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Domain: Exploring Computer Science

Date Range: November 04, 2024 – November 08, 2024

ACOS Standard:

- 28, 39- Introduce data collection and problem solving.
- 39- Introduce the four steps of the problem-solving process.
- 39- Apply the problem-solving process. Use different strategies to plan and carry out the plan to solve several problems.

 Student Friendly Outcome:
 I CAN recognize various forms of communication as data exchange.

 I CAN research technological impacts on society.
 I CAN name and explain the steps in the problem-solving process.

I CAN solve a problem by applying the problem-solving process.

Monday	Tuesday	Wednesday	Thursday	Friday
Communication	Journal Entry (10	Journal entry (10	Journal Entry (10	Solving a Problem
Methods and Data Chart	minutes)	minutes)	minutes)	Using Smart Devices
(15				(30
minutes)	Solving Community	Candy Bar Activity	Solve a Community	minutes)
	Problems Activity (35	(25 minutes)	Problem (as a class)	
Data Journal (40	minutes)		(45	Student presentations
minutes)		Discussion of	minutes)	(15 minutes)
	Journal Entry (10	solutions (10		Discussions
	minutes)	minutes)		Discussion of
				reflections (10
		Introduction to the		minutes)
		Problem-solving		
		Process (5		
		minutes)		
		Reflect/Discuss on		
		the Problem-		
		solving Process (5		
		minutes)		

Instructional Lesson # 1. Days 1-2

Topic Description: This lesson sets the stage for the unit. It provides an overview of data collection and problem solving that will be needed in order to complete the final project.

Objectives

The student will be able to:

- Recognize various forms of communication as data exchange.
- Describe the implications of data exchange on social interactions.
- Consider the privacy of data that they create.
- Explain the difference between data used for making a case and data that informs a discovery.
- Describe good research questions.
- Students identify different community identities.
- Develop a community problem that relates to social justice, mental health, racism, the environment, colonization, climate change, etc.

Outline of the Lesson

Segment	Reason/Purpose
Day 1 Communication Methods and Data Chart (15 minutes) Data Journal (40 minutes)	Recognize various forms of communication as data exchange. Describe the implications of data exchange on social interactions. Consider the privacy of data that they create.
Day 2 Journal Entry (10 minutes) Solving Community Problems Activity (35 minutes) Journal Entry (10 minutes)	Students identify community Describe good research questions. Discuss data collection and analysis and possible bias of data collection and analyzation

Student Activities

- Discuss Communications Methods and Data Chart with an elbow partner.
- Discuss Data Journal with an elbow partner.
- Read and discuss articles about "aggregate" data
- Complete journal entry.
- Groups complete Solving Community Problems activity.
- Complete journal entry.

Teaching and Learning Strategies

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Day 1

- Communications Methods and Data Chart
 - Have students reflect back on the conversation about communication and data from Unit 1 Lesson 7 Day 2 and share with their elbow partner.
 - Have a few students share "What data is available?", "Who has access to the data?"
- Data Journal
 - Have students compare journals with elbow partners and write down 5 ways that they give off data.
 - Take time to discuss what these data sources might tell us about ourselves if we "aggregated" or collected these data from lots of people—What good might be done? What services might be improved? Think back to unit 1 and Telling a Story with Data, how might AI use our data? What implications might the use of data have?
 - Have students think about which of these ways can be linked directly back to them. What are possible implications of the data being linked back to them?
 - Have students read both articles about aggregate search data (See resources for example articles).
 - Does making search data available to researchers help improve search engines? What happens when the data becomes personal?
 - Have students complete a graphic organizer Venn Diagram about the two articles.
- Journal Entry: What are some other ways you might think computers use our data? How is that data collected?"
 - If time, lead a discussion.
- Note: There are many new examples for the topics in each of these readings occurring every day. Teachers should use those as replacements as appropriate.

Day 2

- Journal Entry: What are some of the groups or communities you identify with? What are some problems your community would like to solve?
 - Have students share in pairs and then the larger group. Maybe keep track of students who have similar communities or problem interests.
- Solving Community Problems Activity:
 - Group students in 3 4 based on communities or problems of interest. Have students develop a problem related to their community. Topics for scenarios could include, but are not limited to: Social Justice, Racism, Mental Health, The Environment, etc. See resources for more examples.
 - Teachers should have an example of a community problem they have worked on. Lead students in a discussion to answer some of the following questions. Explain that they should think about these questions as they work.
 - For discussion purposes teachers might discuss community problems such as racial bias in policing or facial recognition for surveillance, language/accent bias in voice detection

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software (like an automated service from a drug store), etc.

