Original article

Concept map as a reinforcement method of teaching biochemistry

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Abstract

Introduction: There has been studies showing advantage of combining newer techniques with traditional methods of teaching . In our study concept mapping was used along with didactic lectures as a method for teaching Case Based Learning. This study was done as there hasn't been any previous studies to show the use of concept map as a technique to reinforce knowledge gained in lectures.

Methods: A batch of 100 students was divided into two groups based on their semester marks .They were taught a clincal topic in conventional and newer method of concept maps following didactic lectures.Subsequently learning gain and perception was assessed.

Observation & Results: The absolute gain in scores was significant, relative gain between conventional and newer technique among low scorers shows a trend towards significance. A significant change was seen in the post test scores in the students taught by the newer method after the didactic lecture. Perception among students was very favourable.

Conclusion: Study showed relative gain of knowledge in low scorers after teaching by concept mapping. This corroborate with other findings that when concept maps was used as a tool in problem solving it had the most impact on students with lowest cognitive competence.

Key Words: Concept Map, Relative Gain, Absolute Gain, Low Scorers, Biochemistry

Introduction

The apex body of India who formulate medical curriculum, MCI in its vision 2015 had suggested that the undergraduate (UG) curriculum should be able to make the student more participatory and competent. To allow this MCI has recommended certain curricular reforms for UG that includes various changes principal among which is an emphasis on early clinical exposure in the form of case based learning and classroom discussion [1]. A study has quoted many new teaching methods, e.g. abbreviated case presentation, concept mapping, fishbowl technique, one minute preceptor role play etc. discussing their advantages, and disadvantages in an exhaustive paper [2]. There also has been studies showing advantage of combining newer techniques with traditional methods of teaching. It has been shown combining didactic lectures with case based problem solving tutorials motivated students to do self - directed learning[3] .In our study we have used concept mapping as a method of teaching case based problem. Concept map first developed by Novak in the year 1972 ,one of the first books on this was A Theory of Education by him [4] . It has been used in various ways as a tool of education e.g. in integrating as a complementary tool with problem based learning [5], for collaborative learning [6],in fact it has also been used to assess a cognitive domain other than that done by using standard test [7]. So far there hasn't been any study to show the use of concept map as a technique to reinforce knowledge gained in lectures.

Aim

Utilize concept maps as a way of reinforcing learning in biochemistry

Objectives

1) To Sensitize the faculty & students towards concept map as a teaching tool.

2) To compare the learning gain of students taught by two different techniques

3) To obtain the perception about concept map as a teaching tool.

Material & Methods

Study Design: Prospective interventional (stratified random sampling)

Setting- Department of Biochemistry, ESIC MEDICAL COLLEGE, Kolkata, India.

Participants – 100 students of 2nd semester, yr.2015.

Duration of study - Six month.

Before beginning the study consent was taken from all the participants. All the 100 students were taught a clinical topic in a series of three didactic lecture .The topic of the lecture was diabetic ketoacidosis. A batch of 100 student was divided in to two groups based on the marks obtained in first semester. Students getting marks < 50% -Gp I, marks > 50% -Gp. II.

These two groups were further divided randomly in to two subgroups each. Thus there were four subgroups in all.

Group A (< 50%)

Group B (>50%)

Group C (<50%)

Group D (>50%)

(FIGURE 1)

Educational intervention

Groups A and B were taught the topic in conventional method of tutorial after didactic lectures. Thus group A and B were together the control group. Groups C and D were taught the same topic in newer method of concept maps after didactic lectures. Thus group C and D were together the study group. Both the methods were conducted by the same faculty member. The concept map was prepared in consultation with other departments like medicine and pharmacology. Crossover was conducted later with the control group where in group A and group B were also taught the topic in the form of concept map.

Tools for outcome measures

Pretest and post-test were conducted by giving a set of 20 MCQ s .The questions were prepared jointly by all the junior and midlevel faculty members. Pretest was given right after the series of didactic lectures ended. After one week the same topic was taught in conventional and new method to the control and study group respectively. Post test was given one day after this session to both the groups. Statistical analysis was done using the software "Graphpad prism" version 5.

