

## Crossword Puzzle: An Active Learning Strategy

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### ABSTRACT

*Educational entertainment is a concept designed to educate through entertainment thus educational puzzles become an engaging activity. Entertainment is often a side effect of simplicity; frustration etc. so there was a requirement of creative and interactive educational method to reinforce the learning objectives and to examine the perception of students towards their learning experience enhancement. So crossword puzzle technique is presented in this paper to increase the interest of students in exam point of view to solve multiple choice questions. Crossword puzzle is advantageous in self-correcting method due to the length of each word and the overlap of each answer with other answers. An experimental result along with the reviews of students about this activity is presented in this paper.*

**Keywords:** Crossword Puzzle, Active learning, Mental ability

### INTRODUCTION:

Learning is not a spectator sport. Learners learn better and retain more when they are directly involved in their learning, not just sitting back and being lectured. Usually, they also prefer active learning. It is very necessary to take the feedback from learners that what they have learnt? Whether they can talk about what they have learnt, whether they can apply their knowledge in their daily lives. So, now a days it has become a need to use active learning strategy to improve students' critical thinking, mental ability, problem-solving skills, improvement in vocabulary, their involvement etc. Active learning instructional strategies include a wide range of activities that involve students in doing things and thinking about the things they are doing.

Active learning instructional strategies can be created and used to engage students in (a) critical thinking, (b) discussion in the classroom grouply, (c) expressing their ideas through writing, (d) examining personal perspective and values, (e) Sharing their feedback and (f) reflecting upon the learning process. Multi-various teaching and learning approaches that attract students' attention, interest and most sense organs find their effectiveness in enhancing students' learning outcomes.

One of multi-various teaching and learning approaches that support student's inclusive education and learning outcomes is the use of educational puzzles. Educational games have inherent potential to: arouse and sustain interest in learning, excite learners, generate new ideas in learners, teach difficult subject concepts, learning to introduce new ideas, test skills, develop critical thinking, remove fatigue, recall information easily, helps low learners and thus can be used as classroom resources and develop students' manipulative skills. There are different types of puzzles such as Wooden puzzles, Jigsaw puzzles, Crossword puzzles, Logic Puzzles, Pattern puzzles (which can be colors, shapes, numbers, letters or any combination of them), Picture puzzles etc. Out of these, Crossword puzzle is used as an active learning strategy, and is presented in this paper.

Among many games, crossword puzzles seems to be more attractive and effective. The crossword puzzle is a kind of word game which can help students to extend their vocabulary knowledge. In exam point of view it plays an important role for solving multiple choice type questions. Thus it can be useful for students to memorize terminology, definitions, spelling, and pairing key concepts.

### PROBLEM STATEMENT

Scholars have recommended different instructional strategies that help students learn collaboratively and encourage problem solving. One of such strategies is Crossword Puzzle teaching strategy. Therefore, this study sought to determine how Crossword Puzzle could as a teaching strategy improve students' achievement in engineering subjects.

### IMPLEMENTATION OF IDEA:

Among many games, crossword puzzles seem to be more attractive than others. The Crossword puzzle is a kind of word game. In crossword puzzle, the blank squares are arranged with number assigned to some of square. The student has to accurately fill in all the blank squares with letters those form words.

The words are based on the clues provided, which can be complete sentences, phrases, or words. It is one type of game, so this an enjoyable activity rather than regular multiple choice questions test. One of the small example of arranging words and matching it vertically and horizontally to complete crossword puzzle is given in fig. 1 below.



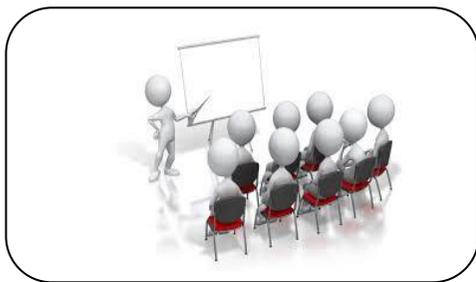
**Fig. 1 Crossword Puzzle**

Apart from motivating student learning, these puzzles can help students to extend their vocabulary knowledge. Crosswords can be used to teach terminology, definitions, spelling, and pairing key concepts. Since students need to spell items correctly to complete the puzzle, they gain greater retention and memorization of vocabulary (Moore & Dettlaff, 2005).

