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Original Article

Biochemistry Section

Crossword Puzzles- An Interesting Teaching Tool to Facilitate Teaching Learning Process in Undergraduate Students of Biochemistry

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ABSTRACT

Introduction: Traditional medical teaching emphasis more on didactic lectures where participation of students is minimum with lowest retention rate and it promotes the learning at the base of cognitive level. Teaching through crossword puzzles enhances active participation of students, evokes student's interest, motivates them and enhance their critical thinking.

Aim: To compare the effectiveness of crossword puzzle and traditional teaching method based on student's performance and to evaluate perception of undergraduate medical students and faculties about crossword puzzle as a teaching learning method.

Materials and Methods: The present study was a cross-sectional study which was conducted in the Department of Biochemistry, Gujarat Adani Institute of Medical Sciences, Bhuj, Gujarat, India, among the first year MBBS students. Total 150 participants were selected. Suitable two topics from the syllabus were chosen. Crossword puzzle prepared by online tools was circulated to the students during lecture of biochemistry. Performance of students were assessed by 10 pre-validated Multiple Choice Questions (MCQs) based test on knows (K) and knows how (KH) levels for both teaching learning methods viz traditional method and crossword puzzle method. Student's and teacher's perception were also recorded using pre-validated questionnaire based on 5 point likert scale. Data was compiled and analysed in MS Excel. To test the significance difference between the averages scored by students, independent t-test was used at significant level $p<0.05$.

Results: Average percentage score of students of crossword puzzle group was 97.1% in Diabetes Mellitus (DM) topic and 96.95% in Gout topic; which were significantly more than the average percentage scored by students of traditional method group ($p<0.01$). More than 80% students felt that crossword puzzles help in better understanding of the topics as well as in remembering the newer terminology. All the students and 79% teachers have suggested more use of crossword puzzles in teaching.

Conclusion: Crossword puzzles improve learning through recreation and it breaks the monotony of traditional lectures. Crossword puzzle based teaching improves the student's performance as compared to the traditional teaching.

Keywords: Active teaching learning, Competency based teaching, Critical thinking, Indian medical graduate, Traditional teaching

INTRODUCTION

Despite rapid strides in advancements in adult learning principles and invasion of technology to develop newer tools and techniques, the lectures remain the main mode of delivery of knowledge in medical Institutes in India and abroad. Studies show that the lectures are perceived by learners as monotonous resulting in poor retention and ability to recall [1]. It is also demonstrated that learners can be actively involved by modifying lectures and including games and puzzles while teaching. Students learn by achieving greater degree of satisfaction and memory retention. It is imperative to develop such exercises is need of hour in medical education also [2].

As a part of new medical curriculum, where Attitude, Ethics and Communication (AETCOM) is introduced in syllabus, it is in need to modify the traditional teaching learning method. Medical educators are always looking forward to develop new and innovative teaching aid which not only enhance the active learning but also complement the traditional teaching learning method. It was discovered by one study that active learning promotes acquisition of generic skills and attitude such as communication skills, co-operative learning, critical thinking and self-directed learning [3].

Crossword puzzles are found to be an interesting educational tool for teaching medical students as it evokes interest, motivates students, enhances their critical thinking and helps in reinforcing the knowledge acquired during lecture [4-6]. Furthermore, crossword puzzles have been used successfully in many different disciplines as teaching aids and have been found to be helpful in acquiring new vocabulary or technical terminology, imparting the ability to distinguish between similar terms, correctly spelling these terms, drawing conclusions, evaluating options, and developing logical thinking [7].

Thus, current study was conducted to test that whether the crossword method is suitable for biochemistry topics as well with significance positive difference to the traditional teaching learning method.

The present study was conducted to evaluate the utility of crossword puzzles as a teaching tool for undergraduate biochemistry and the objectives were to compare effectiveness of crossword puzzle and traditional teaching method based on student's performance and to evaluate perception of undergraduate medical students and faculties about crossword puzzle as a teaching learning method.

