THE K. PATRICIA CROSS ACADEMY

INSTRUCTOR'S GUIDE

Teaching Technique 48

Think-Aloud-Pair Problem Solving

ACTIVITY TYPE

- Active/Engaged Learning
- Group Work
- Problem Solving

TEACHING PROBLEM ADDRESSED

- Lack of Participation
- Low Motivation/Engagement
- Surface Learning

LEARNING TAXONOMIC LEVEL

- Application: Problem Solving
- Learning How to Learn

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Think-Aloud-Pair Problem Solving

In *Think-Aloud-Pair Problem Solving* (or *TAPPS* for short), students take turns solving problems aloud while a peer listens and provides feedback.

1. Clarify your teaching purpose and learning goals for the *TAPPS*
2. Develop a set of problems that are solvable within a limited time frame
3. Set assignment parameters (how pairs will be assigned, amount of time, etc.)
4. Develop a plan for learning assessment or grading
5. Create a handout and communicate assignment parameters to students
6. Implement the technique
7. Reflect upon the activity and evaluate its effectiveness

Step-By-Step Instructions

In this section, we provide you with guidance on each of the seven steps involved as you consider this technique.

STEP 1: CLARIFY YOUR TEACHING PURPOSE AND LEARNING GOALS

TAPPS is a collaborative activity that places the emphasis on the problem-solving process rather than the product. Articulating one's own process and listening carefully to another's process helps students practice problem-solving skills and learn to diagnose errors in logic. The assigned roles of problem-solver and listener requires students to participate and engage in the learning process. Depending upon the problems used, it can also help increase student awareness of the range of possible successful (and unsuccessful) approaches to problem-solving.

TAPPS improves analytical skills by helping students to formalize ideas, rehearse concepts, understand the sequence of steps underlying their thinking, and identify errors in someone else's reasoning. Since it requires students to relate information to existing conceptual frameworks and to apply existing information to new situations, it can also promote deeper understanding. Finally, it can help foster metacognitive awareness, as it provides a structure for students to observe both their own and another's process of learning.

STEP 2: IDENTIFY THE LEARNING TASK'S UNDERLYING PROBLEM AND PROMPT

Spend sufficient time developing an appropriate set of field-related problems that students can solve within a limited timeframe. The problems should engage students in basic problem-solving skills such as:

- Identifying the nature of the problem
- Analyzing the knowledge and skills required to reach a solution
- Identifying potential solutions
- Choosing the best solution
- Evaluating potential outcomes

To be most effective, the problems should challenge students, requiring them to concentrate and focus their attention, whether they are solvers or listeners.

Step-By-Step Instructions (CON'T)

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STEP 3: SET ASSIGNMENT PARAMETERS

Many students, especially new students, will not have highly developed problem-solving skills. Consider preparing students by having students practice problem-solving as a class prior to this activity. When you are ready to implement this as technique with student pairs, consider aspects such as:

- How student pairs will be assigned?
- How many problems they should solve?
- How much time pairs will have for the activity?

STEP 4: DEVELOP A PLAN FOR LEARNING ASSESSMENT OR GRADING

We recommend using assessment techniques with *TAPPS*, since students can reinforce faulty—as well as correct—information and problem-solving processes.

Either to get a rough measure of students' problem-solving ability prior to implementing *TAPPS*, or as a follow-up activity to assess how much they have learned, consider using CAT 19: Problem Recognition Tasks (Angelo & Cross, 1993, pp. 214–217). Provide students with a few examples of common problem types and ask them to recognize and identify the particular type of problem each example represents. This CAT can help you assess how well your students can recognize various problem types, which is the first step in matching problem type to solution method.

If you are most interested in assessing how students solve problems and how well they understand and can describe problem-solving methods, consider using CAT 21 Documented Problem Solutions (Angelo & Cross, 1993, pp. 222–225). After they have participated as partners in *TAPPS*, have them individually track the steps that they take in solving a problem and submit this to you for review. Angelo and Cross (1993) also suggest ideas for adapting and extending the assessment (pp. 224–225):

- **Use Documented Problem Solutions** as a pre-assessment by giving students two problems: one of low and the other of medium difficulty. The results of their efforts to solve the problems can help you to gauge the best level at which to begin whole class or small group instruction.
- **Ask students** with elegant, well-documented responses to explain their solutions to a partner, a small group of students, or even to the whole class.
- **Additionally, Angelo and Cross (1993) offer caveats regarding problem-solving (p. 225) that can be applied to *TAPPS*:** Since most students have little or no experience reflecting on their own problem-solving processes, you may have to help them learn how to do this. Also, to ensure that peers give each other thoughtful and thorough responses, you may need to give students credit for this activity.

To grade this activity, students can submit a record of the solutions with the solver for each problem identified (e.g., by initials). You may also wish to have the 'listener' identified and to have the listener include their suggestions for problem-solving improvement.

