Journal of Engineering Education Transformations ,
Volume 36 , No. 2 , October 2022 , ISSN 2349-2473, eISSN 2394-1707

10.16920/jeet/2022/v36i2/22166

Engineering Education with Tool Based Technical Activity (TBTA)

R.Dineshkumar [1], M.Kalimuthu [2], K.Deepika [3], S.Gopalakrishnan [4]
[1] Department of CSE, Siddhartha Institute of Technology, Hyderabad-500088, India
[3] Department of Information Technology, Kakatiya Institute of Technology, Warangal-506015, India
[4] Department of ECE Siddhartha Institute of Technology, Hyderabad-500088, India

Abstract : The main aim of Engineering education is to impart intellectual development and promote technical skills to engineering students. Teaching methodology plays a major role in the teaching-learning process. The basic goal of engineering students is to nurture knowledge in the relevant areas. Engineering education is technology-oriented; the learners should apply his/her knowledge to a specific application. To develop their technical skills, the students should identify suitable learning styles for their potentialities. The proper teaching methodology is a key point to success in engineering education. The industry expects the students to be high-quality engineers and industry-ready after completing their courses. Due to lagging in technical training and syllabus provided by the university doesn't match with the real- time industry projects. To achieve these outcomes technical-based activity needs to be enhanced in engineering education. In this paper, we proposed a Tool Based Technical Activity (TBTA) teaching method that converges traditional teaching methods which improve the student's attention in learning. Students' feedback with TBTA improves students' learning, communication, technical skills, and knowledge.

R.Dineshkumar
Department of CSE,
Siddhartha Institute of Technology and Sciences,
Hyderabad-500088, India

Keywords : Knowledge, Presentation, Communication, Technical, Teaching-learning, Feedback

1. Introduction

Engineering education demands precise learning skills. The interactive teaching and learning method leads to improve creativity, innovative thinking and problem- solving capabilities. The Proposed effective teaching method improves student's critical thinking. Once they are interested in critical thinking, everyone turns into attentive learning. Hence the psychological needs like approval, recognition, freedom, success must be identified among student's levels and thereby he/she must be motivated.

In this regard teaching and learning process for Engineering students should have little attention to improve cognitive abilities and learning skills. The traditional teaching method does not have more interaction between teachers and students during lecture hours. The primary challenge of engineering educators is to identify a suitable method for classroom learning. The tool based technical activity (TBTA)technique is more appropriate for engineering students to improve his/her cognitive ability.

Going beyond the bounds of textbooks and creating something new might help a person grow in terms of practicality. For an undergraduate student, workshops, seminars, and conferences held at regular intervals serve as an equal motivation. Being exposed to these practices makes a student to prone learning and improving with every session. Configuring various academic highlights is done on studies and workshops on a parallel basis. It is always a better option to exercise the open-source technical tools for enhancing the engineering education system. This experimental study demonstrated on undergraduate engineering students developed their skills through Tool Based Technical Activity over Technical seminars. With the TBTA activity, more knowledge has been gained by the students on software design and development. The industry projects empower knowledge that does not necessarily end with the academic term.

2. Literature Survey

[1] Faculty help the students understand to identify the mathematical ideas towards implementation in application. The collaborative argument is introduced in traditional problem-solving statics. The low-performance students gain more benefit in a collaborative argument.

[2] Identified 53 Open source tools related to the Computer Science Engineering domain and assigned them to 53 batches of undergraduate engineering students. Every batch demonstrated their assigned tool with a presentation. The Tool based Technical activities are evaluated in three dimensions such as knowledge, presentation skills and communication skills. We also compared which relevant skill was developed more by TBTA than the existing method.

[3] The work deals with the various strategies methods carried out. The technology identifies an ecosystem to share technical knowledge between the students. The students are motivated to take a step forward and take up a career with innovative methods.

