

Use of Puzzles as an Effective Teaching–Learning Method for Dental Undergraduates

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ABSTRACT

Introduction: Passive teaching in the form of didactic lecture is the usual mode of disseminating knowledge in dental colleges in India. An innovative way to address the diverse learners learning style at the undergraduate level is much sought after in dental education. Puzzles in the form of crossword and word search are structural, self-learning educational tools that review and reinforce knowledge and concepts acquired during the lecture.

Objectives: To evaluate the effectiveness of crossword and word search puzzles as an active teaching learning method for dental undergraduates.

Materials and methods: This is an open, randomized parallel group interventional study conducted with the final BDS students in the Department of Pediatric and Preventive Dentistry of Sri Ramachandra Institute of Higher Education and Research. Two modules of the “must know” category of the curriculum were selected. The class was divided into two groups (interventional and control) using computerized random generator. Learners in both the groups were exposed to didactic lectures, but the activity of solving the puzzles was undertaken only by the interventional group learners. Questionnaire in the form of MCQ was given at the end of the activity to both the groups, and results were evaluated.

Results: Mann–Whitney *U* test between interventional (Group I) learners revealed an average mean score of 4.2, 6.1, 9.3, and 6 out of 10 in the post-activity test when compared to 2.9, 6.6, 4.6, and 5.1 of the control (Group II) students and was statistically significant in three of four sessions.

Conclusion: Our study revealed that puzzles can be used as an effective active learning tool to reinforce lecture material for dental undergraduates.

Keywords: Activity, Dental Education, Puzzles, Retention, Wordsearch.

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INTRODUCTION

Presentation of factual information through passive teaching methods is the usual mode of disseminating knowledge in most of the medical/dental schools in India.^{1,2} Ushering in a climate of innovation in medical/dental education is much sought after. New teaching methodologies that enhance students' learning process should be implemented.³ Medical research reveals that active learning should be a part of teaching–learning process, as it fosters the development of critical thinking, communication, and co-operative learning skills making learning more effective, efficient, and retentive.^{4,5} As present-day students have more diversity in their learning styles, new strategies like engaging the students in active learning should be introduced in education to make learning more interesting at the undergraduate level.^{6,7} It is surprising that puzzle-based learning existed for over 60 years in education and has the edge of being more interactive and learner centered compared to conventional teaching.⁸ Engaging learners to an activity after didactic lecture could be an effective teaching–learning strategy to facilitate learner acquisition of competence, improve their satisfaction in studying, and improve long-term results.

Crosswords were introduced by Egyptians in 300 AD and features regularly in today's newspapers, magazines, and trade journals.⁴ Several empirical studies reveal crosswords to be an effective learning tool in disciplines, such as undergraduate medical education, psychology, sociology, communication, nursing, and biology.^{9–12} Crossword is a structural, self-learning educational tool that reviews and reinforces knowledge, and concepts acquired during the lecture reach more students, improves vocabulary, stimulate the mind, and help develop healthy skepticism. Word

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search games also known as word find games and are popular for helping learners recognize words. In searching for words, the students seem to read and memorize the words in a way that they enjoy, and which helps them learn the words and their spelling.¹³ This nontraditional pedagogy, a new paradigm for interactive teaching, has not been explored in dental schools, although attempted by few disciplines of medicine such as pathology and pharmacology.

Hence this study was aimed at determining learner’s performance after a didactic lecture through crossword and puzzles as an active mode of learning with the following aim and objective

- To evaluate the effectiveness of crossword and puzzles as an active teaching learning method for dental undergraduates.

MATERIALS AND METHODS

Ethical Committee Approval

The study was conducted after obtaining the clearance from the Institutional Ethics Committee, (IEC-IN/13/JUN/34/42) of Sri Ramachandra Institute of Higher Education and Research.

Study Design and Sample

This is an open, randomized parallel group interventional study conducted with fourth-year BDS students in the Department of Pediatric and Preventive Dentistry, Faculty of Dental Sciences, Sri Ramachandra Institute of Higher Education and Research.

