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Technology Enabled Active Learning in Electrical Engineering

Syed Abdur Rauf Magrabi

Abstract

Educational technology supports meaningful learning and enables the presentation of spatial and dynamic images, which portray relationships among complex concepts. The Technology-Enabled Active Learning (TEAL) involves media-rich software for simulation and visualization in freshman Electrical Engineering carried out in a specially redesigned classroom to facilitate group interaction. These technology-based learning materials are especially useful in safety procedures in transformers in electrical engineering to help students conceptualize phenomena and processes. This study analyzes the effects of the unique learning environment of the TEAL on students' cognitive and affective outcomes. The assessment of the project included examining students' conceptual understanding before and after studying safety procedures in electrical engineering in a media-rich environment. We also investigated the effect of this environment on students' preferences regarding the various teaching methods. As part of the project, we developed pre-test and posttests consisting of conceptual questions from standardized tests, as well as questions designed to assess the effect of visualizations and experiments. It consisted of a small- and a large-scale experimental groups and a control group. TEAL students improved their conceptual understanding of the subject matter to a significantly higher extent than their control group peers. A majority of the students in the small-scale experiment noted that they would recommend the TEAL course to fellow students, indicating the benefits of interactivity, visualization, and hands-on experiments, which the technology helped enable also about teaching learning process for building students confidence is discussed. In the large-scale implementation students expressed both positive and negative attitudes in the course survey and feedback is also mentioned.

Keywords: technology enabled active learning (TEAL), active learning, teaching and learning process

1. Introduction

Active learning requires students to develop their understanding of content through the active construction of product, the solving of a problem or both embodies a long human tradition of learning through doing [1]. Active Learning refers to any strategy or activity where the responsibility of learning is placed on the learner and secondarily on instructor. It emphasizes learning, not teaching. In active learning strategy, students learn by directly engaging in the material they are studying through reading, writing, discussing etc. There is much research going on, educators have been talking over 30 years about active learning. In that

process they have come up with a definition of active learning which is stated as an instructional method in which students actively participate in their learning process via learner-centered activities that exercise the higher order thinking skills of analysis, synthesis and evaluation rather than passively listening to a lecture. Instructors should know that the learner is a unique individual, variations in the culture and background of the learner. As the learner progresses he or she should take increasing responsibilities for his/her learning. Active learning is a highly effective approach to teaching at the university level. Instructional strategies for active learning can take many forms, including writing, role-playing, gaming, constructing, experimenting, simulating, observing, and discussing. Active learning occurs when students participate in their own learning, no matter what specific activity is involved. Active learning is thinking made visible, with evidence of analysis, synthesis, and evaluation. It goes beyond passive listening, memorization, and recitation. The unique characteristics of digital technologies can enhance – intensify, increase, amplify – active learning. Open source software, web apps, common digital cameras, and almost ubiquitous mobile technologies empower and engage students as they construct, build, create, and distribute products that represent and reinforce their learning. These technologies provide opportunities for simulation, experimentation, research, and self-expression. In turn, social media exponentially improve access: access to information, to opportunities for collaboration, to alternative perspectives, and to audiences for student-generated products [2]. Flipped classroom technique has changed my perspective towards teaching and learning process. For the first time, I have come out of myself and watched my class from student point of view. Out of all teaching and learning techniques so far I come across, I feel Active Learning technique has found to be an effective method of teaching the course I am handling now to my students. In my previous years of teaching experience, I used to follow pedagogical approach by teaching detailed explanations about various concepts and dictate the important points to the students. After undergoing various training programs and attending various workshops on teaching engineering education such as the one I am undergoing now, I have realized that only advanced learner can understand my teaching abilities. Even an average learner will get bored and lose concentration and interest on my teaching. In order to bring maximum attentiveness and create interest in students and their learning, I should be able to adopt Active Learning technique to teach engineering course to group of students various cognitive levels. A visual and sequential style of teaching followed by creating an Active Learning environment in the classroom could help the students gain more knowledge and interest in learning. Flipped classroom technique can be adopted to teach some of the topics in Electromagnetic course such as Properties dielectric materials, Gaussian laws, Poisson Equations, Maxwell's equations etc. While discussing about properties of dielectrics I can throw some questions for students by explaining some case studies. For example, while teaching a property of permeability such as density, relative density and surface boundaries. Also they can be asked to explain the phenomenon of capillary rise in tubes of very small diameters, non-mixing of some fluids such as oil and water etc. The topic of flow through pipes can be taught more interestingly by making them to conduct small experiments on branched pipes and how the discharge could be affected. I will also ask the students to divide into groups in order to allow each group to conduct a suitable experiment for understanding the concepts and phenomena and prepare a video on the experiment they will conduct. Also they can be asked to make a pipe with bends and small enlargements and contraction to estimate the loss of head due to various major and minor losses such as bends, sudden enlargement, sudden contraction, friction etc.

