Successful strategies implemented in active learning: ECE Perspective

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Abstract: This paper summarizes the different pedagogies used in teaching various courses of electronics and communication engineering in classrooms and laboratories. These activities may be clustered under ‘active learning’. It is described the Activities and the different attributes associated with each activity, together with the advantages of using them is discussed in this paper. The above activity model instead of just a single finished lecture model. The desire to increase learning between students has exploded while making the topics increasingly interesting for them, they studied several of these techniques internationally as successful teaching Procedures. Traditionally, lecturers might think they do an active learning when they ask questions and a often few students respond or talk within the same group of people happens now and then .While this includes student participation, it only involves a small fraction of a broad class Which is not ideal in terms of gain for the class as a whole and class individuals. Active Learning takes place in your class by asking a question, posing a problem, or throwing some type of dispute with them; Ask your students to respond individually, or in pairs or in small groups; give them some time to do it; interrupt them, and invite one or more individuals or groups to share with the class their answers.. This paper ends with a variety of validated ways to implement active learning approaches in engineering class and also suggested the appropriate active learning scheme for different courses such as introductory, problematic, having more equations, project based , laboratories and many more. The survey/feedback is conducted among the students to suggest the suitable practice for suitable course.

Keywords: Active learning, engineering education.

1. Introduction
Effective learning approaches aim to promote successful ways for learners and teachers. active learning schemes are used to participate in activities based on their ideas and learning levels of students. Every active learning projects uses several active learning techniques.

The aim of this paper is twofold: improve knowledge of active learning and its role in academic career, include strategies to incorporate active learning in curricula of engineering and research. The active learning research promotes the use of constructive learning, higher order thought and increase student enthusiasm for learning. Faculty leaders, including adjunct faculty preceptors, will strive to incorporate constructive learning in the professional curricula using classroom-based activities and outcome-based learning.
The engineering is such a course of study in which the learned concepts need be applied for every future application either in academics or industry. To remember the concept for a longer time it is essential for a student to understand properly. Learning is the teaching commodity; it doesn’t happen effectively just with a conventional class room teaching. In this context it is better to implement active learning strategies in the classroom teaching[2-4].

Active learning is a teaching technique, requires active involvement of students in classroom activities well planned by teachers. This approach will actively engage the students in their classroom of experiential learning environments. Active learning requires transferring some influence from the teacher to the learner over the learning environment.

Passive learning predominates in a conventional lecture, which usually have one-way transmission of teacher-to-learner, which are available in course material. Effective learning involves students as partners in the process of teaching-learning and make them responsible for their own learning.

Effective learning of courses and curricula has the benefit of including student participation in activities such as promoting higher-order thought, problem-solving, critical analysis, and assessment of students on learning process. It also keeps greater focus on student exploration of behaviours, beliefs, habits, and can improve students’ interest in learning to develop their skills. There are Five key shifts in instructional experience to learner-centered curriculum orientation have been recognized: changing and exchanging of authority between instructor and student; changing the position of instructor from specialist mentor to coach facilitator; developing a learning atmosphere that allows students to take more responsibility for their learning. In coordination of course material with the implementation of learning strategies, and the participation of students in the intent and evaluation process, which requires peer reviews and feedback. As the word active learning means, a emphasis on learning will allow teachers to concentrate less on particular instructional methods and more on ways of encouraging learning in their pupils[5-7].

In a typical 60-minute lecture, student interest peaks in the first 10 minutes, decreases gradually in next 45 minutes and then rises again in the last few minutes of the lecture. Furthermore, the concentration of information conveying during the lecture decreases significantly after 10 minutes and continues to drop before the last few minutes of the classroom lecture. It is observed from the literature, immediately after the lecture the students can recall approximately 70 per cent of the information provided in the first 10 minutes of the presentation, and about 20 per cent of the information provided over the last 10 minutes. The active learning is classified into subgroups as follows, first subgroup is Collaborative learning is refer to any educational approach in which students in small groups collaborate together for a shared goal[2]. It means that interactive learning can involve all group-based teaching approaches. Emphasis on students is the main criterion for collective learning Interactions more often than learning as a practice individually.

