International Journal of Biomedical Research
ISSN: 0976-9633 (Online); 2455-0566 (Print)
Journal DOI: 10.7439/ijbr
CODEN: IJBRFA

Original Research Article

Crossword Puzzles – Entertaining tool to reinforce lecture content in undergraduate physiology teaching

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Abstract

Introduction: Games like crossword puzzles can be used to teach undergraduates as it induces interest and is a welcome change in the monotonous routine lecture.
Aims and Objectives: To assess the utility of using crossword puzzles as an adjuvant to lectures in the undergraduate teaching of human physiology.
Materials and Methods: A simple crossword on the Physiology of Hemostasis was constructed with clues given "across" and "down", using TheTeachersCorner.net crossword maker website. A one hour lecture was given and the concepts were then tested in the crossword after appropriate instructions to the students. Feedback from students (n=99) was taken both before and after the conduction of the crossword.
Results: 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.
Conclusion: Using innovative, entertaining and stimulating methods in teaching and learning programs is valuable in stimulating and creating interest among the students.
Keywords: Crosswords, physiology, teaching- learning methodology.

1. Introduction

In spite of the recent innovations and paradigm shift in medical education, the bulk of undergraduate teaching is still delivered in the form of traditional lectures in majority of the medical schools all over the world. Students invariably find these lectures boring and research show that passive lectures provide the lowest knowledge retention rate of any method of learning and encourage learning at the lowest levels of cognitive function [1, 2]. In contrast, active learning that involves discussion, practicing by doing, or teaching others, results in much more effective long-term learning at higher levels of cognitive function [2]. Today with the explosion of knowledge, there is always a constant challenge to educators to develop inventive and creative educational materials that would complement and augment the traditional lecture teaching. These materials must assist active learning, promote problem solving skills and encourage team work.

Games in physiology form an interesting opportunity for teaching as it evokes interest, motivates students and is a welcome change in the monotonous routine lecture. They create a challenging competitive atmosphere that facilitates interaction among students in a friendly and fun environment [4]. They may not completely replace the traditional way of obtaining theoretical knowledge but can reinforce acquisition of content and enhance problem solving skills [3,4].

The first year medical undergraduate students are introduced to many new terms and concepts in a very short time. This has posed a challenge in providing adequate practice and necessary repetition to reinforce key concepts. Crossword puzzle games are a fun, inexpensive and easy way to quickly summarize and emphasize the important facts delivered during the lecture. The author decided to use a simple crossword puzzle to strengthen the concepts of Hemostasis, which is usually covered by the Physiology department during the first year of the MBBS undergraduate program at our university.

This study was mainly carried out to get a measure about the students' reaction to the use of crossword as an adjuvant to lectures.

2. Materials and Methods

Brainstorming was done to develop questions that reinforced the main concepts of the physiology of hemostasis. Care was taken to construct 15 questions that tested both recall and applied analytical ability. The questions were vetted by peers for content, reliability and validity.

The questions and answers were then fed into the software to create the crossword puzzle. The "across" and "down" clues were created at a moderate difficulty level as more difficult clues may have discouraged students from participating in the activity. (Table 1 and Table 2)

The crossword puzzle was created using TheTeachersCorner.net crossword maker website freely available online. (Figure 1)

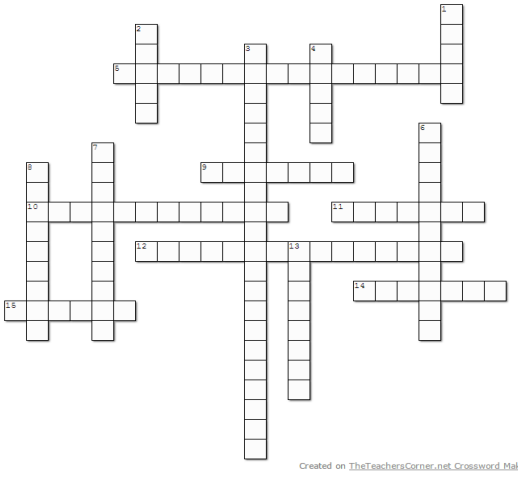
Table 1: Clues for Crossword puzzles

5. Test to assess the extrinsic pathway	1. Factors are produced here
9. Ion necessary for the process	2. Blood minus clotting factors
10. Cells involved in hemostasis	3. Necessary for attachment of platelets
11. Key enzyme for clot dissolution	4. Important vitamin involved
12. Important function of platelets	6. Potent platelet aggregator
14. Anticoagulant produced by the liver	7. "Royal" disease
15. The mesh is made of this	8. The longer pathway
	13. Intravascular clot

Table 2: Answer key for crossword puzzle.

