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Improving the student performance using Think-Pair-Share for Operating System

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Abstract : It is observed that while delivering a lecture in class it is good to ask questions to check understanding of the students, but not all students are able to answer the questions. It is also observe that whenever instructor asks a particular student for answer, other students stop processing for their answer. To keep all the students actively engaged in the class one of the active teaching-learning strategies that is Think-Pair-Share (TPS) has been implemented. TPS is a classroom-based active learning strategy, in which students work on a problem posed by the instructor, first individually, then in pairs, and finally as a class wide discussion. As the Operating System is core subject of computer science engineering, therefore the activity was conducted for the third year students to improve students' conceptual understanding. In this paper, one group Pre-Test and Post-Test model is considered. The experimental results and students feedback related to the activity are also presented.

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1. Introduction

This is the common experience that, while conducting the lecture in the class we find the students are very unresponsive, except one or two who are really intelligent and attentive. This happens because instructor is busy with delivering the contents and students either passively listen to the teacher or make some notes. Sometimes instructor make effort to keep lecture interactive by asking some questions to the students but still some students did not answer the question as they were not concentrating. This becomes very difficult for the instructor to get an idea of how well the class understood the concept. So there is a need of interaction between teacher and student. (Komal and Kanchan , 2015)

Operating System is the core subject of computer science engineering as it is base for other subjects like Unix operating system, Distributed operating system etc. This subject is also important for GATE exam. So it is necessary to clear the concepts of this course. Think-Pair-Share is a cooperative learning strategy that can promote and support higher-level thinking. TPS has its own benefits like, students are actively engaged in thinking and thinking becomes more focused when it is discussed with apartner. Hence, TPS activity is considered to teach Operating System Concepts. So the research questions are:

1) Are the students actively remaining engaged in the class while performing the activity?

2) Does this activity help students to clarify their concepts?

To find the answer to these research questions, one group pre-test post-test experimental study along with feedback was carried out. Result showed that this activity is useful for this course. The feedback analysis shows that 100% students were remain engaged in the class and 75 % students say that the activity improves their maximum conceptual understanding.

2. Related Work

The authors (Aditi et al., 2013) determined patterns of student engagement in the three phases using a real-time classroom observation protocol that they developed and validated. They found that 83% of students on average were fully or mostly engaged. Predominant behaviours displayed were writing the solution to the problem (Think), discussing with neighbour or writing (Pair), and following class discussion (Share). They triangulated results with survey data of student perceptions. They find that students report being highly engaged for 62% during Think phase and 70% during Pair phase.

The author (GargiBanerjee , 2013) presented a set of instructional objectives that instructors have while teaching with visualization in the classroom and mapped them to instructional strategies with visualization. A preliminary validation of this mapping was done through a qualitative survey. We also provide stepwise implementation plan for each strategy.

The authors (Carss and Wendy, 2007) demonstrated the versatility of the Think-Pair-Share strategy as a tool to foster conversation, and one that can be adapted to suit the learning focus and the needs of particular groups of students.

3. Methodology Used

Fig 1. TPS Activity

Variation in TPS Activity: The use of Think-Pair-Share unites the cognitive and social aspects of learning, promoting the development of thinking and the construction of knowledge (Carss and Wendy Diane , 2007 , SunitaDol, 2015). The TPS activity is a little modified while conducting in the class. The think phase is divided into read and write individually shown in figure 2. This provides instructors with the opportunity to see whether there are problems in comprehension. instructors can create a Read-Write-Pair-Share strategy in which students:

1. R: Read the assigned material;
2. W: Write down their thoughts about the topic prior to the discussions;
3. P: Pair up with a partner.
4. S: Share their ideas with a partner and/or the whole class.(http://www.adlit.org/strategies/23277/, 23/9/2015)

Fig 2. Modified TPS Activity

1) Think (Read-Write): Instructor starts the teaching-learning process by seeking answers to specific question about the topic. Students 'think (read and write)' individually about what they know or have learned about the topic for a given specified time slot.

