

EXECUTIVE FUNCTION COG: PROBLEM SOLVING

Ms. Chung was excited to place a brand-new balance bike in the yard for her preschool class. Immediately a group of children approached the bike to try it out. "It has no pedals!" she heard one girl exclaim. Another girl sat on the seat and immediately propelled herself forward about 10 feet. "I want to try," said a boy, and he took the bike from his peer and tried to sit on the stool. As soon as the boy pushed himself forward, the bike tipped, and the boy spilled onto the ground. He tried again, but again the bike fell to the ground. Ms. Chung noticed that the boy leaned towards the right as he pushed himself forward, which caused the bike to tip over. Even though the outcome was the same each time the boy pushed himself forward, the boy kept trying, to no avail.

Children learn from their experiences, and as teachers, we are often advised not to be too quick to come to a child's aid when there is a problem. It is best practice to allow the child to try and approach new experiences and problems with their own ideas, especially during the preschool years. If the child becomes frustrated, the teacher can approach and make suggestions for how the child might think through that problem differently so that they can accomplish their goal. This process is important for development.

But what happens when you notice a child who seems to struggle again and again with problems that he encounters throughout the day. As tempting as it is for the adult to swoop in and help the child each time, we would argue that giving this child some direct instruction on ways to approach and solve problems will provide them with new strategies to broadly apply to problems –wherever they may occur.

Problem Solving – Step by Step

In the empirical literature, problem solving is indicated as one of the underlying skills of the larger construct of executive functioning. Meaning, when we talk about children's "executive function skills," we say things like "the child has a lot of difficulty solving simple everyday problems; they have poor executive function skills." Executive functioning is the macro-construct that spans 4 phases of problem solving: representation, planning, execution, and evaluation.

It's fairly well-known and established that there are systematic steps to problem solving that map on well to the 4 phases (representation, planning, execution, and evaluation). Although the number of steps vary somewhat from source to source, in general, the concepts remain consistent:

1. **Identify the Problem.** Although this seems obvious, we expect that many teachers have experienced situations in which a student sees the problem as something very different than how another sees it. For example, if a student fails a test and sees the problem as not having enough time when actually they didn't know the material, the ability to solve the problem may be ineffective.

2. Define the Problem/Why? Assuming that a problem is identified, then a correct definition is critical. For example, if a student fails a test because they didn't know the material, was it because they didn't allot enough time to learn it? Was it because they had the wrong information? Was it because they did not know the details?
3. Form a Strategy/Brainstorm. This part is creative and thoughtful. Nothing is too strange or bizarre; all ideas should be considered. The goal should be to come up with as many different ways to solve the problem as possible.
4. Organize Information. Then organize the ideas by possible strengths and weaknesses.
5. Allocate Resources. Determine what solution has the best outcomes. Examine resources to factor into what solution is the best.
6. Carry Out and Monitor Progress. Carry out the solution and set up a system to monitor how the process is going.
7. Evaluate Results. Was the problem resolved?

Teaching Children How to Solve Problems

All children encounter problems throughout their day, and as teachers, we consider those to be learning opportunities. While some children enjoy the challenge of a good problem, these obstacles may be a source of stress and frustration for other children. Young children who lack good problem solving skills may shut down in the face of obstacles or become angry and emotionally reactive at the first sign of difficulty.

In treatment literature, improvements in problem solving are frequently a primary focus in studies of children with traumatic brain injury, developmental delay, and autism. For example, in a study to improve the problem solving of teens after a traumatic brain injury, problem solving was taught as a sequential process that involved (1) stopping and thinking, (2) identifying the problem (aim), (3) brainstorming possible solutions (brainstorm), (4) analyzing the potential consequences of various courses of action (choose), (5) implementing the plan (do it), and (6) evaluating the outcome (evaluate). Again, the steps that need to be taught remain consistent across the age span and across evidence-based sources.

COGnitive Development – Lessons to Help Children Improve Problem Solving

The following lessons incorporate both direct teaching and developmental approaches to highlight the executive function skill of planning. Problem solving builds upon the skill of planning, and thus, goal setting and identifying problems are repeated from the *Planning* cog. Different components of executive function intertwine, build upon, and support problem solving.

In this chapter, lessons will teach children to:

- PS1: Identify a goal.
- PS2: Identify all problems for reaching their goal.
- PS3: Identify multiple strategies to accomplish the goal.
- PS4: Organize the strategies into an actionable plan.
- PS5: Execute the plan.
- PS6: Evaluate their plan for how well it accomplished the goal.