Across	Down
5.Prothrombin –time	1.Liver
9.Calcium	2. Serum
10.Thrombocytes	3. von Willebrand Factor
11.Plasmin	4. Vit-K
12. Clot-retraction	6. Thromboxane
14. Heparin	7. Hemophilia
15. Fibrin	8. Intrinsic
	13. Thrombus

Figure 1: Crossword on Hemostasis



The entire process was part of the teaching methodology and was completed in the class time. No sensitive questions were asked as part of the feedback and anonymity was maintained.

At the beginning of the 2 hour class, a 5 item questionnaire on the perceptions of the students regarding the usefulness of crossword puzzles in teaching and learning, was distributed and collected.(Table 3)

Table 3: Questionnaire regarding the utility of crossword puzzles

I have done crossword puzzles before: Yes No

Please answer the questions: 1=Disagree strongly 2 =Disagree 3=Neutral 4= Agree 5=Agree strongly

S.No	Questions	1	2	3	4	5
1.	The crossword puzzle would help me in understanding the new words in Blood Coagulation					
2.	The crossword puzzle is a useful learning tool in understanding the concepts of Blood Coagulation.					
3.	Working and discussing in groups to do the puzzle will increase my understanding of the topic.					
4.	The competitive aspect of doing the puzzle will contribute to their effectiveness.					
5.	I would recommend more crossword puzzles to be used in teaching.					

Other comments:

A one hour lecture was then delivered on the topic. Following this the students were divided into 15 teams of 7-8 members each. Each team was given the printed copies of the crossword puzzles (grid and clues) to solve in 20 minutes. This was followed by a question- answer discussion session where the answers of all the teams were discussed.1 mark was given to the team for the correct answer. This was followed by a discussion and clarification of certain concepts and at the end the post-test survey questionnaire was distributed once again.

2.1 Statistical analysis

An appropriate statistical tool (SPSS 18) was used to analyze the data. Spearman's Rho was used to compare and p value < 0.01 taken as significant.

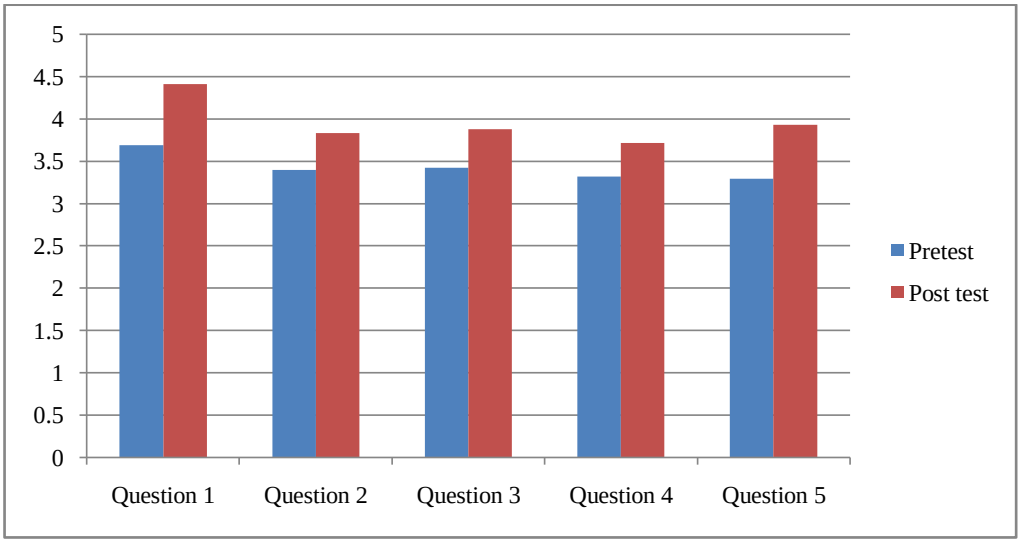
3. Observation and Results

8 teams got full marks15/15, 5 teams got 14/15 and 2 teams got 13/15.