2) Pair: Each student is paired with another student. Students share their solution to the given problem in think phase, discuss ideas, and ask questions to each other. Instructor asks complex question related to previously asked problem and students are asked to solve the problem.

3) Share: Pair has adequate time to share their thoughts and have a discussion; instructor expands the 'share' into a whole-class discussion. Allow each group to choose who will present their thoughts, ideas, and questions. After the class 'share', may again ask the pair to talk about how their thinking changed as a result of the 'share' element.

Figure 3 shows the activity performed by instructor and students while conducting the think pair share activity.

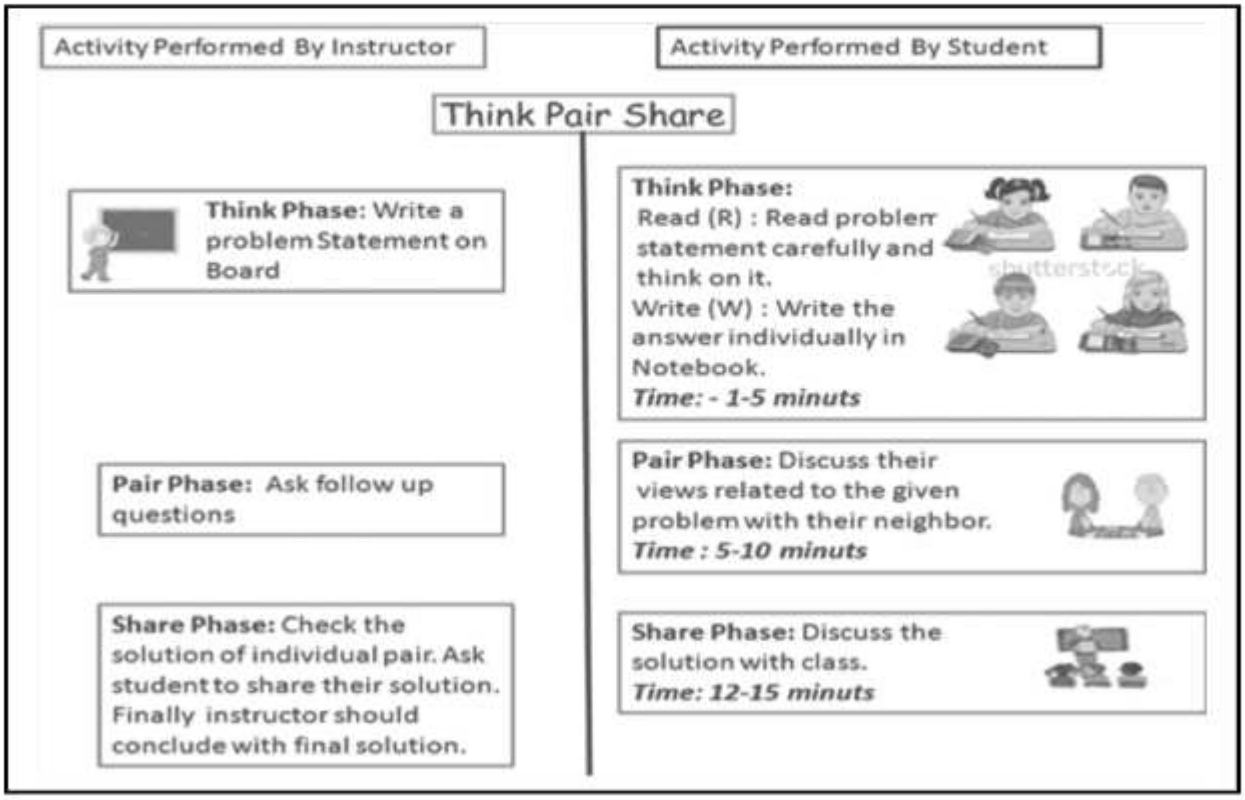

Fig 3.Activity performed by instructor and student

B. TPS for Scheduling Algorithm concept of Operating System Course

The topic covered for the study is introduction to scheduling algorithm- First Come First Serve (FCFS), Shortest Job First (SJF), pre-emptive and non-pre-emptive SJF. It consists of following steps for given example:

1. how to draw Gantt chart,
2. calculate waiting time for each process,
3. calculate average waiting time,
4. calculate turnaround time for each process
5. And average turnaround time.