Second subgroup is cooperative learning can be described as an organized type of group work in which students follow shared goals while being independently assessed[3, 4]. Mutual learning’s essential requirements are based on mutual opportunities rather than competition for learning facilitation. Another sub group is Problem-based learning is an educational approach where specific topics are presented at the outset of the research subject process and used to establish the framework and significance for the learning. This mechanism is still involved and doesn’t always require teamwork or partnership. Problem-based learning can usually require high rates of self-directed learning[1].

This paper outlines the latest scenarios and the way to incorporate constructive learning in Electronics and Communication Technologies used for a few subjects.

2. Different Strategies Implemented
1) Strategy I: Introductory courses are usually pre-requisite for engineering graduates. Analog Electronics is one such example. It has more basic concepts consists of many equations to remember. It is very difficult to remember for a student. Similarly Electromagnetic waves and transmission lines is
another such prerequisite course. All such courses need more learning and practice to understand. The conventional teaching may not solve the purpose.

The active learning strategies implemented in delivering these courses are

**Practice 1:** A set of solutions and formulas in the form of a mini textbook is made available for the students. In this mini textbook along with above specified material it also consists of lots of homework and practice problems. These problems are practiced in tutorial classes.

**Practice 2:** Teaching with active learning strategies, students can understand easily. Think pair share is the perfect one to teach these types of difficult subjects. Students can sit and talk with peers nearby.

**Think pair share:** It demonstrates to students that a Think-Pair-Sharing enables them to access their previous expertise and exchange insights with peers on content or beliefs. This arrangement offers students with an ability to share their ideas—first in their own heads, then in a smaller environment before communicating with the entire school. Students think separately about the problem or idea(s) brought out in a Think-Pair-Share, pair up with others to discuss their thoughts, and then share their conversation with their table party, and eventually with the whole party[8,9].

Give the students 1-2 minutes to think for themselves about the question and allow them for another few minutes to chat with a friend. Which implies to

- Win their answers.
- Allow students to expand on their reasoning by presenting context, facts or interpretation.

Questions recommended for inquiry:
- What is it that makes you think?
- Give us an insight from your perspective
- What are you talking about?

- Seek to stay impartial in your reaction to remarks from the students.
- Encourage them to react by presenting alternate views, compromises and disputes and respond to ideas. Questions recommended for inquiry:
  - Could anyone add to the comment?
  - Who wishes to express a different opinion?

**Strategy II:** One of most understandings from the subjects Probability theory and signals and systems are understanding of problems. The probability questions are very lengthy in nature, once the problems are understood it prepares the students to answer more than 50%. Sharing the ideas and encouraging the discussion among the students will be the best solution as per the understandings. The active learning practices implemented in these are

**Turn and talk:** In this practice a question is posed to the class in turn to chat and the students literally turn to the person next to them to answer it. This will act as a simple place for students to communicate with others their thoughts and set the tone for them to communicate with the wider community. The teacher doesn't need to hear any (or any) of the shared ideas—the crucial part of this approach is for peers to communicate and individuals to have access to their previous understanding of a subject. Reference prompt: Tell students to turn with someone next to them and share their responses to the problem below. Ask them to take two minutes to speak to their companion about this, with each person having some time to chat [11,12].

**Individual plus Group Quizzes:** Offer students a quiz that they independently complete and send in to score. Immediately after the individual quiz, position students in small groups and make them do the quiz again, except this time they share their group's answers and hand it in for group ranking. Both quizzes are graded, and the two scores are combined if the party score is higher. If they get a higher individual ranking, the party ranking can't harm anybody. It promotes individual responsibility, which
also lets students appreciate the content better when they speak to friends about it. We keep up with
the content in this manner, rather than knowing that as we hit the midterm they don't fully grasp it.

