



An Innovative Crossword Puzzle Tool to Evaluate the Undergraduate Medical Student's Knowledge in Forensic Medicine

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Authors' contributions

This work was carried out in collaboration between all authors. Author KMR designed the study, performed literature search, prepared the crossword puzzle with feedback questionnaire, collected data and wrote the first draft. Author ARN helped in collecting the data and analyzed the results. Author SCR collected the data, reviewed and corrected the first draft. Author MNMA read the first draft and added few references. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The main aim is to expose the medical student after completion of their forensic medicine posting to the crossword puzzle and to study their responses given in feedback questionnaire with an effort to introduce an innovative short answer question for the end of posting examination.

Study Design: A Prospective 'survey based questionnaire' study.

Methodology: In this study, 56 students of forensic medicine were given a crossword puzzle exercise to solve individually. They were given 45 minutes to solve a puzzle having 32 words to fill in with the help of appropriate keys given. The students were allowed to sit far apart and use of the internet, mobile, books etc. was not allowed. They were asked to fill in the feedback questionnaire. Crossword puzzle contains 16 horizontals and 16 vertical words and 32 keys.

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Results: After completion of the crossword puzzle, all the data was analyzed in SPSS program. In this result, we considered a total of grade 5 and 4 only. Out of 56 students, only 16 students could not score passing marks. Out of total 56 students, 91.1% (n=51) students agreed that they enjoyed this puzzle and 94.7% (n=53) agreed that this improves their forensic vocabulary and comprehensive knowledge. Out of total students 64.2% (n=36), students liked to have such puzzle as an examination question. Lastly, 92.8% (n=52) of the students agreed that it is a useful tool to learn forensic medicine.

Conclusion: Majority of participants liked the crossword as an examination questions. It improves memory power, performance and critical thinking of student with fun. This can be tried as examination question in end posting examination.

Keywords: Crossword puzzle; forensic medicine; evaluation; examination questions.

1. INTRODUCTION

The crossword puzzle is a century old game and was first used in ancient Egypt. In 1913, Arthur Wynne created a modern crossword puzzle [1]. In recent years, it has become an interesting game and we see it in many new papers, magazines, books, and journals. Some magazines even offer some prizes for solving it and encourage the participants. Recently educationists have started using this puzzle as an educational tool especially in medical education and nursing courses [2-8]. Crossword puzzle can also be used as an innovative tool for assessment of undergraduate medical students and nursing students.

This exercise helps them to remember the forensic medicine terms easily, understand the concept and also help the teachers to evaluate their knowledge and understanding. We can assess the knowledge of students effectively by giving them crossword puzzle questions. It can detect the misconceptions and helps to clarify the concepts in the medical student and help in understanding the facts clearly [9-10]. The benefit of such active learning is that it promotes the communication ability, memory, cooperation among learners and their critical thinking power [10].

Such games are important in acquiring skill and psychomotor knowledge, brain functions like understanding, thinking, remembering, and analyzing the facts [11-12]. The crossword puzzles are in various forms including cryptic form, United states symmetrical form etc. [13].

Since medical education has changed dramatically in last few decades, the assessment of knowledge of medical students also needs to be changed and it should be effective as well as interesting. Crossword puzzle will prove as an

effective tool for assessment in terms of recall and analysis of knowledge to write the words. Forensic medicine is a very important subject for the medical student for their career, and also for the medico-legal system to have more experts. We tried to evaluate the crossword puzzle tool for assessment of their knowledge and also analyzed their feedbacks for the crossword exercise given to them. The crossword short answer question (SAQ) stimulates the cognitive function and performance in the examination. Due to previous experience in crossword puzzles [7], the author got an idea to use this puzzle in the examination as a short answer question.

The literature search did not show any crossword puzzle tool in form of short answer questions to assess the knowledge of the forensic medicine in medical students. This is an innovative tool for the above purpose and hence we have done this study.

2. MATERIALS AND METHODS

Crossword puzzle exercise was given to students of year four, who had already completed their forensic posting in their undergraduate medical program. We invited 56 students to participate and a written informed consent was taken from each participant. They were asked to sit far apart from each other in a spacious auditorium. All the participants were given a crossword puzzle sheet (Fig. 1), a paper for keys, and a questionnaire (Table 1). They were instructed not to use any internet, mobile or any books. They participated individually in this survey and not in groups. They were given 45 minutes to solve this puzzle. The puzzle has 16 horizontal and 16 vertical words (Fig. 1) to fill in with the help of 32 key statements. All the terms and words used in the puzzle were chosen from forensic medicine only. The forensic terms and words with varying degree of difficulties were prepared and evenly distributed in the puzzle.