- What research questions might you ask to solve the problem?
- Why did you choose to collect these data for this question?
- What are the limits of this data?
- What perspectives might be left out based on your data?
- What might you expect your data to say?
- Have students work in groups of 3–4 to complete the project. They should outline how they would:
 - Approach the problem
 - What kind of data they might need to collect
 - How they would collect and analyze the data
- Have students create a poster to display their projects.
- Have students do a gallery walk of student work and add feedback.
- Note: Teacher might keep track of group members and may choose to use the same groups in Unit 2 Lesson 3 Day 2 activity
- Closing Discussion
 - Lead students in a discussion about the types of data that was collected and how. (Surveys, lists, numbers, etc.) What kind of implications might that have on how the problem is solved? What kinds of tools did we use to collect the data and/or solve the problems? Ask students to analyze any bias associated with the solution or tools they might use to solve their problem.
 - Present students with a scenario related to the local community. For example, how does electronic waste or e-waste affect the community?
 - Topics for scenarios could include, but are not limited to: Social Justice, Racism, Mental Health, The Environment, etc.

Resources

- A Face is Exposed for an AOL Searcher
- <u>https://www.nytimes.com/2006/08/09/technology/09aol.html?auth=login-google1tap&login=google1tap;</u> Alternate Link:
 <u>https://www2.hawaii.edu/~strev/ICS614/materials/NYT%20-%20confidentiality%20-%20A%20Face%20is%20Exposed%20for%20A0L%20Searcher%20%202006-08-24.pdf</u>
- Volunteering data on Facebook and other social networking sites might tell people more about you than you intend. See http://www.nytimes.com/2010/03/17/technology/17privacy.html; Alternate Link: https://faculty.fairfield.edu/winston/How_Privacy_Vanishes_Online.pdf
- Note: NY Times has a pay wall, please try alternate links if necessary

Teacher Reflection Notes

Instructional # 2. Day 3

Topic Description: This lesson introduces four main phases of the problem-solving process.

Objectives

The student will be able to:

- Name and explain the steps in the problem-solving process.
- Solve a problem by applying the problem-solving process.
- Explain what the word algorithm means.
- Relate the problem-solving process to computers and AI tools

Outline of the Lesson

Segment	Reason/Purpose
Journal entry (10 minutes) Candy Bar Activity (25 minutes) Discussion of solutions (10 minutes) Introduction to the Problem-solving Process (5 minutes) Reflect/Discuss on the Problem-solving Process (5 minutes)	Solve a relevant, fun problem Students understand what an algorithm is as it relates to problem solving and computer science. What kinds of problems can be solved by a computer Explain how some problems may be solved by AI

Student Activities

- Complete journal entry.
- In groups, participate in the candy bar activity.
- Participate in discussion of solutions.
- Reflect on the candy bar activity as it relates to the problem-solving process.
- Complete journal entry.

Teaching and Learning Strategies

- Journal Entry: What are the steps you use to solve a problem?
- Candy Bar Activity
 - Divide the students into groups of 2 or 3. Give each group a candy bar.
 - Explain that their task is to determine how many "breaks" it will take to break the candy bar into 12 equal pieces. One break of one piece of the candy bar will result in that one piece being divided into two pieces. Demonstrate a "break" by breaking the bar into two pieces. Then stack the two pieces together and break or cut the two pieces into four.
 - At this point, have each student write in their journal the number of breaks they think it will take to break the bar into 12 equal pieces. This should be done without talking to their partner or group members.

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- Working together with their partner or group, have the students discuss and then write their plan for solving the problem. They may revise their guess at this point.
- Once this is completed, the students should implement the plan by opening the candy, breaking the candy, and counting the number of breaks it takes to get 12 equal pieces.
- Discussion of solutions
 - Have several groups present their plan to the class.
 - Teachers should highlight the variety of processes and solutions and the computational practice: analyzing their own work and the work of others.
 - Sample questions to ask—Was your guess correct? What process did you use to come up with your guess? Did working with your group and creating your plan change your guess? Did your plan work?
 - How do the steps they used match what they wrote in their journal?
- Introduction to steps in the problem-solving process (Note: These steps are as defined by G. Polya in How to Solve It. Other "definitions" exist. The purpose is for students to be able to articulate what happens in each phase rather than have a specific definition.)
 - Lead students in a discussion of how the steps they used relate to the "formal" steps of the problem-solving process.
 - 1. **Understand the problem**—read or listen to the problem statement.
 - 2. Make a plan to solve the problem—use pictures, charts, graphs, systematic lists, objects, or act out the solution to help you devise a plan to solve the problem. In Computer Science we call this plan an *algorithm*.
 - 3. **Carry out the plan**—once the plan is conceived and understood, follow the plan. If you have planned well, this is the easy part.
 - 4. **Review and reflect on how the problem was solved**—once the problem is solved, reflect on the plan that was used.
- Exit Journal OR Reflection/Discussion on the Problem-solving Process
 - Have students respond to the following prompts in their journal. Give students time to respond, explain they will be using their answers in the next lesson. If time permits, use think-pair-share or other discussion strategies to have students reflect on the prompts
 - Why is this problem an important problem to solve for: a carpenter, a chef, a teacher?
 - What kind of process might we use if we think about the ways AI might solve a problem like predicting which movie you watch on a Saturday night on Netflix or what song you might like to play next on Spotify?
 - Are there any problems that you think a computer could not solve? Why or why not?
 - Is it always better to use a computer or AI to solve a problem?