It is obvious that online teaching/learning is a proven successful technique to teach engineering education. Still there are some obstacles and hindrances in attaining effectiveness. This could be suitable platform for student community who has high degree of dedication and self-discipline. As it becomes difficult for the teacher to assess the state of level of understanding of the student, online courses are less efficient. Also there exists a lack of credibility and individuality in submitting the assignments. As a teacher we should be in a position to know the different learning styles of students present in the class based on the we have to change our teaching style, the implementation of different teaching styles in the classroom can help us to find way for success of all students. The way a teacher presents the lecture depends on the teacher's preferences. The way a student learn does not always match with the teaching style of a teacher. Mismatches may happen and students become bored sometimes. The teacher finds difficulty in understanding the learning style of the students. In a conventional/traditional classroom the teacher can change learner's style of learning if found not suitable immediately as per the response received from the students attending that class at that moment. But in case of an online teaching/learning, the teacher will require more time to assess the learning style of the students. This is the major challenge in any online course in my perspective. There were thirteen important tricks that will help students for effective learning as [3].

1. Motivate and relate new material to previous and future topics (Sequential, Global)
2. Provide balance of concrete information (sensing) and abstract concepts (intuitive).
3. Encourage all students to exercise both sensing and intuitive learning etc.
4. Encourage cooperative learning of home work.
5. Pause to allow time for reflection.
6. Use computer assisted instructions.
7. Plan active learning strategies such as 5-minute brain storming.

Critical Thinking Attributes	Teaching/Learning Activities	Challenges for Critical Thinking
Look for multiple answers, elucidations, opinions, options, solutions	Use multiple case studies, programs, examples that illustrate variation, comparison and connection	Examine students to generate multiple opinions, views, solutions, investigation in projects/assignments
Evaluate assess concept, planning, methodology, solutions	Taking risk (by implementing various strategies to design an IOT project)	Give feedback (every day, every week) but the process to be continuous to make the students gets satisfaction of what they are doing
Independent and creative thinking	Inductive teaching rather than deductive teaching	Provide students with necessary information and data or material for which they can identify the problem and give various solutions

Table 1.
Shows the attributes on critical thinking towards Teaching & Learning Activities & challenges.

8. Assign some drills for practice and some problems requiring analysis.
9. Encourage creative solutions.
10. Talk students about the learning styles, during advising in the class.
11. Use pictures, schematics graphs etc. before during and after verbal is shown.
12. Prove concrete examples described by theory.
13. Balance practical problem solving with fundamental understanding.

Concept on Critical thinking by the use of technology.

Faculty must poses to solve problem critically the first thing is reasoning, evaluating the data or any analytics, problem solving skills, decision making and analyzing this process can be done as individual work or a collaborative work/group work. The below **Table 1** shows the relationship between critical thinking attributes, teaching/learning activities and challenges for critical thinking.

2. Strategies to think critically

There are various strategies to think critically and most of this work may or may not be only individual role but can be seen in group course work/project work in collaborative manner.

