intervention the only the post-test mean scores significantly improved. This clearly stated that both interventions were effective in teaching applied biochemistry topics for Phase I MBBS students. When the total post score scores of PBL and PBML compared it was found PBML mean score is significantly higher than PBL mean score. This result suggested that PBML is more effective than PBL in teaching applied biochemistry topics in biochemistry for Phase I MBBS students. In student perception analysis, it was found that student's perception about all Likert questions was similar in both methods except Likert-6 and Likert 10

questions. Teacher's interaction with the students and doubt clearance was more with PBL than PBML.

An observational study using e medapp to support self-directed learning in anatomy found that app itself did not resulted in better outcome [1].

Another study of M-learning in radiology found that medical students preferred M-learning [2-5].

A randomized single blinded controlled to teach ultrasound imaging skills among physiotherapy students concluded that M-learning is an effective tool to complement traditional learning [6-10].

CONCLUSION

Both PBL and PBML are effective modes of teaching applied biochemistry topics for phase I MBBS students. Our analysis shows that PBML is more effective than PBL in teaching applied biochemistry in phase I MBBS students. However, interaction with the students and doubt clearance is more effectuated with PBL than PBML. Mobile app based learning can overcome shortage of time in completing the syllabus and promote self-directed learning, which a key factor for the concept of life long learner in the new curriculum, that is, Competency based Medical education. Further studies should be conducted involving larger population and other departments in different phases of MBBS course.

AUTHOR' CONTRIBUTION

Dr. A has finalized the draft and guarantor, Dr. B and C has prepared the conceptual framework, designing of draft, and data analysis, Dr. D was involved in data collection and analysis, and Dr. Ehas done manuscript writing and data collection.

CONFLICT OF INTEREST

None Declared.

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