Student's t-test was used to calculate the p – value. Relative gain(it takes in to consideration the effect of pre existing knowledge) and absolute gain(it shows the gain in knowledge without taking in to consideration prior knowledge)were used to assess the reinforcement of teaching. Approval from institutional ethics committee was taken Ref.No.IEC/RP2/2015.

Table 1 Absolute Gain= (Pretest - Posttest)

Conventional vs New technique

GROUPS	(MEAN ± S.D.)	P value
Group.(A+B)	1.57 ± 3.35	P= 0.027 (significant)
Group.(C+D)	3.60 ± 2.36	

Table2 Relative gain = Pretest - Post test / Pretest

Low scorers (Conventional vs new technique)

GROUPS	(MEAN ± S.D.)	P value
Group A	0.135 ± 0.44	P = 0.098 (trend towards significant)
Group C	0.472 ± 0.23	

High scorers (conventional vs new technique)

GROUPS	(MEAN ± S.D.)	P value
Group B	0.196± 0.28	P = 0.615 (Not significant)
Group D	0.26 ± 0.23	

Conventional vs new technique

GROUPS	(MEAN ± S.D.)	P value
Group.(A+B)	0.18 ± 0.32	P = 0.132(Not significant)
Group.(C+D)	0.33 ± 0.25	

Table 3

Pre testvs Post test scores

FOR GROUP A+B (Conventional technique)

Test Score	(MEAN ± S.D.)	P value
Pretest	13.54 ± 3.4	P = 0.055 (significant)
Posttest	15.11 ± 0.27	

FOR GROUP C+D (New technique)

Test Score	(MEAN ± S.D.)	P value
Pretest	12.3 ± 2.6	P = 0.0001 (highly significant)
Posttest	15.9 ± 2.11	

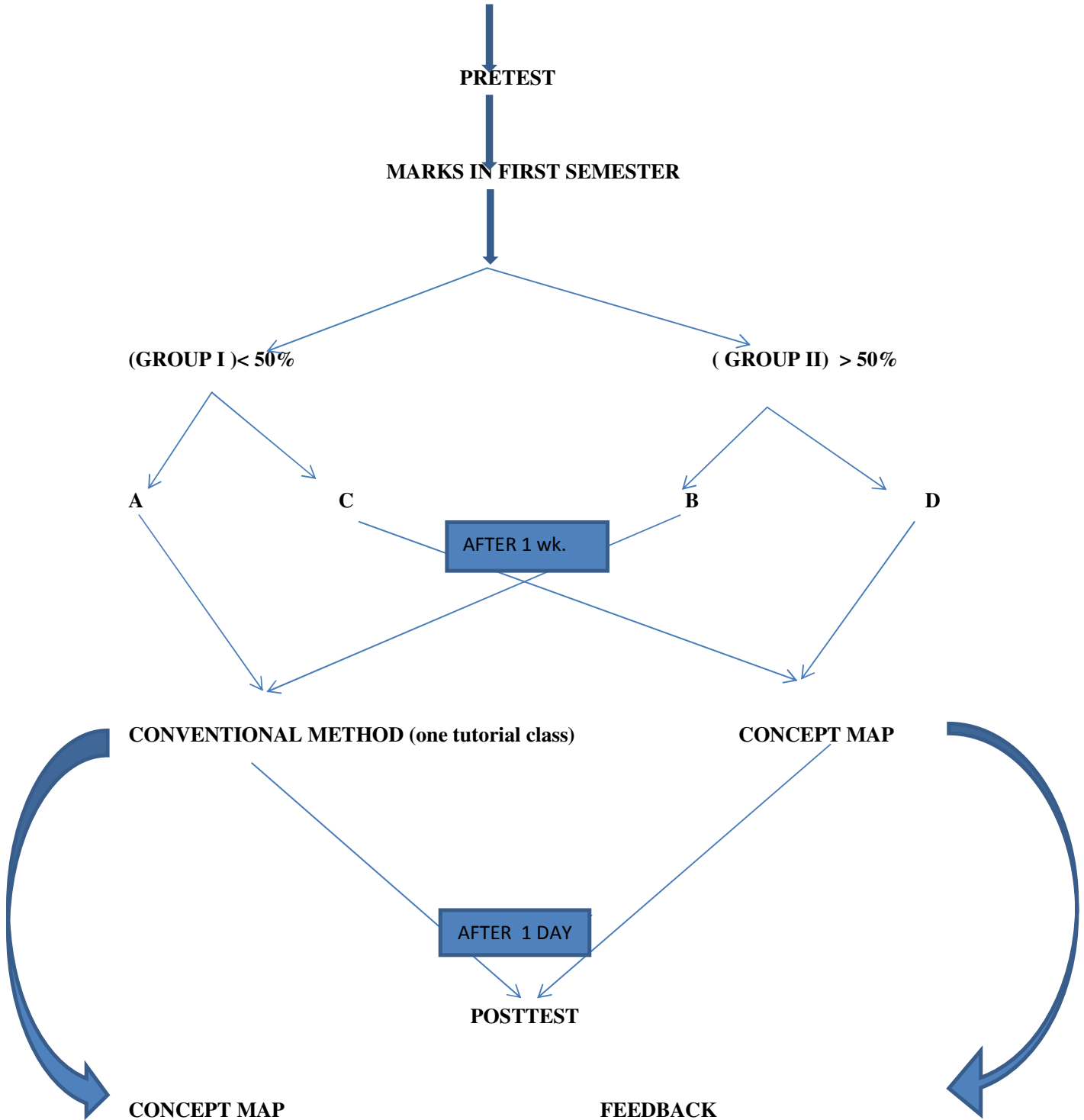BATCH OF 100 STUDENTS OF IST YR, MBBS (2015)

