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Exploring Online Teaching-Learning during COVID-19: A Comparative Study of Team Based Learning and Non-Team Based Learning

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Abstract: The COVID-19 pandemic forced the worldwide and sudden transformations of conventional live teaching strategy to online ICT based format in engineering education. Cognitive engagement of students is the main challenge during online teaching-learning platform. Team-based learning (TBL) is a collaborative teaching-learning approach that allows students to follow a structured procedure to enrich student cognitive engagement in the online platform. This paper is focused on comparative studies of team based learning and non-team based learning for a course "Advance Database System" in computer science and engineering department. The hypothesis is considered that TBL is best learning approach to cognitive engagement of students in the online platform. T-test and Chi-square test is applied to analyse the result. The results exhibited that TBL is the superior learning method and the hypothesis was proved and accepted.

Keywords: **Team-based Learning, T-test, Chi-square test, Cognitive Engagement.**

1. Introduction

The COVID-19 pandemic brings an unexpected challenge for academic institutions. It created unforeseen and worldwide requisite to explore online teaching/learning approach within engineering educational sectors. All engineering educational sectors are striving challenges to adapt online teaching/learning approach (Dechathon, 2021). During the online approach, there is a trouble of continuously focusing on learning for a long time on screen. Inter-communication, mutual understanding between students and teachers is hampered by distance, digital/online learning process (Marie and Giana, 2021). Due to less involvement of students in online platform i) Students may lead to misconceptions (Varun and Sivakumar, 2021) during the learning process, ii) Less effective learning environment (Saravana, 2018). iii) Students are less in critical thinking, teamwork, basic understanding of different courses (Shreeranga and Sathyendra, 2020). Cognitive engagement, active involvement of students, is becoming prime criteria during online teaching-learning platform. TBL is an academic Teaching approach for exploiting the performance amongst an individual and team by encouraging interpersonal communication before learning, and Motivating communication with team members in understanding of concepts of courses. It also an instructional practice to inspire students to learn efficiently and devotedly by working within a team (Suk-Young and Seung-Ju, 2001). TBL can help students enhance their critical thinking, interpersonal communication and cognitive involvement during the learning process (Han, 2016).

This paper describes our practice of online teaching a "Advance Database Management" (Theory and Lab) course in the Computer Science and Engineering department of RIT, Sakharale during Covid-19 pandemic. The course comprised of three credits for theory and one of the lab sessions. During online teaching, we have used Ms-teams platform for delivering lectures. Theory concepts of the course are taught with traditional way (Non-TBL). Lab sessions are conducted with TBL approach. Here, we have done a comparative study amongst learning through team based activity and learning individually (Non-TBL). The result through T-test and Chi-square is shown that TBL is one of the best learning approach to cognitive engagement of students in the online platform.

2. Background

Current pandemic triggered by COVID-19 have extremely changed engineering education of the world. Need of online, teaching learning is initiated in the context of a worldwide pandemic. Cognitive engagement, critical thinking, interpersonal relationships is a major concern during online teaching Platform.

TBL is a good practice in online, teaching learning process. The main Concern of TBL is confirming that students are learning the concepts and actively involving in solving real time problems with learnt concepts. Applying TBL for courses in education can have an encouraging influence on critical thinking, interpersonal, and self-leadership among students and rise satisfaction during the learning process (Suk-Young and Seung, 2001).

TBL contain teams, accountability, and feedback and task design (Janotha, 2015). Recurrent feedback property for the work completed by students in TBL helps to redesign the work in some context (Suman et al., 2018).

Cognitive engagement and active participation in learning provide a complete learning to students (Bransford et al., 2000). Through TBL with real life applications students can understand basic concepts of course deeply.

Jerome (Jerome, 2019) describes their practice of to their first and second year students applying TBL and they

believe that TBL is a better pedagogical methodology for understanding basic concepts.