STEP 5: COMMUNICATE ASSIGNMENT PARAMETERS TO STUDENTS

Create a worksheet with instructions and a series of problems.

STEP 6: IMPLEMENT THE TECHNIQUE

- Ask students to form pairs and explain to students the roles of problem-solver and listener. The role of the problem-solver is to read the problem aloud and talk through the reasoning process in attempting to solve the problem. The role of the listener is to encourage the problem-solver to think-aloud, describing the steps to solve the problem. The listener may also ask clarification questions and offer suggestions, but should refrain from actually solving the problem.
- Ask students to solve a set of problems, alternating roles with each new problem.
- Call completion when students have solved all problems.

STEP 7: REFLECT UPON THE ACTIVITY AND EVALUATE ITS EFFECTIVENESS

When reflecting on the activity and how effective it was, consider the following questions:

- Did the technique match the course learning goals and objectives?
- Did it meet my goals for this learning module?
- Was it appropriate for the students?
- Did students understand their roles and responsibilities?
- Did the technique keep the students engaged?
- Did it promote student learning?
- Did it provide me with information about student understanding?

If you answer yes to all or most of these questions, next consider how you might improve the activity for the next use.

Support Materials

The materials in this section are intended to help you with the process of implementing this technique. For *TAPPS*, we provide additional guidance as well as ideas for variation.

VARIATIONS

- Student "problem-solvers" may not be comfortable having their logic exposed to other students. Student listeners may not be trained in logic so they may not be able to note difficulties. Because of the level of risk students may feel, it is important to have established a high level of trust in your class prior to using this activity. Thus, it may also be a good idea to use this technique with pairs who work together throughout the term or at least over several sessions.
- Students will solve problems at different speeds. In this technique, it is particularly important to have an additional problem (an "extension" or "sponge") on hand for students who complete the problems quickly so that they do not sit around bored waiting for the other students to finish. Consider crafting a particularly challenging 'bonus' question for extra credit.
- *TAPPS* is typically used for a series of close-ended problems, but it can also be used for more open-ended problem-solving. The activity may take more time, so plan for fewer problems.
- If all pairs have worked on the same problem set, select pairs at random to report out their solution or "take a vote" on the most challenging problems and share and examine solutions along with tips for improvement as a class.

Online Adaptation

This section is intended to help you with the process of implementing and assessing *TAPPs* in your online class.

HOW TO GET STARTED

TAPPs is best implemented in a synchronous session where peer feedback can be provided in the moment.

- Create a handout with a series of problems students will solve in pairs within a limited timeframe.
- Include instructions for how students will alternate between "Problem Solver" and "Listener" roles, the responsibilities of each role, and the sequence of steps students must take to solve each problem.
- Set a time limit and assign pairs to breakout rooms to talk through the problem-solving process, prompt by prompt.
- Move around the breakout rooms to offer comments, answer questions and provide time-limit reminders.
- At the end of the activity, have students write up and submit a summary of their exchange, indicating what they learned from it.
- You may also consider having students share their best solutions with the entire class.

Technique Template

Following are two templates to assist you as you think through how you might implement this technique in your own class. The first is a completed template, providing an example of how a Professor adapted *Think-Aloud-Pair-Problem Solving* in their course, *Introductory Statistics*. The second is a blank template for you to fill out to tailor this technique for your course.

Technique Template

Sample *Think-Aloud-Pair-Problem Solving* Completed Technique Template:
Content from *Student Engagement Techniques: A Handbook for College Faculty*

Introductory Statistics

Course Name

COURSE CHARACTERISTICS

What are the situational factors that impact this course? For example, is it on campus or online? How many students? Is it lower division or graduate? Are there student attributes such as attitudes, prior knowledge, reasons for enrolling, and so forth that should be taken into account as you consider this technique?

This course is an introductory course that presumes no prior knowledge of statistics.

STEP 1: CLARIFY YOUR TEACHING PURPOSE AND LEARNING GOALS

Why are you choosing this technique? What do you hope to accomplish?

This professor was looking for a way to have students practice solving problems during class using a collaborative activity. She was hoping TAPPS would not only help students practice solving the problems, but that they would do so in a context that would be supportive, since she would be available to help if pairs got stuck.

STEP 2: IDENTIFY THE LEARNING TASK'S UNDERLYING PROBLEM AND PROMPT

What is the question you want learners to address, or problem you want them to solve?

She decided to try the technique on a series of regression analysis problems.

STEP 3: SET ASSIGNMENT PARAMETERS

What are the assignment logistics? For example, will this be assigned individually or is it group work? How long will the assignment take? Will students be submitting a product? What materials, resources, or additional information do you anticipate needing?

The professor prepared a handout that included a scenario with an attached printout of data. She decided she would ask students to pair with the student next to them and that she would then explain the roles of problem-solver and listener. She decided she would ask pairs to solve 10 problems.