Study Material

When new learning is integrated with an activity with prior knowledge, learning is meaningful and better retained.¹⁴ This study was conducted with the fourth-year BDS learners who were 60 in number, and their consent was obtained before the start of the study. Two modules from the “must-know” category of the curriculum were selected from the department for the study. Module 1 dealt with “Non-Pharmacological Behaviour Management in Children” consisting of four sessions (Flowchart 1). The first session involved didactic lectures, followed by a second session which included activity in the form of crossword and word search puzzle from the lecture material. Students were divided into two groups: Group I–interventional and Group II–control, using random number generator after the first session. They were informed that they would remain in the same group throughout the study. Session 3 involved didactic lecture covering the remaining portions of the chapter followed by session 4, which included activity pertaining to session 3. Session 2 and session 4 were conducted a week after session 1 and session 3, respectively. Module 2 revolved around “fluorides” and followed the same pattern as module 1 with 4 sessions (Flowchart 2).

Activity

The activity included two puzzles (one crossword and one word search) prepared by the other investigator (MSM) using puzzle maker (version 2.2.1 Hokua software LLC.2013). The clues were verified from the standard pediatric dentistry books. Group II students attended only the didactic lecture, whereas group I students took part in an activity in the form of puzzles in addition to the lecture (Figs 1 and 2). After the completion of the activity, both the groups were requested to answer a questionnaire pertaining to the prior lecture.

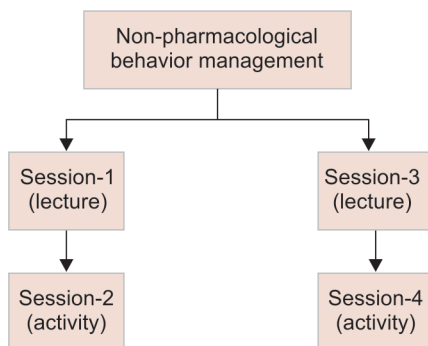
Students in the intervention group (Group I) were sensitized about the two puzzles—one crossword and one word search puzzle. Printed copies of the puzzles were distributed, and 30 minutes were given to complete the puzzles. Students were allowed to interact in groups of 2–3 and use self-learning methods to complete the puzzles.

Crossword Puzzle

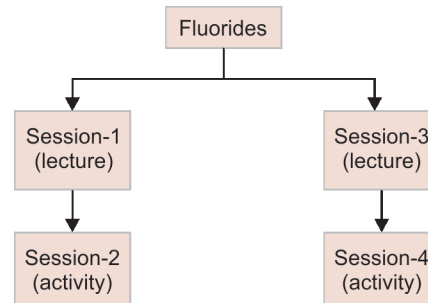
The students were requested to complete a 10-word crossword puzzle using the clues related to the lecture material. The crossword puzzle had both vertical and horizontal components with words running from top to bottom and from left to right. Inverted and diagonal words were avoided. Each clue was numbered and corresponded to the number seen in the puzzle. The number of letters in the answer word was indicated within parenthesis adjacent to the clue. Even if one or two clues were difficult, the students were able to identify concepts and complete the puzzle, as some of the words overlapped. Short and long words were included in the crossword puzzle (Fig. 3).

Word Search Puzzle

In the word search puzzle, 10 hidden words in the grid were identified by the students. Initially, they were allowed to search for known words and mark them. Later, they were given the option of answering the questions which were in the “Fill-in-the-blank” format and complete the puzzle. The puzzle contained words pertaining to the lecture material. Answers within the word search puzzle were placed horizontally, vertically, diagonally, and inverted in the grid. Some letters were common with two to three keywords. Control group students did not participate in the activity. The control group were given access to the puzzles once



Flowchart 1: Diagrammatic illustration of Module I



Flowchart 2: Diagrammatic illustration of Module II

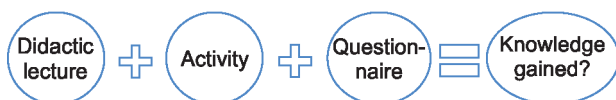


Fig. 1: Schematic representation of interventional group (Group I)



Fig. 2: Schematic representation of control group (Group II)