So for implementation of this idea, following objectives are to be considered. Students should be able to

- Think individually and improve their problem solving skills.
- Improve their test skills.
- Recall information easily.
- Increase their vocabulary.
- Generate new ideas.
- Develop critical thinking.

Fig.2 and Fig.3 shows the Traditional Teaching and Effective Teaching respectively. In Traditional Teaching students are only doing the job of listening, where in effective teaching, they have given the job for doing their own while listening.



**Fig.2 Traditional Teaching**



**Fig.3 Effective Teaching**

The crosswords were intentionally kept somewhat simple and were taken strategically from the definitions and important material covered in the subject. For crossword puzzle, 4 tests have been conducted for a group of 18 students. The first batch of 18 students was considered for test1. Likewise second, third and fourth batch was considered for test2, test3 and test4 respectively. That means total 72 students were there for this experimental setup. For each batch two tests were conducted, one can be said as Pre-test based on Multiple Choice Questions(MCQ) and other was Post-test on Crossword Puzzle activity. Depending upon the score of each student for both Pre-Test and Post-Test, results were calculated.

For every student firstly 20 marks MCQ test as a pretest was conducted batch wise. After this, an idea about solving of crossword puzzle was explained in every batch and then crossword puzzle test of 20 marks as post-test was conducted. For this activity third year Electronics and Telecommunication Engineering students were considered.

The course was "Electromagnetic Engineering and Radiating System". Actually this subject is Mathematical subject, but crossword puzzle activity can be applied to any subject. For MCQ test and crossword puzzle, 30 minutes time limit was given.

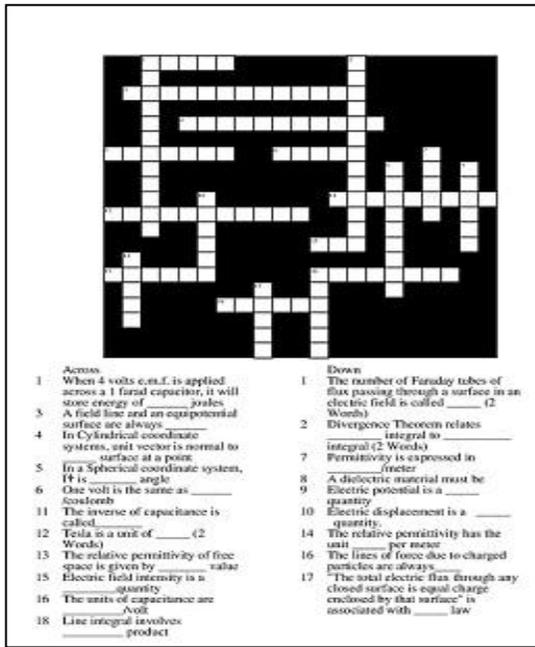


Fig.4 Crossword Puzzle Test with Clues

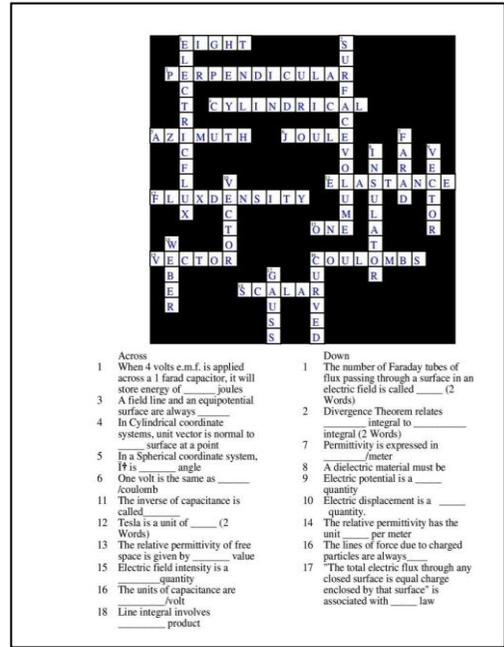


Fig.5 Crossword Puzzle with Answers

After completion of these 4 MCQ tests and 4 Crossword puzzle tests, their results were calculated and feedback about this activity was also taken from every student. Figure 4 shows the one of the conducted crossword puzzle questionnaire with clues is given below. The answer key for this test is given in fig.5.

