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RESEARCH ARTICLE

# Crossword puzzle as a tool to enhance learning among students in a medical school

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## ABSTRACT

**Background:** Even though many recent innovations are done in various teaching-learning methods adopted, the undergraduate bulk of teaching is still delivered through didactic lectures in most of the medical schools. Most of the students find these didactic lectures very boring and also many researches have shown that lectures, a passive method of learning, provide the lowest retention rate of knowledge in comparison to active methods of learning that involves discussing in groups, tutorials, and teaching to others are much more effective. Hence, games like crossword puzzles can be used to teach undergraduates in learning the key concepts in physiology as it can induce interest among students and can also be used as a tool to assess the enhancement in learning after the lectures, this can be a welcome change in the monotonous routine lectures. **Aims and Objectives:** The objectives of this study were as follows: (i) To administer crossword puzzle before and after lecture, (ii) to evaluate the enhancement of learning after lecture, (iii) to obtain feedback on usefulness of crossword puzzle in effective learning, and (iv) to analyze the change in the performance in relation to feedback. **Materials and Methods:** The study was conducted on 150 1st year MBBS students after obtaining Ethical Clearance from the Institutional Ethical Committee, Adichunchanagiri Institute of Medical Sciences. Simple crossword on endocrine physiology was constructed with clues given "across" and "down" using the crossword puzzle maker website. Before the start of lecture on "Introduction to Endocrine Physiology," students were given instruction on the rules of the games and were divided into teams, each team consisting of six students according to their roll number, the crossword puzzle was given to different teams, time allotted was 8 min. Later, 1-h lecture on the topic was delivered and same crossword puzzle was given to solve after the lecture to assess the enhancement of learning after lecture and feedback was obtained on usefulness of crossword puzzle in effective learning. **Results:** Pre-test score of the students of crossword puzzle before the start of the lecture was 4.76± 1.09 and the post-test score of the students after the lecture was 11.72 ± 1.6 ($P < 0.1$); this was highly significant. Feedback obtained from the students was indicative of that they want more such games in physiology which they felt it interesting, innovative, creative, and fun educational tool and helped them in understanding new words as well as concepts in physiology. **Conclusion:** Hence, from the present study, we conclude that games like crossword puzzles can enhance learning among students as indicated by post-test score. Most of the students strongly agreed that discussing in groups could increase their understanding of the topic better as well the competitive aspect of doing the puzzle contributed to their effectiveness.

**KEY WORDS:** Crossword Puzzle; Teaching-Learning Methods; Enhancement; Physiology

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## INTRODUCTION

Games like crossword puzzles during physiology lectures can be fun during lectures.[1] These crossword puzzles cannot totally replace the traditional lectures, but it can provide a very good interesting opportunity for teaching as it can create interest and motivate students in learning

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physiology. It can also create a challenging and competitive atmosphere promoting student interaction in a friendly and fun environment.[2]

Passive method of learning which takes place during lectures, the retention rate among students is only 10%.[3,4] Therefore, medical educators presently are looking to inculcate new innovations and creativity in methods adopted in education which can enhance learning and also which can complement the traditional lectures. These new innovative and creative methods should also help in active learning, enhance problem-solving skills, and promote small group discussion and it should help in strengthening knowledge acquirement and enhance the procedural skills.[1]

Activities like crossword games during lectures are helpful in breaking the monotony of didactic lectures and can also get active participation and attention of students during lectures.[5] These puzzles can also be used as structured educational tools to enhance critical thinking and in reinforcing the content acquired during lecture.[6]