MATERIALS AND METHODS

The present study was a cross-sectional study which was conducted at Department of Biochemistry, Gujarat Adani Institute of Medical

Sciences, Bhuj, Gujarat, India, among 150 students of first year MBBS (2018-19 Batch). The study period was from 15th October 2018 to 15th March 2019. Ethical approval was taken from Institutional Ethics Committee, Gujarat Adani Institute of Medical Sciences, on 23rd October, 2018 and reference number for the same is GAIMS/IEC/EXEMPTION/RESCH/60/2018. Written informed consent was taken from all participants.

Departmental meeting was held for the sensitisation of the project. Students were sensitised regarding the project. Topics included in the crossword puzzles were DM and Gout which were decided after discussion with the faculties of Department of Biochemistry. A crossword puzzle was designed using free online resource and was validated by two experts from the Department of Biochemistry.

Inclusion criteria: Students of first year MBBS who were present and gave consent to participate in the study were included.

Exclusion criteria: Students who were absent and not willing to participate in the study were excluded.

The study group was divided in two groups (Group A and Group B) consisting 75 students in each group. Randomisation of students was done by lottery method. Group A and B consisting of 75 students were divided into 25 subgroups consisting of five students in each subgroup for the solving of crossword puzzles. Topics were chosen after doing meeting and taking suggestions from faculties of Department of Biochemistry, GAIMS with keeping in mind their difficulty level, importance in exam and whether it's from core area or not. Both the topics (DM and Gout) were from core area (must know) from the syllabus of biochemistry. It was ensured that difficulty level of the topic was same for all the groups.

Topic I (Diabetes Mellitus)

Group A: Teaching with use of crossword puzzles (Lecture for 20 minutes+Crossword puzzles 20 minutes)

Group B: Traditional teaching (40 minutes)

Topic II (Gout)

Group A: Traditional teaching (40 minutes)

Group B: Teaching with use of crossword puzzles (Lecture for 20 minutes+Crossword puzzles 20 minutes)

Both topics were taken by same teacher. Printed copies of the crossword puzzle were given to the each subgroup to solve. Group discussions were encouraged while solving the puzzle to promote collaborative learning. The entire process was part of the teaching methodology and it was completed in the class time. No sensitive questions was asked as part of the feedback and anonymity was maintained. The students were asked to fill the pre-validated structured questionnaire about their views and perception of two teaching-learning methods. Feedback given by students was evaluated on a five point Likert scale (i.e., strongly agree, agree, neutral, disagree and strongly disagree). The impact of teaching-learning methods was analysed by assessing performance of students in MCQ based test consisting of 10 MCQs (10 marks) on respective topic taught. Time for the test was 10 minutes.

STATISTICAL ANALYSIS

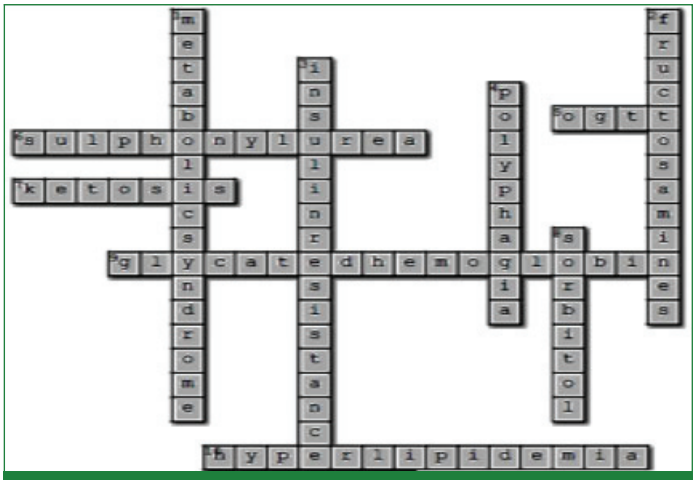
Collected data of questionnaires and MCQ tests were recorded in Microsoft excel worksheet. The data was collected, tabulated, and statistically analysed by two tailed independent t-test after consulting to the statistician at significant level of $p<0.01$.

Example of crossword puzzle used:

Topic 1: Diabetes Mellitus (complete the crossword puzzle below using following Clues) [Table/Fig-1].