**RESULTS AND OUTCOMES:**

It is required to take a measurement of the learning received during the class. Table 1 shows the marks obtained by all 72 students in the pre-test and post-test.

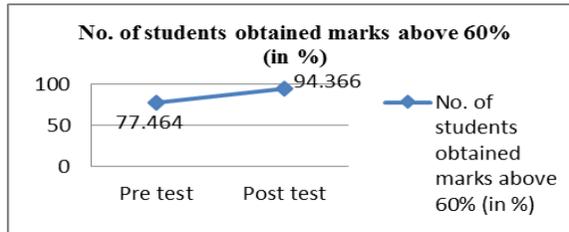
**Table 1: Marks obtained by students in pre and post test**

Roll no	Pre-test	Post-test									
1	12	18	19	7	8	37	14	17	55	14	17
2	15	20	20	16	18	38	14	19	56	15	16
3	12	17	21	16	16	39	12	20	57	14	15
4	8	19	22	13	17	40	13	19	58	14	17
5	10	20	23	10	9	41	12	20	59	15	17
6	14	20	24	16	20	42	17	17	60	16	17
7	13	20	25	12	11	43	10	20	61	11	13
8	10	20	26	14	14	44	8	18	62	13	12
9	16	20	27	14	15	45	10	20	63	15	15
10	11	20	28	13	18	46	15	18	64	12	13
11	10	20	29	15	16	47	17	19	65	13	14
12	11	20	30	15	16	48	11	18	66	13	13
13	14	20	31	17	20	49	12	20	67	14	15
14	12	19	32	12	11	50	13	20	68	16	16
15	12	20	33	11	12	51	11	19	69	16	14
16	15	17	34	15	18	52	12	18	70	15	13
17	13	20	35	13	15	53	9	18	71	14	13
18	12	20	36	16	18	54	16	18	72	13	18

Comparison of the marks obtained by the students in a pre-test and post-test is performed and table 2 shows the result.

**Table 2: Students record for more than 60% marks**

Test \ No. of students	Marks above 60%	Marks above 60% (In %)
Pre test	55	77.4647
Post test	67	94.3662



**Fig.6 Student’s Performance above 60%.**

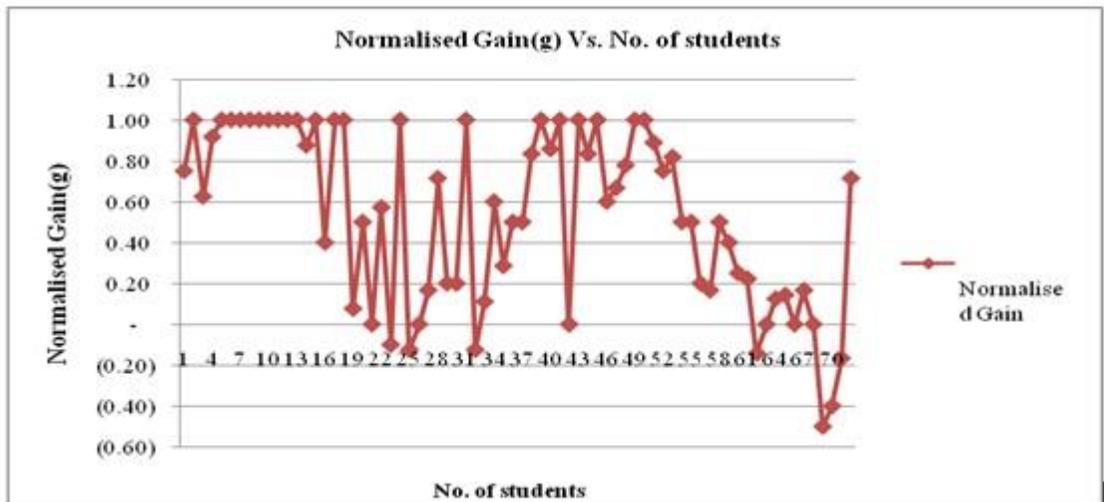
It was observed that out of 72 students, number of students scoring more than 60% marks is more for Crossword puzzle method than traditional MCQ method

To increase conceptual understanding it is necessary to take the effectiveness from the result of crossword puzzle activity compared with MCQ, therefore a normalized gain (g) is calculated. It is defined as “a rough measure of the effectiveness of a course in promoting conceptual understanding.”