For TPS activity the problem statement was given as shown in figure 4

Draw Gantt Chart for Shortest Job First (Preemptive)algorithm for given processes

Processes	Burst Time in mili seconds	Arrival Time in mili seconds
P1	5 ms	0 ms
P2	7 ms	1 ms
P3	4 ms	2 ms

Fig 4. Given Example

The three phases in TPS are structured as follows:

1) Think Phase -The instructor poses a question to which students read it individually, and write their answers. In this case instructor ask student to draw Gantt chart for given problem.
2) Pair Phase– In this phase, instructor asked students to discuss their answer with their neighbour and try to convince each other regarding how their answer is correct.

As this example is related to shortest job first scheduling algorithm, 80% students consider only burst time and draw Gantt chart as shown in figure 5.

As shown in figure 5, student thinks that Process P3 is arrived at 2ms and it has burst time less than process P1, so Pre-empt process P1 and schedule process P3 in Gantt chart. This is the misconception faced by the students. But in pair phase they clear their idea with their neighbour.

Figure 6 shows the shortest remaining time first after 1 ms, and after 2 ms for each process. It is observed that most of the student forget about the shortest remaining burst time of the process, and they only check the burst time of process given in the problem statement.

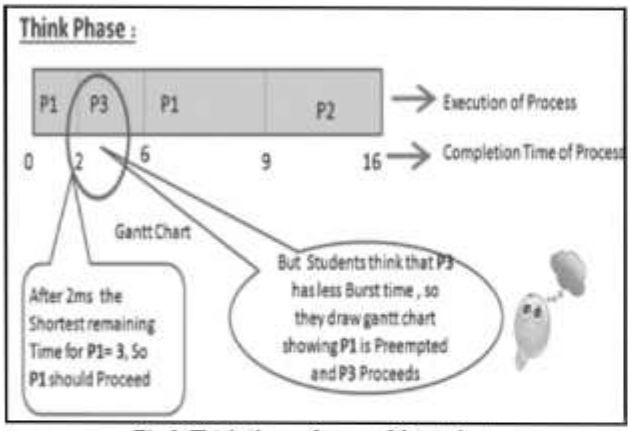

Fig 5: Think phase of some of the students

Due to this they drew wrong Gantt chart in think phase. After discussion with their neighbour they get the clear idea about the process shortest remaining burst time and now they can draw the correct Gantt chart.

After this, instructor asks the students to find out waiting time and turnaround time for each process.

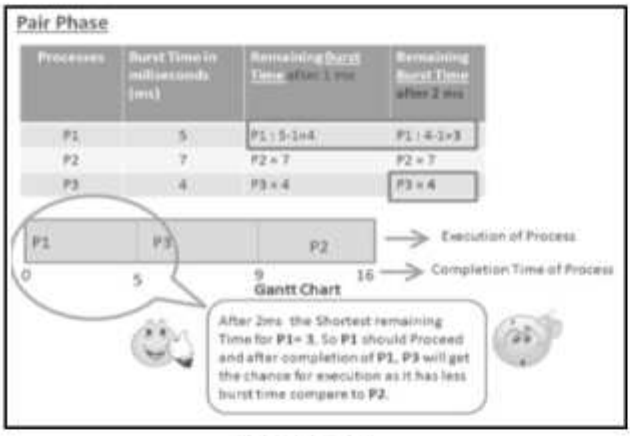

Fig 6. Pair Phase

As shown in figure 7 waiting time, turnaround time is completely depends on Gantt chart. If students draw wrong Gantt chart they get wrong waiting time and turnaround time for each process.

