

Visualization and Crossword: In-class Exercise---An active learning Strategy

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Abstract : Objective: Implementation of active learning methods into classroom enhances the learning experience of students. Instructional strategy followed by proper active learning activity increases engagement, attention, thinking skill of students. This study was carried out to incorporate an instructional strategy i.e visualization followed by active learning activity- crossword puzzle to first year B.Tech students and to find out its effectiveness in the learning process

Methods: The animated videos available on internet were used for visualization. Then by using free online resources, crossword puzzles were created and provided to the students. Evaluation was done by crossword puzzle as well as by feedback in the form of questionnaire using a 5-point Likert scale. The data was collected and analyzed.

Results: More than 90% students indicated that visualization and crossword puzzle enhanced their learning, oriented to the important topics and served as good tool in effective learning of engineering physics.

Conclusions: This activity contributed to a helpful learning experience which allows the students to engage better in the learning, to review the lecture material as well as examination and also provides a more relaxed and friendly classroom atmosphere by proper break in the lecture without breaking learning.

Keywords: Active learning, Visualization, Crossword puzzles, Questionnaire.

1. Introduction

The primary goal for any faculty/ instructor while engaging a class of 60 to 70 students is to actively engage the students. In a traditional classroom, students are expected to sit for hours, listen and theoretically absorb information presented by the instructor. Active learning is learner centric and requires more than just listening. It relates to three learning domains to as Knowledge, Skills and Attitude (KSA). Active learning engages students in two aspects viz doing things and thinking about the things they are doing. So if learner knows the idea behind it, then it helps to develop his/her thinking capabilities. Active learning techniques and strategies can be used to develop quick activities that punctuate lectures. They can also be used to completely fill the class time. Active learning means students engage with the material, partake in the class and team up with each other. Active participation in the learning process makes the learners more responsible for their performance in the course or activity. Active learning

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can take many forms and be executed in any discipline. Commonly, students will engage in small/large activities centered on writing, talking, and problemsolving or reflecting.

Visualization is any technique for creating images, diagrams, or animations to converse a message. Visualization through visual imagery has been an effective way to communicate together conceptual and existing ideas. Educational visualization is using a imitation to create an image of something so it can be taught about. We can consider visualization as the tool which can help instructors to make instructional decisions about how to teach, the content and the nature of tasks. Visualization is very useful when teaching as it proposes a method of seeing the unseen and to 'see' not only what comes 'within sight', but also what we are unable to see [1]. It is a fact that today's students are visualized to learn. Visualization includes videos, animations, simulations related to the topic to be taught in the classroom. Most of the students love to watch videos/ movies. Video helps the student to understand what they are learning at the time in an alternative presentation mode. So to have an active learning experience, use of technology tools and multimedia give a hand to enhance the atmosphere of the classroom.

By effective video, learner understands the content in a better fashion. Visualization being an instructional strategy is basically at a recall or understand level. But demonstration and explanation of visualization will not be sufficient for effective learning. If visualization is integrated with active learning strategy then this will definitely improve the outcome. Instructor has to make the students engage with the content by making them do specific well designed activities.

Successful implementation of active-learning can be carried out by choosing meaningful activities. While choosing the activity, it is necessary to consider some points such as what are the most important things students should learn from this lecture? What are the common mistakes/ difficulties that students face related to this topic? And what kind of practice will help students for its preparation? Prior information to the students regarding such in-class activities will surely make the approach for the instructor successful towards the course and exams.

There are a wide range of alternatives for the term 'active learning' like learning through play,

technology-based learning, activity-based learning, group work, project-method etc. This can include the activities like-a class discussion [2], a think-pair-share[3], a learning cell, a small group discussion[4], short written exercise, student debate[5], learning through teaching, class-game, gallery walk etc.

One of the effective pedagogy is using games in the classroom. Games can transform learning into a less threatening and more enjoyable process for learner as well as instructor [6-7]. Games add flexibility and interest to the classroom by allowing students to adjust to ways in which they learn best [8]. These kinds of activities also allow students to work either in groups or alone, to be competitive or not, to be creative and to have fun learning [9]. By making use of crosswords in the education dome, educators can hone students' critical thinking and problem-solving skills. Puzzles can also be used to help emphasize skills in subject areas such as English mathematics, science, and social studies. Providing definitions in the crossword puzzle format challenges students to explore past experiences, recall recently learned information, and manipulate vocabularies to find the right word. The process of filling in a crossword puzzle encourages independence, creativity, and active engagement[10].

Participants

This activity was carried out among the first year B.Tech students of Electronics and Telecommunication and Information Technology program of batch 2018-19 of Walchand Institute of Technology, Solapur, Maharashtra. Out of 134 students, 120 students participated in this activity.

