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Original Research Article

Self-Directed Learning Module in Biochemistry: A Teaching - Learning Study Conducted on Graduate South Indian Medical Students

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ABSTRACT

Background: Research is on to detect novel methods in fostering self- learning with critical thinking and communication skills. The purpose of the study is to evaluate the effect of assignment; case history based problem coupled learning and mini-seminar presentation in teaching-learning Biochemistry, for and by the students.
Methods: Fifteen randomly selected teams consisting of three groups of achievers namely low, average and high achievers with group leaders. Learning objectives and study material assignment templates were distributed to all the students one week before the problem coupled case history based learning (PCCBL) with group discussion and mini-seminar presentations. Pre-exercise test, post PCCBL test and one month delayed test were conducted and at the end of the modules student's feedback was obtained.
Results: Significant difference was observed in term of marks obtained after assignment and PCCBL followed by mini seminars with satisfactory delayed test mark in different study groups ($p< 0.05$).Gain score were higher among different levels of achievers ($p<0.05$). Maximum gain was observed in average, low and high achiever females respectively.
Conclusions: Students performance by this module was effective and their views on this module were encouraging as self-directed learning tool.

Key words: Biochemistry, Teaching, Self learning, Assignment, Case history, Problem based learning.

INTRODUCTION

Private medical schools have taken the main role in producing an increasing number of medical students in recent times. Medical Council of India (MCI) recommends good teaching learning (T-L) practice by early clinical exposure (ECE) and development of soft skills such as communication for undergraduate medical students. But due to limited faculty strength, didactic lectures, constitute the common teaching mode adopted in several institutes, where in the students are kept passive with limited chances to clarify their doubts. [1-3] Novel teaching methods like Problem coupled learning; Team-based learning, community-based learning, and spaced teaching-learning techniques, etc. are often limited and vague in many institutes till date due to various reasons. Biochemistry is considered one of the difficult subjects by medical students and extremely difficult to learn during pre or post lunch session by didactic teaching mode. [4,5] Students from different parts of the country differ in cultural and social background and speak

different languages, and if the students were subjected to didactic lectures without active learning, it could make the students lose their interest in early part of graduation. [6,7] It is the duty of the teacher to sculpture tomorrow's doctors with proper guidance and encouragement. Moreover, they should be trained to manage the embarrassing situation without anxiety, especially while talking in groups with opposite-gender peers, and about on stage presentations like seminars, mini-lectures, etc. In every student, there are latent teaching skills which need to be brought out by the teachers at the earliest. And it is important for the tomorrow's doctor to inculcate the confidence while communicating with peers or patients. This should be trained and maintained over a period of time. [8,9] With a large group of students who are slow learners and coupled with limited trained faculty, lecture-based teachings are often considered as less productive. This could hamper critical thinking and self-interest in learning. To the best of our knowledge, there are limited studies in private medical colleges that address the above problems and attempt to create a module for development of self-interest, comfort learning and inculcate soft skills like communication, interpersonal relationship. So, the present study was designed to evaluate the effect of assignment; case related problem-solving exercise in small group discussion and mini-seminar presentation using audiovisual aids in teaching Biochemistry by the students and for the students with the following objectives:

To assess the effect of assignment, problem-coupled case history based learning followed by mini-seminars as self-directed learning tool in different study groups

1. To compare the level of performance between average and poor achievers
2. To see any difference of opinion in average and poor performers
3. To assess the gender related differences between the groups
4. To compare student`s feedback about this module in different study groups

METHODOLOGY

The study was conducted in the Department of Biochemistry, using selected topics of mineral metabolism, among the students of Mahatma Gandhi Medical College & Research Institute (MGMCRI), Sri Balaji Vidyapeeth. 150 undergraduate medical students who were admitted during the year 2012-2013 were enrolled in the study, 149 students attended this module of teaching, and this included 70 males and 79 female students. The study materials in the form of handouts with specific learning objectives (SLOs) as given below were given to the students.

