Original Article

Crossword Puzzles – A Fun Educational Tool to Reinforce Information

Vaddatti Tejeswini, B. Chaitra, I. V. Renuka, Potti Ramya
Department of Pathology, NRI Medical and General Hospital, Guntur, Andhra Pradesh, India

Abstract

Introduction: Students-centered teaching and learning methods are the trends in medical education. Many innovative techniques are introduced and implemented to promote active learning by students, like crossword puzzles, a fun educational tool to generate interest, motivate, and enhance the critical thinking of medical students. Hence, this study was conducted to assess the perception of medical students toward crossword puzzles. **Materials and Methods:** This is an interventional study done on II MBBS students in the department of pathology. The crossword puzzles are created, and students are allowed to solve them for 15 min after a didactic lecture. Then, students are provided with a questionnaire to assess their perceptions toward this technique. The knowledge gained and retained was evaluated by short answer questions in comparison with topics dealt with only by traditional lectures. Descriptive and analytical statistical analysis of mean, standard deviation, and paired *t*-test for analysis of scores of both methods are done. **Results:** The majority of the students in this study perceived that crossword puzzles helped in better understanding of concepts, were fun education tools, challenging and problem-solving, emphasized the core topic, helped reinforcement of lectures, encouraged active learning, and improved overall thinking. The *P* value between the scores by only lecture method and that reinforced by crossword puzzles was extremely statistically significant. Thus crossword puzzles can be used to enhance retention and help in reinforcement learning. **Conclusions:** Crossword puzzles are an innovative learning method which promotes active learning and overall thinking of the students. This can be implemented in medical schools as a simple, creative, and effective means of holistic learning.

Keywords: Critical thinking, crossword puzzles, medical students, perceptions, reinforce

Introduction

There is a paradigm shift in learning technologies in medical education. Many innovative learning strategies have been employed in the recent past in medical education to make learning interesting and interactive.[1] The engagement, attention, and thinking skills of students can be increased by an active learning activity following lectures.[2] Active learning helps students to do things and think about the things they are doing. Thus, it would help in sharpening his/her thinking capabilities.[2] The active learning activities include methods such as class discussion,[3] think-pair-share,[4] learning cell, small group discussion,[5] short written exercise, student debate,[6] learning through teaching, class-game, gallery walk, etc., games will turn learning into a more enjoyable process for learners as well as instructors[7,8] and add flexibility and interest in the classroom by allowing students to adjust to the ways in which they learn best.[9] Think pair share is a good active learning activity, but in a large class, it is very difficult for the instructor to control who shares the information with the class. Though small group discussion increases peer thinking and creativity, it would be exhaustive to conduct with a limited number of instructors. Short-written exercises enhance the creativity of students but are cumbersome. When compared to the above methods, the teaching, which includes modules, is more interesting for the students. The students can work in groups or alone, can be competitive and creative, and have fun learning. Crossword puzzles are innovative methods which help students learn while being in an environment of

Submitted: 05-Dec-2022 **Revised:** 22-May-2023
Accepted: 12-Jul-2024 **Published:** 29-Aug-2024

Access this article online

Quick Response Code:

Website: http://journals.lww.com/amit

DOI: 10.4103/amit.amit_104_22

Address for correspondence: Dr. B. Chaitra, #32-15/1-67, Vijayashradha Towers, S3, Dasarilingaiah Street, Moghalrajpuram, Vijayawada - 520 010, Andhra Pradesh, India.
E-mail: dr.chaitra.b@gmail.com

How to cite this article: Tejeswini V, Chaitra B, Renuka IV, Ramya P. Crossword puzzles – A fun educational tool to reinforce information. Acta Med Int 2024;11:168-71.

playing, which is usually not possible with other active learning modules. Thus, one such strategy is a crossword puzzle which can be used by educators to hone the critical thinking and problem-solving skills of students. This study was conducted to introduce crossword puzzles as a learning strategy to medical students and assess their perceptions.

The aim of this study was to assess the perceptions of medical students toward crossword puzzles.

Materials and Methods

Study design

This is an interventional study done to assess the perceptions and effectiveness of newer technique crossword puzzles among II MBBS students.

Study setting

This study was conducted in the Department of Pathology, NRI Medical College, Guntur. The study population includes II MBBS students.

Sample size

One hundred and forty-five students were included taking inclusion and exclusion criteria into consideration.