Jumana (Jumana, 2015) discuss feasibility, efficiency, and students' attitudes in the readiness assurance process (RAP) of team based learning (TBL). He concludes that cooperative learning is enhanced with the use of TBL.

Marnie (Marnie et al., 2021) has proposed team base structure for engineering courses and stated that improve technical and professional skills in students better making them for their forthcoming roles in a domain demanding sustainable solutions.

TBL enhance to abilities by providing and encouraging associations and understanding the basic concepts in depth (Lehmann et al., 2008). Integration of TBL with Cooperative learning helps to clarify specific content, make sure active cognitive engagement of students during a lecture, and provide a complete structure to team based work in engineering education (Smith, 1995).

3. Methodology

This study is focusing on picking a superior path during online, teaching learning approach to learn various important concepts in course with active engagement.

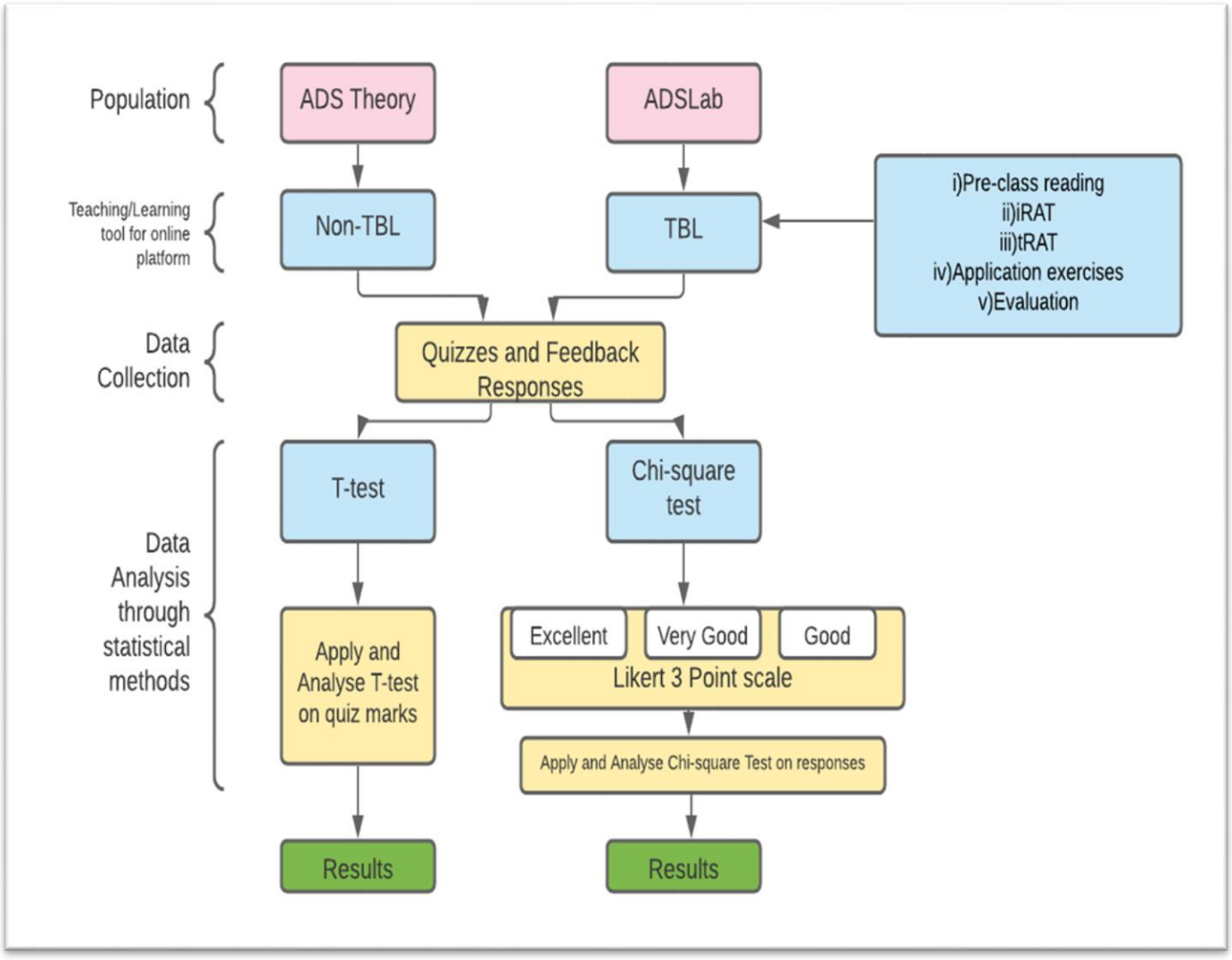

Fig 1. Proposed Structure

The population for this experimental study is from Rajarambapu Institute of Technology, Sakharale engineering college. The input data used for analysis are collected from the 3rd year students of B.E computerScience and engineering department for the course of "Advance Database System (ADS Theory) "and "Advance Database system Lab (ADSLab). The courses were taught through Ms-Team online Platform.

In ADS Theory teaching –learning process completed without TBL (Non-TBL). For ADSLab teaching learning process completed with TBL. Teams are balanced and diverse teams. For both courses, Quizzes and Feedbacks were conducted. Sample questions for feedback are shown in Table 1. For setting, the questions for ADS Theory and ADSLab quiz same blooms taxonomy used. Marks of quizzes and responses of feedback were collected. One of statistical measure T-test is used to analyse quiz marks and other Chi-square test used to analyse responses collected from both TBL and Non-TBL population. Fig 1. Show the overall structure of the proposed methodology.