e.g. for Calcium

1. Must be able to classify minerals and group them into macro, micro minerals (trace elements),
2. Must be able to list the dietary sources of calcium,
3. Must be able to list the factors affecting the absorption of calcium,
4. Must be able to list Recommended Dietary Allowance for calcium in different age groups,
5. Must be able to write the reference range of calcium in the blood,
6. Must be able to list the biochemical functions of calcium,
7. Must be able to write and explain the regulation of blood calcium levels in the body,
8. Must be able to brief the route of excretion of calcium,
9. Must be able to list various clinical manifestations attributed to deficiency of calcium in the body,
10. Must be able to list various clinical manifestations pertaining to high levels of blood calcium,
11. Must be able to list various lab investigations in identification of the calcium deficiency,

Power point slides, for example calcium and assignment template (Figure1)

pertaining to mineral metabolism which included, Calcium, Phosphate, Magnesium, Manganese, Chromium, Iodine, Fluoride, and Selenium respectively were distributed to all the students one week prior to the conduct of problem coupled with case history based learning (PCCBL); the templates were handed over to the students and following it, pre-exercise test was conducted. We assured the students, of the impending group discussions with Problem Coupled Case Based Learning (PCCBL).

S.no	Richest sources	Minerals
1.		Iodine
2.		Calcium
3.		Magnesium
4.		Chromium
5.		Selenium
6.		Phosphorous
7.		Manganese

Figure 1 (a): Source

S.No	RDA					
	Adult male	Adult female	Supplementation in Pregnancy	Supplementation in lactation	Children	Minerals
1.						Iodine
2.						Calcium
3.						Magnesium
4.						Chromium
5.						Selenium
6.						Phosphorous
7.						Manganese

Figur 1 (b): Recommended dietary allowance

S.no	Mention the key biochemical functions of the minerals listed below
1	Iodine
2	Calcium
3	Magnesium
4	Chromium
5	Selenium
6	Phosphorous
7	Manganese

Figure 1 (c): Biochemical functions

S.no	Cause	Sign and Symptoms	Deficiency Diseases	Lab tests with blood reference value	Minerals
1.					Iodine
2.					Calcium
3.					Magnesium
4.					Chromium
5.					Selenium
6.					Phosphorous
7.					Manganese

Figure 1 (d): Deficiency manifestations and laboratory investigations

Figure 1

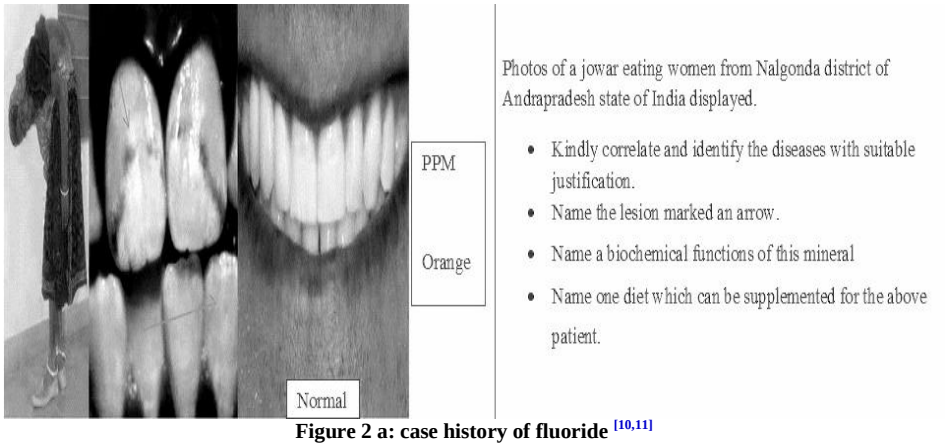

Figure 2 a: case history of fluoride [10,11]

Case history was handled as questions related to a particular disease manifestation, and explanatory images as depicted in Figure 2 (a & b) were distributed to the fifteen different randomized groups which included an equal number of low, average and high performers.

