Enhancing Student's Engagement in Learning: Shades of Interactive Online Offline Session

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Abstract : The daunting horizon of Covid-19 has certainly upraised a new normal of e-learning environments. Nevertheless, participative engagement in online teaching has floated a challenge which is an implicit need for joyful learning. There is a need of keeping our online as well as offline sessions live and enhance the student's involvement with joy. In this paper, two novel and interactive techniques are proposed namely Idea Spinner and Crossword. These techniques have assured its emphasis in online/offline educational teaching along with improvement in student's engagement. Idea Spinner is an underlying concept of a spinning wheel with 'n' concept quadrants interfaced via wheeldecide.com. Eclipse crossword is a free tool to articulate our custom crosswords and inline them with our interactive sessions by sharing screen controls. The above-stated techniques were instigated for Third year B. Tech. – CSE (System Software) and Final Year B. Tech. ETC (System Verilog, Elective). The idea spinner technique has essentially assisted to uplift the global outreach with a rise of 55 percentage active responses over regular questioning. Crossword has especially helped weak learning students to enjoy a lesson-themed puzzle for enriching the feeling of joy. The pre and post-activity feedback was collected and analyzed over two parameters namely Impression of the lecture and Boredom period. The post-analysis has shown a noteworthy rise in parameters like the Impression of lecture which implicitly states a 52 percentage increase in interactive lecturing and secondly, the Boredom period which has reduced by 67 percentage.

Keywords: Boredom period; Crossword; Idea Spinner; Impression of lecture; Lesson-themed puzzle; Online sessions.

1. Introduction

The Covid-19 pandemic has provided an insight of new normal for almost many fields including education. In fact, it has broken our discernment of normal activities. During the pandemic period, every step taken by students and teachers as a preventive measure has toppled the life of an individual. Governments have temporarily shut down academic institutions during the period of a pandemic. The unknown period of closure was a decisive time for every sector including education. As the situation lead to an up growth of online schooling, this raised the bars of the education sector with great responsibility. These days, the new normal is e-Learning in the education field (Mou, 2023).

In the post-COVID-19 session, the field of education has seen various gadgets and tools engaging students efficiently (Patil, 2020), (Munna, 2021), (Moussa, 2021). Technologies supporting e-Learning

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platforms have materialized as a lifesaver as well as a catalyst to upscale learning in online mode. Communication plays a major role in the education field and e-

Learning platforms have strived the driving force of interconnections. These 360-degree changes in online sessions have led to a new perception to make education more flexible and available. Additionally, the young generations of college, as well as school students, are well-defined by the proficient use of technology. Looking at the current scenario, we can surely admit that the utilization of technology will make its best to empower learning. Integrating technology with speedy changes in every domain has set a new corridor for an upended lifestyle in a pandemic. The concern of time-honored teaching is the only part that faculties need to address in a very vital way. The unplanned delivery may lead to make-off during live sessions who listen passively. The only solution to avoid such absconding behavior is to enrich interactive lecturing (Prince, 2004). Teaching with active learning techniques is a malleable approach that can be adopted gradually in the learning process (Hernández-de-Menéndez, 2019), (Hartikainen, 2019).

Active learning presents a prospect for experimenting with e-Learning content while enriching knowledge. Student engagement involves faculty, course content along with peers in a planned and effective teaching-learning process (Tanis, 2020), (Selçuk, 2020). The techniques should venture to strengthen critical thinking and decision-making skills (P. Jadhav, 2017), (Armbruster, 2009). The exchange of lecture contents between teacher and student is the main preface for quality education. Interactive lecturing encourages active learning along with intensifying attention (Tartavulea, 2020). At the same time, live feedback escalates satisfaction at both ends. Interactive lecture engages delivery in an effective segmented way which triggers engagement and results (Theobald, 2020). This paper will help to explore the engagement triggers (Idea Spinner and Crossword) with the advanced digital techniques which will facilitate active student's engagement. The proposed techniques have been experimented with students at the undergraduate level of class sizes 65-75 students. These techniques were examined across the Understanding and Engagement of lecture and Boredom period parameters and found impressive. The outline of the presented work is as follows: section II deals with techniques in detail, section III arranges the review/analysis, and section IV deals with runtime issues. Finally, the conclusion in terms of outcomes of overall work is stated in section V.

2. Online/offline Interactive Learning Techniques

The procedure of both online/offline interactive learning techniques for the courses at Third year B. Tech. – CSE (System Software) and Final year B. Tech. ETC Elective (System Verilog) is as follows:

A. Idea spinner

Wheel Decide (wheeldecide.com) is a free tool. These online spinners assist to design custom digital wheels. These wheels can be useful for various activities like decision-making, raffles, etc. Coin flipping aids to make a decision, make has only two sides. But Wheel Decide can help to flip a coin with 100 sides. It explicitly helps to settle disputes wherein a decision is involved.

