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RESEARCH ARTICLE

Implementation and evaluation of puzzle-based learning in the first MBBS students

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ABSTRACT

Background: Innovative techniques have been employed in medical education to make the process of learning interesting and interactive. Games and puzzles, forms of active learning, are helpful to review, summarize, practice, find out gaps in knowledge, and develop new relationships among concepts. By implementing puzzle-based learning, the learner will be enough competent to understand the basic concepts of complex topic and apply this understanding in the future learning process. **Aims and Objectives:** The aim of the study was to determine the utility and effectiveness of the crossword puzzle, as a novel teaching-learning tool in medical education. **Materials and Methods:** Puzzle was introduced in routine tutorial class in a group of 60 students. 20 min time was given to solve the puzzle followed by discussion for the next 20 min. The gain in knowledge was assessed by pre- and post-test. Session evaluation done by taking the feedback from students on a Likert scale and analysis was done using SPSS software. **Results:** There was a significant improvement in knowledge of the students (Overall gain in marks = 120.06%). 73% of students are feeling that method is useful and effective, 22% of students gave a neutral response, and 5% of students are disagreeing. **Conclusion:** The crossword puzzle was very well appreciated by the students, and significant learning was occurred. The rational use of crosswords was useful to transfer of content, provide an opportunity to discuss and recall essential concepts in undergraduate studies. To make medical education more fascinating and interactive, future development of a computer-based interactive crossword puzzles is suggested.

KEY WORDS: Crossword Puzzle; Medical Students; Teaching-Learning Method

INTRODUCTION

Innovative techniques have been employed in medical education to make the process of learning interesting and interactive.[1,2]

Games and puzzles, forms of active learning, are helpful to review, summarize, practice, find out gaps in knowledge, and develop new relationships among concepts.[3]

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Various formats of games and puzzles have been used to supplement traditional teaching, for example, Jeopardy-style game in obstetrics.[4]

By implementing puzzle-based learning, the learner will be enough competent to understand the basic concepts of complex topic and apply this understanding in the future learning process.

The main aim of this project is to implement and evaluate the puzzle-based learning in the routine teaching-learning process.

- To determine the utility and effectiveness of the crossword puzzle, as a novel teaching-learning tool in medical education
- To increase students interest and involvement with a topic

- To improve the vocabulary of the students
- To understand the basic concept in innovative ways.

MATERIALS AND METHODS

Prior approval for the study was obtained from the Institutional ethics committee of Gujarat Adani Institute of Medical Sciences (GAIMS) and written informed consent was obtained from the student's then crossword puzzle on the topic of "exercise physiology in routine tutorial class among first MBBS students was introduced."

The study design is the cross-sectional type and it is conducted at GAIMS, Bhuj.

