Algorithm of Sound:

Creating Video Game Sound Effects

Computational Thinking Focus:  Algorithm

Additional Computational Thinking Concepts Supported:  Decomposition,  Pattern Recognition

Neurodiverse Workplace Skills: Problem Solving,  Communicating,  Persevering,  Collaborating, Creating

Elements of Telematics: Embodied learning through movement, Collective/ensemble activities

Arizona Computer Science Standards

*Computing Systems (CS), Networks and the Internet (NI), Data and Analysis (DA), Algorithms and Programming (AP), Impacts of Computing (IC)

- 6.AP.PD.3 Test programs using a range of inputs and identify expected outputs.
- 6.AP.A.1 Identify planning strategies such as flowcharts or pseudocode, to simulate algorithms that solve problems.
- 7.AP.A.1 Use planning strategies, such as flowcharts or pseudocode, to develop algorithms to address complex problems.
- 6.AP.V.1 Identify variables that represent different data types and perform operations on their values.

- 6.AP.PD.1/7.AP.PD.1 Seek and incorporate feedback from team members and users to refine a solution that meets user needs.

Arizona English Language Arts Standards

- 6.RL.2 Determine a theme or central idea of a text and how it is conveyed through particular details; provide a summary of text distinct from personal opinions or judgments.

- 6.RL.3 Describe how a particular story's or drama's plot unfolds in a series of episodes as well as how the characters respond or change as the plot moves toward a resolution.
- 6.W.3 Use narrative techniques, such as dialogue, pacing, and description, to develop experiences, events, and/or characters.

Arizona Academic Standards in the Arts: General Music

*Creating (CR), Performing (PR), Responding (RE), Connecting (CN)

- MU.RE.7b Demonstrate and explain how musical concepts and context affect responses to music.

Objectives

- Students will use if-then statements (inputs/outputs) to create an algorithm.
- Students will create an algorithm to solve a real-world problem or for a real-world application.
- Students will connect sound effects to emotions and themes in video games.
- Students will create sound effects to evoke emotions and themes in video games.

Timeline

Day 1: Activation and Foundations (40 – 60 minutes)

Day 2: Application (40- 60 minutes)

Day 3: Culmination (40-60 minutes)

Day 4: (Optional) Extensions

Vocabulary

- Algorithm
- Setting
- Theme
- Emotion
- Sound effects, sound, audio
- Trigger
- Character
- Environment
- Interaction
- Input (If…)

- Output (then...)

Materials

- Wearable Music Sensors (e.g. M5Sticks)
- Rainstick and Sonic Introduction apps
- Computer (one per student)
- Super Mario
- Algorithm Worksheets (or modified worksheet)
- Slide Deck (music examples)
- Writing Utensil (Pencil)
- Optional (for extension) - bandanas or eye-covers

Day 1:

Activation (Engage & Explore)

(20-30 minutes)

Explain to the students that they will be exploring sound through video games. Ask questions, such as: Who has played games before? Which games? Which have sounds that relate to a specific action? Can you share examples? **Do the action-sound connections ever change?** How does it add to the feel of the game? What are the emotions that these sounds make you feel?

Think of *happy* games, *scary* games, and *goofy* games. What in the game makes you decide which kind of game it is? (Either have students share out to the whole group or have each partner or small group come up with two examples to share.) It's okay if students share games that the teacher is not familiar with.

Communicating:

Students are developing vocabulary to describe emotions, feelings, and themes.

? Problem Solving:

Students are determining which axes must be crossed to make which sounds.

Next, give students 5-10 minutes to play with their Wearable Music Sensors. Show students how to find sounds using the sound dropdown menus in either Rainstick or Sonic Introduction (Tap and Loop). Each of these apps have a variety of sounds, so there are plenty of sounds to explore. Ask students to find *happy, scary,* and *goofy* sounds. Then ask them to choose a motion that relates to the sound when it is played using the Sensor (jump is on Y axis, spin is on z axis, slide is on x, etc.). Post a list of possible motions (jump, spin, slide). Use a graphical organizer, such as this:

	Happy  Sounds	Scary  sounds	Goofy  sounds
Name of sound: Motion: Sensor motion: Axis:	Fast bubbles Pouring out of a cup Point lighted end up, then point down Y		
Name of sound: Motion: Sensor motion: Axis:			
Name of sound: Motion: Sensor motion: Axis:			

Foundations (Explain)

Introducing vocabulary (25-30 minutes)

Play Super Mario game on the classroom screen for about 5 minutes. Listen to sounds that accompany game actions.