Classification of achiever was based on previous formative assessment marks:

1. Those with marks ≥65 %were named as high achievers
2. Those with marks between 40-65 % as average achievers
3. Those with marks ≤39 % were termed as low achievers

Students ranked 1 to 15 of high achievers were considered for team leadership, after obtaining consent and readiness to take the lead. The team leader was selected with a faculty member nominated to monitor them. One volunteer from each group was asked to present a selected topic out of eight given topics as mini-seminar, with the help of handout which was prepared by the teacher e.g. Annexure 1 as a visual aid, for two

consecutive weeks during *post-lunch sessions*. Totally, they were engaged for six hours and all the students attended the session, following mini-seminar which lasted for 15-20 minutes each, self-direct learning, interaction and communication were encouraged and the best question was suitably rewarded. Due to time constraint, only 12 presentations were possible with completion of the topics. A delayed test was conducted following one month of the conduct of the last mini - seminar session.

Figure 2b: Case history of Iodine [12,13]

Statistical test

Data from excel sheet was used for generating graphs and to calculate the gain score. Data was exported to Graph pad statistical analysis software. For comparison among the three groups, ANOVA was performed. Students "t" test was performed to evaluate intergroup gender difference. Values were expressed as mean ± SD. Pre-validated feedback questionnaire were prepared with Likert five scale score. A 'p' value <0.05 was considered significant.

RESULTS

Our study included 150 first year undergraduate medical students of MGMCRI. Following one week, duly answered assignments were obtained. The number of students who had submitted the assignment was 149; the average marks obtained by the students after the assignment was 6.7 (Max. marks=13). This was comparatively lower with reference to the conduct of PCCBL with mini seminar (8.9) and delayed test (7.6) (p=< 0.05). The significant gain was observed in terms of mean, as depicted in Figure 3(a).

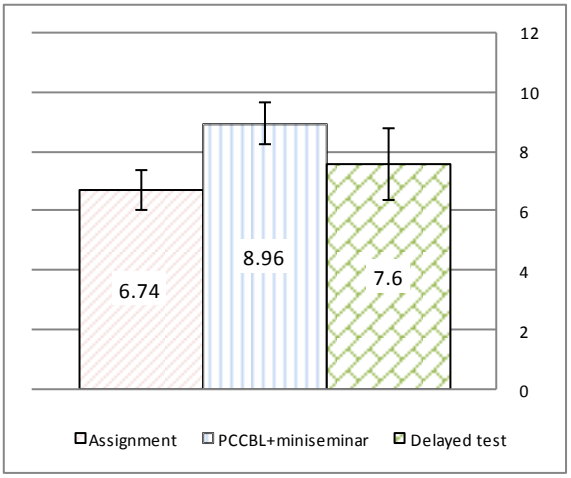

Figure 3a: Comparison between the effect of assignment, Problem Coupled Case Base Learning with miniseminar and delayed test in study subjects.

When we analyzed the effect of assignment and PCCBL with mini seminar as self-learning processes in different achievers of undergraduate medical students, there was a significant improvement in performance as depicted in Figure 3(b) and table 1.

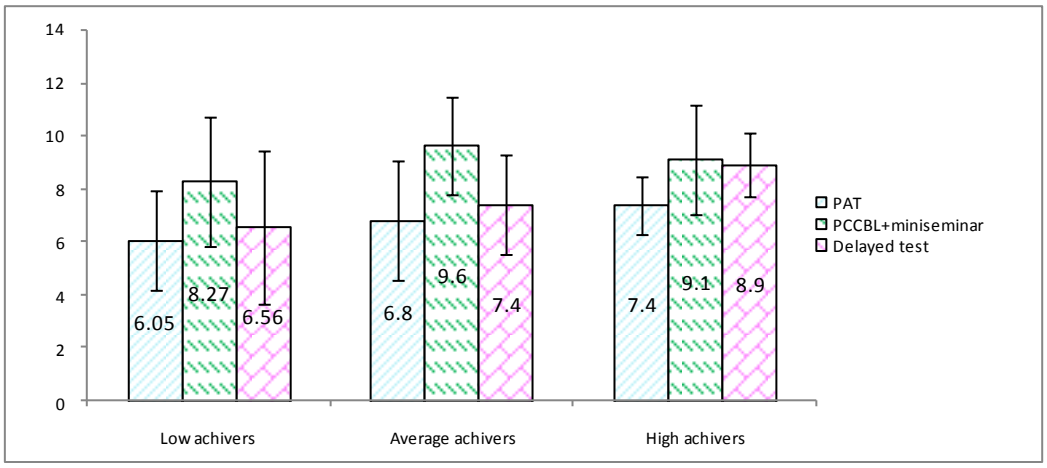

Figure 3 b: Effect of assignment, PCCBL+ mini seminar and delayed test as self-learning process in undergraduate medical student