In pair phase students were able to draw correct Gantt chart and they get correct answer for waiting time and turnaround time.

1) Share Phase - Students engage in a class-wide discussion, sharing their answers and reasoning, and debating alternate solutions (Aditi et al., 2013). Pair phase gives enough time to share their thoughts and have a discussion with each other; instructor allows each group to choose who will present their thoughts, ideas, and questions. This includes class-wide discussion, after that instructor expand the "share" into a whole-class discussion.

Figure 7 shows that due to wrong Gantt chart in Think phase students calculated wrong average waiting time and average turnaround time.

After discussion in pair phase students were able to calculate correct average waiting time and average turnaround time.After this activity Post Test was conducted in the class and feedback form was designed to collect immediate feedback from the students on moodle.

4. Experimental Setup

Sample- Since Operating System Concepts is the course of third year Computer Science and Engineering, a group of 35 students was selected for this experiment.

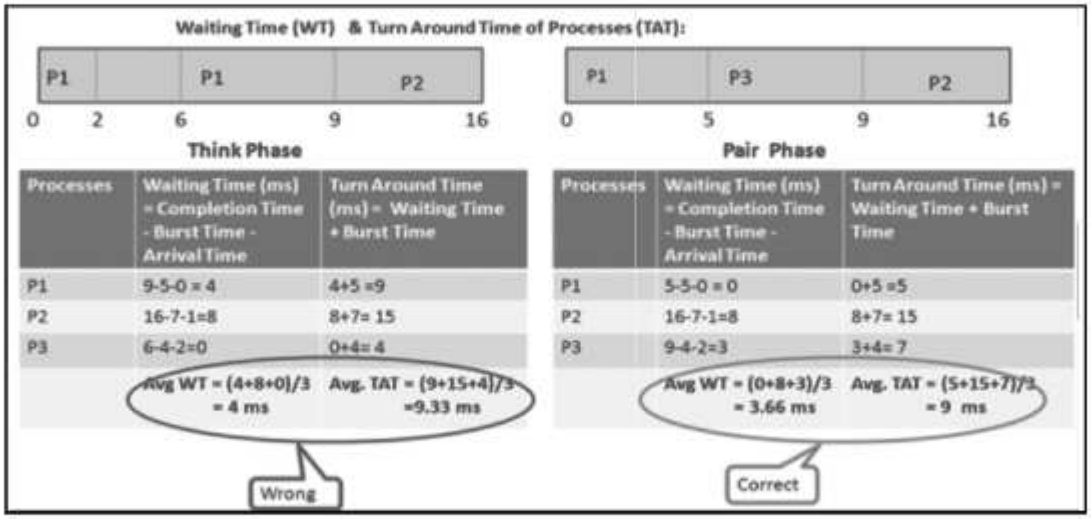

Fig 7. Calculation of Average Waiting Time and Turnaround time

Five different TPS were conducted for five different problem statements. Only one question were given at a time to the students

Research Design - Figure 8 shows the architecture. Before conducting the activity, simple black-board teaching was done, after that one group post test of 25 marks was conducted in the class. While checking the papers instructor found that there was confusion while drawing Gantt chart for shortest job first scheduling algorithm.

If Gantt chart was wrong then automatically it results in wrong waiting time and turnaround time of so instructor decided to conduct Think-Pair-Share activity in the class and it was conducted. After that immediate feedback and post test of 25 marks was conducted. After evaluating the post test paper instructor found the best result.