- Continuous discussion between faculty and students
- Analyzing the problems through case studies and providing necessary solutions
- Reading lecture material and referring to research articles from reputed journals
- Use of software's to trace and track problems wherever encountered in designing and building files
- Summarizing the concepts gathered from the date of project given
- Identifying the types of components to be used and to list the working principles of those components
- Asking question between different groups and teams members
- Resources/materials/data sheets to be used for the products
- Enumerate the possible aspects of outputs and results
- Instructors need to show some involvement when the students get stuck completely and making them to understand the situation and showing ways to rectify the problems in their projects for real time applications.
- Online/offline mode of discussion between students-student's interaction, faculty-student interaction etc.

- Self-correctness for identify, analyzing and summarizing between theoretical and practical concepts.
- Should poses the caliber to manage time using GNATT chart, PERT-1 chart, and PERT-2 chart or must take advice from guide or supervisor for time management between regular classes and project works (mini and major project).

How to ask the right questions?

Asking the Right Questions: Critical thinking is best supported when instructors use critical questioning techniques and demonstrating the live projects on IOT to engage students actively in the learning process.

Sample questions from all these studies include the following:

- What do you think about this?
- Why do you think that?
- What is your knowledge based upon?
- What does it imply and presuppose?
- What explains it, connects to it, leads from it?
- How are you viewing it?
- Should it be viewed differently?

These questions require students to evaluate the clarity and accuracy of their thinking as well as the depth and breadth of their thinking. Have they considered all the alternatives? Do they know why they think the way they do? Students need to determine whether the content they are using is relevant and if their thinking process is logical. By questioning their thought process, students can begin thinking about their thinking. Research on questioning methodology also suggests that instructors should wait for student responses too often the students' silence is filled by the instructor re-wording the question or asking a different student for a response. However, most students need at least 8 to 12 seconds to process and formulate their response, especially in critical thinking situations. If a question is based on rote memory recall, speed may be relevant; however, thinking requires time and patience. Give students the time they need to think critically [4].

The 21st century essential skills includes:

1. Personal and social responsibility
2. Planning, critical thinking, reasoning and creativity
3. Strong communication skills, both for interpersonal and presentation needs
4. Cross-cultural understanding
5. Visualizing and decision making
6. Knowing how and when to use technology and choosing the most appropriate tool for the task [5].

3. Active learning benefits and teaching learning process

Active Learning.

The benefits of Active Learning are as follows:

- Students are more likely to access their own prior knowledge, which is a key to learning.
- Students are more likely to find personally meaningful problem solutions or interpretations.
- Students receive more frequent and immediate feedback.
- The need to produce forces learners to retrieve information from memory rather than simply recognizing a correct statement.
- Students increase their self-confidence and self-reliance.
- For most learners, it is more motivating to be active than passive.
- A task that one has done himself/herself or as part of a group is more highly valued.
- Student conceptions of knowledge change, which in turn has implications for cognitive development.
- Students who work together on active learning tasks learn to work with other people of different backgrounds and attitudes.
- Students learn strategies for learning itself by observing others [2].

The benefits of active learning are widely acclaimed in higher education. According to Guthrie and Carlin (2004), modern students are primarily active learners, and lecture courses may be increasingly out of touch with how students engage their world. Chickering and Gamson (1987) early proponents of active learning, designated “encourage active learning” as one of seven principles of good practice in higher education. Clickers offer one approach to employing active learning in the classroom. They are more formally denoted as Student Response Systems (SRS), Audience Response Systems (ARS), or Personal Response Systems (PRS) (Johnson, 2004). Clickers allow students to participate in classroom activities, regardless of class size and common student dynamics. These remote-like gadgets transmit individual student responses to an instructor’s computer to record and even share these results directly back to the class. Instructors can also use this data to customize their lessons for each learning group (Kenwright, 2009). Johnson (2004) describes how clickers address three of Chickering and Gamson’s (1987) seven principles for good practice in undergraduate education, as follows [2]:

- Actively engage students during the entire class period.
- Gauge their level of understanding of the material being presented.
- Provide prompt feedback to student questions.

4. Teaching learning process

The article written by R. Felder and L Silverman is gave me a thoughtful idea on implementing different learning styles and then to relate it on teaching style.