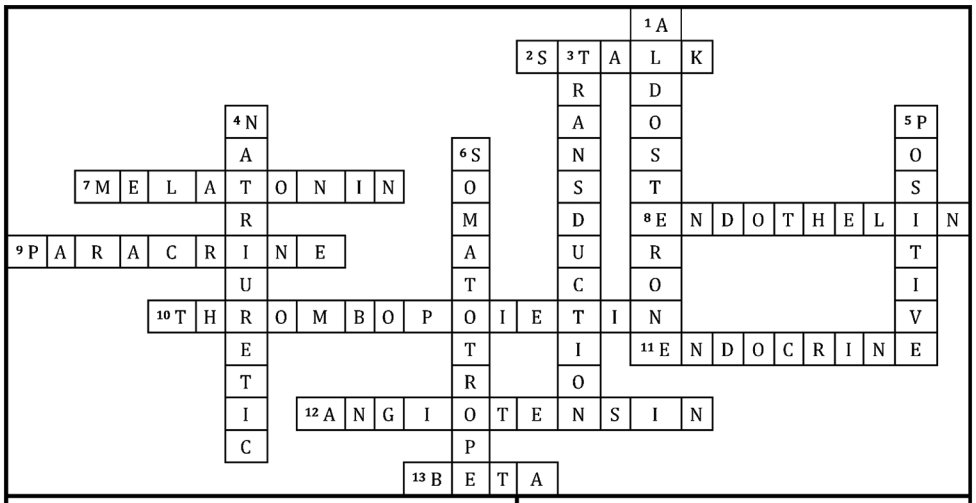
Active learning strategies adopted in teaching-learning method have its own benefits which can enhance development of critical thinking, communication, cooperative learning skills and attitudes, and values promoting concept formation, providing an avenue for discovering misconceptions, and increasing motivation, various formats of interactive games and puzzles have been advocated by researchers as active learning strategies which create an interactive learning episodes where the learners are active players and participants.[7]

Crossword puzzles stimulate the mind, increase the vocabulary, and help to develop healthy skepticism; therefore, instead of passive memorization of material, crossword puzzles can be beneficial as a self-learning tool to promote active learning and to develop critical thinking.[7]

Games can be used during the lecture classes as a motivational tool before, during a class as a teaching tool, or after a lecture for the revision of concepts. Educational games have previously used in life science careers, in various disciplines and specialities.[8]

The crossword puzzle by solving in teams is a very good method adopted in teaching as it promotes the team work. This method also complements the traditional method of teaching.[9]

Crossword puzzles were designed to provide students with feedback regarding their understanding of the material presented in the lecture and to promote student involvement in the learning process. Evaluation of the crossword puzzles as a low-stakes educational tool for enhancing student learning. The present study provides the use of crossword puzzles in lectures covering the Introduction to Endocrine Physiology.



**ACROSS**

2. The pituitary ___is the connection between the Hypothalamus & The posterior pituitary
7. Pineal gland secrete the hormone___
8. ___is a vascular peptide plays role in vascular homeostasis
9. ___is a peptide hormone from anterior pituitary associated with lactation
10. ___is a glycoprotein hormone that regulates the production of platelets
11. ___glands secrete their product directly into the blood
12. ___is a oligopeptide in the blood that causes vasoconstriction and Increases B.P
13. ___cells in the pancreas causes insulin production

**DOWN**

1. ___steroid hormone produced by adrenal gland which regulates sodium & potassium balance
3. Signal___ refers to process which converts one kind of signal or stimulus into other
4. Atrial ___peptide is involved in water & sodium homeostasis
5. Parturition reflex is an example ____feedback mechanism
6. ___s are the cells in the anterior pituitary which produce growth hormone

**Figure 1:** Crossword puzzle of endocrine physiology

## MATERIALS AND METHODS

Ethical clearance was obtained from the Institutional Ethical Committee, Adichunchanagiri Institute of Medical Sciences. The study subjects were 150 1st year MBBS students of Adichunchanagiri Institute of Medical Sciences, students voluntarily participated for the study. A simple crossword on endocrine physiology was constructed with clues given "across" and "down" using the crossword puzzle maker website [Figure 1]. Before the start of lecture on "Introduction to Endocrine Physiology," students were given instruction on the rules of the games and were divided into teams, each team consisting of six students according to their roll number, the crossword puzzle was given to different teams before the start of the lecture, time allotted was 8 min. Later, 1 h lecture on Introduction to Endocrine Physiology was delivered and same crossword puzzle was given to solve after the lecture to assess the enhancement of learning after lecture and feedback was obtained on usefulness of crossword puzzle in effective learning.

A questionnaire seeking the student's perception about the utility of crossword puzzle in enhancing their learning after the lecture was obtained. A five-point Likert scale with 5 = strongly agree, 4 =agree, 3 = neutral, 2 = disagree, and 1 = strongly disagree was used to compare the feedback regarding the utility of crossword puzzle [Table 1].

