

# Technology Enabled Active Learning in Electrical Engineering

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**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 analyses the effects of the unique learning environment of the TEAL on students' cognitive and affective outcomes. As part of the project, we developed pre-test and post-tests 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 group and a control group. TEAL students improved their conceptual understanding of the subject matter to a significantly higher extent than their control group peers. Most 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 student's 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:** Teaching, learning, pedagogy, instructional methods, engineering education, teachers

## 1. Introduction

Active learning requires students to develop their understanding of content through the active construction of a product, the solving of a problem, or both and embodies a long human tradition of learning through doing. 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,

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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].

## 2. Active Learning Benefits and Teaching-Learning Process

- 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.

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 student's 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

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 won't be able to perform well as compare 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 behaviour 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 poses 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.

### 3. Strategies Implemented

The concept of active learning comes out of interest of students and making lectures interactive but when we are 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 an activity called ICE Breaker. Active learning among students recuperates the quality of education and 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 as follows:

1. Time management
2. Forming good groups/ average groups
3. Organizing an activity with limited time
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 implemented on Electrical subjects to overcome the major concerns as described below

Course: Electrical Installation and Estimation

**Class Strength: 34**

**Time: One hour**

#### 4. Conclusion and Results:

There are advantages and disadvantages of active learning in class room some students learn but some

**Table 1: shows implementation of strategies**

<b>Time Management</b>	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.
<b>Forming good groups/ average groups</b>	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.
<b>Organizing an activity with limited time</b>	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.
<b>Active Participation</b>	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.
<b>Large size classroom</b>	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 a mount of time. If the questions posted by students are thoughtful in that case I will discuss in class with all.
<b>Material/hand outs</b>	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.

<b>Regularity and Punctuality</b>	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 doesn't know. Sometimes we must engage in learning with them and at times students really find some interest in attending classes/lectures.
<b>Disturbance</b>	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 their mobile phone in college cellar and there is no such cause of disturbance.

don't 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

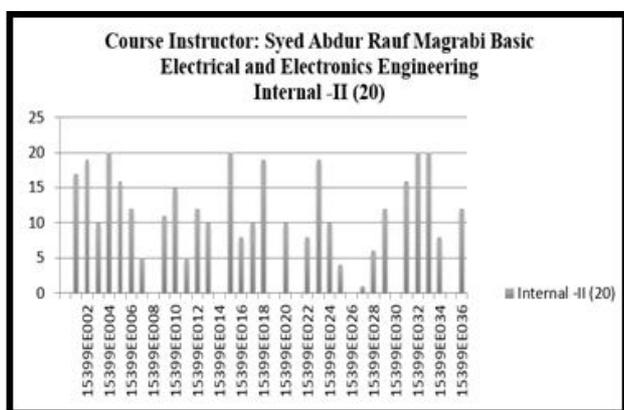


Figure 1: shows the results analysis of students after the implementation of active learning strategies.

Course Instructor		SYED ABDUR RAUF MAGRABI			
Course 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%	

Figure 2: shows the result analysis and performance level of students.

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 traditional 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.

Students Feedback: The above activity through technology based learning was implemented in last semester (2016-2017) for diploma EEE second year students in Electrical Installation and Estimation, topic design safety procedures in transformers (step-down) in electrical engineering.

**References**

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Table 2: shows the student feedback on activity

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%

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