[4] The various pedagogies involved in classroom-based learning are discussed to ensure the learning mindset of the students in a better way. Problem-based learning in the classroom achieved a good result. It also includes new advanced pedagogies to support better understanding.

[5] MATLAB is a software package that is for designing, optimizing and visualizing data. It helps to solve a problem quickly and efficiently by using computer algorithms. The main aim is to convert the teaching methods into the learning experience through hands-on practice. At the end of the course based on the questionnaires and communications with academics, it may reach a good position.

[6] This explains the two issues on curriculum development programmes among faculty and to increase the learning experiences on different problems in the schools. It makes the foundation to study engineering in various disciplines. It starts with the setting the context of the developments, fulfils the skill gaps of graduates and provides details of themodel finally it concludes with the re-building of the curriculum across many disciplines.

[7] The computing professional skills assessment (CPSA) is a tool used by ABET to evaluate non-technical student learning outcomes in the computing field. Quality assessment methods are needed in computing education to give accurate and valid assessments for the learning skills and knowledge. To effectively meet this need, the CPSA was developed and work to guarantee that it is a reliable and effective instrument has been performed. CPSA has demonstrated reliability and validity through the implementation, construction and concurrent forms of validity

[8] In engineering education problem solving is very much important from the first year onwards. During the study, the students are involved with various other disciplines which require problem-solving skills to achieve industry-ready engineers. The Previous scenario on teaching methodologies reflects a very less percentage of learning skills among the students. After the implementation of ICT- based teaching methodologies, the learning capability of the students is increased. The computer programming subject in the first year lays the foundation to provide solutions for various problems using recent technologies.

[9] The traditional-based technique is not suitable for today's current scenario. The tool-based technique enhances the student's knowledge in thinking and creativity. The conversion from syllabus topic to digital is somewhat difficult for the faculty to

adapt. Technology- oriented teaching has been made to the students to understand the topic easily.

[10]The complex problem in computer science is inculcated with learning outcomes, assessment and teaching-learning activities provide a holistic way for the department for a better teaching-learning process. The procedure applies to all the engineering disciplines depend on the student learning outcomes.

3. Observational studies

Tool based technical activity is focusing qualitative research approach that is more and more used to examine the dissimilarity, or the variation, in the way that persons within a specified population experience a particular incident. For example, within education, TBTA can be used to recognize and measure the different ways of students experience in this meticulous part of learning.

The following research questions are addressed by TBTA system.

1. How to create a group of students are interested in understand, appreciate or experience this concept after studying it?

2. What are the ways to facilitate engineering students to comprehend this concept?

3. What are the different methods used for teaching and learning?

4. What are qualitatively studies has been taken for engineering students learning experience during this study period?

5. What are the methods used for evaluating, and improving the teaching -learning process in this TBTA model?

4. Methods and experimental design

The teaching and learning process in engineering education is always evolving to incorporate the possibilities that technological advancements provide. Remote and virtual laboratories, virtual classrooms, augmented reality, data visualizations, and mobile applications are examples of emerging technical supports for lecture approaches based on problem-based education, case-based learning, and virtual education that are currently in use. In engineering education, these approaches are linked to more active student-centred teaching.

As a result, it is critical to assess the true impact of new teaching approaches in engineering education, as well as to be prepared to expand and share successful case studies. Now we are introduced a new method is participative learning. This learning system is together with the teacher and students actively involved in improving the teaching-learning process. This learning system intends to create a good relationship between teachers and students. In this method of teaching, students are taught to be independent, under the supervision of the teacher.

To enhance teaching-learning system, participative learning was attained by segregating students into a cluster. The students have grouped into five members based on their interest. The follow-up is taken in such a way that each group engages with different learning styles and is graded. The Participative learning method was evaluated using a group presentation on the technical subject. It is observed that each group presented the topic to their best using information gathered from multiple sources.