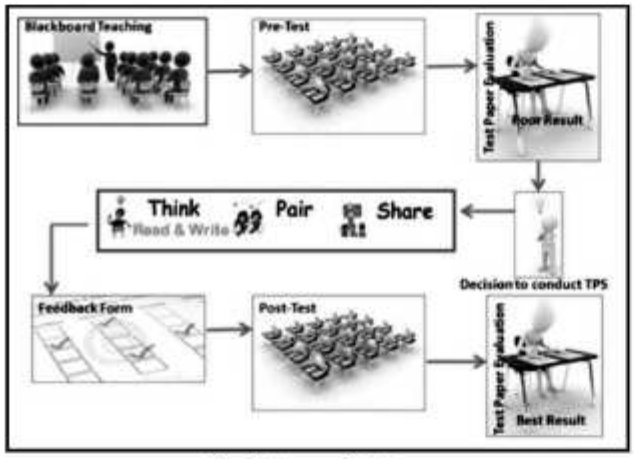

Fig 8. Research Design

Table1 shows the course, sample, method, instruments used and learning domain used in experimental setup.

Course	Operating System Concepts
Sample	A group of 40 students from Second Year Computer Science and Engineering of Solapur University
Method	One group and a pre -test post -test model
Instruments Used	1.Pre-test 2. Post-test 3. Survey questionnaire and 4.feedback from open ended questions
Learning Domain Used	Bloom's Taxonomy - Analysis level of Cognitive domain

Benefits of Think-Pair-Share

- When students have appropriate "think time", the quality of their responses improves.

Students are actively engaged in thinking.

- Thinking becomes more focused when it is discussed with a partner.

More critical thinking is retained after a lesson in which students have had an opportunity to discuss and reflect on the topic.

Many students find it easier or safer to enter into a discussion with another classmate, rather than with a large group.

No specific materials are needed for this strategy, so it can be easily incorporated into lessons.

Building on the ideas of others is an important skill for students to learn. (http : // www. eworkshop.on.ca / edu/pdf/Mod36_coop_think-pair-share.pdf, 24/9/2015)

Teacher has an opportunity to hear from many students.

It engages the entire class and allows quiet students to answer questions without having to stand out from their classmates.

Feedback - To get the student's perception regarding this activity, the feedback was conducted after the activity using moodle. Figure 9 shows the feedback analysis. The feedback form contains the questions related to the engagement of the students while conducting the activity and how the activity helped students to clarify their concepts. Analysis shows that maximum students actively participated in the activity and this activity helped them to clear their concept about the scheduling algorithm in detail.