The basic concept is as follows:

- The teacher creates a spinner (wheel) marked into n quadrants and labels it as per the context of his topic/unit

  - For eg. A custom wheel created of 3 quadrants having labels as "Identity entities/relations, Design and Draw, Formulate constraints" for topics related to E-R modeling in a Database course

- After the presentation of the new material, the spinning activity is carried out by the teacher. The student has to respond based on the location of the spinner

  - For eg. when the spinner lands to the region "Formulate constraints", the faculty proceeds to ask the student, "List the key constraints over E-R diagram just presented"

- In online mode:

  - The teacher needs to spin the wheel on behalf of the student or can provide the control of the screen towards student end to spin the wheel

  - When the spinner lands to respective region then the faculty will ask the question to the student inline to that region

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- Likewise, the teacher will proceed to next remaining questions

1) Education usage

- Can select a random student to answer a question or participate

- The spinning of a wheel is carried out

  - A kind of substitute for shuffled learning with flash cards keeping each one on their toes

- Can make use of wheel for assigning groups or teams

  - Similarly allocating jobs/tasks to teams or individuals

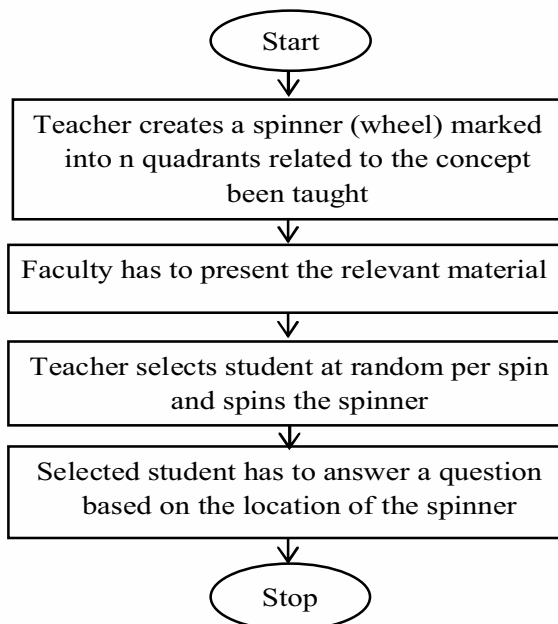 - It has no biases

Fig. 1 represents the detail steps of idea spinning technique.

Fig. 1 : Flowchart of Idea Spinner Technique

The step-wise procedure from idea wheel creation till questioning a student for a random spin is sighted in Fig. 1 flowchart. The flowchart position the role of faculty and student in specific.

B. Crossword

Eclipse Crossword is a free tool and easy to build crossword puzzles. Students of any class level enjoy doing a lesson-themed crossword puzzle. Most instructional manuals or booklets have some kind of "chapter review test". A creative crossword at the end of chapters makes it more sensible instead of insipid questions. Crosswords assist to create more interest in learning patterns.

Plan to impart a departmental newsletter with technical crossword and examine the engagement. Any kind of work-domain gets brightened and cheers employees to read it. In workplaces where people need to wait a long as like a dentist's clinic, a small puzzle on a leaflet in the waiting room helps to lower the pressure on patients' thoughts. It helps to keep your patients entertained!

The basic concept is as follows (For creating crossword from scratch):

- Download Eclipse Crossword (https://www.eclipsecrossword.com/)

- Start the app

- Go with the option "I would like to start a new crossword" and press the "Next" button

- Go with the option "Let me create a word list from scratch now" as shown in Fig. 2 and press the "Next" button
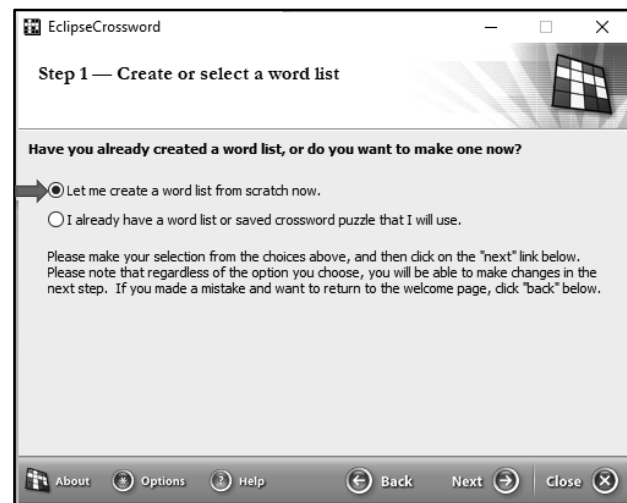

Fig. 2 : Creating Word List from Scratch

- Now add the new word for the word list & its clue and press the "Add the word to list" button