Across

5. Useful for the diagnosis of DM (OGTT)
6. Used for the treatment of type 2DM (sulphonylurea)
7. One of the main complications of type 1DM (ketosis)



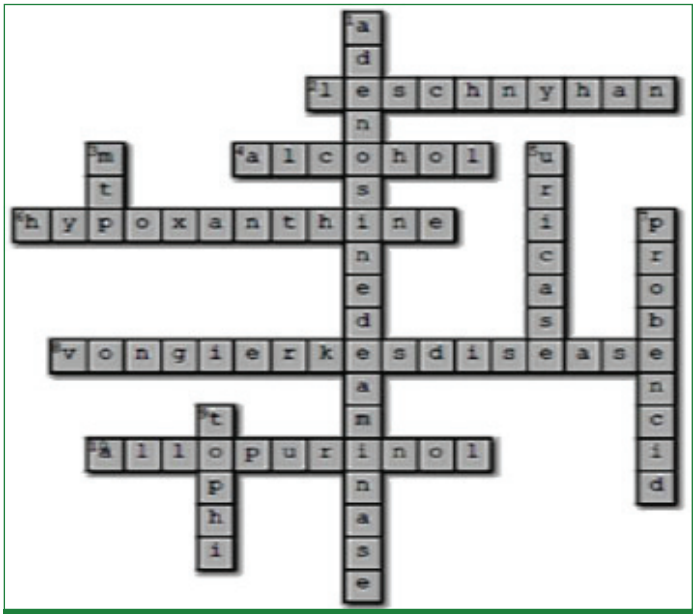
[Table/Fig-1]: Crossword puzzle for diabetes mellitus.

9. Gives average blood glucose value for 8-10 weeks (glycated haemoglobin)
10. One of the factor which leads to cardiovascular disease in DM (hyperlipidemia)

Down

1. Diabetes mellitus, hypertension and obesity leads to me. (metabolic syndrome)
2. Helpful in diagnosis of pregnancy induced DM (fructosamines)
3. Aetiological feature for DM seen in aged people (insulin resistance)
4. One of the classical triad of symptoms of DM (polyphagia)
8. Accumulation leads to diabetic neuropathy (sorbitol)

Topic 2: Gout (complete the crossword puzzle below using following clues) [Table/Fig-2].



[Table/Fig-2]: Crossword puzzle for gout.

Across

2. Syndrome associated with hyperuricaemia (leschnyhan)
4. Substance interfere with excretion of uric acid (alcohol)
6. I am structural analogue of allopurinol (hypoxanthine)
8. One of the conditions associated with primary gout (vongierkes diseases)
10. Drug of choice for the primary gout (allopurinol)

Down

1. Enzyme deficiency associated with hypouricaemia (adenosine deaminase)

3. First joint affected by gout (mtp)

5. Method used for the estimation of uric acid (uricase)

7. Drug which increase the excretion of uric acid (probencid)

9. Uric acid deposits in the soft tissue called as (tophi)

RESULTS

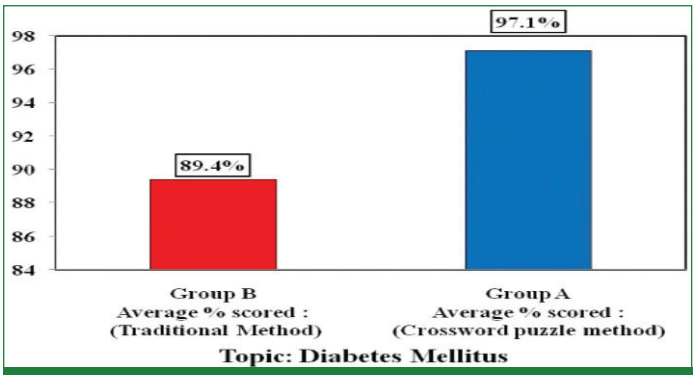
Out of 150 students 149 students participated for DM topic and 142 students participated for gout topic. Rest students were absent on that particular days.

The [Table/Fig-3] shows comparative performance of students with crossword puzzle and traditional teaching learning method.