Explain that sound or audio added to a movie or video game can be called sound effects and sound effects can make people feel something as well as creating an emotional theme. (Find examples of how different kinds of music can set the scene in the example Slide Deck listed in the materials section.)

Define **emotion** as the sensations in our bodies that are connected to the words we use for feelings. For example, our heart rate might speed up when we are scared or excited. Define **setting** as where an event or action takes place, and **character** as a person, animal, creature, or thing in a story that acts in a way to move the story along. Define **theme** as overall topic or idea in a game, movie, book, etc.

Use the Algorithm Worksheet (10 minutes). Have students (individually or in groups) write in the brainstorm area (gray box). Encourage them to consider what emotion was portrayed during the level that was played. Was it scary, intense, urgent, nervous? Post a list of emotions as examples.

Have students share (individually or in groups). What sounds led them to their conclusions?

As a whole group, discuss the following (5 minutes):

- If we wanted to recreate the intended theme, what other sound effects could we use? Any from sounds we explored earlier on the instruments?
- If we wanted to make this a more exciting theme, what sounds could we use?
- If we wanted to make it whimsical and fun, what sounds could we use?

(5 minutes) Return to the idea that one action in the game was usually connected to one sound. Explain that the video game designers used **inputs** and **outputs** to code which actions would **trigger** which sounds.

Define **input** as a signal or instruction sent to the computer and **output** as the signals sent out from the computer. Define **trigger** as something

Communicating:

During the Foundations section, students are developing vocabulary to connect to the experiences they had during the Activation section. Vocabulary building also includes time for teachers to give definitions and for students to apply new words on a worksheet and in a classroom discussion.

Keeping a list of vocabulary posted or in an accessible place will support students in vocabulary building, in their writing and during discussions.

? Problem Solving:

Students are determining which sounds connect to a theme, which motions make those sounds, and which axis must be crossed with the Sensor.

that produces a reaction, it makes something else happen. Then state that when the video game designers decide on these signals/instructions/rules, they then list them out in steps that become an algorithm. Define **algorithm** as a set of instructions to meet a specific goal.

Explain that the next time you work with the Sensors, the students will get to design algorithms for a specific goal, to use video game actions and sounds that set the emotional theme.

Day 2:

Application (Elaboration)

(60 minutes)

Give each student a level of Super-Mario (chosen at random) to play. After 5-10 minutes, ask students to use the Algorithm Worksheet to identify the theme of the level, what sounds they hear, and how the sounds support the portrayal of the theme. The students might need to go back to play the level again before filling in the information on the worksheet.

Now, have the students open the Tap, Loop, or Rainstick (Sonic Introduction and Rainstick instrument groups) and connect their Sensors. Have a list of possible themes posted. Direct the students to:

1. Choose a theme from the list.
2. Identify at least three sounds from the app that connect to their theme.

Communicating:

Using new vocabulary during the lesson and in discussions supports student learning of the new terms.

Creating:

Students are creating sound effects for a video game. They are bringing together multiple skills, making practical and creative decisions, and assessing how the outcomes make them and others feel.

Collaborating:

Students must work together to add sound effects to the video game. Each partner has a specific job to do to contribute to the team.

Problem Solving:

Students are determining whether an algorithm leads to the desired outcome. If the algorithm does not, then they are deciding how to improve the algorithm.

3. Decide which motions and triggers from the game should connect to the sounds.

Then tell the students to complete the algorithm using if/then statements on the Algorithm Worksheet. Be sure to use vocabulary when possible. Instead of what is your IF, say what is your trigger (or input)? Students can respond, “My trigger is _____.”