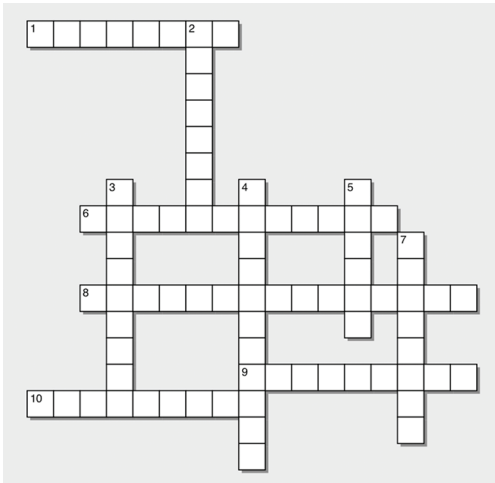


Fig. 3: Schematic illustration of a sample of crossword puzzle activity. [Module 1, Session 2]

Down

2. Contingent withdrawal of a stimulus increases the frequency of behavior is _____ reinforcement. (8)
3. Touch, pat, hug and smiling are forms of _____ communication. (9)
4. Presentation and withdrawal of reinforcer is _____ management. (11)
5. Praise, positive facial expression, nearness and physical contact are examples of _____ reinforcers. (6)
7. Increasing the probability of a desired behaviour by withdrawal of or threatening to withdraw a pleasant stimulus is _____. (8)

Across

1. Observing one or more individuals who demonstrate positive behaviour is _____. (8)
6. Talking loud to gain attention, startle the child from disruptive behaviour is _____. (5 7)
8. Substitution of appropriate responses for inappropriate responses gradually is systematic _____. (15)
9. Use of alternate word in dentistry is called _____. (9).
10. Tell, Show, Do technique was introduced by _____. (9).

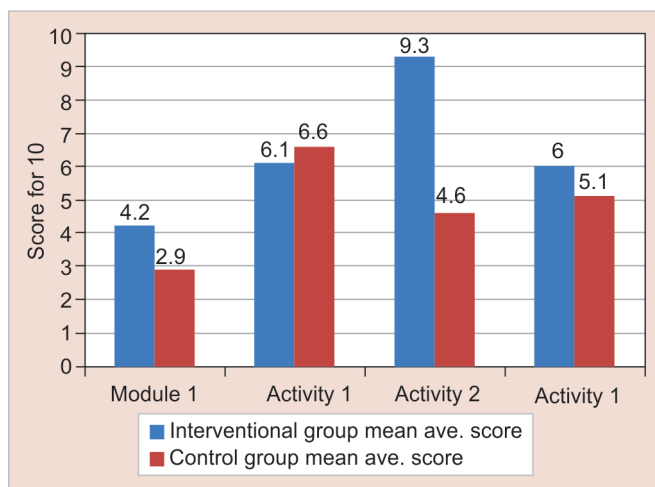


Fig. 5: Graphical representation of the mean scores of Group I and Group II * $p < 0.05$, Mann–Whitney test

the post-activity questionnaire was collected from the intervention group as fair play to the innovation in T/L methods (Fig. 4).



Fig. 4: Schematic illustration of a sample of word search activity. [Module 1, Session 2]

Clues

1. Systematic desensitization was introduced by _____.
2. Giving candies, cookies as a reinforcer are grouped as _____ reinforcers.
3. The important objective of both voice control and HOME technique is to get the _____ of the child.
4. Albert Bandura introduced this behavior management technique.
5. For an anxious child, a _____ model is more effective than a "mastery" model.
6. Triangular sheet is a restraint for the _____.
7. One whose presentation increases the frequency of behavior is called as _____.
8. Euphemism for rubber dam is _____.
9. The goal of modelling is to have the patient _____ the behavior exhibited by the model.
10. Euphemism for suction is _____.

Questionnaire

The questionnaires consisted of 10 questions. Multiple-choice formats were used as a tool to measure the effectiveness of puzzles as an innovative T/L method. The questions were distributed, and students were requested to give one best response. These questions were based on the lecture material taken in the previous week and prepared by the other investigator (MSM). Completed questionnaires were collected from the students after 10 minutes. The keys were verified from standard pediatric dentistry textbooks. The highest possible test score was 10 with a score of 1 per question. The same questionnaires were used for both the interventional group and the control.