DIDACTIC LECTURES (ON DKA -3 IN NO.)

PRETEST

MARKS IN FIRST SEMESTER

(GROUP I)< 50%   (GROUP II) > 50%

A   C   AFTER 1 wk.   B   D

CONVENTIONAL METHOD (one tutorial class)   CONCEPT MAP

AFTER 1 DAY

POSTTEST

CONCEPT MAP   FEEDBACK

Figure 1 Flow diagram of study design

Observation & Results:

Total no. of students who participated were 64 i.e. the dropout rate was 34%. Average age of the students was 17 yrs. Out of this 56% were male. Average per capita income of the family of the students was 5,207(INR). In only 20% students both parents were earning members. Relative gain between teaching by conventional (tutorial) and newer (concept map) method was not significant (Table 2). Though the absolute gain was significant (p = 0.027)(Table 1).Relative gain between conventional and newer technique among the Results of data from feedback form of students:-

students scoring above pass marks (> 50%) is not significant. But the relative gain between conventional and newer technique among the students scoring below pass marks (< 50%) shows a trend towards significant (p = 0.098).

A highly significant change was seen in the post test scores in the students taught by the newer method (p <0.0001) after the didactic lecture. Though the change in the post test scores in the students taught by the conventional technique of tutorial was not statistically significant (p = 0.055).(table 3)

QUESTIONS	
1.The newer method of teaching was very good?	70%-agree ; 13%-strongly agree; 10% - do not agree
2.Helped in better retention of the knowledge as compared to older method?	53%-agree; 16%-strongly agree; 16%-neither agree nor disagree; 10%- do not agree
3. Able to clear concept of the disease condition with respect to its sign symptoms, diagnosis, and management as compared to the didactic lecture?	58% - strongly agree 42% - agree
4.Method made you feel more involved in the whole process of learning?	100%-yes

Suggestions given to the open ended question:-

What is it about this technique that impressed you the most?

1. Most of the student preferred the depiction of correlation/linkage between biochemical theory and the clinical findings.

2. It was more interactive due to which few advantages were pointed out –effective, encouraged to go to the depth of knowledge, and explore scope of things.

3. As small groups were addressed there were some other advantages- better discussion and   concentration, easy assimilation thus retention was more than in a lecture.

4. Built up of the topic along with the presentation (which was only chalk and talk) was appreciated very much.

5. Few said that it helped in revision of the topic already taught in the class-in away reinforced their existing knowledge.

6. This method helped in covering lot of metabolic aspects of the clinical condition in a short time.

Do you think this method could have been improved further if so how?

Majority said that they preferred the technique used and it did not require any further improvement.