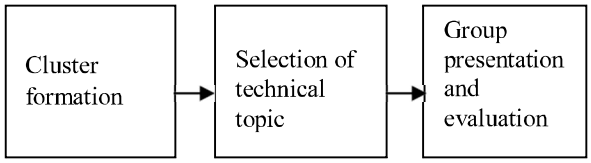

Fig.1: Process of participative learning

5. Methods For Enhancing Learning

Creativity and Critical Learning

With the beginning of knowledge-based engineering education in modern years, creativeness has developed into an essential issue for teachers and students in both teaching and research. It has more and more predictable that engineering students must be creative and inventive to deal efficiently with the fast-shifting technology and conditions in the engineering career around the world.

In latest years, several research studies have established that creativity can be motivated or inspired by teachers who have the passion for and enjoy the teaching profession, understand the natural history of creativity, and believe that most engineering

students are talented on the increasing creativity. A modern study of engineering teachers reported positive results on their observation of the nature of creativity.If creativeness is predictable from students, a teacher must give them chance for creativity by having them effort on open-ended problems. Moreover, case studies of engineering projects and individual stories from the teachers own understanding give practical content and can stimulate students in shaping new ways of thought and a new attitudes in seeing themselves as being involved in a creative line of work and in becoming imaginative individuals. Tools must be afforded to facilitate students to take into custody and influence ideas.

Cooperative - Competitive Learning

Cooperative learning is the contradictory of aggressive learning methods. In cooperative learning, student clusters work together both internal and external the class trial, on assignments, or talk about and share knowledge of the course material. The procedure can be explained generally as constructive for all group members as the result is based on the combined effort of different students, each contributing according to his or her capability.

In comparison, the aggressive learning method is unique and in general, explains as a less constructive understanding though it often has a preference by students who like competing with others for the uppermost grade and those students who do not need the maintenance of a cluster in finishing problem-solving assignments. So it is taken as whole excellence of the learning experience is improved by the use of the cooperative learning technique. It benefits students that require some support and help in consultation, explanation and getting recognizable with the course subject.

On the other hand, many teachers use an aggressive approach where they launch a new and testing topic requiring a warm-up period of come up with that places individual student's to be more interactive classroom discussions

Group Learning

The performance of a communication-intensive curriculum in engineering teaching is exigent because of the inadequate number of engineering faculty trained in both communication and engineering. At last, the individual flavor of communication-based courses evaluate to the objective and consistent nature of courses in the core areas of engineering investigation and mathematics is a challenge for the communications teachers in inspiring engineering students to employ with the courses.

Communication ability and group effort can be perfect through group projects that engage presentations to the class. But, normally, students did not provide enough concentration to group projects and group verbal presentations if the marks did not calculate for a considerable share of the total marks for the course. In addition, as much as some students are not provoked by or are dispirited by oral requirements and would prefer not to have them, they do advantage from practice and understanding with “dry runs” in their education instead of building their first proper presentations before their superior.

6. Proposed Method

In the past few decades, many teaching methods have been developed to provide better engineering education which includes ICT-based learning, team learning and problem-oriented learning. To excel in the teaching and learning process we initiate an effective teaching-learning system. In this method, a learning circle is created by assigning a task to a set of students which develops teamwork culture and creates interest in learning.

In this paper, we proposed an enhanced engineering education system using Tool based technical activity (TBTA). TBTA integrates presentation and demonstration of various computing Open source tools such as Wire shark, Autopsy, Orange, HashMyFiles etc.,

7. Student Survey And Feedback

At last, after the demonstration of each tool, the feedback from the students have been collected to ensure better education on three principles

- Knowledge
- Presentation skills
- Communication skills

The survey consists of 5 statement columns like strong conflict, conflict, neutral, accept & strong accept. Students are assessed with a 5-point scale to