Inclusion criteria

All students of II MBBS who were interested to participate in the study were included.

Exclusion criteria

The students who were absent on the day of the intervention were excluded from the study.

Institutional ethical clearance (NRIMC 134) was taken before the start of the study. All the students who participated in the study were evaluated with a formative examination and feedback questionnaire.

The crossword puzzle was designed on hemodynamic disorders and validated by experts. Then, a feedback questionnaire was designed, which included a 5-point Likert scale and a few open-ended questions to holistically assess the perceptions of students. A consensus was taken from experts regarding this. The questionnaire was designed, and two experts were selected and given guidelines for validating the questionnaire. They were asked to rate on relevance and clarity of the items by a four-tier score. Score 1 not relevant, 2 somewhat relevant, 3 quite relevant, and 4 highly relevant. A score of 3 and 4 were considered acceptable. The responses from both experts were tabulated and analyzed for content validity ratio. We got a score validity index of 0.9, a score average of proportion relevance of 0.9, and a universal average score of 0.8. These values were acceptable validity scores.

The reliability of the questionnaire was assessed using Cronbach's alpha taking all the responses of the participants into consideration. We got a relevance score of 0.78, which is acceptable. The students were given a brief overview of crossword puzzles. For open-ended questions, the experts were in 100% agreement. After this, the faculty were sensitized regarding the framing and effectiveness of crossword puzzles for 20 min. Their inputs were taken into consideration, and crossword puzzles were prepared.

Later, the students were sensitized to these puzzles. A crossword puzzle with 10 questions on hemodynamic disorders was prepared using an online crossword maker and divided into two sections. The cross section had 4 questions, while the down section had 6 questions. The crossword clues were substantiated from the textbooks of pathology. The feedback questionnaire was developed to record the perceptions of students about crossword puzzles as an active method of learning. The questionnaire included 10 questions with responses on a 5-point Likert scale (1 strongly disagree and 5 strongly agree). It also included 4 open-ended questions. Traditional lectures on hemodynamic disorders were taken as per schedule and then students were provided with print copies of crossword puzzles. Fifteen minutes were allotted to solve the puzzle, and later, a thorough discussion on the answers was done. The feedback questionnaire was given to the students, and the responses were recorded and analyzed.

A formative assessment was conducted 15 days later including the topics taught only by traditional lecture and that reinforced with crossword puzzles. The marks scored were compared and analyzed using a paired *t*-test. The response in the feedback questionnaire was expressed in percentages. Descriptive and analytical statistical analysis of mean, standard deviation, and paired *t*-test for analysis of scores of both methods was done.

Results

A total of 145 students were included in the study after taking inclusion and exclusion criteria into consideration. The study included 90 (62.07%) female students and 55 (37.93%) male students. 105 (72.41%) students had prior experience with crossword, while 40 (27.59%) students were not exposed.

The anonymous questionnaire survey provided to the students showed their response toward this method, which was tabulated and analyzed, as depicted in Table 1. Majority (71.73%) of students either agreed or strongly agreed that understanding concepts was better with crossword puzzles than the traditional didactic lectures alone. About 96.52% felt crossword as a fun education tool, while 88.96% agreed that it is challenging and problem-solving. The majority of the students were of the opinion that crossword puzzles emphasized the core topic, helped reinforcement of lectures, encouraged active learning, and improved overall thinking. They also enjoyed the faculty reviewing and felt the time given was adequate. 55.45% of students perceived this method as effective, while 41.38% could not have a definite opinion.

In the open-ended questionnaire, for advantages, about 60% of students felt that crosswords helped in recall and thinking, while 20% said that it was fun and interesting, 11% said it was a method of active learning and 9% had opined that crosswords