After completion of 45 minutes, a survey questionnaire was given to the participants and 15 minutes to read the questions carefully and to answer. The crossword entries were checked and each participant was given marks out of 32 marks. No negative marks were given for the wrong entries. All the feedback responses in the questionnaire and marks scored by them were entered in SPSS program and analyzed.

This research project (without grant) was approved by the Research and Innovation center of our university for doing this survey based study including ethical approval and future publication in the journal.

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Fig. 1. Showing crossword puzzle

Some examples of keys:

Horizontal keys:

- 3- Every witness has to take this in the court before an examination. (4)
- 9- The test is done during autopsy in case of infanticide. (11)
- 14- Asymptomatic period (interval) in case of head injury. (5)

Vertical keys:

- 8- These bodies inside the cells indicate female sex. (4)
- 16- Indicate antemortem drowning death, bone marrow. (6)

3. RESULTS

Out of 56 students, one student scored 32 out of 32 marks; seven students 31 marks, five students scored 30 marks; Twenty-one students

scored between 16 to 29 marks. Sixteen participants scored less than 16 marks (Fig. 3).

In this result, we considered a total of grade 5 and 4 only. The majority of student participants (91.4%, n=51), liked and enjoyed this puzzle and 94.7% (n=53) agreed that this improves their forensic vocabulary and comprehensive knowledge, whereas 89.3% (n=50) student agreed that this improves their memory power. Many students (64.2%, n=36) liked and agreed to have such puzzle as an examination question (Fig. 2), and 85.8% (n=48) student said that such puzzle stimulates their lateral or critical thinking. Only 5.2% (n=3) students say that it is wastage of time. About 92.8% (n=52) agreed that it is a useful tool for assessment and also to learn forensic medicine whereas 89.2% say it reflects the concept of forensic medicine and 84.8% (n=48) students were in favor of this crossword for using as a tool for student 's assessment. Many students (85.7%, n=48) believe that it is brain teasing game. Overall, total 90.5% (n=51) student gave very favorable grades 5 and 4 for this crossword puzzle.

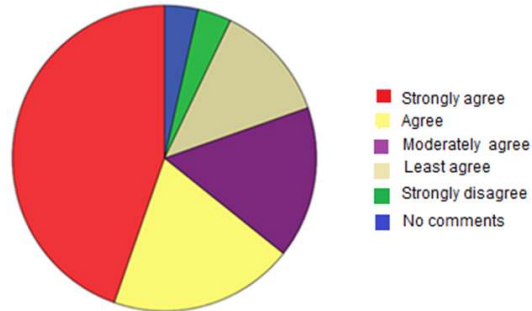


Fig. 2. Pie chart showing response of student for crossword puzzle as an examination question (Question No: 12) in given questionnaire

4. DISCUSSION

The crossword puzzle is a very interesting word game and many people enjoy this game. Crossword puzzle as a teaching tool is a very beneficial and helps to remember the words and terms by the help of keys. The keys are facts, hints or statements that are attached to a particular word, facts, term or incidences and when a student read the key he remembers the word easily. As we know that that memorizing any fact needs attachment with other related facts. Once he remembers the few closer words he has to fit exact word or term in crossword by counting a number of alphabets mentioned in key

and to compare with the spelling of those words. This is how it stimulates thinking and improves the memory. This same mechanism of recall is useful in an examination which will automatically improve the performance in an examination too. We did this survey to study the individual performance of undergraduate medical student without any help or without the cooperation of groups. So it becomes easy to know the performance of a single student, because in a group usually, one or two students are active and other simply don't do anything and so the assessment is not much accurate for all.

Bailey et al used four types of games like crossword puzzles, words scrambles, word search and hidden message puzzles in gastrointestinal physiology teaching. According to her, in the crossword puzzle, inability to identify the word indicate the weakness and that can be corrected by proper teaching [6].

Htwe et al. did the study on crossword as a teaching tool on the group of students and revealed that is an excellent tool for teaching pathology with fun [7]. Saxena et al. [8] also did the same study on groups of students and he concluded that student liked the crossword puzzle as a teaching tool.