Table 1: TBTA Student Feedback Summary

S.No	Dimension	Survey Questions	Strong Conflict %	Conflict %	Neutral %	Accept %	Strong Accept %
1	Knowledge	i) TBTA had clear goals and course outcomes.				28	72
		ii) I have gained knowledge and information through this activity.			5	58	37
		iii) The information which was presented in this activity highly pertinent to my needs and expectations		2	6	77	15
		iv) This activity helped to create awareness and to have practical exposure of various Open Source tools			3	15	82
2	Presentation skills	Overall aspects of TBTA was basedon i) Download and Installation of Tools.			9	67	24
		ii) Oral Presentations			3	82	15
		iii) Tool demonstration			2	70	28
		iv) Relevant to practice		3	4	64	29
		v)Technical issues during installation		2	4	75	19
		vi) Questions and discussions		3	5	72	20
		vii)This activity was highly pertinent to emerging technologies			2	7	91
3	Communicationskills	i)The Questioning session was very useful to clarify the doubts			3	82	15
		ii)Discussion part was more beneficial for me to upgrade my knowledge			5	85	10

rate these claims. More than 500 students and 150 faculty members participated in the demonstration and provided feedback. In Table 1, the quantitative responses are reported as a percentage.

7.1 Peer Learning:

Students study from peer groups and associate students in a relaxed way rather than under an authority. Peer learning gives confidence to students to share thoughts and creates them more learner-centric. As part of civilizing teaching culture, peer learning was put into practice by bunch students into groups. The students are crowded together in a group of 5 based on their interests and each group is assigned an advanced technological topic in the Communication Engineering course. The proposed topic to each cluster is an end-to-end method which was constructed using the essentials talk in the class. The Peer learning method in employment was assessed using a cluster presentation on the technical topic.

8. Outcome of the survey

Students would like better to work in these innovative methods and to engage personally in participative learning. The majority of students comprise that they can learn at their own pace contentedly through participative learning. Most of the students are same mind that the TBTA delivered by his/her faculty teaching the subject help the students to learn effectively.

8.1 Analysis of survey

The survey was conducted based on 3 major dimensions focusing on TBTA methodology. The survey focusing the first dimension is Knowledge. In this category questions are used to assess the goals and

course outcomes of the engineering courses. The second major part is to assess presentation skills and information gain through the TBTA method. The Third category is used to check communication skill. So the set of questionnaires helped to a generate report, assessments for the innovative TBTA method.

9. Evaluation of TBTA method

An assessment was conducted with a selected group of faculty and students for measuring the impact of the learning process on engineering theory courses and practical applications. The evaluation was conductedthrough a rubric that calculated numerically for traditional teaching and innovative TBTA teaching methods. The primary part of the survey focuses on any teaching methods used by the teacher, continues to evaluate the criteria of innovative TBTA teaching methods.

The survey was conducted at the end of the two students was preferred at random taking into account; more than hundred faculties participated in the course study. More than 85% of participants reported that they had used only new teaching techniques or in a mixture with the traditional method. The left-behind 15% said to be using conventional teaching. It should be pointed out some teachers desire the survey be conducted at the end of the second semester and not in the first semester, as they required to develop the resources learned in the course study.

For students, it is essential to have an activity in TBTA, where the technique proposed by the teacher permits them to function both separately and in groups to solve the given problem. Furthermore, the teacher must clear idea of the educational tools. So these can contribute to significant learning of the study to engage efficiently students and consequently they find it interesting to work in groups and experiment new learning circumstances.

9.1 Knowledge Acquisitions

The survey was made among CSE/IT students with various questionnaires. Table 2 elaborates the collective feedback from the students and performance evaluation of TBTA with traditional methods.

10. Results And Discussions

It is inferred from Table 1, that 80% of students agreed that they improved their knowledge through TBTA. 70% of students developed their presentation skills throughthis activity. 60% of students developed their communication skills through TBTA. Fig 2.TBTA report summarizes the students perform well in their academics and enhance their technical knowledge, which the industry needs.11. Conclusion.