Table 1: Responses of students to the questionnaire

Likert Scale category/question	1 - strongly disagree, *n* (%)	2 - disagree, *n* (%)	3, *n* (%)	4 - agree, *n* (%)	5 - strongly agree, *n* (%)
The concept was better understood using crossword puzzle than traditional method	5 (3.45)	10 (6.9)	26 (17.9)	84 (57.93)	20 (13.8)
The crossword puzzle are fun educational tools	1 (0.69)	2 (1.38)	3 (2.07)	90 (62.07)	50 (34.45)
Crosswords are challenging and problem-solving	0	4 (2.76)	12 (8.27)	84 (57.93)	45 (31.03)
The crossword puzzles emphasized the core area of topic	0	7 (4.83)	36 (24.83)	80 (55.17)	22 (15.17)
Solving crossword puzzles in the classrooms are good appraisal and reinforcement of lectures	0	2 (1.38)	11 (7.59)	84 (57.93)	48 (33.1)
I would recommend their use to other subjects also to encourage active learning	2 (1.38)	9 (6.21)	32 (22.07)	55 (37.93)	47 (32.41)
Crossword puzzles improved my overall thinking	0	14 (9.65)	31 (21.38)	77 (53.1)	23 (15.86)
Enjoyed faculty material and reviewing while solving crossword puzzles	0	3 (2.07)	22 (15.17)	88 (60.69)	32 (22.07)
The length of time given to solve the puzzle was adequate	4 (2.76)	27 (18.62)	21 (14.48)	78 (53.79)	15 (10.34)
How do rate overall this method over traditional learning (1–5, 1 - not effective, 5 - very effective)	1 (0.69)	5 (3.45)	60 (41.38)	53 (36.55)	26 (17.9)

Table 2: Comparison of scores obtained by II MBBS students on topics with and without reinforcement by crossword

Scores	Mean	SD	*P* value paired *t*-test
Scores in noncrossword topic	5.10	1.45	0.0001
Scores in topics with crossword puzzle	6.41	1.76	

SD: Standard deviation

helped in emphasizing core topics and terminologies. In the suggestions, 40% wanted more frequent sessions, while 20% wanted to include cases, images, and group-wise discussions. Majority of students (93%) showed a positive attitude, while 7% wanted to include crosswords routinely for classes.

A formative assessment was conducted both on the topics taught only by traditional lectures and that reinforced with crossword puzzles. The scores obtained for both the sections by the students were analyzed using paired *t*-test. The mean score in the topics taught only by traditional lecture was 5.1, while in the topics reinforced by crossword, it was 6.41. The *P* value was extremely statistically significant as shown in Table 2. This shows that crossword puzzle helps in recall and remembering the concepts.

Discussion

The syllabus in medical education is voluminous and vast, especially in subjects like pathology.

The major problem faced by medical students is difficulty in recalling the learned concepts. The students feel difficulty in concentrating for long hours and get bored with the lecture method of teaching and learning. To address this problem, several learning strategies are introduced in medical education. One such novel technique is the crossword puzzle, an active method of learning. It is observed that the students are unable to remember and recall the information gathered. In order to overcome this, there should be reinforcement and concept understanding. For solving the crossword puzzles, the students need to read and analyze the clues, recall and review the literature, and discuss among their peer group. This would enhance understanding of the concepts and clear misconceptions. Thus, crossword puzzles would promote the engagement of the students in the learning process, improve their recalling capacities, and enhance their learning experiences.[10,11]

Hence, in this study, crossword puzzles are used as a method of active learning for medical students. The perceptions of students toward this method were assessed by a validated questionnaire. This study showed that 71.73% of the students perceived crossword puzzles as a better strategy over lectures in understanding the concepts, which is slightly lower than the study done by Joshi, where 97% of students agreed that crosswords helped them to understand the concept more easily.[2] Nazeer *et al*. and Mohan *et al*. revealed that 94.6% and 98.6% of students, respectively, in their study felt that crossword puzzles helped them understand better.[12,13] The slightly lower perceptions in this study might be due to a single experience with crosswords. If it was done as a module, it probably would be more effective.

Almost all the students in this study (96.25%) agreed that crosswords are a fun educational tool similar to the study by Nazeer *et al*. (91.3%), while it was higher than the study by Abuelo *et al*. (77.8%).[12,14] Nearly 89% of students felt that the crosswords are challenging and problem-solving, which is similar to the studies by Joshi (92%) and Nazeer *et al*. (80%) and slightly higher than Patrick *et al*. (70.5%).[2,12,15] In this study, around 70% felt that crossword puzzles emphasized the core topic, which was lower than Nazeer *et al*. (91.3%) and Mohan *et al*. (90.8%).[12,13] Reinforcement 91% in this study.