Mean and standard deviations were calculated. Paired Student's "*t*" test was used for comparing pre-test and post-test scores and *P* values were calculated using SPSS software, $P < 0.1$ was considered as statistically significant.

Evaluation of crossword puzzle score before and after the lecture was carried out on different groups. The obtained data were tabulated, analyzed, and expressed as mean ± standard deviation. To compare the pre-test and post-test score between the two groups, the paired Student's "*t*" test was applied and statistical significance was indicated by $P < 0.01$.

The statistical software, SPSS, is used for the analysis of the data and Microsoft Excel has been used to generate graphs, tables, etc.

## RESULTS

According to Table 2, pre-test score of the students of crossword puzzle before the start of the lecture was 4.76 ± 1.09 and the post-test score of the students after the lecture was 11.72 ± 1.6 ($P < 0.1$); this was highly significant. This significant difference in the post-test score was indicative of enhancement in learning after the lecture. Figure 2 depicts the number of students who have previously played crossword puzzles. Figure 3 depicts the feedback from the students regarding utility of crossword puzzles.

## DISCUSSION

The study was conducted to analyze the utility of crossword puzzles in teaching physiology for the first M.B.B.S students effectively.

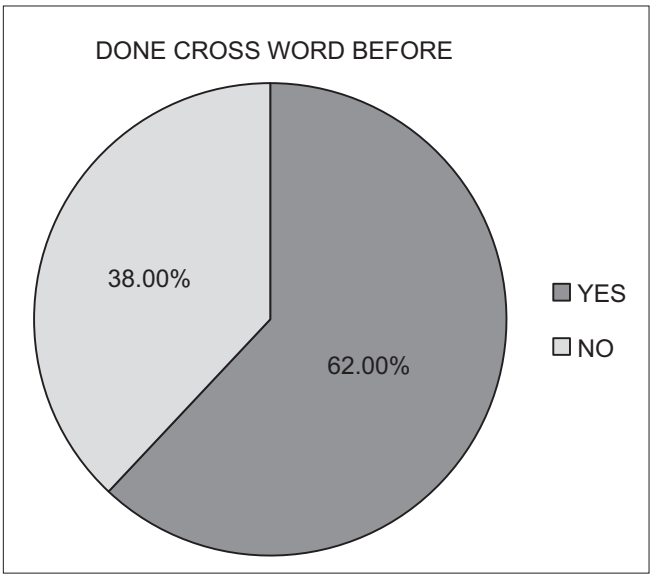



**Figure 2:** The number of students who have previously played crossword puzzles

**Table 1:** Questionnaire regarding the utility of crossword puzzles

| **I have done crossword puzzles before: Yes/No** | | | | | | |
|---|---|---|---|---|---|---|
| **Tick in the appropriate box (√) Please answer the question: 1=Disagree strongly; 2=Disagree; 3=Neutral; 4=Agree; 5=Agree strongly** | | | | | | |
| **S. No.** | **Questions** | **1** | **2** | **3** | **4** | **5** |
| 1 | The crossword games in physiology would be interesting | | | | | |
| 2 | The crossword games will be a fun educational tool | | | | | |
| 3 | The crossword games are innovative and creative | | | | | |
| 4 | The crossword puzzle would help me in understanding new words and concepts in endocrine physiology | | | | | |
| 5 | Do you think working and discussing in groups to do the puzzle will increase my understanding of the topic better | | | | | |
| 6 | I recommend that the crossword puzzle continues to be part of this course material | | | | | |
| 7 | The competitive aspect of doing the puzzle contributed to their effectiveness | | | | | |
| 8 | I would like to have more crossword puzzles in physiology | | | | | |