Table 1: Overall effect of assignment and problem coupled case history based Learning (PCCBL) as a team/ self-learning process in undergraduate medical students

Exercise	Low achievers (n=97)	Average achievers (n=33)	High achievers (n=19)	p value
	Mean ± SD	Mean ± SD	Mean ± SD	
Pre exercise test (a)	6.05±1.85	6.8±2.25	7.4±1.09$^{\$}$	0.005
Post (PCCBL+ mini –seminar session test)(b)	8.27±2.42	9.6±1.85$^{\$}$	9.1±2.07	0.011
Gain score=Post PCCBL- Pre exercise test	2.22 ± 0.57	2.8 ± 0.4$^{\$\$}$	1.7 ± 0.98$^{\$\#\#}$	0.000
One month interval				
Delayed test 1 month(c)	6.56±2.89	7.4±1.9	8.9±1.22$^{\$\$}$	0.001
'p' value of (a)Vs.(b)	0.001	0.001	0.003	-
'p' value of (b)Vs.(c)	0.000	0.000	0.7	-
'p' value of (a)Vs.(c)	0.14	0.21	0.0003	-
Median Retention score	6.25/13	7.5/13	9/13	NS
% retention score	48.05	57.65	69.2	

PCCBL: Problem coupled case based Learning, P<0.05 is considered significant, $ means when compared to low achievers, # means when compared to Average achievers

Table 2: Students' perception as assessed by questionnaire about this teaching module

Comments	Low achievers		Average achievers		High achievers	
	Mean ± SD		Mean ± SD		Mean ± SD	
Elicited information	4.1	1.1	4.2	1.0	4.4	0.5
Enjoyable	4.3	1.2	4.1	1.3	4.6	0.6
Made Personal Contacts	4.1	0.9	3.2	1.5	3.7	1.0
Establish rapport with peers	3.6	1.1	4.2	1.0	4.1	1.0
Support & encouragement	4.3	1.0	4.3	1.1	4.0	1.4
Controversies, flows and Transition during discussion	3.6	1.1	3.8	1.4	3.5	1.3
Students own comfort /organization and preparation	3.5	1.5	3.7	1.3	3.9	0.9
Difficulty noted during student presentation like paralanguage, fluency	3.1	1.8	2.8	1.8	2.4	1.5
Burdening	1.1	1.7	1.4	1.8	0.8	1.1

The questionnaire was prepared based on the teaching module

The gain score was calculated by subtracting Post PCCL from pre-exercise test. It was significantly increased in all study groups, but the maximum gain was observed in low and average achievers (P=0.000) than high achievers (p=0.003).Students' perception was assessed by questionnaire, regarding this teaching module. This is shown in Table 2.
The uninhibited free comments about these modules are as follows:

1. Some students were not co-operative and were not really interested.
2. This could be valuable class.
3. Team-based learning helps in understanding facts and concepts and was interesting.
4. Please be strict so that we will read and come. Seminar part is really good.
5. This is very beneficial to us.
6. This is very helpful in gaining more information.
7. Discuss the post-test questions.
8. Please encourage all the students. Don't be partial.

9. Helpful in improving the confidence regarding subject.
10. Better way of teaching; enjoyable discussion in comparison to boring didactic lectures after heavy lunch.
11. It was new experience really satisfied.
12. Hard work for teacher and student who wish to utilize the scheme. Some are reluctant, not cooperative.
13. It can serve as a step for preparatory competitive postgraduate exam.
14. The best part is the seminar in which we came to know what we are capable of.

As shown in table 2. There was a meager amount of gender-related differences following PCCBL session among average achievers (p=0.04), but other groups of achievers didn't indicate any difference significantly. But, in terms of gain score, there were significant differences among the different levels of achievers (p<0.05). Maximum gain was observed among females than males, as depicted in Table 3.Butthere was no significant difference among male high achievers following post PCCBL in comparison with pre-exercise test.