STEP 4: DEVELOP A PLAN FOR LEARNING ASSESSMENT OR GRADING

If you decide to assess learning, how will you determine that learning has occurred? For example, will you use a simple +/check/- grading system? If you use a rubric, will you use an existing one or create one? What will be your criteria and standards?

The professor decided to use this as a formative assessment technique and not to grade it. She decided she would ask pairs to solve the problems and then she would review the problems with the whole class so that students could see if they solved them correctly and if they did not, learn where they made their errors.

STEP 5: COMMUNICATE ASSIGNMENT PARAMETERS TO STUDENTS

How will you communicate assignment parameters to students? For example, through a handout? A prompt on a presentation slide? Assignment instructions in your online course?

She decided to create a handout that she would distribute in class that included a scenario with an attached printout of data along with the 10 problems.

STEP 6: IMPLEMENT THE TECHNIQUE

How will you adapt steps/procedures for your students? Are there any additional logistical aspects to consider?

She distributed the handout and allowed 30 minutes for the activity. The students worked on the problems, alternating between problem-solver and listener until all of the problems were completed. She then held a full class discussion to review the answers and to clarify questions regarding the problem-solving process.

STEP 7: REFLECT UPON THE ACTIVITY AND EVALUATE ITS EFFECTIVENESS

Note: This step will be completed after you have implemented the technique.

After implementing the technique, she concluded it was an effective way to vary class time and to have students practice problem-solving in a collaborative, scaffolded context.

Technique Template

This template is intended for use when planning to implement ***Think-Aloud-Pair-Problem Solving*** in your class. Fill in the blanks below, and use the information provided elsewhere in the Instructor's Guide to assist you in your thinking.

Course Name

COURSE CHARACTERISTICS

What are the situational factors that impact this course? For example, is it on campus or online? How many students? Is it lower division or graduate? Are there student attributes such as attitudes, prior knowledge, reasons for enrolling, and so forth that should be taken into account as you consider this technique?

STEP 1: CLARIFY YOUR TEACHING PURPOSE AND LEARNING GOALS

Why are you choosing this technique? What do you hope to accomplish?

STEP 2: IDENTIFY THE LEARNING TASK'S UNDERLYING PROBLEM AND PROMPT

What is the question you want learners to address, or problem you want them to solve?

STEP 3: SET ASSIGNMENT PARAMETERS

What are the assignment logistics? For example, will this be assigned individually or is it group work? How long will the assignment take? Will students be submitting a product? What materials, resources, or additional information do you anticipate needing?

STEP 4: DEVELOP A PLAN FOR LEARNING ASSESSMENT OR GRADING

If you decide to assess learning, how will you determine that learning has occurred? For example, will you use a simple +/check/- grading system? If you use a rubric, will you use an existing one or create one? What will be your criteria and standards?

STEP 5: COMMUNICATE ASSIGNMENT PARAMETERS TO STUDENTS

How will you communicate assignment parameters to students? For example, through a handout? A prompt on a presentation slide? Assignment instructions in your online course?

STEP 6: IMPLEMENT THE TECHNIQUE

How will you adapt steps/procedures for your students? Are there any additional logistical aspects to consider?

STEP 7: REFLECT UPON THE ACTIVITY AND EVALUATE ITS EFFECTIVENESS

Note: This step will be completed after you have implemented the technique.
Did this technique help you accomplish your goals? What worked well? What could have been improved? What might you change if you decide to implement the activity again?

References and Resources

PRIMARY SOURCE

Content for this download was drawn primarily from "Student Engagement Technique 25: Think-Aloud-Pair-Problem Solving (TAPPs)" in *Student Engagement Techniques: A Handbook for College Faculty* (Barkley, 2010), pp. 259–263. It includes material that was adapted or reproduced with permission. For further information about this technique, including examples in both on campus and online courses, see the primary source:

Barkley, E. F. (2010). *Student Engagement Techniques: A Handbook for College Faculty.* San Francisco, CA: Jossey-Bass.

CITATIONS AND ADDITIONAL SUGGESTIONS FOR FURTHER READING

- Barkley, E. F., Cross, K. P., & Major, C. H. (2014). CoLT 13: Think-Aloud-Pair-Problem Solving. *Collaborative learning techniques, a handbook for college faculty.* (pp. 226–231). San Francisco: Wiley/Jossey-Bass.
- Blackburn, J. J., & Robinson, J. S. (2016). Determining the effects of cognitive style, problem complexity, and hypothesis generation on the problem-solving ability of school-based agricultural education students. *Journal of Agricultural Education,* 57(2), 46–59.
- Fakomogbon, M. A., & Bolaji, H. O. (2017). Effects of collaborative learning styles on performance of students in a ubiquitous collaborative mobile learning environment. *Contemporary Educational Technology,* 8(3),268–279.
- Millis, B. J., & Cottell, P. G., Jr. (1998). *Cooperative learning for higher education faculty.* American Council on Education, Series on Higher Education. Phoenix, AZ: Oryx Press.

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