We believe that for teaching and learning purpose this survey can be used on a group of student, but for an assessment of the students,

the student must solve the crossword puzzle individually. In our study, the main aim was to study the crossword puzzle as a tool to assess the students in an examination, so we did not make the groups of students. Playing with such puzzles psychomotor skill and knowledge both are increased [11-12].

We did this study on forensic medicine which is brain teasing subject where the student has to think a lot of for any complicated case scenario with various medico-legal aspects like a detective. Nowadays many of the medical schools and colleges emphasize on student-oriented medical education where the active involvement and participation of every student is necessary, especially in small group teaching for better and detail understanding of concepts in medical science and students are encouraged to solve the problems by themselves [14-15].

O'Leary et al. [16] did this type of research using educational Jeopardy style game on the topic of ectopic pregnancy and he concluded that the student shows much interest in such game. Odenweller et al. [17] did such study with card and puzzle game on topics of gastrointestinal physiology. Eckert et al. [18] used immunology topics to study on such game and puzzle. Berryhill et al. [19] mentioned that Crossword puzzles can provide an alternative, interesting learning tool to support continuing education.

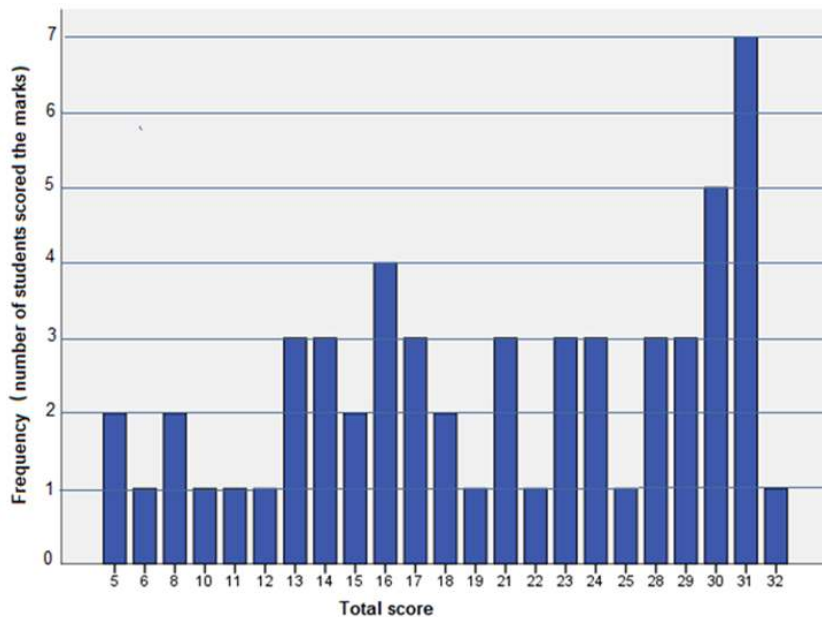


Fig. 3. Showing overall results of correct answers by students in solving crossword puzzle

Table 1. Showing questionnaire and responses according to grades in percentage

	Questions	Responses in grades 5 to 0 (in %)					
		5	4	3	2	1	0
1	Did you like and enjoyed this crossword puzzle game?	64.3	26.8	5.4	1.8	0	1.8
2	Does this puzzle game help you to improve forensic medicine vocabulary?	67.9	26.8	3.6	0	0	1.8
3	Does it reflect the key concepts of forensic medicine?	57.1	32.1	7.1	1.8	0	1.8
4	Do you think that it is a useful tool to learn forensic medicine?	60.7	32.1	5.4	0	1.8	0
5	Does it improve team spirit when played in groups?	73.2	8.9	8.9	5.4	1.8	1.8
6	Is this puzzle more effective in competitive form?	53.6	21.4	19.6	3.6	1.8	0
7	Is this a good tool to assess the student's knowledge?	63.4	21.4	3.6	3.6	3.6	3.6
8	Is this wastage of time?	3.6	1.8	5.4	14.3	17.9	57.1
9	Are the keys given were too easy to find out the exact word?	14.3	16.1	25	25	7.1	12.5
10	Is this a brain teasing game and stimulate lateral thinking?	55.4	30.4	8.9	1.8	3.6	0
11	Is this puzzle help to stimulate memory power?	71.4	17.9	8.9	1.8	0	0
12	As a student do you like this puzzle as an exam question?	44.6	19.6	16.1	12.5	3.6	3.6
13	Should there be a huge collection of such puzzles in medical education?	59.9	19.6	17.9	1.8	0	1.8
14	Do you think that in another discipline such puzzle will be interesting?	58.9	21.4	17.9	0	0	1.8
15	Can you make such keys and crossword puzzle by yourself?	14.3	10.7	10.7	30.4	10.7	10.7
16	Is this a time consuming exercise?	17.9	14.3	14.3	16.1	14.3	23.2
17	Would you like to play other general knowledge crossword puzzles?	57.1	23.2	14.3	3.6	0	1.8
18	What is the overall grading for this puzzle?	67.3	23.2	7.1	1.8	0	0