Table 3.Gender difference on the effect of assignment and PCCBL with Mini-seminar with reference to self-learning process in undergraduate medical students

Exercise	Low achievers		p -value	Average achievers		P -value	High achievers		p -value
	Male (50)	Female (47)		Male (15)	Female (18)		Male (5)	Female (14)	
Pre exercise test	6.08 ± 2.1	5.97 ± 1.6	Ns	6.9 ± 2.2	6.7 ± 2.3	Ns	7.7 ±1.3	7.1 ± 0.87	Ns
Post PCCBL session test	8.05 ± 2.6	8.5 ± 2.24	Ns	8.6 ±2.1	10.6 ± 1.6	0.04	8.6 ±2.3	9.6 ± 1.83	Ns
Gain score =Post PCCBL- Pre exercise test session test	1.97 ± 0.4	2.6 ± 0.6	<0.00	1.7 ± 0.1	3.9 ± 0.7	<0.00	0.9 ± 1	2.5 ± 1.5	0.04
(a) Vs (b)	<0.00	<0.00		0.03	<0.00		Ns	<0.00	

DISCUSSION

Group discussion can be conducted in large (or) small groups. Several studies have documented small group discussion as an effective tool in teaching. We conducted both small group and large group discussions at two different levels and intervals which showed significant overall improvement in the performance of students. In the present study, following the mini-seminar presentation, the large group discussion was found efficient and during the session, there was a healthy competition among the students in seeking clarification and thereby clearing the doubts by themselves or with the help of the facilitator. The only apparent drawback noticed during the course of mini -seminar presentation was prolonged discussions which got truncated owing to the paucity of time. This prevented other discerning and eager students from presenting.

"Please encourage all the students, don't be partial'' is the adage that has manifested out of this time constraint. Overall, this learning style by students has received their approbation and also encourages cognitive thinking under a competitive, but healthy environment. Recently, experts lay emphasis more on the development of soft skills for medical students which include good communication skills which will help the students to verbally express their views with conviction. Several studies have also documented that group discussion plays a valuable role in the development of communication skills which would eventually enable them to conduct themselves as doctors of repute. Moreover, this module helps students to work as groups, and the leader of the team also acquires leadership qualities which are absolutely essential for today's physicians. [14,15]

Teamwork thus paves a way for less work, but more benefit as every student contributes and provides free comments, thereby rendering teaching and learning process more interesting, objective and

logical. In a previous report elaborated by Bobby et al. it was observed that small group discussion as a mode of revision exercise in learning Biochemistry was fruitful. [16] Several studies have shown enhanced performance by students when hybrid teaching module is promulgated. Similarly, our module of teaching mineral metabolism included team, problem coupled and case-based learning in a well-planned phased manner. [17,18]

In our study, we have sincerely tried to evaluate learning outcome in the light of the gender perspective. However, there was no difference noted in pre-exercise test significantly, except for the difference in average achievers (p=0.04); but gain scores were significantly higher among female achievers. These results prompt us to express gender-related differences, in the light of this method of teaching module. Despite the gender difference with maximum positive feedback and less than 3% negative feedback, this can be an active, self-directed teaching aid devoid of didactic lecture mode, especially during post lunch sessions when the productivity would be at the lowest rung. This would go a long way in raising the objectivity of the teaching-learning process.

CONCLUSION

Assignments leading to the acquisition of knowledge, as problems, case history and trigger charts with group discussion can be an effective way to inculcate soft skills such as communication, interactive and enjoyable learning process, synonymous with the decreased burden on undergraduate medical students, mainly during post-lunch teaching sessions.

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Practice Points:

- Vision 2015 Medical Council of India aims good teaching practice with soft skills and early clinical exposure.
- Self-directed learning by assignment, group discussion with trigger photos, problems as case history followed by mini lecture was effective.
- Student quotes about this module were encouraging and effective.
- Difference noted on the performance between average and poor achievers.
- Gender difference noted in average achievers but overall gain score were higher in females.

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