As it basically happens with me that when I teach students hear me out but what's the outcome of it students just make notes/clearing exams do they really obtain necessary knowledge which they can implement in their real time application and could they become that much confident in the ever changing competitive world. I teach a subject which is more practical oriented rather than theoretical and yes my learning style always influenced my teaching style. The mode of learning style which merely I adapt is Sensing Learning (Sensing Learners) though I acquire visual learning, active learning and I am more enthusiastic in blended learning by using CANVAS, MOOC (global leaning), because I see the devices and would like to work with devices but yes it takes time for me to implement, and to be clear to the point I explain them based on practical methodologies like how to make necessary connections, current calculation, parameter measurements and synthesis. A teacher should always be dynamic must poses interdisciplinary skills to share knowledge with different levels of students.

The course which I teach is Electrical Installation and Estimation which is highly practical oriented course which requires high understanding and problem solving skills to make this course interactive and engaging, I prepare some prototypes (devices) and take it to class room and display its working/principle functionalities to all different levels of students. I continuously adapt new teaching methodologies to felicitate lecture which becomes highly engaging with students they ask various questions. After taking the course, I have implemented many ways of learning and teaching styles. Each student has its own way of learning but what I believe and have observed is that.

**“They listen-they forget,
They do-they understand,
They implement-they remember”.**

Foremost thing what exactly we are teaching and what are the objectives of the concerned course that matters the most. At the end of the course what students ability is did they possess clear understanding of the topics, did they implemented any prototypes etc. There are different courses each course has its unique identity some contains theoretical, practical, problematic, application oriented.

In the reading there are various model show cased that improves the quality of teaching and learning style to be used when felicitating a lecture to the different levels of learning styles (different levels of students). The models which are reflective in the paper are

1. Jung-Myers-Briggs model
2. Learning style model
3. Teaching style model
4. Kolb's model

As mentioned in the reading there are different types of learning styles and each learning style are sub divided into two types (**Table 2**).

Each learning style has advantage and disadvantage, if a student is a sensory learner then he is keen observant, more practical oriented, relies on fact/concrete data, does work in effective manner but this learner will not be able to perform well as compare

Perception		Input Modalities		Organization		Processing		Understanding	
Sensory	Intuitive	Visual	Auditory	Inductive	Deductive	Active	Reflective	Sequential	Global

Table 2.
Shows the different types of learning styles.

to intuitive learners they are fast but reckless, they grasp quick but no implementation etc. As per the R. Felder and L Silverman reading that each learning styles differs it also depends based on the ability and the type of exam they choose. In the organization based learning style there are two types inductive learning style is based on natural behavior of student but a deductive learning style reduces interest in learning in the field engineering. The major impacts of teacher on different learning styles are

1. Be organized: In one-hour session what teacher should do and how activity can be assigned so that each learning styles meets the required level of understanding (proper time management).
2. Pleasant: Always sound pleasant to students such that when they ask question they should not hesitate.
3. Sound knowledge: A teacher must pose technical and practical knowledge to address all the levels of students and to meet their pre-requisite standards.
4. Disciplined
5. Trustworthy
6. Honest
7. Sincere
8. Committed to teach: not by chance or choice; should have zeal and passion to teach all levels of learners.
9. Be present and available for students whenever they came to ask question or doubts

As per the R. Felder and L. Silverman, in engineering education there are students which have different learning abilities, different customs, rules/regulation but as a teacher we must follow new learning and teaching styles to address all the students effectively. As in a class room there are active learners or passive learners we should encourage all the students to majorly focus on objectives, content for the course which they are undertaking. As a teacher we need to be versatile, upto-date and dynamic since there are huge advancement in technologies day by day. This article was very helpful in finding ways of teaching by implementing new ways of learning in engineering education.

Technology plays an important role in making students more interactive, participative in classroom especially after the post lunch session where students feel drowsy in detail discussion on Technology enabled active learning is explained in [6]. As there is advancement in technology the demand of online learning courses increases over traditional class room courses. Due to flexibility in time, type of course, quality of education, completion of assignments etc.