Topic	Topic 1: Diabetes mellitus		Topic 2: Gout	
Teaching-learning method	Group A Crossword puzzle	Group B Traditional	Group B Crossword puzzle	Group A Traditional
Sample size (n)	74	75	73	69
Mean±SD (Score out of 10)	9.71±1.24	8.94±1.30	9.69±0.81	8.99±1.18
Independent t-test	0.003, <0.01;		0.00, <0.01;	
p-value	Highly significant		Highly significant	

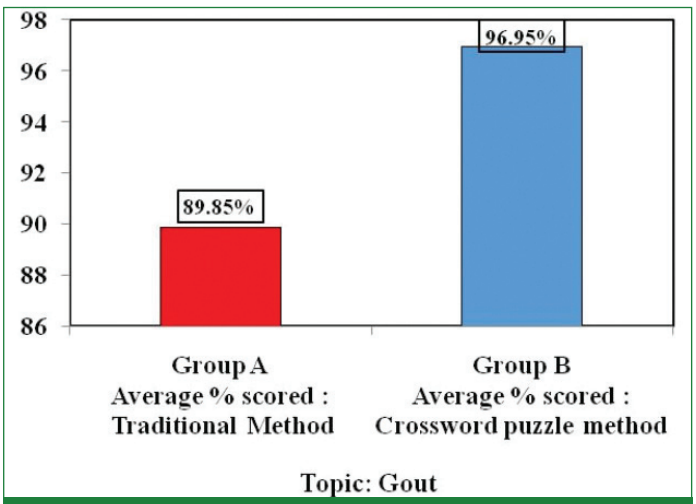
[Table/Fig-3]: Comparative performance of students with crossword puzzle and traditional teaching learning method.

The [Table/Fig-4] shows average percentage scored by students by crossword puzzle and traditional learning method in DM topic respectively.



[Table/Fig-4]: Average percentage scored by students in learning topic "Diabetes Mellitus" using traditional method v/s crossword puzzle method.

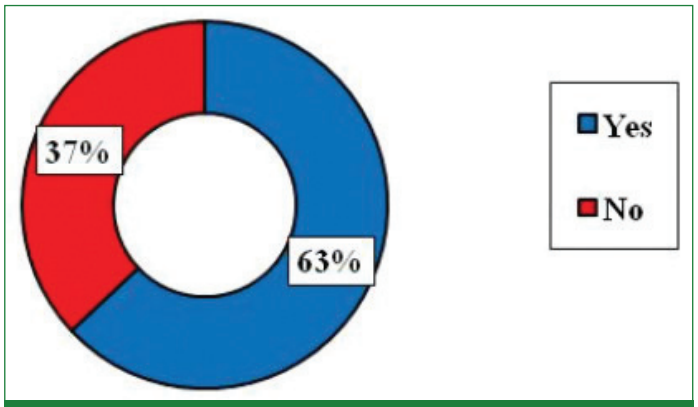
The [Table/Fig-5] shows average percentage scored by students by crossword puzzle and traditional learning method in gout topic, respectively.



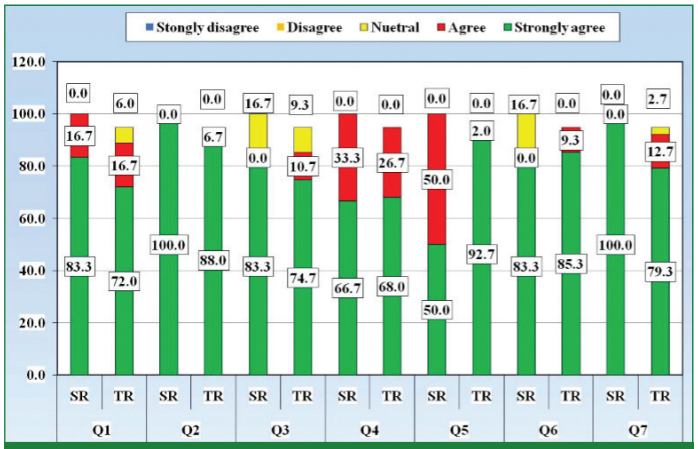
[Table/Fig-5]: Bar diagram: Average % scored by students in learning topic "Gout" using traditional method v/s crossword puzzle method.