Data between the two groups were analyzed using Mann–Whitney *U* test between interventional (Group I) post-activity test scores and test scores of the control group (Group II).

p value < 0.05 was considered statistically significant.

RESULT

Mann–Whitney nonparametric test was used to assess for any significance among the groups. Out of four activity sessions, the interventional group students performed well with p value being significant in three sessions when compared to the control group students who did not participate in the activity (Fig. 5).

The result was not statistically significant (p value > 0.512) in the fourth session of Module 1 (Table 1).

Table 1: Evaluation between interventional and control group

	Session	Group I (n)	Mean average scores	Group II (n)	Mean average scores	P value
Module I	2	28	4.2	27	2.9	0.000 ^a
	4	16	6.1	11	6.6	0.512
Module II	2	20	9.3	14	4.6	0.002 ^a
	4	27	6.0	22	5.1	0.032 ^a

^a $p < 0.05$, Mann–Whitney test

DISCUSSION

Keeping in mind the objectives of the study, this study was aimed to evaluate the effectiveness of the puzzle activity as an innovative T/L method for the dental undergraduates. An activity or a practical exercise to recall and revise the concepts of the previous didactic lecture was attempted for the first time.

Bailey stated that educational games were popular among students, as it provided a nonthreatening environment, where students were challenged in active learning.¹³ Evidence-based studies reveal that students improve their understanding and learning through active learning, as the students are active players and participants.¹⁵ Hence, in our search to facilitate learning through innovative activities, crosswords and words search puzzle activity were introduced to our dental students. Both the puzzles provided excellent review material to recall and apply previously taught lecture material. Bergman et al. stated that an effective active learning environment should be created for the students, to apply from the information presented to them, for better retention and recall, and our study coincided with the same.^{16,17} Multicentric approach to learning is more effective than a single one, which was substantiated in three of our four sessions of our study. With regard to testing students' knowledge and their retentive capacity of the lecture, after a week, our study was in accordance with Logan et al., revealing positive benefits in retention of the lecture material supplemented by the activity.^{18–20} Saxena et al. supported that puzzles provided an opportunity to facilitate small group discussion effectively, recall essential concepts, and promote student interest in reading and learning and improve communication skills.^{4,14} Bailey et al. developed educational puzzles as a supplement tool to enhance learning that encourages students to be creative and that which reinforces concepts that have been covered in traditional teaching. Nitin in his study in evaluating the crossword efficiency utilized pretest and posttest scores as one of the factors in claiming crossword as an useful inventory of active learning methods. It exerts a definite positive effect in both students' perceived learning and in their attitude towards the subject. Crossword not only provides in fun but also in identifying the learning concepts that have been mastered and has a unique feature of self-correcting that helps student to correct their mistakes instantly. Word search puzzle challenges students to look out for the keyword in the grid that allows them to evaluate their recall and their level of knowledge.

Since we had significant results in three of four sessions, in our study, we too claim that the intervention consisting of word search and crossword activity helped students perform better and concluded that the puzzles can be used as an active teaching learning tool supplementing traditional teaching for dental undergraduates.

Limitations to Our Study

Our students had prior information about the questionnaire they had to answer at the end of the activity which is contradictory to

Nitin et al.'s study, where the students were not informed. Moreover, the number of participants for the session 4 of module 1 was less than 50% which could have contributed for the results being not significant.

CONCLUSION

Our study revealed that in changing trends in dental education, interventional methods in the form of puzzles are successful in better retention. Use of puzzles and crosswords in a classroom setting should be encouraged to enhance active learning as they are simple and creative. This could be hailed as an innovative T/L method and could be implemented in the dental curriculum.

CLINICAL SIGNIFICANCE

This study revealed that learners from the interventional group scored better than the control group in three of 4 sessions conducted. Activity-based learning in the form of puzzles, educational online games, quiz, debates, etc., in a class room set up, provide learners with good opportunities to apply theoretical concepts to perfection. This will break the monotonous yesteryear's system of passive listening in a large group gathering.

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