Generalization Throughout the Day

Executive function skills in children improve the most when the child practices throughout the day in a variety of contexts. As you directly target problem solving using the following lessons, make sure to point out problems that exist throughout the day. You can say things such as:

- “Tell me the problem you have.”
- “What is your goal?”
- “What are three ways we can solve the problem?”
- “What is another way you can accomplish your goal?”

References

- Bransford, J. D. & Stein, B. S. (1993). *The IDEAL problem solver: A guide for improving thinking, learning, and creativity* (2nd ed.). New York: Freeman.
- Derry, S. J. (1991). Strategy and expertise in solving word problems. In C. McCormick, G. Miller, & M. Pressley, (Eds.). *Cognitive strategies research: From basic research to educational applications* (pp. 269-302). New York: Springer-Verlag
- Gick, M. L. (1986). Problem solving strategies. *Educational Psychologist*, 21, 99-120.
<https://doi.org/10.1080.00451520.1986.9653026>
- Pokras, S. (1989). *Systematic problem-solving and decision making: Rational methods for problem-solving and decision-making*. Menlo Park, CA: Crisp Publications.
- Wade, S.L., Walz, N.C., Carey, J., Williams, K.M, Cass, J., Herren, L., Mark, E., & Yeates, K.O. (2010). A randomized trial of teen online problem solving for improving executive function deficits following pediatric traumatic brain injury. *Journal of Head Trauma Rehabilitation*, 25(6), 409-415.
<https://doi.org/10.1097/HTR.0b013e3181fb900d>
- Zelazo, P.D., Muller, U., Frye, D., & Marcovitch, S. (2003). The development of executive function in early childhood: I. the development of executive function. *Monographs of the Society for Research in Child Development*, 68(3), 1-34.

PROBLEM SOLVING LESSON 1: HOT LAVA

LESSON OBJECTIVES

- The child will verbally identify a goal for the activity (PS1).
- The child will verbally identify each identified problem in accomplishing their goal (PS2).
- The child will generate multiple solutions to solve each problem using a “brainstorm” (PS3).

MATERIALS

- Dry erase board and marker
- Various objects the children step on. May include:
 - Large blocks
 - Cardboard boxes
 - Small mats
 - Furniture items (e.g., chairs)
 - Large blankets (to represent lava)
- A “treasure chest” (a box filled with something fun for the kids to play with)

GETTING OUR COGS IN GEAR: AN INTRODUCTION

For this lesson, have all the children seated on mats on the ground. The teacher should be presenting as if they are about to read a story to the children.

Teacher:

“Today, we are going to play the lava game.” *Spread blankets across the floor with a “treasure” at one end.* “We are going to pretend that the blankets are hot lava, and we need to cross the lava to get the treasure. So, we have a **goal**. A goal is what we want to do at the end of the game. What is the **goal** of the hot lava game?”

Students:

The children should respond, “Get the treasure!”

Teacher:

“Right! But we have a **problem**. A problem is something that keeps us from our goal. What is between us [point to yourself and the children] and the treasure?”

Students:

The children should respond, “The lava!”

Teacher:

“Yes! And what happens if we step on the hot lava? Why is that a **problem**?”

Students:

The children should discuss lava. Child responses may include:

“The lava is hot!”

“The lava will burn me.”

“I could get hurt!”

“If I step on the lava, it will burn my shoes!”

Teacher:

“Exactly. Luckily, everything we have in the room is magically fireproof, so it won’t melt. So, we can use anything in the room to help us not get burned or hurt.”

Select two children. Invite them to look around the room and say, “Each of you go and find two things that you can use to get across the lava.” Allow the children to gather two items and bring them to the front of the group.

For example, let’s say Child 1 brings a chair. Say, “I see you brought a chair. What will we do with it?” Child 1 may say, “We can put it down to sit on.” Ask Child 1 to demonstrate how they will use the chair to stand or balance on the chair without touching the floor. As Child 1 demonstrates, invite the children to comment on whether or not they think the chair is a good way to get across the lava. Help them consider the characteristics of a good item (e.g., flat, wide, easy to balance on).

Repeat this process with both items and both children. Write on the dry erase board the various items that the children selected and whether or not they were good choices for getting across the lava.

Teacher:

Draw the children's attention to the dry erase board. "Look at all these ideas for good things to **solve our problem**. This is called a **brainstorm**. Let's circle all the things we decided we should use to help us remember and organize. Which items should we circle?"