Table 1. Sample Feedback Questions for ADS/ADSLab (Non-TBL/TBL)

1.	Non TBL/ TBL result in effective solutions
2.	Non TBL/ TBL tool is good for cognitive engagement during classes
3.	Non TBL/ TBL is good at understanding the basic concept deeply.
4.	Non TBL/ TBL is good for developing critical thinking and interpersonal communication.
5.	Non TBL is better than TBL.
6.	TBL is better than Non-TBL.

Procedure for TBL activity

Step 1: Topic announcement and Pre-class reading

At the beginning of foundation-level understanding of topics, some study material like videos, notes, links, PPTs are provided to students. It is expected from students to complete a reading of a given material.

Step 2: Individual readiness Assurance Test(iRAT)

Individual quiz is taken for student on a given material. It contains 10-20 multiple choice questions

Step3: Team formation and Team readiness Assurance Test (tRAT)

After completion of iRAT, teams are formed. Then team needs to complete same test and submit answers. In the same step instructor give more clarification related to test questions.

Step 4: Application Exercise

In this step, some points from given topic and related task (application problem) are allocated to each Team. Ask each team to complete the task and make videos for demonstrating the same. Then team needs to complete same test and submit answers.

Step 5: Evaluation

Finally, students (in team) need to apply their knowledge on application. They must reach at the combined response to the application problem and present their answers. The instructor will evaluate the answer as per rubrics.