The key aspects to remember in online courses over traditional class room courses are

1. Flexibility/Time management
2. Discipline
3. Blended education model
4. Social interaction
5. Organized lectures
6. Resources, materials and assignment on time

Online course requires dedication and interest to complete the course in a given amount of time. There are many misconceptions from student's side that by skipping classes they can complete the course, completing the assignment one day before or two days before the deadlines.

5. Key aspects for instructors in online courses

1. Focus on quality of education in online course
2. Design of online course material
3. Schedule of online course
4. Course planning/Lesson plan
5. Time management
6. Assessment
7. Evaluation/Rubrics
8. Quizzes
9. Attendance
10. Interactive (Poll questions, clearing doubts)

6. Problems faced by instructors in online courses

1. In large online classes clearing doubts in one-hour session becomes difficult for faculty and when it comes to assessing student performance of more than 90 students becomes very arduous.
2. Time management is important factor to discuss cognitive issues in online courses.

7. Advantages of taking online courses (students)

1. **Flexibility and Convenience:** Reading of modules is highly required but as per the flexible time for them to read and an easy way to join discussion.
2. Able to adapt different learning styles from the beginning
3. **Opportunities in Online Learning Courses/Career Advancement:** There are number of opportunities for students to learn as compared to traditional class room course where they can accumulate better knowledge and technical skills. It makes them an individual in the competitive world why? Because it develops students listening abilities, understanding (Reading skills) abilities, communication and making notes.
4. After going through an online course student will be able to develop own learning styles and self-learning abilities it also builds up confidence.
5. Sharing knowledge is highly encouraged in discussion forums among students and faculty which makes them to think in different learning levels.
6. For all different levels of students, it gives a clear platform to acquire required skills and knowledge by asking questions.
7. As most of the LMS or CMS is implemented and developed in US based education system which is highly resourceful and knowledgeable as expert faculties and advisors will be available to upgrade and enhance students learning also expert technical team will be available to tackle out the problems associated with E-Learning class room.
8. Online courses are organized in an effective way to provide quality education to students for upgrading their skills and knowledge.

8. Significant issues for students in online courses

1. **Due-dates:** As there is flexibility in choosing the course, there is also flexibility in reading modules and assignments as per students' needs but remember that due date will be mentioned for the particular assignment and discussions.
2. **Self-Motivation:** The students should be self-esteem; motivated to learn a distant education and must poses some technical literacy otherwise it is difficult.
3. **Number of online course availability:** Many online courses are available such as MOOC, UDEMY, YOUTUBE Videos, NPTEL lectures and notes, edX, Udaacity and many more but choosing and deciding right particular course to update skills and knowledge is an invariable challenge for students otherwise high cost.
4. **No face to face interaction:** in online courses hardly face to face interaction occurs between professors and students.
5. No social communication with classmates

6. **Adaptability to struggle at beginning of course:** When taking an online course, after going through all traditional class room course makes little difficult for students of traditional mind set for adopting to online classes, in short for students it takes time to get settled in online learning courses, Course Management System (CMS).
7. Limited time period to complete the course
8. **Technical Problems:** There are various technical issues comes around during online learning courses for students such as trouble shooting problems, good internet connectivity (for examples most of online courses requires more data and speed but due to lack of knowledge in computer and wifi connectivity students find problems to get registered into online courses even though for the present generation here the students are tech savvy but unable to create a proper word document to complete the assignment for a particular task.
9. **Computer Knowledge:** As mentioned above for the present generation students are tech savvy but due to lack of knowledge in soft skills in making documents, storing the data, and retrieving the data is a major problem for students.
10. **Time Management:** Here the ability to manage time is important because all the material and resources provided to them will not be discussed in online class most of learning comes from students only which makes them self-leaners and it helps students to develop their own technical skills and knowledge which can be applicable in real time application. Students must manage time to do their reading last minute reading makes their assignment and discussion quite confusing.