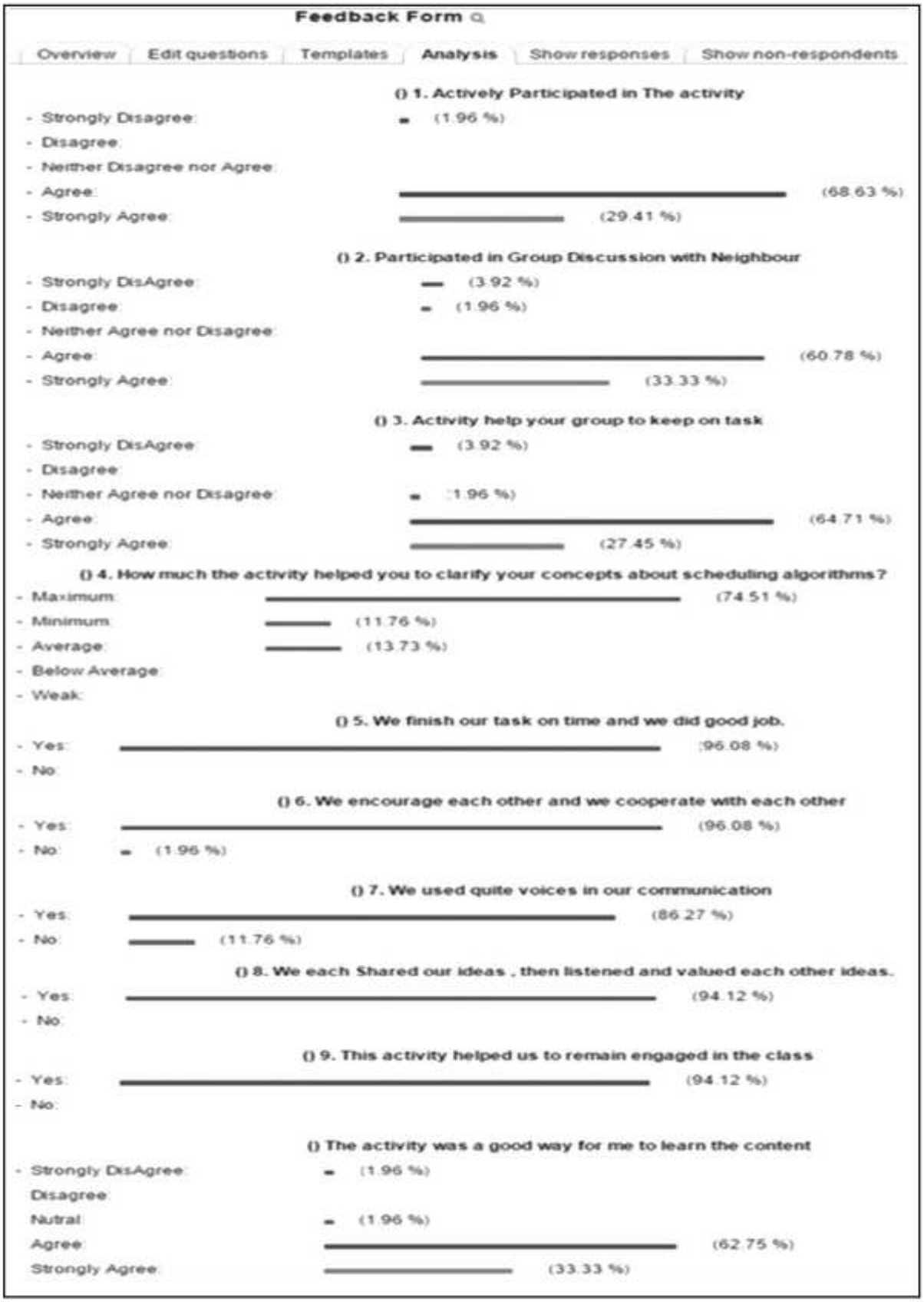

Fig 9. Feedback Analysis

5. Result

Students' understanding about the topic was analysed using pre-post test marks as shown in figure 10. Graph in figure 10 shows that students performed better in post-test as compared to pre-test. t-Test is used to determine if two sets of data differ significantly from each other. It compares the means of two groups. For t-Test to be significant statistically, t value must be 2.145 and p value must be less than or equal to 0.05. t-Test result is shown in table 2. t-Test result also shows statistical significant difference between pre-test and post-test conducted for this activity.

Table 2.t-Test Result

Degree of freedom	Standard Deviation	t value	p value
68	5.70	6.19	0.0001

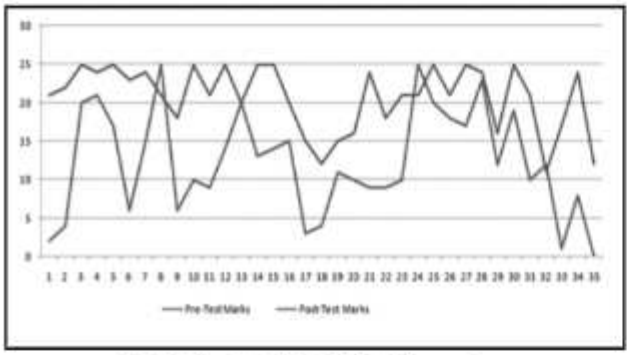

Fig 10. Pre-Post Test Marks Comparison

Range	Pre-Test no.of students	Mean of Pretest	Post-Test no. of students	Mean of Post-test	Average Gain
High (>= 70%)	9	21.22	27	22.7	1.48
Medium (50-69%)	7	15	5	15.8	0.8
low (<50%)	19	7.15	3	11.6	4.45

Fig 11. Average gain according to pre-test and post-test level

Figure 11 shows the average gain according to pre test and post test level i.e. high, medium and low. As average gain is maximum for students whose range is less than 50%, it can be said that, TPS activity is useful for low performer students.