Though few suggestions were given:

1. Increase the frequency of such classes,

2. More time in this methodology of class was demanded,

3. Do it in the form of quiz,

4. Case studies should be given to the students to solve on their own

5. Comparative case studies to be introduced,

6. Preventive aspect also to be discussed along with case m/g in emergency,

7. More elaborate diagrammatic

8. Prior information to be given to the students so that they can do their part of

preparation.

9. Basics also should be recapitulated.

Feedback received from the faculty:

S.No.	Question	
1.	Concept map helps in better representation of the case.	75%- strongly agree
2.	Concept map improves retention of knowledge.	70%- strongly agree
3.	Discussing the case in the form of of concept map made the teaching more interactive.	80%-strongly agreed
4.	Lot of preparation required for the newer technique?	100% - stongly agreed

Discussion:

The change from teacher to facilitator of learning is the major pedagogic shift from traditional teacher centred approach to student centred approach. Here the emphasis is on students and what they are taught. In this respect PBL has been described as the most significant development in professional education [8] .It has shown some distinct advantages e.g. promotes deep learning, stimulates learning environment, is more interactive, has better retention of knowledge etc. [9]. A study was done using CBL(case based learning) as a way to reinforce biochemistry in first yr. MBBS students, as biochemistry involves many complicated metabolic pathways [10] .

In our study we have used concept maps as a way to reinforce the topic.We have used a very commonly encountered clinical case of diabetic ketoacidosis, (which has alteration of multiple metabolic pathways). This was taught as concept map apart from conventional method of tutorials. Concept map was chosen as Novak and Gowin have described it as a good learning tool by linking new with old or known concepts [11].Some authors showed that task based teaching method through concept map enhanced the theoretical learning in biochemistry [12].

We have used pretest - posttest assessment model as a measure of learning gain. Both relative gain and absolute gain was measured. Relative gain between the two types of teaching was not significant, neither was it significant in high scorers. Though it did show a trend towards significance in low scores. Since relative gain has dependency on prior knowledge (having pretest as a common denominator), it showing a trend towards significance is an indication of reinforcement of knowledge gained in didactic lectures.

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Our findings corroborate other authors who have shown that when concept maps was used as a tool in problem solving it had the most impact on students with lowest cognitive competence [13]. This in effect indicates that concept mapping could be used by facilitators to assist medical students who are struggling to learn and perform. Relative gain in the full class i.e. low and high scorers not being significant could be due to dilution of the results as gain was measured in both the scorers. Relative gain not being significant in the high scorers indicate that the technique of reinforcement is not needed by high scorers as the knowledge gained in didactic lecture is sufficient for them. Secondly it also indicates their retention ability.

Studies have shown that students get very less opportunities and time to clarify their doubts and reinforce concepts learnt during lectures, due to this they have trying times to relate clinical conditions with basic biochemical concepts during clinical training [14] .Various other alternative methods are being used in many medical colleges to reinforce didactic lectures like case simulated learning [15], patient centred learning [16] multiple format sessions [17] etc.

 Absolute gain was significant from the new technique, which indicates the value of the newer technique though not necessarily as a reinforcement technique. The significantly high gain in post test after the newer teaching technique indicates that the understanding of the clinical case after the new teaching technique is far reaching and better than the conventional method. Though both were conducted in small groups the newer technique being more interactive and student friendly has given better results. It has improved the understanding also by being able to link various older concepts known to the students along with newer ones .

Senior faculties were apprehensive about increasing the duration of teaching in this mode of teaching instead of the conventional method. The junior faculties appreciated this mode of teaching, though they did agree that it required a completely different approach and preparation of the topic.

Scope of the study :The technique of concept mapping can be used from first to final year students as a method of reinforcing knowledge. Student generated concept maps can be made and they can be used as a mode of assessment of student performance.

Limitation : the study was conducted only only once in a batch . It should be followed up in the same batch of students especially the low scorers for the subsequent years so that their level of understanding can be tracked and also assessed.

Conclusion:

The present study showed relative gain of knowledge in low scorers after teaching by concept mapping. Hence this technique can be used in low scorers as a method of reinforcing knowledge .

Future scope :

Study can be conducted to see the effect of concept maps as learning tools after incorporation in e-tools of simulated cases as a part of pathophysiology of the disease process of the case being taken up. Effect can be worked out both in terms of learning gain as well as perception.

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