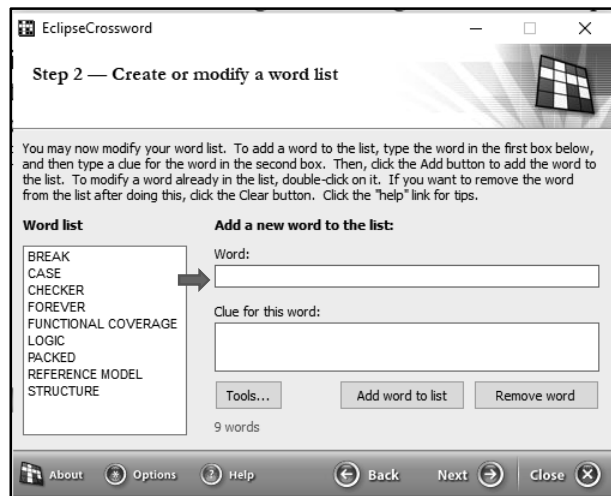- Once the list is done then press the "Next" button as shown in Fig. 3

Fig. 3 : Creating / Modifying Word List

- Save the wordlist for future usage by pressing the "Yes" button

- As stated in Fig. 4, provide the name for crossword and your name and copy the right info as required, and then press the "Next" button
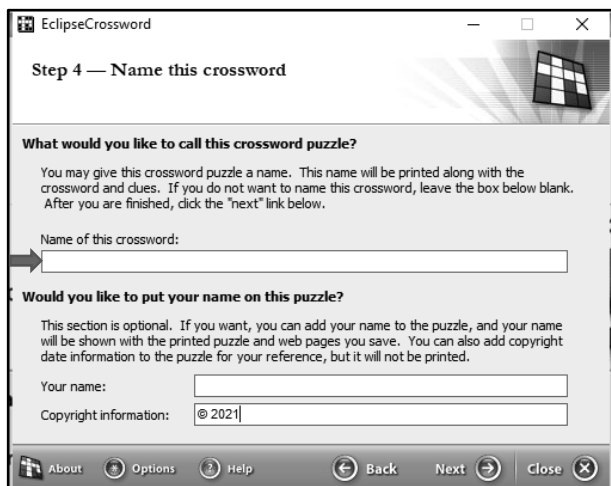

Fig. 4 : Naming Word list

- Input the values for letter width and height to represent the crossword as shown in Fig. 5 and press "Next" button

- Before-hand overview of the crossword is presented in Fig. 6. If OK proceed with the "Next" button

  - Else you can opt for "Make another puzzle like this one" under Keep this Crossword. Option for changing the orientation
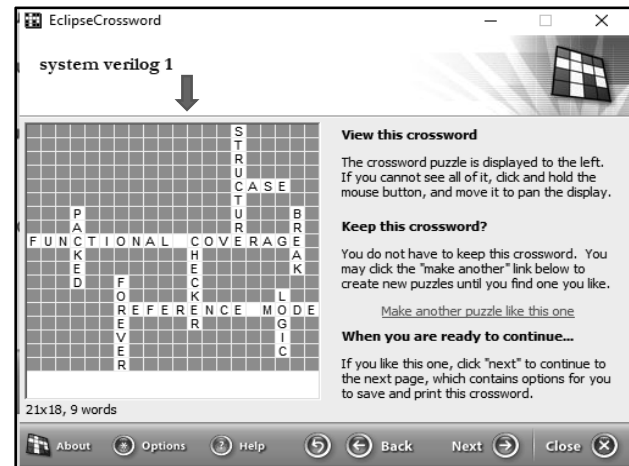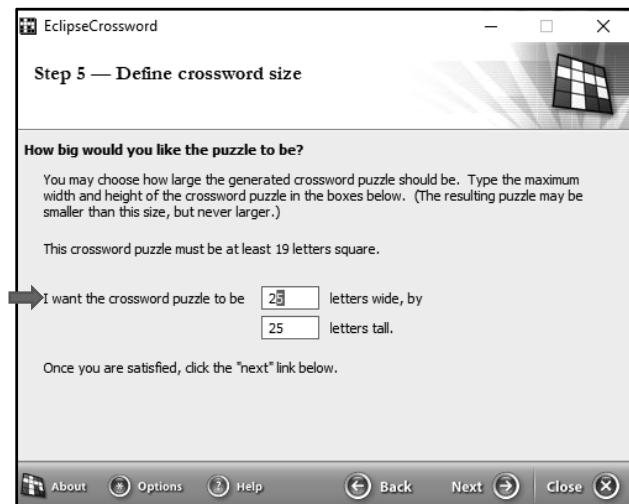

Fig. 5 : Defining Size for Word List

Fig. 6 : Viewing Word list

- Go into the "Share Online" option and select the "Interactive with JavaScirpt" option as shown in Fig. 7
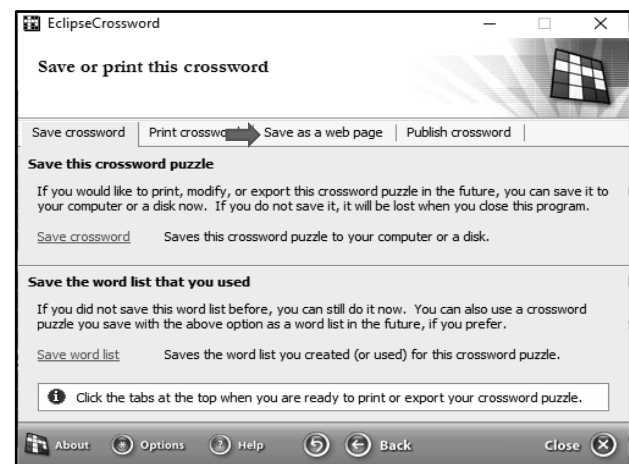