Figure 12 shows the mean for pre-test and post test marks of the students. The graph shows for High range (>= 70%) and medium range (50-69%) students there is slight difference in improvement, but for low range (<50%) students is maximum difference in improvement of marks. Thus, TPS activities pose a question to students that they must consider alone and then discuss with a neighbour before settling on a final answer. This is a great way to motivate students and promote higher-level thinking of the students.(http://serc.carleton.edu/introgeo/interactive/tpshare.html, 16/9/2015)

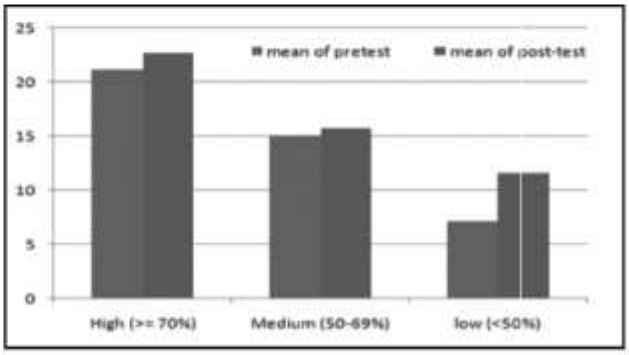

Fig 12. Mean for Pre-Test, Post Test Marks of the students

6. Conclusion

This strategy allows students for thinking on a given topic, enable them to formulate individual ideas and share these ideas with a peer. This learning strategy promotes classroom participation by encouraging a high degree of student response. The feedback analysis shows that 98% students actively participated in the TPS activity, 94% students participated in group discussion with their neighbour, 92 % students felt that the activity help their group to keep on task, activity helped 75% students to clarify their concepts about scheduling algorithm. 100% students say that the activity is a good way to learn the content. TPS activity can be applicable for any subject. Creating an interactive classroom environment is very important to the success of students. Think-Pair-Share activity proved useful in clearing the doubts of the course. This TPS activity makes class interactive and involves all the students in the teaching-learning process.

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References

Komal R. Pardeshi, Kanchan A. Khedikar (2015) "Peer Instruction: An Active Teaching Learning Strategy To Improve Programming Skills" , Golden Research Thoughts, ISSN 2231-5063 , Volume-4 Issue-9March, Available online at www.aygrt.isrj.org

Mrs.SunitaM.Dol(2015)" TPS(Think-Pair-Share): An Active Learning Strategy to Teach Theory of Computation Course", I.J. Information Technology and Computer Science, 2015, 09, 52-58 Published Online August in MECS (http://www.mecs-press.org/) DOI: 10.5815/ijitcs.2015.09.08

Susan Ledlow, (2015) " Using Think - Pair - Share in the College Classroom" http : // www. hydroville. org / system/files / team_thinkpairsha re.pdf . 24/9/2015

http://serc.carleton.edu/introgeo/interactive/tpshare.html, 16/9/2015

http://www.eworkshop.on.ca/edu/pdf/Mod36_coop_think-pair-share.pdf , 24/9/2015

Think Pair Share [https:// www.ocps.net/cs /services / cs /currareas/ read/ IR/ bestpractices/ SZ/ Think-Pair-Share.pdf] 15/9/2015

http://www.adlit.org/strategies/23277, 23/9/2015

Aditi Kothiyal, RwitajitMajumdar, Sahana Murthy and Sridhar Iyer (2013), "Effect of Think-Pair-Share in a Large CS1 Class: 83% Sustained Engagement," ,ICER '13 Proceedings of the ninth annual international ACM conference on International computing education research.

Gargi Banerjee et.al (2013) "Teaching with visualizations in classroom setting: Mapping Instructional Strategies to Instructional Objectives", IEEE Fifth International Conference on Technology for Education.

Carss, Wendy Diane (2007) "The Effects of using Think-PairShare during Guided Reading Lessons" The University of Waikato,