9. Strategies implemented

The concept of active learning comes out of interest of students and making lectures interactive but when we conducting an active learning environment for the first time in class room students find it difficult in the beginning but when they are accustomed to it becomes simple and energetic, during the first class activity were all students are new to each other we can use can activity called ICE Breaker. Active learning among students recuperates the quality of education and also improves students' performance in solving critical problems, retention of knowledge for longer period, motivation, confidence and better development in communication/ interpersonal skills. It is a learner centered approach to teaching.

The major concerns in designing and implementing active learning in class are

1. Time management
2. Forming good groups/average groups
3. Organizing an activity with limited time period
4. For all different levels of students an active participation
5. Large size classroom
6. Material/complete handouts

7. Regularity/Punctuality of students

8. Disturbances (use of mobiles, ring tone, outside disturbance)

Strategies to overcome the major concerns (Table 3).

Course: Electrical Installation and Estimation.

Class Strength: 34.

Time: One hour.

Time Management	It is an important factor to any cause. In one hour session how to manage the lecture, topic and an activity. I have chosen a 15 minutes group activity for design of circuit and to do basic calculations. What I have found is some students have completed the task in 8 minutes and remaining seven minutes for them got wasted. For other groups they took entire 15 minutes to complete the task but some groups not even completed.
Forming good groups/ average groups	To know the level of understanding of each student I have conducted a pre-test to check everyone's knowledge depending on that I have formed groups.
Organizing an activity with limited time period	As said time is a major issue every second counts. We need to make sure that students get engaged in the task and try out new ways to solve critical problems even though the solution is not correct but trying is worth more than enough during this session.
Active Participation	It is very important that every student participate in activity choose an activity which catches students attention if its difficult problem they will hesitate to do it. If the activity is short and simple for them to design then students can ask more question related to that topic. The activity which I have chosen was JIGSAW, Think-pair-share and one minute paper writing.
Large size classroom	Not all the question of students will be covered in the activity but I have suggested students to pen down their question on a paper and submit to me so that the very next day I can able to answer all questions. I am presently using CANVAS for this task where students have asked me questions about their topics frequently. This becomes quite simple to answer all their queries in small amount of time. If the questions posted by students are thoughtful in that particular case I will discuss in class with all.
Material/handouts	Basically students like spoon feeding, the more we feed them the more they crave for. In this area I have encouraged my students to make their own notes or do self-study by providing them with necessary links and materials. If the situation is very worse (average or weak students) then I personally provide them with proper material/handout to understand the subject and should be able to apply in real time application. This happened with me where I have provided students with proper material and they really have implemented their micro, mini and major projects which are highly applicable for any application.
Regularity and Punctuality	Students can learn only if they are regular and punctual to their lectures. As the activity or the topic which we teach is thoughtful then the students will be regular/punctual. We should not repeat the same activity day by day as students feel that the teacher knows the area only apart from it does not know. Sometimes we must engage in learning with them and at times students really find some interest in attending classes/lectures.
Disturbance	Now days as there is huge demand of technology if we bring into classroom it causes disturbance in teaching and for other learners. In my previous experience students are allowed to bring the mobile phones with them for every 5 to 10 minutes a ring will be there which causes huge disturbance for me and to the learners. But in my present experience here students deposit they mobile phone in college cellar and there is no such cause of disturbance.

Table 3.
Shows the activities performed on various parameters.

9.1 Strategy to be adopted in classroom to enhance learning

- a. **Research based methods:** Students prefer a variety of active learning methods when they are not interested in something, their attention quickly shifts elsewhere. Interestingly many of the components of their ideal learning environment less lecture use of multimedia, collaborating with peers are some of the techniques to be adopted.
- b. **Relevance:** The role as a teaching is to shift the methodology from dissemination of information to application of information. The connection of course content to the current culture and happening is most important.
- c. **Rationale:** There are variety of students, one of them are millennials who are more pampered by the parents and they are not readily accept the chain of command. A culture of sharing, caring, nurturing is important to deal with the millennials.
- d. **Relaxed:** These days students prefer informal learning environment and informal interaction with the faculty inside and out of the classroom helps the students to develop the confidence on the faculty who is being taught and thus develops the respect on the subject.
- e. **Rapport:** The students are extremely relational they are more attached with the friends rather than parents. Hence, collaborative learning, team projects, group assignments etc., helps them to learn more.
- f. **Developing teaching modalities:** More usage of smart boards, audio clips just like play way method, teaching through management games are useful to attract various types of learners [3] and to stimulate the cognitive level.
- g. **Materials related to learning:** Case study methodology helps the students to understand the learning and encouraging the students to present the ideas through point of discussion.
- h. **Collaborative Learning:** Encouraging the open up of a dialog with the students and letting the students to develop the curiosity and explore the new things is a part of brain based learning.