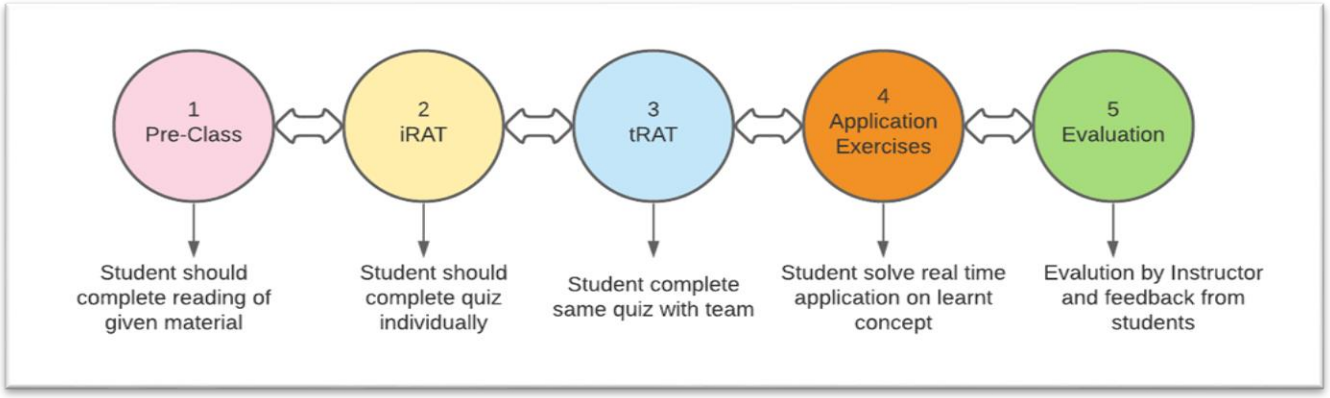

Fig 2. Procedure of Team based Learning Activity

4. Result Analysis

i)T-Test:

Quiz marks were then evaluated by applying T-test. The T-test was considered as an analysis on two populations i.e. ADS (Non-TBL), ADSLab (TBL) of small sample size. The hypothesis were anticipated as fallow.

Null hypothesis H_0= "TBL is not better form of online teaching Learning platform "

Alternative hypothesis H_a="TBL is better form of online teaching Learning platform "

The result showed that mean for the ADSLab TBL is 12.65 and ADS non-TBL is 11.8 as described in Table 2. The level of significance was assumed to be 0.05. The result from the test showed the observed P value for a one tailed test is 0.25. The p-value is greater than the alpha level: p >0.05. The alternative hypothesis "TBL is the best form

of online teaching Learning platform for cognitive engagement" is accepted.

Table 2. T-test: Two-Sample Assuming Equal Variances

	ADSTheory NonTBL	*ADS Lab TBL*
Mean	11.8	12.65
Variance	14.06	18.66
Observations	20	20
Pooled Variance	16.36	
Hypothesized Mean Difference	0	
Df	38	
t Stat	-0.66	
P(T<=t) one-tail	0.25	
t Critical one-tail	1.68	
P(T<=t) two-tail	0.51	
t Critical two-tail	2.02	

ii) Chi-square Test:

Responses to feedback, questions were considered for analysing ADS (Non-TBL), ADSLab (TBL). The Chi - square test is applied on feedback responses. Total 40 responses were collected for to chi-square test by separating into 3 Likert scale as Excellent, Very Good and Good based refers Table 3.

Table 3. Three Point Likert Scale

	Excellent	**Very Good**	**Good**	**Total**
TBL	5	12	7	24
Non-TBL	4	6	6	16
Total	9	18	13	40

Here,

Null hypothesis: H_o: "Cognitive engagement of individuals depends on TBL learning approach".

"Degree of freedom: (columns-1) (row-1) =2, Significant level: 0.05, the chi-square value is calculated in Table 4 is $x^2 = 0.611$ is < 5.99. Thus, the null hypothesis is accepted.

Table 4. Result of Chi-square

The calculation of Oi ,Ei			
Observer (Oi)	**Expected (Ei)**	**$(Oi-Ei)^2$**	**$(Oi-Ei)^2/Ei$**
5	5.4	0.16	0.029
12	10.8	1.44	0.133
7	7.8	0.64	0.082
4	3.6	0.16	0.044
6	7.2	1.44	0.2
6	5.2	0.64	0.123
			X^2=0.611

From Fig 3. The graph shows that quiz marks with TBL activity on my axis and number of students on x-axis. It is observed that marks with TBL activity is at a higher level, whereas in Non-TBL marks are less as compare to TBL.