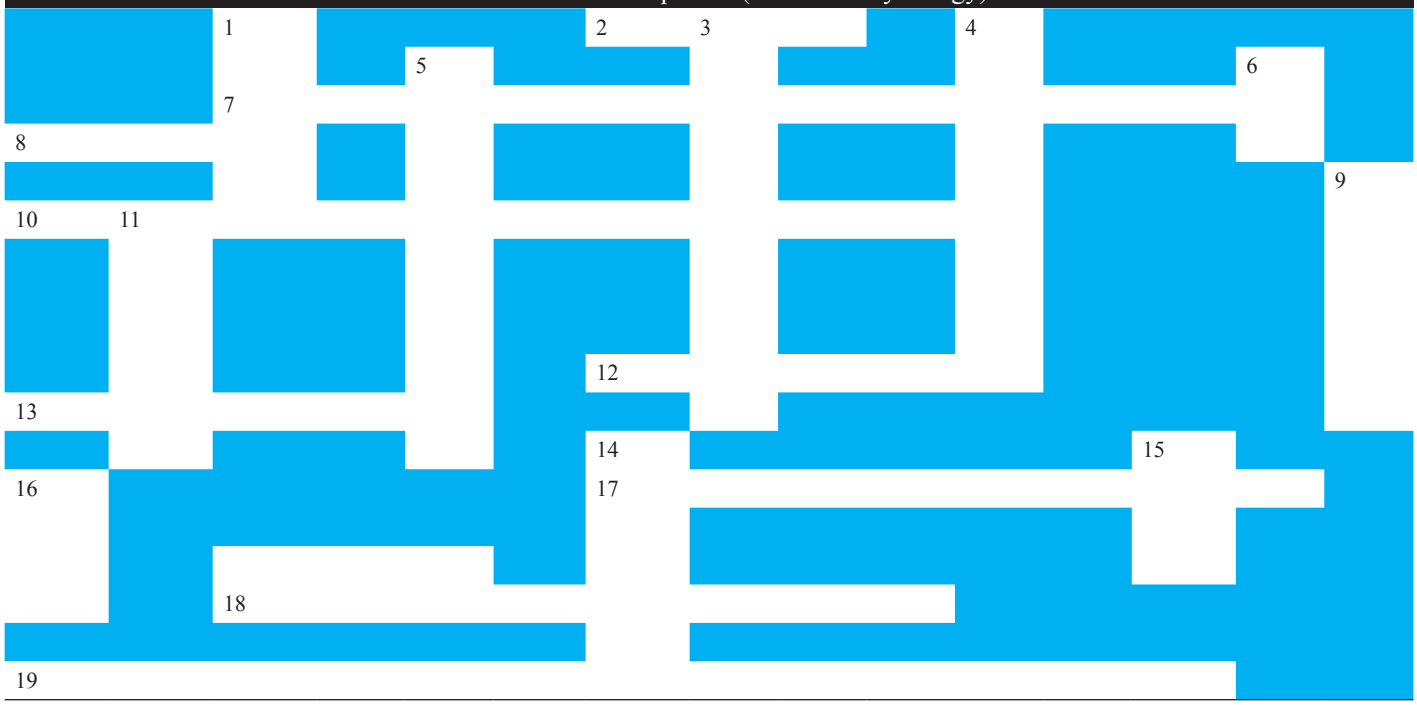
The crossword puzzle was prepared and reviewed by the peers in the department. In this puzzle, there were a total of 19 questions (9 questions in across and 10 questions in down) [Tables 1 and 2].

Before implementing this puzzle pre-test (seven multiple choice questions [MCQs] and three short-answer questions [SAQs]) was taken, then puzzle-based learning session was implemented in routine session as a tutorial in the group of 60 students.

20 min time was given to the students to solve the puzzle and then the discussion was done in the next 20 min.

After finishing the discussion, post-test (7 MCQs and 3 SAQs) was conducted.

Table 1: Crossword puzzle (Exercise Physiology)



Across:
2. Stroke volume increased during exercise due to increased _____. (Short form) (3),
7. Type of Diet which prolonged the exercise duration. (12)
8. Basal O2 consumption is also called? (Short form) (3)
10. Anticipatory _____ (11)
12. Site of fatigue in living human (6)
13. Currency of energy during exercise. (Short form) (3)
17. Disease in which exercise is one of the physiological measures (8)
18. Muscular activity depends upon store of _____ (8)
19. Hormone which increased during exercise (13)

Down:
1. Type of Acidosis during exercise (6)
3. Exercise in humid environment leads to ____. (11)
4. Name the artery in which blood flow is increased. (8)
5. Effect of high vagal tone (11)
6. Synonyms of BMR. (Short form) (3)
9. Property of muscle that is seen in exercise. (7)
11. Group of person in which there is high vagal tone (7)
14. Tissue in which blood flow increased during exercise (7)
15. During recovery phase of exercise there is O2 _____ (4)
16. Type of muscle fibers (4)

Table 2: Crossword puzzle (exercise physiology) – Key

		1L				2E	3D	V		4C			
		A		5B			E			O		6R	
		7C	A	R	B	O	H	Y	D	R	A	T	E
8M	E	T		A			Y			O			E
		I		D			D			N			9F
10T	11A	C	H	Y	C	A	R	D	I	A			A
	T			C			A			R			T
	H			A			T			Y			I
	L			R			I						G
	E			D		12C	O	R	T	E	X		U
13A	T	P		I			N						E
	E			A		14A						15D	
16F						17D	I	A	B	E	T	E	S
A						I						B	
S						P						T	
T		18G	L	Y	C	O	G	E	N				
						S							
19N	O	R	A	D	R	E	N	A	L	I	N	E	

Table 3: Student feedback form

Question:	Response: Likert scale				
	Strongly Agree (SA) (5)	Agree(A) (4)	Neutral (N) (3)	Disagree (D) (2)	Strongly Disagree (SD) (1)
This crossword puzzle helped me with the vocabulary and concepts in exercise physiology					
I enjoyed doing the crossword					
The crossword puzzle reflected the key concepts of the course					
The crossword puzzle was a useful learning tool					
Connection between subtopics is very well emphasized in the crossword puzzle					
Working in groups to do the crossword contributed to their effectiveness as a learning tool for me					

Special Remarks/comments in own words (Any Language): _____

Feedback was taken from students using questionnaire (pre-validated) with a 5-point Likert scale. Written feedback as the written comment was also obtained from students [Table 3].