**Strategy III:** Communication based subjects have more theory with block diagrams, to remember all
block diagrams is very difficult, Jigsaw is most suitable learning strategy to learn better way.

*Jigsaw:* Students operate in small groups interpreting knowledge grouped into categories. student in
the school reads one part of the content and then shares the detail with the rest of their school. They
respond to prompts such as: How do you mean by that idea? What is the big idea? How to use your
idea to help understand the concept(s)? Which questions do you have about what you're reading? How
do you agree with / do not agree?

Jigsaw permutations are complex. Another such model incorporates specialist and cooperative
groups: a specific aspect / part of the overarching knowledge should be delegated to each group-they
read it independently and then address it in a small community of "experts" to ensure that they all
understand it.

*Cooperative groups:* "Cooperative" groups are formed, consisting of one-two students from each of
the initial groups of experts. In this way, the new groups have a "expert" delegate from each of the
original groups such that the current cooperative community actually contains all of the details. The
"expert" has had an opportunity to experience communicating and hearing different opinions on the
knowledge in their initial group, and therefore is likely to be more confident communicating within the
current community. For communication-based subjects this form of active learning approach is
needed. So that they can learn more about sharing their thoughts with others, and helpful in studying
based on the problem before the exam.

**Strategy IV:** For classes where labs play an important role, it is an excellent opportunity to allow
students to commit to conducting laboratory sessions themselves in the teacher's presence. In the
laboratory experiments are divided into three 1) demo experiments: students connect as per the circuit
diagram and observe the results. 2) Design experiments: the students are design the circuit with a
given aim with different component values. 3) Structured experiments: students can decides an aim
and solve the solution and make circuit based on the topic given, so that they can practise and feel the
laboratory environment effectively. A balanced debate on the topics will usually take place and can
very easily relate the principles from philosophy to reality. Peer support is also an essential aspect
and can be used effectively in laboratory sessions. This ability to communicate is very effective. Perhaps
this effectiveness of this method is linked to student attention span during lecture.

**Strategy V:** In the curriculum some courses ends with implementing a project, To improve the practical
and applications knowledge the suggested active learning is Project-based learning (PBL)

*Project-based learning:* is a student-cantered pedagogy that includes a collaborative classroom
approach through which students are expected to gain a deeper understanding through the constructive
investigation of real-world challenges and problems.[1] Students learn about a topic through engaging
for an extended period to explore and respond to a particular issue, challenge or problem[2]. It is a
type of learning focused on constructive learning and questioning. PBL compares with paper-based,
rotary memorization or teacher-led teaching, which introduces proven facts or represents a seamless
road to understanding by presenting questions, difficulties or scenarios instead [3].

**Strategy VI:** To create interest among the students and for better understanding most of the faculty in
the department prepared the puzzles, one of such practice is crossword puzzle. It is a word puzzle that
typically takes the shape of a square or a rectangular pattern with shaded squares in white and black.
The goal is to fill the white squares with letters, type words or phrases, by solving clues leading to the
answers. In languages written from left to right, terms and phrases of the answer are put in the grid
from left to right, and from top to bottom. The shaded squares are used for dividing verbs or sentences. This practice shows fruit full results if we implement the same in delivering the instruction set of microprocessor or micro controller. The students are given with a worksheet of crossword puzzle in which, horizontal and vertical hints are provided to fill the puzzle [10].

The above are the strategies used in various courses of Electronics and communication engineering. The student survey/feedback is conducted after implementing these techniques. The student feedback is discussed in the next section.

3. Students feedback
After completion of active learning class taken a feedback from the students. They respond more positively and it is reflected in external examinations. Examination results 20% more improvement in obtaining marks and pass percentage.