5: Strongly agree. 4: Agree 3: Moderately agree 2: Least agree 1: Strongly disagree 0: No comments.

Thompson et al. [20] have discussed on the preparedness of Joint Commission on Accreditation of Healthcare Organizations which develop and maintain standards of quality in medical facilities in the United States by using crossword puzzle in their educational plans.

Crossword puzzle definitely improves cognitive function as per clinical trial was done by Wolinsky et al. [21] He used computerized crossword puzzle in a clinical trial on middle aged and old people to study the cognitive processing speed and concluded that crossword puzzle delays the decline in the cognitive process and improves the speed of the cognitive process.

Gupta et al. [22] did the study on a crossword puzzle in accounting students and concluded that

course grades of the students were almost correlated with that of attempted puzzle's grades and overall participation and motivation of students were high as well as the number of puzzles attempted by the students were also high.

Based on this study and inspired by the results we propose to introduce a short answer question in a form of crossword puzzle as shown below. It requires only five words to fill in the crossword. There will be one mark for each word and no negative mark for the wrong answer. The keys will be given in a form of either a short police or a relative's history, or crime scene description, case scenario, or findings of the clinical examination of the victim, pathology, and/or toxicology laboratory reports, or autopsy findings etc.

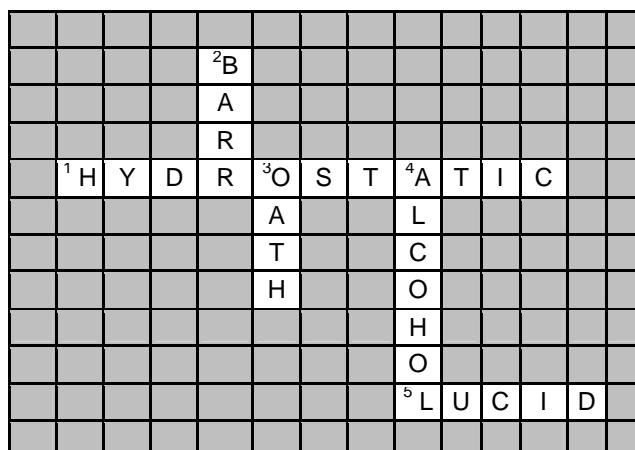


Fig. 4. An example of a short answer question crossword for examination

Key statements for the question: (Marks 10)

Horizontal keys:

1- A body of newborn baby found dead and a test was done during autopsy to confirm whether born alive or dead. (11)

5- After head injury even if the patient doesn't complain for any symptoms, he must be observed for 24 hours in A & E ward. (5)

Vertical keys:

2-In an Olympic game a male player was found to be female during oral swab cytology test. (4)

3-If any witness lies to the court after having this procedure, he may get punishment for perjury. (4)

4-In dipsomania a person suffers from intermittent bouts of craving for this drink. (7)

5. CONCLUSION

The overall result has shown that this type of crossword puzzle exercise is an interesting and effective tool in assessing the knowledge of forensic medicine among the undergraduate students as well as improves the performance. This tool stimulates cognitive function to remember the terms and facts of forensic medicine and helps to correlate the facts which may help to come to the conclusion in medico-legal issue. This puzzle can be tried as short answer question (5 vertical and horizontal words)

as a short answer question at the end of posting. Based on the feedback of students 64.2 % (n=56) students, they liked this as an examination question. We can use the crossword puzzle in medical examination theory question and one example of the question is shown above.

CONSENT

All authors declare that 'written informed consent was obtained from the participants for publication of this research paper.

ETHICAL APPROVAL

The authors have obtained all necessary ethical approval from suitable Institution.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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