TATA CONSULTANCY SERVICES | Discovery EDUCATION

IGNITE MY FUTURE

THINK | SOLVE | CREATE | CONNECT

SUBJECTS

English Language Arts
Computer Science

COMPUTATIONAL THINKING PRACTICE

Recognizing and Defining Computational Problems

COMPUTATIONAL THINKING STRATEGY

Develop Algorithms

MATERIALS

Digital DIY student capture sheet

Design Thinking teacher prompt (you will need to make copies and use scissors or a paper cutter to divide the definitions)

Design Thinking student capture sheet

Paper

Pencils/pens

LESSON TITLE

Digital DIY

Guiding Question: How can technology improve our lives?

Ignite Curiosity

- Why are online tutorials so popular?
- Can you teach other people how to do something you love to do?
- Do online courses help students learn as well as in-person courses?
- Can sharing our talents improve the lives of others?

In this lesson, students will use the computational thinking strategy of developing algorithms to teach a skill to others. In **THINK**, students reflect on their skills and analyze different approaches for teaching. In **SOLVE**, students will use the Design Thinking Process to prototype their tutorial. In **CREATE**, students create a flowchart algorithm to help plan and execute their tutorial. In **CONNECT**, students discover how technology can provide resources like experts, knowledge, and classes to people who couldn't otherwise access them. Students explore how to leverage different applications to teach someone something new. Students will also identify how many professionals, such as teachers, bloggers, and data science consultants, use algorithms to share information.

Students will be able to:

- **Understand** how the computational thinking strategy of developing algorithms helps us teach people and computers new things,
- **Evaluate** a tutorial using the Design Thinking Process, and
- **Create** an algorithm flowchart that provides step-by-step instructions on how to learn a skill.

Students reflect on their skills and analyze different approaches for teaching a skill to others.

1 **Ask** students to reflect on the following problem: how can we make education and training more accessible to people around the world?

2 **Engage** students in a class discussion with the following questions:

- What's a skill or talent that you have? Has someone told you that you're really good at something? *This could be something like making three-point shots in basketball, applying eyeliner, or asking good questions.*
- Do you watch any how-to videos or tutorials? If so, do you attempt the skill outlined in the tutorial?
- Have you ever tried to teach someone how to do something? What worked and what didn't?
- There is a new trend in education called massive open online courses (MOOCs). These courses make lots of knowledge accessible over the internet for free or a very small fee. While many people participate in these courses, very few people complete them. Why do you think that is? What strategies can you use to keep people engaged in your tutorial?

3 **Provide** students with 5 to 10 minutes to complete the first section of the Digital DIY student capture sheet. Explain that the capture sheet asks students to teach someone how to perform their skill or talent in only 10 steps.

4 **When students have finished** writing their 10 steps, have them exchange their sheets with a partner. One student will attempt to perform the skill or talent based on the written instructions while the other student takes notes and observes. When the task is completed, have students return the Digital DIY student capture sheets to their owners. Instruct students to repeat this exercise two more times with different partners.

5 **When students are finished**, regroup as a class. Explain that algorithms are rules and commands that humans give to computers to tell them what to do. Common examples of algorithms in our daily life include things like recipes, directions, and instruction manuals. Divide students into groups and have them round-robin other examples of algorithms in everyday life.

6 **Summarize** by informing students that they will be utilizing the computational thinking strategy of developing algorithms to make education and training more accessible to people around the world.

Students use the Design Thinking Process to prototype their tutorial.

1. **Explain** that the 10-step tutorials and instructions that students have created are a type of algorithm. When computer programmers develop algorithms, they must think through all the possible scenarios that might arise. For instance, when you are playing a video game, you have many choices. You can make a character move left or right, jump or run, and the like. The computer programmer has to give the computer a series of instructions that accounts for all these potential possibilities. In a similar way, educators and tutorial creators have to think through all the different ways that their instructions might be perceived.

2. **Ask** students to review their notes from observing their classmates completing their rudimentary algorithm. What did they observe? Did some things happen that surprised you? What things happened that your algorithm didn't account for?

3. **Explain** that students will now edit their algorithms using The Design Thinking Process. The Design Thinking Process is a way of testing and refining a product that is based on how people think and behave.

4. **Divide** students into groups of five. Provide each student in every group with one definition from the Design Thinking teacher prompt. Inform students that they are to teach the other students in their group about their stage of the Design Thinking Process. When each student has provided his or her definition, ask students to work as a group to organize the definitions in the correct order. When students have finished, tell them that there is no correct order of steps. The steps can occur in any order and two steps might even happen at the same time.

5. **Instruct** students that they will now work individually to edit their algorithm using the Design Thinking Process student capture sheet. They should use the notes they collected on the Digital DIY student capture sheet to complete this task. Provide students with 15 to 20 minutes to complete their capture sheets, offering assistance as needed.

6. **When students have finished**, call on a few students to have them provide examples of how they changed their algorithm by using the Design Thinking Process.

Students create a flowchart algorithm to help plan and execute their tutorial.

1. **Tell** students to make any last-minute edits to their algorithm that they would like to make in order to make it as detailed as possible.

2. **Pass out paper and markers**. Instruct students to modify their algorithm by taking it from a step-by-step instructional format to a flowchart. Provide students with 15 to 20 minutes to create their flowcharts.