Another strategy, I conducted in classroom Active Learning with concerns & strategies adopted Technology tool as Smart board, Mobile Phone Ring tone to commence & complete the activity:

Concern-1: I got ready and prepared with one topic and due to active learning technique, lost control over the topic and I ended up in teaching other content which wasted time.

Strategy: I should concentrate on the topic and should know where to stop if the content is getting diverted. As I cannot resist the students from learning, I can give the topic for home assignment.

Concern-2: Actually I took 20 minutes' time to explain the topic Electrical Machine: Synchronous Generators but due to the activities it was extended to 50 minutes.

Strategy: I should blend the course delivery according to the time schedule provided by university and plan according to maintain relevance of activities for students. I should be able to spend some good time to planning and designing the course delivery.

Concern-3: In group activities, some students were not involved completely. I found minimal involvement of some students.

Strategy: As my class strength was of 60 students, I divided the students into ten groups each of size 6. I found that for some of the activities one or two persons is enough to address the issue other four/five students were just observing. So I need to take care in designing the questions for group activities so that every student is having solid work to think and engage. In case of smaller activities, I will design tasks for individuals even though they are working in groups.

Concern-4: Some students are feeling that I am not taking enough responsibility in teaching the content and they are feeling burden to learn themselves.

Strategy: Since childhood days, they are trained and brought up in the same old traditional method. It is then better to start with small topics rather than going extensively as they need time to adjust to the changing system.

Concern-5: I am also in learning stage in adopting this system.

Strategy: Implementing such activities is quite interesting for me but I need to spend lot of time in knowing the techniques available in active learning. The interesting part in this activity is that I am learning a lot from my students.

9.2 Results and evidences of canvas implementation

Technology and Engineering Education is the use of accumulated knowledge to process resources to meet human needs to improve the quality of life. Students develop the ability to select and correctly use course materials, modern tools, techniques and processes to answer questions, understand explanations and solve problems encountered in real life applications in mini/major projects. These over-riding themes require students to design, research, create, use, evaluate and modify systems of Electronics, Electrical, Biotechnologies, Information Technologies, Cyber Technologies and Physical Technologies [7] (Figures 1–15).

Figure 1.
Shows the dashboard of LMS which includes various courses.

Figure 2.
Shows the syllabus of EIE course.

Figure 3.
Shows the notes uploaded for students reference and learning.

Figure 4.
Shows the assignments/discussion given to students.

Figure 5.
Shows the discussion question for 10 points.

Figure 6.
Shows the students response for the given question.

Figure 7.
Shows another student response for the given question.

Figure 8.
Shows the assignment task.

Figure 9.
Shows the assessment tool used rubrics.

Figure 10.
Shows evaluating students' performance using speed grader system.

Figure 11.
Shows the attendance list of students and their activity details when using canvas (2019).

Figure 12.
Shows the total strength of students list when available online & date.

Figure 13.
Shows the attendance list of students & faculty and their activity details when using canvas (2019).

Figure 14.
Shows the use of technology through Whatsapp54 6 for transferring the information on EEE course.

Figure 15.
Shows the use of technology mentioned here is the four-year duration of course of syllabus (2017–2021) batch.

10. Conclusion and results

There are advantages and disadvantages of active learning in class room some students learn but some do not but I as a teacher it's my responsibility to make them learn and concentrate in class. Active learning boosts the confidence of students and their involvement towards the subject.