Students can use create as many instances of the instruments as they want (Tap, Loop, Rainstick, etc…). They can connect these instruments to different axis of the sensor (Pitch/Roll/Shake, X/Y/Z-axis) to make their sensor into a multi-sound creation device. For example, one could connect three instances of Rainstick to Pitch, Roll, and Shake of a sensor in EASY mode and have an instrument that generates a sound scape from you movement and the chosen sounds.

Once the algorithms are written, pair students up for the final part of the Application. Partner A will play Super Mario on a computer, with the sound off. Partner B will have their Sensor connected to the Tap, Loop, or Rainstick instruments and will follow their own written algorithm to play the sounds depending on the character’s actions in the game. After about 10 minutes, have the partners switch so that they each get to play the game and to add the sound effects according to their own written algorithms.

Explain to the students that they will have more time to play and get feedback on their algorithms the next time you work with the Sensors.

Day 3:

Culmination (Evaluate)

(40-60 minutes)

Explain to the class that today they will get to use someone else’s algorithm to add sound effects to Super Mario. Pair up students and designate a Partner A and Partner B for each pair. Each student will give their written algorithm and Super Mario level to their partner. They should not discuss or clarify directions. Give the students about 5 minutes to practice playing the designated sounds with the Sensor based on written instructions.

Once time is up, group A partners will play the game while their partner B will use the Sensor to add the sound effects using the written algorithm. Then give Partner Bs 3-5 minutes to give feedback and ask for clarification. Direct the pairs to explain how the algorithm could have been clearer by writing in the space provided, or by audio recording their discussion.

Repeat the activity with partners switching roles so that all students receive feedback on their algorithm.

Engage the students in a whole class discussion. Some driving questions to ask:

- What emotions did you evoke? How do you know you were successful?
- How do the sounds in your setting support your overarching theme?
- What was the easiest part of this challenge? What was the most challenging part? What made that the most challenging?
- What was the biggest obstacle you had to overcome?
- What did you learn about writing algorithms that are clear enough for someone else to follow?

Adaptations:

1. Some students may be overwhelmed by having to choose between many combinations of motions and sounds. If

Communicating:

Giving effective feedback is an important skill to learn. Support the students by giving examples of how to respectfully give feedback. They might begin by stating what works well, then by offering one way to improve the algorithm.

Creating:

When creating something new, people often need to assess the outcome to see if it matches their goal. Making adjustments is part of creating.

Collaborating:

Assessments do not always have to be done by teachers to students or student work. Students can collaboratively assess each other's creations, give feedback, and support each other's improvement.

Problem Solving:

Support student decision making by offering a bank or list of options to choose from for students who are overwhelmed and by allowing students to come up with their own ideas for students who have unique ideas.

the students appear overwhelmed, provide alternate worksheets with some multiple-choice options rather than fill-in-the-blank. Alternatively, predetermined themes and levels can be combined or chosen randomly based on knowledge-level. Have (emotion, theme, motion, etc.) lists posted for the whole class to help students identify which concepts they would like to work with.

2. To create a more embodied experience, modify the movement so that they are recreating the movement in the game. For example, a spinning machine in the video game would require the student to spin their arm with the Sensor in the same motion to trigger the desired sound. Students would need to identify which axis (x, y, z or pitch, roll, shake) needs to be chosen to achieve the desired sounds and then perform it that way each time.
3. An adaptation that does not use video games and might be more suited to students with visual impairments might be Robot Obstacle Course. Have one student be the robot (character) who can only move by following directions. Have some other students connect to the Sensors and apps. Determine which robot moves will trigger specific sound effects. Write the algorithms for each sound effect and determine which student will play which sound effects. Then send the 'robot' out of the classroom while the rest of the class decides where in the room to hide the 'flag' (or other object). Call the 'robot' back inside. Have students take turns giving the 'robot' directions that will lead them to the hidden object. For example, "take two regular steps forward," "turn 90 degrees to your left," or "reach your right hand forward." As the 'robot' follows the directions, have the students in charge of sound effects use the Sensor and app to create the sound. For example, moving forward could be accompanied by the sound of footsteps, turning can be accompanied by a swirling/twirling sound, and reaching can be accompanied by a stretching sound. Students will have practice creating and following algorithms in multiple formats during this activity. A student with visual impairments could be the robot, with assistance if needed. They could use the Sensors with the app to make the sound effects, with someone acting as the trigger if needed.