Students:

The children should call out items they want to use to get across the hot lava.

GETTING THE GEARS MOVING: AN ACTIVITY

1. Say, "Awesome! We have such great stuff! Now, how are we going to do this?"
2. Teacher should model a bad idea to demonstrate how some plans fail. "I have an idea, I'll take the mat myself and I'll put it right here." Demonstrate putting it about arms-length and then step on it. The teacher should be about one foot into the lava and shrugging. "Does this get me to the treasure?" The children should shout, "No!"
3. Ask, "What's the problem?" The children should say, "We need more stuff on the lava!"
4. Demonstrate that you cannot walk on the lava and say, "So how should we get across the lava with all our good fireproof stuff?"
5. Allow the children to give you new strategies. Even if you realize the strategy is not going to work, allow the children to try out the ideas anyway. Some good strategies may include:
 - A "fire line": First person goes on the mat, next person hands them the chair, that person moves to the chair and the prior person moves to the mat, then the third person hands the second person a chair who then hands it to the first person who has moved up a spot.
 - One person is nominated to set it up by having each other person hand them items as they go back and forth across the previously built items.
6. Say, "GREAT! You guys decided to do it like ____ (point to the dry erase board). Let's get started and get our treasure! As you are doing it, I'll ask you how it's working and you can tell me 'great' or 'hard' or 'not working' and I'll put it here on the dry erase board."
7. Allow the children to start executing their plan. As the children are carrying it out, make sure you point to the steps on your dry erase board with a symbol to represent the options (e.g., star for great, circle for hard, and x for not working).
8. If an idea is not working, remind the children that they can change strategies.
9. Let the group work together to get across the lava and reach the treasure.

CHECKING THE SYSTEM: A REVIEW

Have all the children return to their mats.

Teacher:

“What was our **problem** today?”

Students:

The children should say, “We couldn’t step on the lava to get the treasure.”

Teacher:

“Right! That was the problem. Why was that a problem?”

Students:

Responses may include:

“Because we could get burned.”

“Things could melt.”

Teacher:

““That is definitely a problem. But we wanted that treasure.

Let’s think about how we solved our problem. First, we **brainstormed** ideas, and everyone got things they thought could help. What stuff was great or not so great?”

You can point back to things you circled and maybe now cross off things that were once circled and after trying it decided it wasn’t a good plan. For example, if they picked a really huge heavy item, maybe that wasn’t such a good idea.

Students:

Responses may include:

“The chair was good because I was high from the lava.”

“The book was only OK because it was small.”

“The table wasn’t a good idea because it was too heavy.”

Teacher:

“Did any of you reach the treasure alone? Or did you work together? “

Students:

The children should say, "We worked together!" or, "We made a fire line together."

Teacher:

Guide the children to tell you about things that were good, hard, and not good about going across the lava.

Students:

The children should discuss parts of the exercise that were easy, hard, fun, or not fun.

Teacher:

*If the children successfully reached the treasure, say, "Today we **solved our problem**. [Direct attention back to the dry erase board]. What way did you go that worked?"*

Students:

The children should discuss the items and talk about why there are stars, circles, and Xs on the various items.

Teacher:

*If the children did not reach the treasure, say, "Today we were stumped. We did not **solve our problem**. [Direct attention back to the dry erase board]. What happened when we did our plan?"*

Students:

Guide the children to talk about the items and why the plan did not work. Reassure them and guide them to discuss what they can do differently next time.

Teacher:

*"Today our **goal** was to get across the hot lava. We had a big **problem**, but we used a **brainstorm** to help us with ideas to solve our problem. Great job everyone!"*

ADDITIONAL IDEAS USING THE “HOT LAVA” LESSON PLAN

1. Spider web: Instead of having the children cross over “hot lava,” set up a spider web with painter’s tape (criss-cross tape across various walls, desks, and chairs and have the class get through the “spider web” without touching the tape).
2. Jellyfish: Using the same concept as the “spider web,” hang string by criss-crossing between furniture and hanging from the ceiling. The children must cross the classroom along a path without touching “jellyfish tentacles.”
3. Lasers: Challenge the class not to trip the lasers that protect the treasure. Use string to represent a laser obstacle course, with some requiring the children to go low, or cross through.

Full curriculum available for purchase on 2/1/2022 HERE:
<https://diffelearn.com/products/executive-function-in-the-early-childhood-classroom>