Fig. 7 : Sharing Crossword Options

- It will ask for the name of the file to save it as a web page

- You will get a browser-based interactive crossword showcased on the left part of Fig. 8

  - Click on any part of it so that clue along with the text box to input the answer is seen on the right side
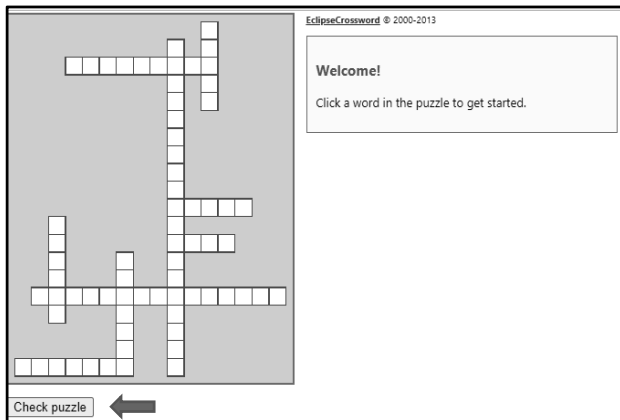

Fig. 8 : Eclipse Crossword Puzzle

- Once you provide the input for answering the cross-word question within the clue, press the "OK" button

  - The input will fit into the letterbox in the crossword window

  - If there is a mismatch in the count of letters showcase and answered then the error will be shown

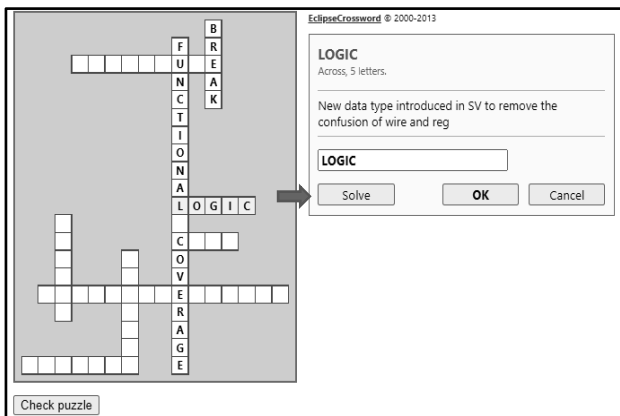 - Pressing the "Solve" button will auto-fill the correct answer as shown in Fig. 9

Fig. 9 : Eclipse Crossword Puzzle

- Once overall answers are provided for the displayed crossword then press the "Check Puzzle" button to find the count of right and wrong answers provided

- In online mode:

  - The teacher needs to float the crossword and ask the horizontal/vertical questions to fill up the provided answers on behalf of the student/group

  or

  - Can provide the control of screen towards student end to ask the questions to their peers and follow the above-given procedure till end of all questions

  - Likewise, the teacher/groups will proceed for all the next questions

- Education usage

- It can be a case that crossword puzzles may or may not have a theme. Moreover, they mostly keep you focused while editing words to add.

- Advantages:

  i. Just give Eclipse Crossword a list of words and clues, and it does the rest

  ii. Use crosswords to review vocabulary and lessons for all subjects

  iii. Students may actually even enjoy doing the assignment

  iv. Crossword puzzles encourage logical thinking and correct spelling

  v. Crosswords can be printed or uploaded to your website.

A few topics you can start with:

- Seasonal puzzles

- Obscure history facts

- Family tree puzzles

- TV shows, movies, and music

- General-purpose crosswords

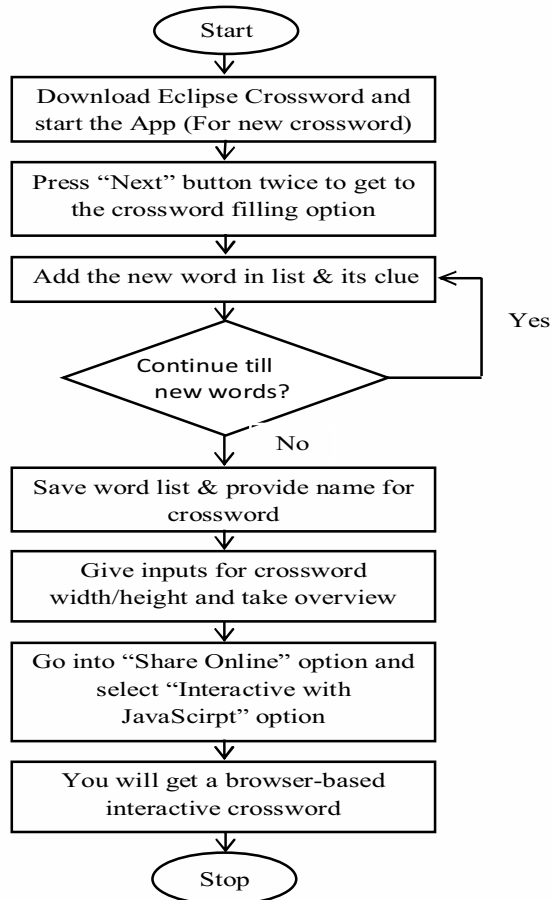Fig. 10 represents the detailed steps of Crossword preparation and usage.