The University question paper structure of first year includes 14 marks i.e about 20% of total questions as MCQs for each subject. Such questionnaire are helpful for increasing the percentage to high performing student and to support the passing of poor or slow learner. Objective questions require recall, memorizing which can be easily understood or memorized through games.

2. Methodology/ Methods

The lectures were taught through visualization in the classroom, covering various aspects of the topic such as definitions, key concepts and specific terms involved in various topics of engineering

physics. Visualization covers different visual elements such as videos, animations, figures, working process, simulations etc. The animated videos available from You-tube were used for this activity. Then crossword puzzles were designed using a free online resource (<https://crosswordlabs.com/>). Crossword puzzles were designed for the relevant topics.

Such terms in the lecture were supplied into 'down' and 'across' clues to solve the crossword puzzle. The puzzle clues were designed in alignment with the learning objectives for the lecture. At the end of lecture, printed crossword puzzle sheets were distributed in the class. Students were asked to complete the puzzle in 15 minutes. One mark was assigned for each clue. Each question was discussed and doubts were clarified at the end of the activity through discussion. This activity was conducted three times covering different topics of engineering physics in the class. So in each lecture visualization was followed by solving crossword puzzle. The results and analysis is dependent on the data collected from these three different topics. Evaluation was done by crossword puzzle as well as by feedback in the form of questionnaire. Feedback was expressed as the percentage of responses. The data were analyzed using graph plotted in Origin software and presented as percentage of responses.

Feedback

Students' perceptions of the visualization and puzzle activity were evaluated through 9-item questionnaire using a 5-point Likert scale (1=Strongly agree, 2= Agree, 3=Neutral, 4=Disagree and 5= Strongly Disagree). The data was collected, tabulated and analyzed.

3. Results and Analysis

Visualization strategy upto what extent it was successful, its evaluation was done by crossword puzzle. Each question carries 1 mark. The results showed the improvement in successful solving the puzzles which is revealed by Pie-chart as in figure 1.

The analysis shows that in first lecture, about 71% students have scored marks between 80-100%. This number had been increased to 94% by third lecture. The percentage of students who have successfully solved the crossword within time with score 100% was also increased from 14% to 27%.

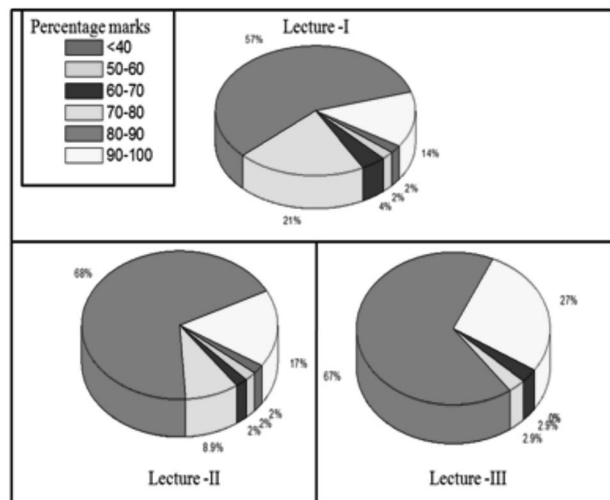


Fig.1: Result Analysis of crossword puzzle

While evaluating the feedback questionnaire, it was found that most of the students had an enjoyable experience. The results of questionnaire survey on usefulness of visualization and crossword puzzle activity in classroom learning is given in table 1. The feedback analysis was nearly same for three lectures.

Table 1. Results of questionnaire survey on usefulness of visualization and crossword puzzle activity

Questionnaires	Response in %				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Visualization helped me to understand the concept more easily	58	39	3	--	--
2. I could comprehend the phenomenon or definition more simply.	60	29	11	--	--
3. Visualization helped me to solve the questions/ assignment more easily.	58	34	8	1	--
4. Imagination is easier due to visualization method.	66	33	3	1	--
5. Crossword surely helped me to memorize the difficult/ important terms of the topic.	50	43	5	1	1
6. Crossword surely helped me for multiple choice questions	53	44	3	1	--
7. Solving crossword puzzles in the classroom are good appraisals of lecture content.	58	40	2	--	1
8. It is an entertaining way to boost my understanding of the topic.	57	38	3	2	--
9. I would enjoy doing more crossword puzzles.	53	42	5	1	--

More than 92% of the students either agreed or strongly agreed that visualization helped to understand the concept more easily and crossword puzzles helped to memorize the important or key terms of the topic. More than 90% students indicated that imagination is easier due to visualization method and visualization assisted to solve the questions more easily. More than 89% students agreed that solving crossword puzzles are good appraisals of lecture

content and it helped me for multiple choice questions in class tests.

Also, over 92% students suggested for more use of crossword puzzles in the classroom. Students' response for each question is interpreted by figure 2.