Analysis of data was performed by calculating frequency/percentage and mathematical mean.

Table 4: Pre- and Post-test results

Learning (10 marks)	Pre-test (Mean±SD)	Post-test (Mean±SD)	Sig. (two-tailed)
n=60	2.94±1.45	6.47±1.46	0.000

SD: Standard deviation

RESULTS

Table 4 shows that by implementing and evaluating the puzzle-based learning in first MBBS students we can observe that significant learning was occurred.

Table 5 shows that by puzzle-based learning help in improving the vocabulary and at the same time they also enjoyed the new tool of learning. Students also feel that by puzzle-based learning the important concept of the topic was discussed. Most of the students reflected that method was useful and effective. By looking at mean for the individual question the mean of all questions is 3.91 this suggests that response of most of the students is somewhere between neutral to agree for a particular question asked in feedback.

Table 5: Response data (Feedback)

Feedback (Reaction)	Frequency (*n*=60)					
	Mean	Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
Vocabulary	3.92	12	33	13	02	00
Enjoyed	4.13	23	26	08	02	01
Concepts	3.85	10	33	15	02	00
Usefulness	4.02	18	31	06	04	01
Connections	3.93	21	20	15	02	02
Effectiveness	3.62	10	25	20	02	03
Summary	3.91	16	28	13	02	01
		SA+A (%)		N (%)		SD+D (%)
	3.91	44 (73)		13 (22)		03 (5)

SA: Strongly agree, A: Agree, N: Neutral, SD: Strongly disagree, D: Disagree

Students were very happy with this method and they mention many positive aspects of the puzzle in their written feedback as comments.

DISCUSSION

Results of this study show that puzzle-based learning was very well accepted by the students and students feels that puzzle-based learning improved the vocabulary and majority of the students are agree that method is useful, effective, and they enjoy a lot.

Manzar and Al-Khusaiby observed that crossword puzzle in a small group teaching set up showed that using such exercise stimulated and activated the interactive learning among the students, reflected by their positive attitude and response. We utilized the discussion on a common neonatal problem covering the different aspects of neonatal jaundice including etiology, differential diagnosis, laboratory investigation, management approach, and complications.[5] Saxena *et al*. also observed that that crossword puzzle provides insight into (1). The utility of crossword puzzles in undergraduate medical education to reinforce concepts and vocabulary in an interactive learning atmosphere, (2) the response of students and other instructors to the inclusion of crosswords, and (3) evidence of its feasibility in a large class setting.[6] This study shows quiet similar results with the previous study on the same topic.

This type of method is very effective and can be introduced in a routine tutorial session, also can be used as an assessment method in form hybrid tool. Making a crossword puzzle is time consuming and not suitable for a small topic in which there is word limitation.

Overall, this method shows great utility and effectiveness; the feedback on the study was very encouraging.

Limitations and Direction for Future Research

In crossword puzzle topic should be large enough so we can justify the puzzle in a better way.

It is a bit difficult to prepare the puzzle and also time consuming so we need advance preparations for this. Group size is a major limitation; in the present study, the group was not small.

The judicious use of crossword puzzles in a collaborative/competitive environment is a useful adjunct to the repertoire of active learning strategies.

Future research in this area may be directed at determining the impact of crossword puzzles on retention of vocabulary and concepts in undergraduate medical education, development of teams and critical-thinking skills, and a controlled experiment to identify the key contributory aspects of this intervention.

To make medical education more fascinating and interactive, future development of computer-based interactive crossword puzzles is suggested. In future, such crossword puzzles can be used as an assessment tool also.

CONCLUSION

From the above study, we can conclude that significant learning was occurred by the puzzle. The crossword puzzle was very well appreciated by the students. The rational use of crosswords was useful to transfer of content, provide an opportunity to discuss and recall essential concepts in undergraduate studies.

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