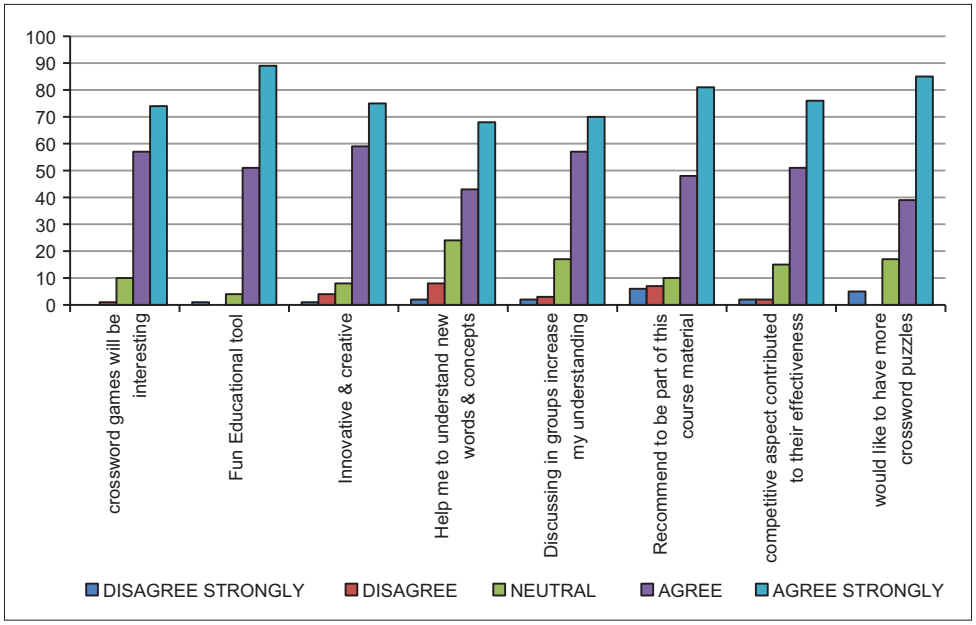



**Figure 3:** Feedback from the students regarding utility of crossword puzzles

**Table 2:** Comparison of the students score in the pre-test and post-test

| Pre-test | Post-test | *t* | Significance of *P* value |
|---|---|---|---|
| Mean±S.D | Mean±S.D | 47.36 | 0.000 ($P$<0.1) |
| 4.76±1.09 | 11.72±1.6 | | |

Results revealed that pre-test score of the students of crossword puzzle before the start of the lecture was 4.76 ± 1.09 and the post-test score of the students after the lecture was 11.72 ± 1.6 ($P$ < 0.1); this was highly significant. This significant difference in the post-test score was indicative of enhancement in learning after the lecture.

The response rate for the questionnaire was 100%. Questionnaire regarding the utility of crossword puzzles, of the students 62% had previously played the crossword puzzle, 74% strongly agreed that crossword games in physiology will be interesting, 89% were it will be a fun educational tool, 75% strongly agreed it will be innovative and creative, 68% of students it helped them in understanding new words and concepts in endocrine physiology, 70% thought working and discussing in groups can increase their understanding of the topic better, 81% recommended that the crossword puzzle continue to be part of this course material, 76% agreed strongly that competitive aspect of doing the puzzle contributed to their effectiveness, and 85% wanted to have more crossword puzzles in physiology.

The present study is similar to the study done by Muthukumaran and Cruz where structured pre- and post-test were developed and used during physiology lecture class, perception of 136 students was that pre-test is a useful method to be focused on the lecture and hence be more attentive and learn the important points of the lecture, which was also evidenced by their performance on the post-test, which showed a significant improvement with an overall increase in mean score in post-test compared to overall mean score in pre-test which highly significant statistically.[10]

The present study is similar to the study conducted by Bryant, where most of the students agreed that the use of the crossword was fun and an innovative method of teaching. Majority concluded that it helped them in learning the new terminology and understanding the concepts and that they wanted more of such games.[11]

Davis *et al.* studied the effectiveness of crossword puzzles in reviewing for examination but found no significant differences between learners who used crossword and those who did not.[12]

Bailey *et al.* in their study designed various educational games and were of the opinion that crossword puzzles provided an opportunity to the students to evaluate their own level of learning and also identify and subsequently correct areas of weakness.[9]

### Limitations

Students found the lecture classes very interesting with the puzzle. It took time to make groups among students and also additional workforce was required in class to conduct the study.

## CONCLUSION

Hence, from the present study, we conclude that games like crossword puzzles can enhance learning among students. Feedback obtained from the students was indicative of that

they want more such games in physiology which they felt it interesting, innovative, creative, fun educational tool, and helped them in understanding new words as well as concepts in physiology. Most of the students strongly agreed that discussing in groups could increase their understanding of the topic better as well the competitive aspect of doing the puzzle contributed to their effectiveness.

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