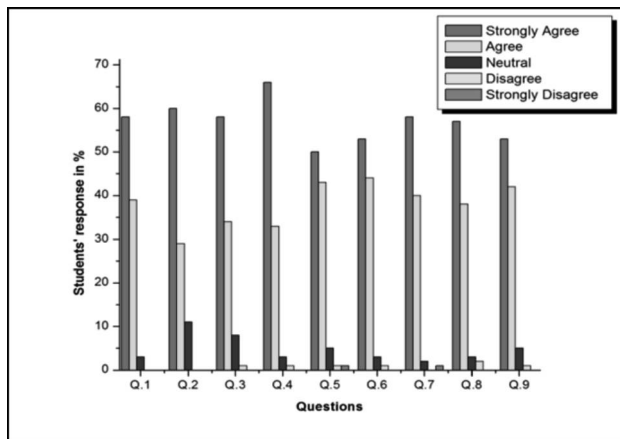


Fig. 2: Student's response for each question in feedback

The statements in the questionnaire measured student's responses such as an ability to recognize key areas of the lecture, enhanced understanding of concepts, well understanding of key terminologies, better performance in examination and improvement in their learning skills.

Students were asked to provide additional comments regarding the activity in addition to 9 questionnaire statements.

There were no serious objections found among the student comments. Some of the comments were:

- It is a good way for learning and teaching.
- There should be crosswords on every topic.
- There should be crosswords on physics numericals.
- It breaks the routine of traditional class.
- It helps to recall and memorize the important terms of physics.
- It is very new and fun to solve the puzzle.
- It encourages the students to think and use their skill to complete the crossword.

- Discussion after this activity helps to clear misconceptions immediately.
- Active learning strategies enhance the learning skills of learner.
- It is innovative, new, and different and fun means to know own level of understanding.

4. Discussions

This study was carried out to incorporate an active learning strategy i.e visualization followed by crossword puzzle to first year B.Tech students and to find out its effectiveness in the learning process.

Visualization through illustrative images has been an effective way for communication between instructor and learner. Today's students are generation that is visualized to learn. So, these students should recommend knowledge throw the visual way, with strategy of active learning. Visualization is an umbrella that has been used to mean a variety of visual elements- figures, phenomenon, working, videos, animations, simulations etc. After visualization, the students were instructed to solve the crossword puzzle by reading the clues and then recalling what had been taught in lecture or seen through videos or animations. Students were then encouraged to participate actively to solve these puzzles. This assisted to form an environment for active learning. Students felt that it was a competitive and enjoyable method of effective learning. Similar findings were reported by Ritzko,et.al.[11].It is often difficult for students to recall and reproduce during written examination. So, such strategies overcome such problems.Crossword puzzles provided a much needed break to the students from monotonous lecture without breaking their learning and making the learning more enjoyable. Shah, lynch and Macias Moriarity et.al had reported similar results[12].The students pointed out that completing the crossword puzzle provided a good review of the content discussed in classroom lectures/videos. These findings are consistent with the results of study of Carlos Mario et.al [13].Crossword puzzles motivate learners to remember and understand a word's meaning. Crossword puzzles are entertaining study materials which help to increase self-motivation in learners to learn and study moreCrossword puzzles have unique feature of self-correcting due to length and overlapping of each answer from the other answer. This helps students to correct their mistakes immediately and assist in

developing their critical thinking and helps them to hold the knowledge gained. Bailey et.al reported that games create an environment of interest not only for learner but also for the instructor [14]. Cracking puzzles are seen as a type of recreation. As a result, students see them as less nerve-wracking when they are used in a classroom setting. They are more receptive to solving crosswords. Students were also able to identify their weak area while finding the exercise to be fun [15]. Hence, students' engagement, attention, recalling abilities and learning experiences can be enhanced through crossword puzzles [16]. The students' responses to 9-questionnaire survey confirmed the multiple benefits of crossword puzzles as supplements to traditional lecture [17]. Such activities are suitable for first year students to build up skills related to handling basic conceptualization allied with a knowledge area.

5. Conclusions

Visualization followed by crossword puzzle was implemented for this study. Crossword puzzles were used as in-class activity. Student's perceptions of the use of visualization and then solving crossword puzzles as an active learning instructional tool were gathered using a feedback based on a 5-point Likert Scale. A majority of students found that visualization followed by crossword puzzle enhanced their learning of the topic. This activity contributed to a helpful learning experience which allows the students to better engage in the learning, to review the lecture material as well as examination and also provides a more relaxed and friendly classroom atmosphere by proper break in the lecture.

This study showed that specially designed crossword puzzles showed a better short-term recall of terms. Thus crossword puzzles are creative tool whose proper execution certainly has a positive impact on the student's skill and performance.

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