From Fig 4. The graph shows observed and expected values have very less varied and henceforth calculated chi-square value is less. So, the null hypothesis is accepted as the P calculated is less than 0.05.

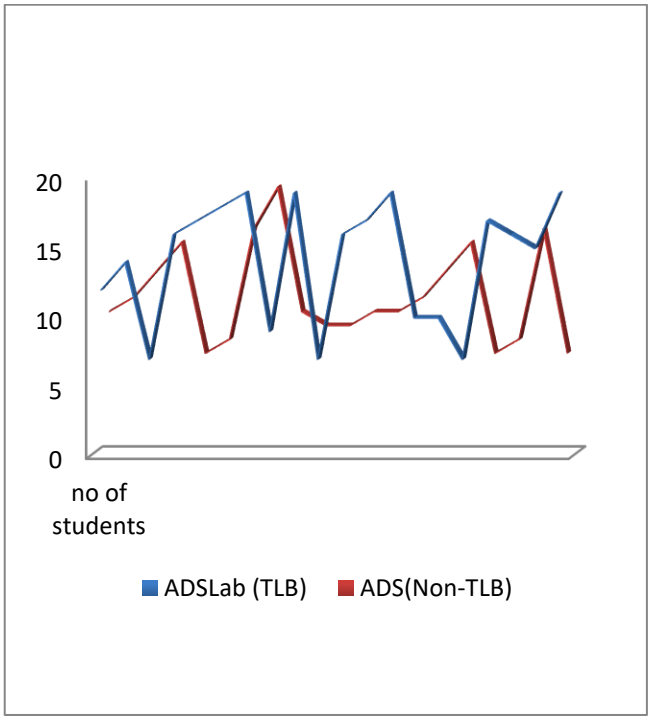

Fig 3. Graph showing quiz marks for TBL and Non-TBL

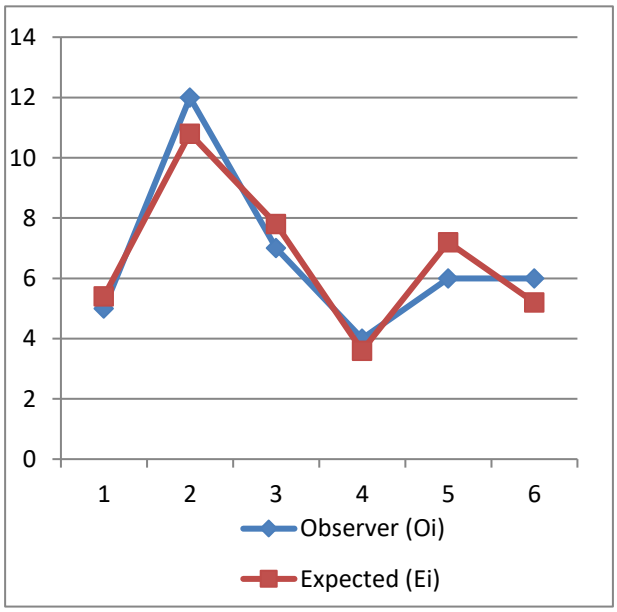

Fig 4. Graph showing observed (Oi) and Expected (Ei) values as per 3 point Likert scale

5. Conclusion

The paper shows the comparative study of TBL and Non-TBL pedagogical activity for ADS and ADSLab courses. The quizzes and feedback responses were taken for each course and analyse with the help of T-test and Chi-test. The study shows that the team based learning enhances individual performance, cognitive engagement, critical thinking of students. This approach is good for basic understanding of the topic; students can apply their learnt concepts in real time application. TBL is a good approach for the online teaching learning platform.

This TBL activity work can be extended with other learning attribute like creativity, problem solving and communication.

One disadvantage of TBL is if any student came to class unprepared, they are unable to contribute meaningfully to teamwork. In this case, instructor should offer more attention to such a students to help them regarding meaningful contribution for teamwork.

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