Fig. 10 : Flowchart of Crossword Preparation and Usage

3. Examination And Analysis Of Techniques

The introspection of conducted techniques has revealed its ingenuity while conducting online/offline sessions effectively. Almost of the time, students have shown active interest in participation and collaborative learning.

The active involvement and its outcome in experimented courses are as follows:

A. Idea spinner

This technique was demonstrated in Third Year B. Tech. – CSE (System Software course). The proposed activity was planned for the following lectures:

This activity is planned for the following chapters/points:

- Chapter 1:

  - Pass structure of assemblers

  - Time for this activity: Lecture-5

- Chapter 2:

  - Advanced macro facilities

  - Time for this activity: Lecture-10

- Chapter 3:

  - Design of a linker

  - Time for this activity: Lecture-14

One can demonstrate some online dynamic wheels demo readily available on the site. A custom wheel is created during each lecture once the content is delivered. One prepared for a lecture viz. "Advanced macro facilities" is as:

- A custom wheel as presented in Fig. 11 is created of 7 quadrants having labels as "AIF Statement, AGO Statement, ANOP Statement, GBL, EV specification, REPT, IRP"
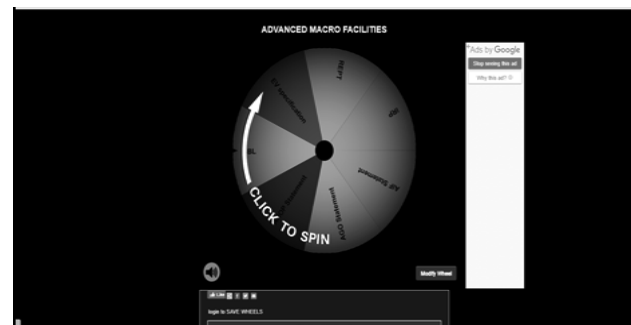

Fig. 11 : Idea Spinner of Advanced Macro Facilities over Wheeldecide.com

- After the wheel is created, a student is selected to answer the usage of the respective macro facility pointed by the wheel pointer

- If the same point relocates then either the student can respond with a new example or can re-spin the wheel

- In response to student reply, faculty engage the

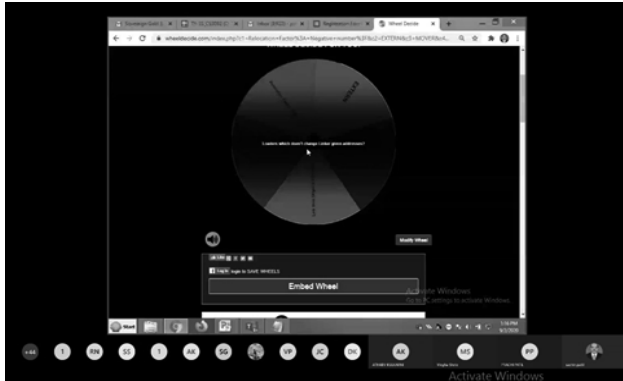discussion in line to the response and motivate others to provide different dimensions over that point

Fig. 12:Idea Spinner for Content "Design of a Linker"

The activity has helped to keep students interactive and engage with on-the-fly attention at random. It also stimulates to improve attention and interest during content delivery.

An overview of outcomes is stated as:

- Tangible outcomes:

Feedback based on hand-raise was collected and analyzed for to note the Impression of Lecture under

Table 1. Feedback Responses

Particulars	Percentage of Offline class responded (Average Regular lectures) A	Percentage of Online class responded (Average Idea Spinner-based lectures) B	Percentage of Offline class responded Idea Spinner - based lectures) C	Percentage of rise in response (A v/s C)
Interactive	34	57	66	64
Attention	48	70	81	51
Joyfulness	41	NA	76	59
Teamwork	25	NA	36	35
			Average	52

*NA: Not Applicable during Online session

non-activity versus activity-based lectures. The feedback was noted on four different parameters viz. Interactiveness, Attention, Joyfulness and Teamwork.

The analysis in Table 1 states the feedback responses which signify an average rise of 52 percentage in Idea Spinner-based activity lecturing compared to regular lecturing in offline mode. Moreover, the percentage of interaction and joyfulness is elevated compared to other parameters. As per outcomes of experiments conducted by (Armbruster, 2009) and (Moussa, 2021), the joyful status of learning in offline classes has uplifted showing remarkable trends. There is a need to improve teamwork components for planned activities. The feedback for online lectures exemplifies the same outcomes. But, the comparative study of responses between offline to online lectures for Idea spinner activity depicts an elevated impact of offline conduction on the basis of the first two parameters (The Joyfulness and Teamwork parameters can't be directly assessed in online sessions).