The [Table/Fig-6] shows the percentage of students who had played crossword puzzle before.

The [Table/Fig-7] shows that 83.3% student's and 72% teacher's strongly agree that crossword puzzle help them to identify the important areas of the topic. All 100% students response that crossword puzzle will improve their understanding of the topics.



[Table/Fig-6]: Depicts the percentage of students previously played crossword puzzle.



[Table/Fig-7]: Student's and Teacher's perception regarding utility of crossword puzzle teaching methods.

*SR: Student's response; TR: Teacher's response; Q1: Crossword puzzles help me to identify the important areas of the topic; Q2: Crossword puzzle improved my understanding of the topic; Q3: Crossword puzzle helped me to memorize important terminology of the topic; Q4: It helps in active learning through recreation; Q5: Working and discussing in groups to do the puzzle will increase my understanding of topic; Q6: Competitive aspects of puzzle will contribute to their effectiveness; Q7: I will suggest more use of crossword puzzles in teaching

DISCUSSION

Traditional teaching learning methods especially in medical undergraduate education basic sciences subjects has constantly focused on communication, memorisation and retention of content rich factual information. With regards to teaching biochemistry to medical students at the undergraduate level, many new terms and concepts are introduced in a short time frame. In new medical curriculum, to make medical undergraduates competent Indian Medical Graduate (IMG), there is a need to introduce new methods of learning which make students more interested. According to student's point of view lectures are considered as monotonous and passive way to transfer knowledge. Thus, the concept of the crossword puzzle lightens the teaching environment and makes learning fun, active and more thoughtful.

The aim of the current study was to assess the changes in student's grasping power, memorising power and interest in learning two different topics of biochemistry namely "Diabetes Mellitus" and "Gout" using two different teaching learning methods "Crossword Puzzle" and "Traditional method". In present study, there was a significant difference between the average percentages scored by students with both different learning methods. Significantly more marks have scored by crossword method than traditional method. Similar results were recorded by another study given by Bryant J that

crossword puzzles are an interesting tool to deliver lecture content [1]. Current study suggests that crossword puzzles encouraged small group discussion; it helps in recalling and promotes critical thinking.

In current study, 100% students strongly agreed on the question that: "I will suggest more use of crossword puzzles in teaching", which is similar to the study done by Kumar LR et al., [8]. Similar to this study, other study also suggest that the crossword puzzles provide students a unique, innovative and fun opportunity to evaluate their own level of learning by identifying concepts that have not been mastered [9]. In now-a-days, most medical schools apply small group teaching in the form of problem-based learning sessions and integrated learning activities. Present study also supports introducing crossword puzzle for small group activity. It is useful not only in stimulating intra group activity, but also in inter group competitive activity. With the same set of questions being used for both batches, the insignificant difference in performance between the two batches also reflected the consistency and contingency of construction of the questions as well as the students' performance.

Medical educators look for materials that balance and augment lecture material without compromising class time. These supplemental materials do not require the instructor to remain in the classroom, and no additional class time is required. The game allows the student to review information in a new, exciting, fun and challenging format. Crosswords and other educational games are low stakes educational tools which require very little resources. They aid in improving active learning abilities with very little cost keeping the students as well as the administration happy. The teaching learning of any subject should include multiple tools. Teaching with crossword puzzles one of the many available tools that this study had incorporated in teaching some topics in biochemistry. It is not possible to implement crossword puzzles for all the topics of biochemistry due to time constraints. However, wherever possible they should definitely be incorporated for enhancement of active learning of students.

Limitation(s)

Crossword based teaching learning requires greater preparation and planning. Inter topic variability may exist depending on the difficulty level of the topics.

CONCLUSION(S)

Crossword puzzle make teaching more interesting and it promotes the learning through recreation. Student's performance in test increased significantly after teaching by crossword puzzle as compared to the traditional teaching. All the faculties of Department of Biochemistry would use crossword puzzles in teaching more often and students also feel that there should be more use of crossword puzzle in teaching. It is recommended to further evaluate effectiveness of crossword based teaching learning method in other topics of biochemistry as well as in other subjects of medical field.

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