Hence by implementing the above strategies student's confidence has improved they discuss their ideas and thoughts without any hesitation. There were some difficulties in managing classroom due to sudden change of teaching from tradi- tional method to active learning methodologies in the initial classes but later with more organized manner I was able to implement good strategies in classroom such

as Think Pair Share, Write Pair Share, Collaborative learning, JIGSAW etc. and many more. Below statistical representation of data is shown and improvement of students leaning through active learning techniques [8] (**Tables 4 and 5**).

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The major goal for engineering educators who want to instill critical thinking skills in their classrooms is to think of their students not as receivers of information, but as users of information. Learning environments that actively engage students in the investigation of information and the application of knowledge will promote students’ critical thinking skills. In engineering education any skill, critical thinking requires training, practice, and patience. Students may initially resist instructional

Course Instructor	SYED ABDUR RAUF MAGRABI			
Couse Title	Basic Electrical and Electronics Engineering			
Classification of Students	Advanced Learners	Slow Learners	Absentees	Total Students
No. of Students	11	18	7	36
Percentage (%)	8.33%	80.55%	11.11%	100%

Table 4.
Shows the performance of students.

Aspect	Excellent	Very Good	Fairly Good	Unsatisfactorily
Deepening the understanding of the concept	✓	—	—	—
Promoting motivation to learn more about the concept/subject	—	✓	—	—
Encouraging class participation	✓	—	—	—
Building confidence	✓	—	—	—
Contributing to the joy of learning	—	✓	—	—

Table 5.
Shows the feedback obtained from students upon the conduction of activity based learning.

questioning techniques if they previously have been required only to remember information and not think about what they know. They may struggle with assessment questions that are not taken precise from the book. However, by encouraging students throughout the process and modeling thinking behaviors, students' critical thinking skills can improve [5]. The reasons for allowing new teaching & learning techniques in classroom is to enhance the ideology of students to learn new things and to develop a real time project to tackle day-to-day life challenges, engaging in group learning activities helps the students to communicate with their peers without any hesitation. The learning outcomes for any engineering subject allows them to think and to do self-learning where teacher acts as facilitator and students a learner.

11. Students feedback

The above activity through technology based learning was implemented for diploma EEE second year students in Electrical Installation and Estimation and for B.Tech CSE Third year students on Non-conventional Energy resource, has a common topic on Safety procedures in electrical power engineering (Table 6).

At the end of the conclusions the following issues the students face when using technology and solutions as per student's feedback being provided below:

11.1 Issues of students

- Limited social interaction
- There is a limited opportunity to interact face to face to professors and other peers.
- Difficulty to develop relationships with classmates.
- Possibility of limited local networking opportunities.
- Most of the communication through e-mail, chat room of discussion groups, but no office to get together.
- No campus atmosphere to create social interaction.
- Computer boot-up time, software, connection to internet student may be required to learn computer trouble shooting skills.
- Addition cost of high speed internet.

S.No.	Questions	Poor	Fair	Good	Excellent
1.	Clear to understand the course content	0%	10%	20%	20%
2.	Discussions/materials posted was useful	0%	15%	10%	15%
3.	Would you recommend this course to friends	0%	12%	24%	14%
4.	Have you enjoyed online learning through technology based	5%	10%	15%	10%
5.	How far the topic was relevant	4%	20%	20%	6%

Table 6.
Shows the feedback obtained from students on electrical & electronics engineering course.

- Planning and adjust the studying schedule around instructor's assignment due date. If a student is scheduling to study in the nights, then he/she will have to wait for response from instructor.

11.2 Solutions to student's issues

- Students must have convenient access to the internet at home or through college, library and community computer.
- Students must know exactly what kind of technological support they need for certain course and properly equip themselves for the successful completion of assignments.
- To manage the assignments and course in an organized manner student need to develop proficiency in computer.
- Students must learn basic knowledge of computers, internet and typing.
- Students must have their own email accounts to access to a group conferencing program.
- Students must demonstrate the maturity to be responsible in the use of internet and own email accounts.
- Students must be self-motivated to get online and conduct their homework internet activities.
- Students and faculty can communicate through discussion forums, discussions can help group work among students and sharing the knowledge which leads to higher learning outcomes.

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