

Resource – Think-Pair-Share Activity constructor	Version 1.0, Dec 2013
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Part 1 – Plan your TPS activity

1. Choose a topic from your current/next course that has scope for multiple solution approaches, or detailing of an abstract concept, or some form of *open-ended discussion*. See Appendix for some examples.
2. **Think phase:** Write an initial (seed) question on the problem or topic you want to discuss.

Example from cs101: “Write the pseudo-code to find the smallest element in an integer array”.

Ensure that: (i) The question is broad enough so that most students in your class can write some response. (ii) A student can think about it and write an individual answer in about 1-3 minutes. (iii) There is a clear deliverable for the student.

Write your Think phase question here:

Write the pseudo code for searching an element in the array.

3. **Pair phase:** Write a follow-up question, that two students can work on together.

Example from cs101: “Identify missing pieces in each other’s pseudo-code. Together, build on your pseudo-code and write the C++ code to sort the array, using exchange sort”.

Ensure that: (i) The question is connected to the Think phase, i.e., they should use the output of their Think phase. (ii) Two students are required to answer the Pair question, and should be able to do so in about 5-10 minutes. (iii) There is a clear deliverable for the pair. (iv) The question leads to the discussion that you want to carry out later.

Write your Pair phase question here:

Students will take their time and pair wise they will write different searching Pseudo code .

4. **Share phase:** Write a follow-up task that all student pairs should do. Invite a few pairs to share their answer.

Example from cs101: “Compare your solution with instructor’s demo program for exchange sort. Identify points where your solution is different and share them with the class”.

Ensure that: (i) You have anticipated a few likely responses. (ii) Give about 1 minute for each pair to explain their answer. (iii) Highlight important points (or pros-cons) of each answer. (iv) Invite answers that are conceptually different from previous ones. (v) Summarize the entire discussion after 12-15 minutes, and move on!

Note: This works even in large classes, since the responses are likely to fall into a few categories.

Write your share phase task here:

Students : Each group will have different answer (ex.linear search and binary search)now they will discuss with other groups to enhance their knowledge

Teacher : will summarize the discussion and tell students what can be the most efficient approach to solve the problem .

5. Continue further discussion into the topic, as per your plan. If you find that many of the points that you wanted to convey are already covered, then your TPS activity was a success!

Part 2 (Optional): Refine your TPS activity

Do either or both of the below:

1. Talk to a colleague who is familiar with your topic or the TPS technique. Get feedback on whether:
 - (i) the statements that you wrote in Part 1 capture what you want students to do in each phase,
 - (ii) there is a logical connection between your phases, and
 - (iii) the timings for each phase are ok.
2. Predict the responses that you will get from students in the share phase. Use the space below to write down some predictions and later compare them with what actually happens in your class.

Some students may write linear search pseudo code ,some may write binary search pseudo code . Students will discuss which is the most efficient way to search an element in the array .

Part 3: Implement your TPS activity

Some guidelines for what to do in class when you implement your TPS activity:

1. Don't panic if no activity happens in the first minute. Students will take time to get started.
2. Do encourage students to write their ideas down, especially during the think phase.
3. Do walk around the class during the pair phase, answer relevant queries, encourage students to talk to their neighbor, and to write down their answers. Keep track of time also.
4. Do discuss a few representative students' solutions in the share phase, and then transition into points that you want to highlight. It is ok if this phase takes 20% more time than you anticipated.
5. Don't expect 100% participation. If 80% of your class is participating, you are doing fine. ☺

Part 4 (Optional): Conduct an education research study

If you are interested in determining the effectiveness of your implementation, beyond informally asking a few students for their opinion, then contact convener.et@iitb.ac.in . Research scholars from the IDP-ET will be happy to work with you to structure an education research study for your TPS activity.

Further Reading:

1. <http://olc.spsd.sk.ca/DE/PD/instr/strats/think/>
2. <http://www1.umn.edu/ohr/teachlearn/tutorials/active/strategies/>

Appendix: Examples of Think-Pair-Share activities from CS 101 for specific instructional goals

Instructional goals	Think Pair Share	Example as shown in the slide to students,
Conceptual understanding	<p><i>Think</i> Students write down answer the given question</p> <p><i>Pair</i> Students (i) Identify parts of the answer that they have missed out. (ii) Discuss which answer is better; do pros-cons analysis if there are multiple solutions.</p> <p><i>Share</i> Instructor discusses (i) What are all the essential parts in the answer? (ii) Pros-cons of various solutions given by students</p>	<p>“Consider an unsorted array of N elements.</p> <p>Think: Write the pseudo code for sorting the array</p> <p>Pair: Discuss your answer with your neighbor, do pros and cons analysis of your algorithms</p> <p>Share: Follow instructor led discussion of your solutions and others.”</p> <p>*This led to a discussion of various sorting algorithms.</p>
Code tracing: Predict the output; Debug/modify the given code	<p><i>Think</i> Students determine and write down the answer.</p> <p><i>Pair</i> Students (i) check each others' solution (ii) discuss change in code to get others' solutions</p> <p><i>Share</i> Instructor (i) executes the program and shows the output (ii) discusses a few modifications based on student answers</p>	<p>“Predict the output of the following program:</p> <pre>int a = 1, b = 2, c = 3; int* p, int* q; p = &a; q = &b; c = *p; p = q; *p = 13; cout << a << b << c << endl; cout << *p << *q << endl;”</pre> <p>Think: Draw the memory arrangement and predict.</p> <p>Pair: Check your neighbor's solution. If you don't agree, discuss and come up with a solution that you both agree upon.</p> <p>Share: See demo of above code and modified versions.”</p> <p>*The example for the outcome “Debug/modify” is similar</p>
Develop programming logic for a problem: Write program.	<p><i>Think</i> Students write down the pseudo-code.</p> <p><i>Pair</i> Students (i) identify missing pieces in each other solutions (ii) write the program.</p> <p><i>Share</i> Instructor (i) shows one possible solution. (ii) Discusses a few representative student solutions.</p>	<p>“Recall your program to reverse a 4 digit number.</p> <p>Extend your solution to arbitrary integers.</p> <p>Think: Write the pseudo-code individually.</p> <p>Pair: Write the C++ code with a partner.</p> <p>Share: Compare your solution with demo10-reverseNum-mod1.cpp”</p>
Design a solution: Write pseudo-code	<p><i>Think</i> Students write down the different parts (structures and functions) of the solution</p> <p><i>Pair</i> Students discuss the pseudo-code for the functions that are required</p> <p><i>Share</i> Instructor discusses a few representative solutions.</p>	<p>“Design a taxi scheduling service for an airport as follows: (i) When a driver arrives, his ID is entered in an array (ii) When a customer arrives the earliest waiting driver is assigned</p> <p>Think: What structures and variables are required?</p> <p>Pair: Discuss the pseudo-code for the functions that are required.</p> <p>Share: Follow instructor led discussion of your solutions and others.”</p>

Contribute an appendix of TPS activities for your discipline/course, based on the TPS activities that worked in your class. This will be useful to other instructors who plan to implement TPS. If interested, send mail to convener.et@iitb.ac.in

End of Resource: *Think-Pair-Share Activity constructor*