A total of 99 students returned the completed questionnaire. 18 students had not done crossword puzzles before.

The responses of the students to the questions before and after the crossword puzzle were compared using the Spearman's Rho. All the questions showed a strong positive response after the conduction of the crossword puzzle which was statistically highly significant. (Figure 2 and table 4)

Figure 2: Pre and posttest response comparison using mean scores in each item



n= 99

Table 4: Statistical analysis of the pre and posttest scales

		Q1	Q2	Q3	Q4	Q5
Spearman's Rho	Correlation Coefficient	0.451**	0.612**	0.698**	0.746**	0.681**

**. Correlation is significant at the 0.01 level (2-tailed). n=99

All the students enjoyed the crossword puzzle immensely and strongly agreed that puzzles were useful in helping them to learn new words and understand the concepts. They felt that it was a competitive and entertaining method of effective learning. Most of them agreed that crossword puzzles promoted group discussion and active learning and that they would like to see more puzzles to be used in teaching.

Positive comments given by the students were: "very interactive"; "enjoyed it hugely"; "better than lectures"; "interesting"

Some students pointed out that certain students in the groups did not participate wholeheartedly. Other comments: "more time is needed to understand and answer."

4. Discussion

Traditional educational strategy especially in healthcare basic sciences education has constantly focused on communication, memorization and retention of content rich factual information. Undergraduate physiology courses are replete with terminology, concepts, and processes. Beginner students frequently struggle in learning the jargon as well as in associating structure and function, explaining concepts, and making broader connections within the discipline [11]. Blouin RA *et al* noted that the necessity to provide students with exhaustive foundational content in class, together with large class sizes from varied backgrounds, essentially eliminated meaningful student-faculty exchange of ideas within the classroom setting [1]. This had created frustration among both students and faculty who aspire to engage the students at a higher level of learning. Bailey MC *et al* observed that using of games during teaching increases student involvement, motivation and interest and allow the faculty to be creative and original while teaching [4]. In many studies researches developed games including crossword puzzles, word scrambles, jigsaw puzzles which they used effectively to analyze and integrate the concepts of physiology and other subjects [4-10].

Bailey CM *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 [4]. Using games during teaching decreases stress among students and thereby provides a relaxed environment that increases curiosity [5]. A contributing factor to the enriched learning experienced by the students may have been the break in lecture itself which provided an opportunity to restart their "attention clock"; as learners typically have an attention span of about 20-30 minutes [6, 12].

Rodenbaugh *et al* opinioned that accepting challenges and testing knowledge are natural instincts present in students which can be whetted using educational games [7]. This would lead to a sense of accomplishment and boost the self-confidence of students.

Davis TM *et al* studied the effectiveness of crossword puzzles in reviewing for examinations but found no significant difference between learners who used crossword and those who did not [8]. This underlines the fact that since modern day learners have more diversity in learning styles, educational games could cater to and stimulate a certain class of learners and enhance their performance.

Similarly in this study the students welcomed the refreshing change in course delivery. The maximum significant increase in response was seen for the first question where in the posttest students felt that crossword puzzles most certainly helped them to comprehend and get conversant with the new words. This is especially pertinent to the medical college where this study was carried out, where there are students from varied background and many of them have learnt English only as a second language. Using games during teaching is a fun, non-threatening method of including students from diverse cultures and speaking different languages which is very applicable during this era of globalization of medical education. Rather than worrying about completing content, teachers must design activities to focus student learning on how to use scientific knowledge and solve important questions.

Crosswords and other educational games are low-stakes educational tools which require very little resources and time. They aid in improving active learning abilities with very little cost keeping the students as well as the administration happy.

5. Conclusion

As DiCarlo stated "How we teach is much more important than what we teach, because nothing reduces enthusiasm for a subject faster than poor teaching" [13]. Classroom instruction can be made more effective and efficient by incorporating simple interactive games like crossword puzzles. These will motivate and improve the performance of both students and faculty.

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