Around 70% of students in this study agreed that crosswords encouraged active learning and overall thinking, which is in concordance with studies done by Patrick *et al*. (68%) and

Nazeer *et al*. (79%) while lower than Mohan *et al*. (92%).[12,13,15] Eighty-two percent of students in this study felt that faculty reviewing was helpful, which is in concordance with Patrick *et al*. (88%).[15] Almost all the participants in the study by Nazeer *et al*. agreed that the time allotted was adequate for solving the crossword puzzle, while in this study, around two-thirds felt that time was adequate, similar to the findings of Patrick *et al*.[12,15]

In this study, the crossword learning method was perceived as an effective method by more than half of the students. After a formative assessment, the mean score in the topics taught only by traditional lecture was 5.1 while in the topics reinforced by crossword was 6.41. The *P* value was extremely statistically significant, which is in concordance with the study done by Patrick *et al*. and Abuelo *et al*.[14,15]

This study not only assesses the perceptions of medical students to this innovative method but also gives insight into the effectiveness of this method in learning. A formative assessment was conducted for the topics with and without reinforcement by crossword puzzles. There was a statistically significant difference in the scores obtained, emphasizing the effectiveness of this method. To the best of our knowledge, in the literature, very few studies are done on the efficacy of this method. It would be better if we could use this method can be used as a module for the entire phase and assess its efficacy.

The strengths of the study

An intervention was used, and the perceptions of the participants were recorded.

This study also analyzed the scores obtained by students for topics dealt with only by lecture and those reinforced by crossword puzzles.

The limitations of this study

The intervention was done in a single institution and for a limited topic. A study involving multiple batches and institutions would be more accurate and meaningful.

Conclusions

Crossword puzzle was introduced to medical students as an innovative teaching–learning module. Majority of students felt that this method was useful in promoting active learning and overall thinking. They perceived this methos as a fun tool which helped them in solving problems. This also promotes self-learning and aids in recall and better understanding of concepts. Thus, crossword puzzles can be implemented as a module in the curriculum of medical education.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Patel JR, Dave DJ. Implementation and evaluation of puzzle-based learning in first MBBS students. Natl J Physiol Pharm Pharmacol 2019;9:519-23.
2. Joshi PS. Visualization and crossword: In-class exercise-an active learning strategy. IJERT 2019;8:115-9.
3. McKeachie WJ, Svinicki M. Teaching Tips: Strategies, Research, and Theory for College and University Teachers. Belmont, CA: Wadsworth; 2006.
4. Robertson K. Increase Student Interaction with "Think-Pair-Shares" and "Circle Chats;" 2006.
5. Harmann K. Assessing student perceptions of the benefits of discussions in smallgroup, large-class, and online learning contexts. Coll Teach 2012;60:65-75.
6. Michael J. Where's the evidence that active learning works? Adv Physiol Educ 2006;30:159-67.
7. Franklin S, Peat M, Lewis A. Non-traditional interventions to stimulate discussion: The use of games and puzzles. J Biol Educ 2003;37:76-82.
8. Weisskirch RS. An analysis of instructor-created crossword puzzles for student review. Coll Teach 2006;54:198-202.
9. Moore LS, Detlaff AJ. Using educational games as a form of teaching in social work. Arete 2005;29:58-72.
10. Gaikwad N, Tankhiwale S. Crossword puzzles: Self-learning tool in pharmacology. Perspect Med Educ 2012;1:237-48.
11. Shah S, Lynch LM, Macias-Moriarity LZ. Crossword puzzles as a tool to enhance learning about anti-ulcer agents. Am J Pharm Educ 2010;74:117.
12. Nazeer M, Sultana R, Ahmed MM, Asad MR, Sami W, Hattiwale HR, *et al.* Crossword puzzles as an active learning mode for student directed learning in anatomy teaching: Medical undergraduate perceptions. Int J Med Res Health Sci 2018;7:12-9.
13. Mohan BS, Nambiar V, Gowda S, Arvindakshan R. Crossword puzzle: A tool for enhancing medical students learning in microbiology and immunology. Int J Res Med Sci 2018;6:756-9.
14. Abuelo A, Castillo C, May SA. Usefulness of crossword puzzles in helping first-year BVSc students learn veterinary terminology. J Vet Med Educ 2016;43:255-62.
15. Patrick S, Vishwakarma K, Giri VP, Datta D, Kumawat P, Singh P, *et al.* The usefulness of crossword puzzle as a self-learning tool in pharmacology. J Adv Med Educ Prof 2018;6:181-5.