The normalized gain (g) is given by,

$$g = \frac{(posttest\ marks) - (pretest\ marks)}{100 - (pretest\ marks)} \quad \text{----- (1)}$$

This measure is commonly described as "the amount students learned divided by the amount they could have learned." Fig.7 shows the normalized gain chart for this activity.



**Fig.7: Chart of Normalized Gain calculation for 72 students**

Another parameter, Standard Deviation is a quantity expressing by how much the members of a group differ from the mean value of the group.

Standard Deviation is the square root of the Variance. The Variance is defined as the average of the squared differences from the Mean. It is calculated by the formula given below:

This is the formula for Standard Deviation:

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2} \quad \text{----- (2)}$$

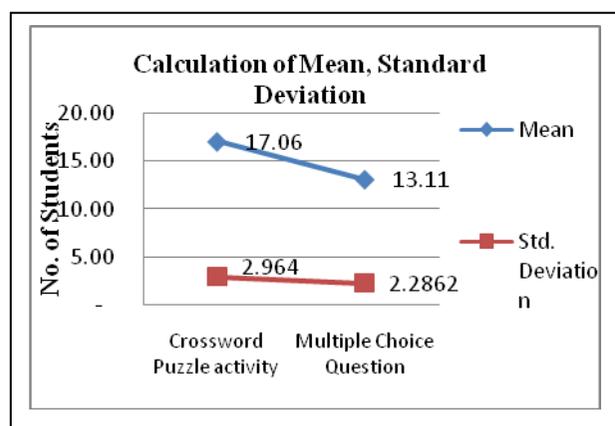
Where,

$\sigma$  = Standard Deviation,  $\mu$  = Mean,  $x_i$  = Individual Value,  $N$  = No. of students

According to above calculations, the mean and Standard Deviation for Multiple Choice Questions Test and Crossword Puzzle Test were calculated as shown in Table 3. Fig. 8 shows the graphical representation for Mean and Standard Deviation.

**Table 3: Mean and Standard Deviation**

Treatment	Mean	Std. Deviation
Crossword Puzzle activity	17.06	2.964
Multiple Choice Question	13.11	2.2862



**Fig.8 Graphical representation for Mean and Standard Deviation**

Thus the mean value is 17.06 and estimated standard deviation is 2.96 for Crossword Puzzle activity, whereas 13.11 is the mean and Standard Deviation value is 2.28 for Multiple Choice Test. Along with this Analytical feedback of every student was taken. Feedback forms consist of 10 questions. Some of them were discussed here in this paper. 80.55% students agreed that this crossword puzzle is motivating, challenging and competitive and it is useful in enhancement in course terminology and vocabulary. 77.77 % students enjoyed the crossword puzzle. 79.16% students agreed that this puzzle is useful in exam point of view. According to 31.94% student's opinion group discussion is necessary for this activity. 75% students felt that this activity was excellent while remaining 25% students felt this activity was good. Some of the comments of students for this activity listed below:

1. Crossword puzzle is useful to memorize any topic.
2. It is very interesting, but time consuming.
3. Really enjoyed, it's better than regular MCQ's test.
4. Must be applicable to university.
5. Should be conducted once in a week.
6. Best idea to develop our vocabulary.
7. Main point is group discussion and team work.
8. Great fun.
9. This idea is very good.
10. It improves higher order thinking skills, concepts can be clarified.

## CONCLUSION

Educational puzzles can play a major role in attracting students to engineering programs. Students strongly supported the use of crossword puzzles in the classroom. The students described the crossword puzzles as being a fun and unique way to test their comprehension of the material. Apart from motivating student learning, this puzzle can help students to extend their vocabulary knowledge, engagement with the course material, increase students' confidence in their ability and understanding. Learning vocabulary through crosswords is one of the best ways to

improve students' vocabulary. Student motivation to learn English can be increased if the teacher provides them with enjoyable learning environments.

Crossword puzzles provide students with an opportunity to evaluate their level of knowledge and to identify areas of further study in a fun way.

Hence, including crosswords in the Engineering field teaching repertoire can be an innovative way to engage students in learning and help them to acquire knowledge and skills.

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