Table 2:Evaluation of TBTA with traditional methods

Student cadre	Seminar based	Problem based	Case based	TBTA
Creamy Layer students	40%	60%	50%	70%
Average students	30%	35%	40%	50%
Below Average students	25%	30%	35%	40%

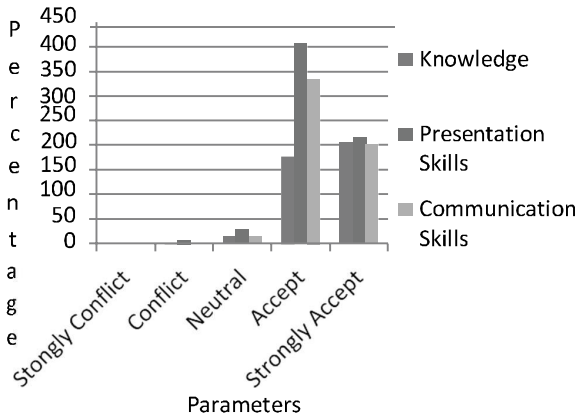

Fig. 2 : TBTA report

11. Conclusion

Nowadays, information is demonstrated, and the teacher's function is shifting to that of facilitator. We require interactive instruction, and the introduction of the Tool Based Technical Activity approach predictably changes the function of education. This method boosts creativity, imaginative thinking, problem-solving skills, and the ability to apply current techniques. Based on student input, this article accomplished that the Tool Based Technical Activity technique promotes student attention in learning. At every stage of engineering education, the TBTA transformation comprises novel teaching and learning processes with a modern approach. The teaching and learning process is never-ending; new methods and techniques are presented daily to improve knowledge and meet global needs.

References

[1] Foutz, T. L. (2018). Collaborative argumentation as A learning strategy to improve student performance in engineering statics: A pilot study. American Journal of Engineering Education, 9 (1) , 1 1 – 2 2 . https://doi.org/10.19030/ajee.v9i1.10185

[2] LipAYa. (2011) Open Source Software in Computer Science and IT Higher Education: A Case Study, International Journal of Advanced Computer Sciences and Applications, 2(1) (pp. 10–17).

[3] Prince, M. J., & Felder, R. M. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. Journal of Engineering Education, 95(2), 1 2 3 – 1 3 8 . https://doi.org/10.1002/j.21689830.2006.tb00884.

[4] Smith, K. A., Sheppard, S. D., Johnson, D. W., & Johnson,R. T. (2005). Pedagogies of engagement: Classroom-based practices. Journal of Engineering Education,94(1),87–101. https://doi.org/10.1002/j.21689830.2005.tb00831.

[5] Warren, C. (2014). MATLAB for engineers: Development of an online, interactive, self-study course. Engineering Education, 9 (1), 86 –93.https://doi.org/10.11120/ened.2014.00026

[6] Mitchell, J. E., Nyamapfene, A., Roach, K., & Tilley,

[7] E. (2019). Faculty wide curriculum reform: The integrated engineering programme. European Journal of Engineering Education, 6(1), 48–66

[8] Danaher, M., Schoepp, K., & Rhodes, A. (2019) Reliability and validity of the computing professional skills assessment. Global Journal of Engineering Education, 21(3), 214–219.

[9] Patil, J. A., & Kale, S. P. (2019). Impact of ICT tools in logic development of computer programming skills. Journal of Engineering Education Transformations, 33(1), 7–15.

[10] Doshi, N. (2021). Technology Based Teaching (TBT): A Transformational study with Database Management System. Journal of Engineering Education Transformations, 34(3), 30–34. https://doi.org/10.16920/jeet/2021/v34i3/145919

[11] Adamuthe, A. C., & Patil, M. A. (2020). Roadmap to inculcate complex problem-solving skills in CS/IT students. Journal of Engineering Education Transformations, 34(2), 6 1 – 7 4 . https://doi.org/10.16920/jeet/2020/v34i2/149313