Note: what makes a problem solvable by computer—being able to provide a step-bystep algorithm is one important piece, but context matters. Think back to unit 1 and making a peanut butter and jelly sandwich. Even if we refined our algorithm would a computer be able to make one? No, but a robot could. (Foreshadow Unit 5.)

Resources

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- Polya, G. How to Solve It. 2nd. Princeton, NJ: Princeton University Press, 2004.
- Candy bar problem suggested by Dr. Manuel Blum, Carnegie Mellon University
- Candy bars for student groups to use
- Number of Pieces/Number of Breaks Chart

Teacher Reflection Notes

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Instructional Lesson # 3. Days 4-5

Topic Description: Students will apply different strategies to help them make a plan and carry out the plan to solve problems. These strategies may include (but are not limited to): draw a diagram or picture, make systematic lists, divide and conquer, find the pattern, etc.

Objectives

The student will be able to:

- Name and explain the steps in the problem-solving process.
- Solve a problem by applying the problem-solving process.
- Express a solution using multiple design tools.
- Determine if a given solution successfully solves a stated problem
- Solve problems using Smart Devices

Outline of the Lesson

Segment	Reason/Purpose
Day 1 Journal Entry (10 minutes) Solve a Community Problem (as a class) (45 minutes)	Name and explain the steps in the problem- solving process. Solve a problem by applying the problem-solving process.
Day 2 Solving a Problem Using Smart Devices (30 minutes) Student presentations (15 minutes) Discussion of reflections (10 minutes)	Solve a problem using smart devices What bias might come from the tool used or the solution presented

Student Activities

- Complete journal entry.
- Solve a community problem as a class.
- Students solve a community problem.
- Students give presentations of community problem.
- Students participate in discussion and reflection

Teaching and Learning Strategies

Day 1

- Journal Entry: Have students reflect or add more to their exit journal from the previous lesson.
 - What kind of process might we use if we think about the ways AI might solve a problem like predicting which movie you watch on a Saturday night on Netflix or what song you

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might like to play next on Spotify?

- Are there any problems that you think a computer could not solve? Why or why not?
- Is it always better to use a computer or AI tool to solve a problem?
- Spend some time discussing this with the class before moving on to the next activity.
- Solve a Community Problem (as a class)
 - Teacher chooses the problem discussed at the beginning of Unit 2 Lesson 2 Day 2 or chooses a problem presented by students in the previous lesson.
 - Discuss with students how computers and technology might help solve that problem.
 - Explain that today you all will solve a problem using the problem-solving process.
 - Teachers may choose to present the initial problem in a variety of ways. Have each group
 - 1. Understand the problem- have students restate the problem in their own words. Use the <u>Problem-solving Process Note Catcher</u> for students to record their answers. Have students share their answers in a think pair share.
 - 2. Make a Plan to Solve the Problem Have students write a plan to solve the problem. Encourage students to think about the AI tools they explored in Unit 1. Can they use those tools to help them solve the problem, if so, how? Give students time to write their own solution, then have students talk to 2 3 other students to share and revise their solution.
 - 3. Carry Out the Plan Guide students through a possible solution to the problem.
 - 4. Reflect
 - Does your solution answer the question?
 - Recall the different elements of identity explored in Unit 1 Lesson 1 and the Bias in Data from Unit 1 Lesson 9. Does your solution reflect any bias? How did/does the tool you used help you solve the problem? Is it efficient? Will all parts of the problem be solved? Would there be a better way to solve the problem?

Day 2

- Journal Entry: What ways can computers make our lives more automatic?
 - Ask students to share their lists with their elbow partners.
 - Explain that the term "smart" is used to signify computational automation and with a show of hands ask how many students have heard the term "smart" in this context.
- Solving a Problem Using Smart Devices
 - Explain to students that we will be looking at the community problems they have already brainstormed. Specifically, we will be analyzing how smart devices can help us solve problems.
 - Group students in groups of 3 4.
 - Have students create an artifact (poster, chart, slideshow, webpage, etc.) using the problem-solving process to solve a community problem using smart devices. Remind students that the problem-solving process has 4 parts, but they will focus on their plan for solving the problem.
 - 1. Understand the problem
 - Students should be familiar with the problems.

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- 2. Make a Plan to Solve the Problem
 - Encourage students to think about what smart devices they could use to solve their problems. If they do not know what a specific device is, or it has not been invented yet, encourage students to create their own.
 - Students should think about what data they might need to collect and what data is available to them.
- 3. Carry Out The Plan
 - Students will not have time to carry out a real plan. Encourage them to explain how they would use the tools to solve the problem.
- 4. Reflect
 - Does your solution answer the question?Recall the different elements of identity explored in Unit 1 Lesson 1 and the Bias in Data from Unit 1 Lesson 9. Does your solution reflect any bias? How did/does the tool you used help you solve the problem? Is your solution efficient? Will all parts of the problem be solved? Would there be a better way to solve the problem?

Resources

• No additional resources needed

Teacher Reflection Notes

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