Additionally, the tangible impact was seen in Unit Test-1 and End-Sem. Exam for the covered topic under this activity.

The analysis of percentage of attempts for UT and ESE questions in mandatory and optional modes is affirmed in Table 2. The percentage of attempts represents an average of 85 percentage whereas it's above 95 percentage for compulsory questions. Equally the rise in average marks compared to other questions have aided to improve course outcome which is also experienced in (Hartikainen, 2019) (Selçuk, 2020) and (Mou, 2023).

Table 2 : Questions Attempted Inline to Idea-Spinner activity

Exam Category	Question no.	Total Students	No. of Questions Attempted	Avg. Marks (Out of)
Unit Test (UT)-1	1.a) Optional	72	63	6 (8)
End Semester Exam (ESE)	1. b)	72	69	6 (7)
	2.a) Optional		61	7 (8)

- Intangible outcomes:

  - Extended the joy of learning

  - Experienced collaborative efforts towards refining the answer provided by a peer member

  - Seamless attentiveness along with interest

B. Crossword

This technique was demonstrated in the Final year B. Tech. – ETC (System Verilog elective course). The proposed activity was planned for the following lectures:

This activity is planned for the following chapters/points:

- Chapter 2:

  - Looping

  - Time for this activity: Lecture-9

- Chapter 3:

  - Packed and Unpacked structures

  - Time for this activity: Lecture-16

  - Continue-Break statement
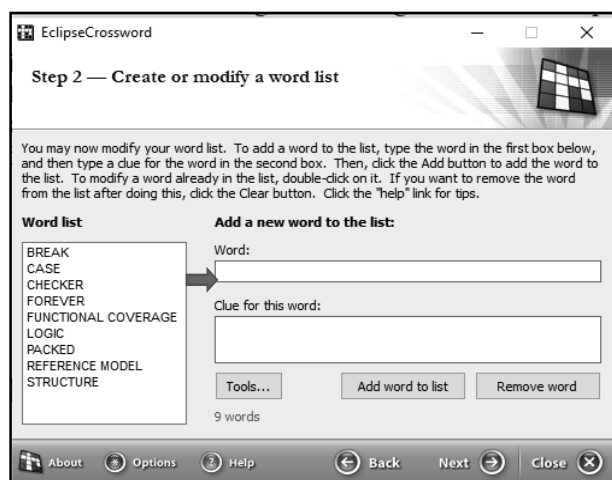
  - Time for this activity: Lecture-18

- Chapter 5:

  - Functional Coverage

  - Time for this activity: Lecture-28

A custom crossword is created during each of the above stated lectures based on the content of delivery. One prepared for a lecture viz. "Looping" is as:

- A crossword as presented in Fig. 13 is created of 9 words with respective clues

- Once the crossword is created, the application asks for confirmation of a preview of the crossword as stated in Fig. 14
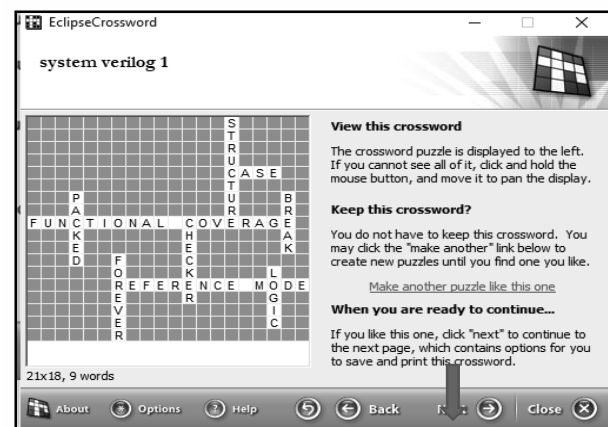

Fig. 14 : Crossword Pre-view

- After the crossword is created, a student / group / row is selected to answer the selected horizontal / vertical crossword

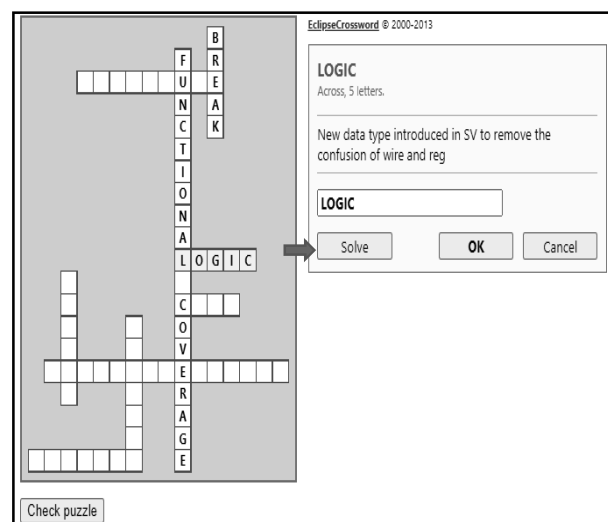**Fig. 13 : Crossword of "Looping" Over Eclipse Crossword**

Fig.15:Crossword Review during Attempt of Question

- If the question/clue is non-attemptable then the faculty can provide some additional hints or may ask another student/group/row

- In response to the student's reply, the faculty will input the given answer and press the "SOLVE" button as shown in Fig. 15. Thereafter, he/she may float a discussion inline to the response and motivate others to provide different dimensions over that point
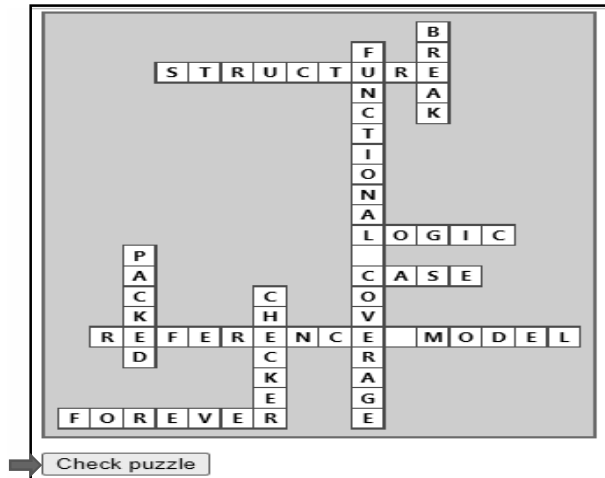

Fig. 16 : Crossword Final Review after Pressing "Check Puzzle" Button

- Once all the crosswords are attempted, the faculty needs to press the "Check Puzzle" button as shown in Fig. 16. The correct and incorrect answers are showcased which will help the students to diagnose their understanding of the given answers.

The activity has helped to keep the courteous attention of students in dynamic classrooms focusing on the engaged theme of delivery. This activity has helped students to understand the basic concepts by putting the keywords and hints on the eclipse crossword.

An overview of outcomes is stated as:

- Tangible outcomes:

A survey based on G-form was collected and analyzed for to note the reduction in the Boredom period. The feedback was noted on three different questions (on a scale of 1 to 5: 1 as Strongly Agree and 5 as Strongly Disagree):

1. How well the activity creates joy in learning

2. How well it is effective to understand the concepts

3. The activity has helped to create interest in the subject

The analyses for responses are stated in Fig. 17, 18, and 19.

The analysis in fig. 17, 18, and 19 states the average drop in the Boredom period by 67 percentage experimenting with Crossword-based activity in
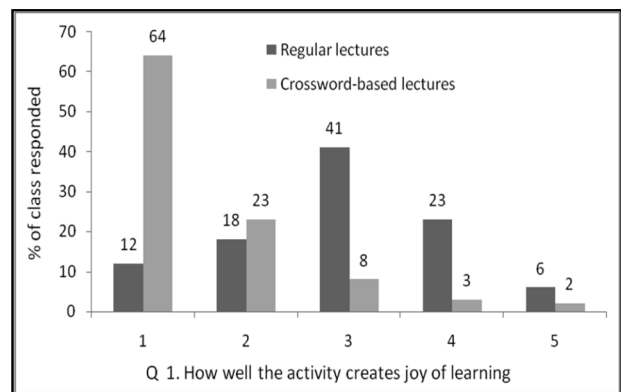

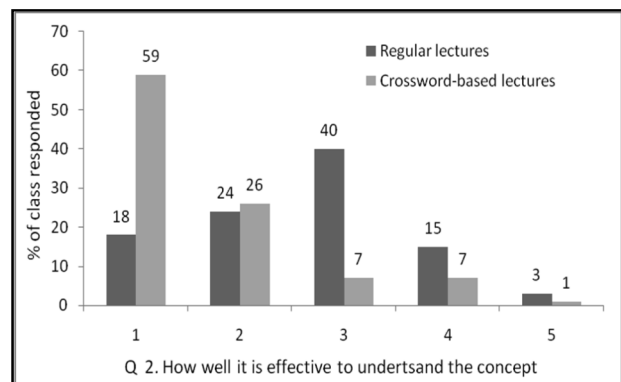**Fig. 17 : Comparative Analysis of Responses for Q.1**

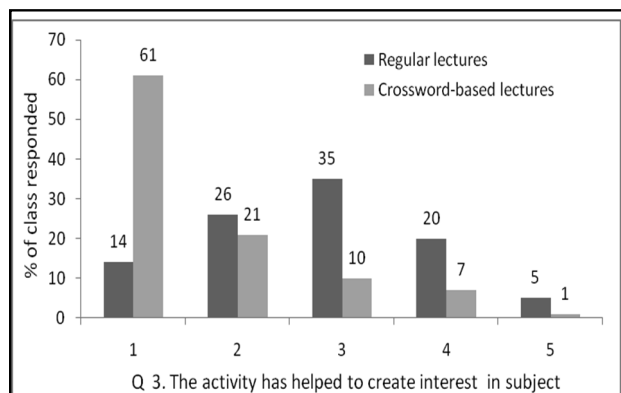**Fig. 18 : Comparative Analysis of Responses for Q.2**

Fig. 19 : Comparative Analysis of Responses for Q.3

lecturing sessions. The learning compared to study in (Hernández-de-Menéndez, 2019) and (Tartavulea, 2020) has shown marginal improvement. Implicitly the rise in inter-activeness has shown preeminent context. Moreover, the percentage of joyful learning is elevated compared to other parameters.

• Statistical Analysis using Index of Quality Variation (IQV):

IQV is a statistical technique that helps for determining the dispersion of cases across categories of variables. The value of dispersion ranges from 0 (no dispersion or variety) to 1 (maximum dispersion or variety). 1 refers to even numbers of cases in all categories, NOT that cases are distributed like population proportions. IQV is affected by the number of categories under consideration.

The formula for IQV is stated below:

$$IQV = \frac{K(100^6 - \Sigma \text{ cat. }\%^6)}{100^6(K-1)} \quad (1)$$

K=# of categories
cat.% = percentage in each category

As per data in fig. 18 for the Q.2 "How well it is effective to understand the concept", ", the following variables are initialized as:

K=5

∑cat. 1(% of Offline class responded
(Average Regular lectures))$\%^2$ = 2734

∑cat. 2(% of Offline class responded
(Average Idea Spinner-based lectures))$\%^2$ = 4256

$$IQV \text{ (Cat. 1)} = \frac{5(10000 - 2734)}{10000(5-1)}$$

$$IQV \text{ (Cat. 1)} = \frac{36330}{40000} = 0.90$$

$$IQV \text{ (Cat. 2)} = \frac{5(10000 - 4256)}{10000(5-1)}$$

$$IQV \text{ (Cat. 2)} = \frac{28720}{40000} = 0.71$$

Comparing the IQV values of both the categories states that the category 1 values inline to responses for "Regular Lectures" depicts more dispersion. The responses overall 5 categories of scores in "Regular Lectures" represents more scattering of reactions which implicitly conveys the trend towards Crossword-based lectures.

Table 3 : Questions Attempted Inline to Crossword activity

Exam Category	Question no.	Total Students	No. of Questions Attempted	Avg. Marks (Out of)
Unit Test -2	1. a)		69	6 (8)
	2. b)		71	7 (8)
End Semes ter Exam	4. a) Optional	76	61	6 (7)
	5. a)		72	8 (10)

Furthermore, the analysis of direct outcomes is visualized in terms of Unit Test-2 and End-Sem. exam marks. The details of the attempts are as above.

The analysis of percentage of attempts for UT and ESE questions in mandatory and optional modes is affirmed in Table 3. The percentage of attempts represents an average of 90 percentage whereas it's above 95 percentage for compulsory questions. Equally the rise in average marks compared to other questions have aided to improve course outcome which is also experienced in (Hartikainen, 2019) (Selçuk, 2020) and (Mou, 2023).

• Intangible outcomes:

• Productive collaboration while group learning

• Shades of additional clues for the taken concept

4. Concerns While Conducting The Activities

Conduction of activities was a new learning for all of us. Planning and its conduction as per expectations were augmented with some intangible outcomes stated in section III. Furthermore, a few issues were faced during the experimentation of these active learning strategies as follows:

• Time management as per desirable units

• Quality of questioning across expected outcome

• Measurement of complete joyful status

• Absenteeism of engaging students

More focus attention is to be provided for recording joyful status in a concrete sense along with time-controlled actions. The deficit of quality

questioning has to be refined further with multiple angles for its tangible measurement. The issue of attendance is still out of the strategic plan which needs program-level policies for all courses.

2. Conclusions

Proposed active learning techniques namely Idea-spinner and Crossword were demonstrated at diverse graduation levels from different departments. Two courses were taken under consideration while experimenting these techniques viz. System Software of Third year B. Tech (CSE) and System Verilog (Elective) of Final year B. Tech. Program. These techniques have assisted in effectively connecting large classrooms along which improving student engagement. Various shades of interactive online/offline sessions with the proposed two techniques have provided a wholesome degree of angle over the conducted activities. The comparative responses in Table 1 have helped to diagnose an average 52 percentage rise in interactive lecturing using the Idea-Spinner technique. While the tangible ascend was observed seen in the attempt of Unit and End-Sem. examination. Experimentation has facilitated to extend the joy of learning with picture-perfect attentiveness while learning. Crossword has been able to provide an intact view of the proposed topic while trailing the relation of the clue with a unique crossword. As stated analysis in Table 3., a tangible increase in attempts of compulsory/optional questions is visualized along with average marks for attaining course outcomes. The statistics of the survey plotted in Fig. 17 to 19 implies a reduction in the Boredom period by 67 percentage. The percentage of joyful learning is elevated compared to other parameters. Direct involvement of students/groups with random pin-point has elevated the attentiveness with leveraging dynamic environment during the teaching-learning process. An intangible reimbursement across collaborative learning and argued responses in teams to prepare complex topics is observed. Special efforts towards time management and qualitative questioning need to emphasize further.

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