Extensions:

1. Explain that games, and most other computer programs, do not follow all bits of instruction at once, but rather wait for a trigger by another event in-game (for example, when a cutscene plays once you've reached a certain area in game, or you can't get a certain item until you've reached a high level). Then have the students complete the Activation activity with the following twist. Place students in groups

of 4 or 5. One person will be the Super Mario player, one will be the trigger, and each of the others will move Sensors to create a specific sound. Sound students have eyes closed, are wearing a blindfold, or sit turned away from the video game screen. While the player plays the game (with no audio), the trigger must tap the shoulders of the sound effects people to play at the right times. It might help to have the students create a sign with a picture or word to hang around the neck or on the back of the sound effects people. Increase the difficulty by having sound effects students control more than one sound. To do this, the teams must create different "triggers" for students to know which sound to play at the right time.

2. Play a clip of a movie with different background sounds and music. Discuss how different sounds elicit different emotions for different themes. Assign a 30 second movie clip without audio to each group of 3 to 4 students. Have each group come up with 3 to 4 sound effects to use during the clip based on the actions in the movie. Once the group has written out their algorithms, give them time to practice adding sound effects to the movie clip before asking each group to perform for the whole class. Sonic Introduction (both the Tap and Loop sections) and Rainstick can be used in this foley exercise. Encourage students to use Rainstick's parameters to morph and change the quality of the sounds.

Expansions:

Discussions about emotions and themes can cross subject areas, such as in ELA, music, and media (audio, short clips, editing). Video game maps, the Robot Obstacle Course maps, and any kind of movement through space builds math, geometric, spatial, and graphing concepts and skills. To build on the concept of **algorithms** in other content areas, see the following ideas:

1. Toothbrushing Breakdown (20 minutes)

Content areas: Life Skills, Health & Wellness, Occupational Therapy

Remind the students that they have been learning about the CT concept called ***algorithm***. Explain that the students will be practicing writing algorithms by writing down the steps to perform a familiar activity, the act of brushing their teeth. They are to write the directions using as many steps as they can in 10 minutes. Give an example of how missing small steps might keep someone from learning how to brush their teeth. For example,

guide students to come up with small steps, such as “grab toothbrush with your hand” and “put the toothbrush under the faucet.” Organize students into groups of 3. Have students write each step on a post-it note, then organize the post-it notes on a flowchart posted on a wall or whiteboard. As students work, walk around and encourage students to break down the steps even further. Give students a 2-minute warning after they have been working for 8 minutes. Ask them to begin organizing their post-it notes. Once the 10 minutes are up, ask for a group to volunteer their flow chart and a student to volunteer to ‘learn’ how to brush their teeth. Read each step aloud and ask the volunteer to follow the direction. Have the rest of the class raise their hand or indicate in some way when a step might have been missed. Add the step in with a new post-it note. (This activity can be done with other life skills, such as making a burrito or folding a towel.)

2. Find more examples of everyday algorithms here: https://www.learning.com/blog/7-examples-of-algorithms-in-everyday-life-for-students/#:~:text=Any%20step%2Dby%2Dstep%20process,swoop%20and%20pull%E2%80%9D%20knot).
3. Alternate Algorithms for Addition. Give the students the problem 227 + 117. Ask the students to find the sum. Then have the students write the steps for solving the sum. (Many might use the traditional algorithm used in the United States.) Next, have the students find the sum a different way. Then have the students write the ‘new’ algorithm. Have students share all the different algorithms that were thought of in the class. Follow each algorithm to assess if they will lead to the correct sum of 344. Edit the algorithms that do not lead to the correct sum.

This lesson was co-developed by a research-practitioner partnership (RPP) and supported by NSF CS for All award #2122924, Engaging Teachers and Neurodiverse Middle School Students in Tangible and Creative Computational Thinking Activities.

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