![EMTL students feedback](chart1)

![PTSP students feedback](chart2)

![SSD students feedback](chart3)
The next strategy to implement more than one Active learning strategy in each subject, but students more liked ones are different in various subjects based on student’s feedback concluded that various courses has various strategies. Report on examination results:

| S.No. | Subject cleared without using active learning strategies. | No. of students Subject cleared without using active learning strategies. |
|-------|----------------------------------------------------------|------------------------------------------------------------------------|
| EMTL  | 70%                                                      | 90%                                                                    |
| PTSP  | 65%                                                      | 88%                                                                    |
| MPMC  | 72%                                                      | 91%                                                                    |

4. Conclusion

There are several active learning methods to improve the learning levels of students. The 21stpeer group students have very less patience and fast grasping, keeping these constraints in view it is essential to use the class duration effectively. The strategies discussed in this paper are proven practices implemented in the Department of Electronics and communications of S R university. It is observed from the survey conducted among the students the above strategies are given good result. These strategies improved the students learning. Strategies 1 is very effective for the subjects where the more equations and more formulas to remembers.

It is very difficult to frame or prepare a question in some subjects like probability theory the strategy2 is worked a lot in this kind of subjects, students are assessed for both framing the question and preparing the answer. One of the best active learning practices found is jigsaw it improved the learning levels of the students effectively discussed in. strategy 3. The next strategy 4 of dividing the laboratory experiments into different categories helped the students and results in a greater number of students are actively participated and executed the experiments. Project based learning (strategy 5) is implemented in smart system design where the students are developed a good number of projects. The students found very interesting in assessing the instruction set of microprocessors by using a cross word puzzle which was discussed in strategy6. In addition to these practices continuously assessing the students using google forms, discussions in Learning managements software (LMS) results in effective engagement of students and found great improvement in their learning.

References

[1]. Bonwell CC, Eison AJ. Active Learning: Creating Excitement in the Classroom. Washington, DC; George Washington University Press; 1991. ASHE-ERIC Higher Education Report No. 1
[2]. Kember D, Gow L. 1994, Orientations to teaching and their effect on the quality of student learning. J Higher Educ 65(1), 58–74.
[3]. Barr RB, Tagg J. 1995, From teaching to learning—a new paradigm for undergraduate education 27(6),12–25
[4]. Akerlind GS. 2003, Growing and developing as a university teacher–variation in meaning Studies Higher Educ 28(4), 375–390
[5]. Millis, B., and P. Cottell, Jr. 1998, Cooperative Learning for Higher Education Faculty American Council on Education, ORYX Press.
[6]. Feden, P., and R. Vogel 2003, Methods of Teaching: Applying Cognitive Science to Promote Student Learning, McGraw Hill Higher Education.
[7]. McKeachie WJ, Svinicki M. McKeachie's 2006, Teaching Tips. 12th ed. Boston, MA: Houghton Mifflin
[8]. S. Talele 2013, Effective Active Learning Strategies I Have used in University Class Room, Proceedings Of Edulearn13 Conference
[9]. Sangaraboin, S. 2019, Technology contribution for effective teaching and learning of languages International Journal of Recent Technology and Engineering 8(1C2), 244-249
[10]. Shailaja, S., Satyanaraya, T., Goverdhan, C. & Srinivas, A. 2018, Definite aims and objectives of teaching english language Indian Journal of Public Health Research and Development 9(11), 726-729.
[11]. Reddy, R.A. & Reddy, G.S. 2018, Identifying the evolution of ways towards thinking about the students mathematical learning process Indian Journal of Public Health Research and Development 9(11), 734-738
[12]. Kumar, J. T., Malathy, V., Anand, M., & Kamali, S. M. 2020, Collaborative Learning in Engineering Education and Overcoming the Hassles in the Classroom Implementation Solid State Technology 63(1), 183-187
[13]. Venkateswarlu, P. 2017, Establishing a Centre for Engineering Experimentation and Design Simulation: a step towards restructuring engineering education India, European Journal of Engineering Education 42(4), 349-367