3. **When students have completed** their flowcharts, engage the class with the following critical thinking questions:
   - How can you ensure that learners will remain engaged with your tutorial from beginning to end? Could you incorporate elements of a game, such as points, competition, or play?
   - What is the best format for your tutorial? Would it work best as a video, podcast, or presentation? Why?
   - How can digital learning and online tutorials help provide greater access to education?

IGNITE MY FUTURE

THINK SOLVE CREATE CONNECT

Select one of the strategies listed below to help students answer these questions:

- **How do this problem and solution connect to me?**
- **How do this problem and solution connect to real-world careers?**
- **How do this problem and solution connect to our world?**

1. **Write** the three questions on PowerPoint or flip chart slides and invite students to share out responses.
2. **Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.
3. **Assign** one of the questions to three different student groups to brainstorm or research, and then share out responses.
4. **Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

Students likely use algorithms several times a day to solve problems without realizing they are using this process. Breaking down large tasks into steps or manageable chunks of information allows us to better understand what actions we need to take.

Once we break down problems into manageable data, we can easily resolve the problem through an algorithm design. This is where "if" statements, variables, and loops are helpful. These strategies are not only useful to humans, but also important elements of coding that helps computers think.

How does this connect to careers?

Teachers prepare students for careers and successful lives by teaching various lessons and skills.

Bloggers are authors who write web articles on a variety of subjects. Bloggers are typically familiar with diverse social media platforms and have basic web design skills.

Data Science Consultants use algorithms to create programs and share information. Data science consultants analyze different uses of technology and solve problems for businesses and organizations.

How does this connect to our world?

Many organizations use computer coding. People who are able to write computer code are essential in any field that uses computers to perform or produce the work that they do. Algorithms help create the set of rules that need to be followed.

While coding is important in keeping technology running in the organization, the ability to identify and solve problems adds value to the computer's ability to provide the resources needed. Algorithms help in developing the solutions that are automated.

National Standards

COMMON CORE STATE STANDARDS CONNECTIONS

- CCSS.ELA-LITERACY.WHST.6-8.2.D: Use precise language and domain-specific vocabulary to inform about or explain the topic.
- CCSS.ELA-LITERACY.WHST.6-8.2.E: Establish and maintain a formal style and objective tone.

K-12 COMPUTER SCIENCE FRAMEWORK

Practice 3. Recognizing and Defining Computational Problems

The ability to recognize appropriate and worthwhile opportunities to apply computation is a skill that develops over time and is central to computing. Solving a problem with a computational approach requires defining the problem, breaking it down into parts, and evaluating each part to determine whether a computational solution is appropriate.

Digital DIY

Identify a skill or talent at which you excel:

Now, write down how to perform that skill or talent in 10 easy-to-follow steps:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Hand your paper to a classmate and see if he or she can perform the skill!
While your partner is reading and performing, record notes in the space below. When your partner is finished, have him or her return this sheet. Then, repeat this activity two more times with different partners.

Trial #1 Notes:

Trial #2 Notes:

Trial #3 Notes:

The Design Thinking Process Teacher Prompt

Cut and distribute these definitions to student groups.

Empathize
This step means really understanding the problem you are trying to solve. In this stage, you will engage with users of the product or process to understand their experience. In this stage, you have to identify any assumptions (such as prior knowledge or skills) that might be hindering your product and gain insight into the interests and needs of the end user.

Define
In this step, you look through the data you have collected in order to develop a clear understanding of the problem or problems facing your users. The key to this step is designing what is known as a problem statement. The problem statement should not be focused around your own wish or need. Rather, it should focus on the needs of the end user. For instance, instead of identifying your problem statement as "my tutorial has to be funny so that it gets more views," it should focus on the learner by reading "students learn best when they are engaged with the material."

Ideate
When you understand your users and their needs, it becomes possible to think outside the box and create new solutions. You might brainstorm, play, act, or use other techniques to encourage lots of free thinking. The goal of this step is to generate many ideas. It doesn't matter if they are good or bad. You just need to be creative!

Prototype
A prototype is a rough draft or trial version of the product. In this stage, you share a preliminary version of your product with a small group. You might incorporate some ideas and remove them if they don't work. When you finish this stage, you should have a pretty good idea of how a user would interact with your finished product.

Test
In this stage, the product is shared with a wide group of users. As new people interact with the product, you learn more about what works and what doesn't. You use data from the testing phase to make the product better.

The Design Thinking Process Student Capture Sheet

With your algorithm in hand, complete the following stages of the Design Thinking Process. Perform the tasks in the right-hand column and record your thoughts in the space provided.

Empathize *Think like the user*
Identify five reasons why a user might want to use a tutorial about your skill:

1.
2.
3.
4.
5.

Thoughts:

Define *Get a clear understanding of the problem*
Answer this: What problem is your tutorial trying to solve? Make sure the problem is phrased from the perspective of the user.

Thoughts:

Ideate *Think outside the box to create a solution*
Brainstorm and free-write five ideas about how to solve the problem you wrote above:

1.
2.
3.
4.
5.

Thoughts:

Prototype *Make a rough draft*
Rewrite your algorithm using the steps of the Design Thinking Process you've completed. Share your revised algorithm with a partner and see how it goes. What did you learn?

Thoughts:

Test *Try it out with users*
Share your revised algorithm with three more people. What changes do you need to make?

Thoughts: