Sonic Pi Composition Lesson Plan #4: Synthesisers and effects

"If you talk to any director, they'll say music is fifty percent of the movie." –Hans Zimmer

Lesson Overview:

The aim of this lesson is to: (1) understand **how computers use data and represent audio**, (2) get students to **create their own synthesiser sounds** from fundamental waveforms, (3) use **basic audio effects**, and (4) work on both group and individual project.

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Contents:

Learning Outcomes:

Key concepts	Sonic Pi syntax to be taught this lesson	Interdisciplinary Curriculum Links			Learning Outcomes
		Computational Thinking	Programming	Music (strands)	

Music:
-reverb, delay, distortion
-attack, release sustain, decay
-sine, sawtooth, triangle waves
	Activity #1
	(none)
	
	Activity #2
	`with_fx:`
	`-reverb`
	`-echo`
		Abstraction, debugging, decomposition	Methods, parameters	PK, DI	Music:
					-All students will create their own unique sounds using additive and subtractive synthesis
					-All students will use basic effects e.g. `reverb, delay, cutoff`

Programming:
-decomposition (making synthesisers)
-abstraction
-bits to audio (data representation)
-methods
	`synth: (sine, square, saw, tri)`
	`-attack -release -sustain -decay`
	
	Activity #3 and #4
	`(none)`
					Programming:
					-All students will create and use their own personalised synthesiser
					-All students will explore `attack`, `release` and `sustain` of synthesising a unique and personalised electronic instrument

Introduction: What did we cover in the last lesson **(5 minutes)**

Activity Overview: Every lesson in this unit of work starts with refreshing knowledge and identifying gaps in understanding from the previous lesson.

Student Activity:

1. For three minutes, students are to reflect on the code they saved at the end of the previous lesson
2. The teacher should roam the room, quickly surveying the code produced and ask a sample of students about key music and programming concepts covered in the previous lesson
3. If the teacher deems necessary, have a 2-3 minute discussion on identified concepts that need to be reinforced

Notes to the Teacher:

- Reflection will begin each lesson in this unit and the teacher should try to get around to all groups every two lessons

Activity 1: Data representation of audio **(10 minutes)**

Activity Overview: Introduce students to the data representation audio in computers.

Suggested Teacher Instruction Sequence:

1. Watch "Morse code & Trying to make Will remember" [1.19 minutes] from the Netflix TV series 'Stranger Things' 2x08. → how long and short sounds can be converted into text messages

2. Play https://www.youtube.com/watch?v=pmY7pOQCOr8 (how sound and images are represented in computers) [2 minute video]
3. Explain that computers do everything with just 0s and 1s (or two different states like high voltage and low voltage). This means a picture can be represented as audio and a piece of music can be represented as a picture, because to a computer, the files are just a bunch of 0s and 1s

Suggested links and resources to facilitate activities:

- https://www.youtube.com/watch?v=QQSXlFe9LZ0 morse code in sound from “Morse code & Trying to make Will remember” from the Netflix TV series Stranger Things 2x08
- https://www.youtube.com/watch?v=pmY7pOQCOr8 How sound and images are represented in computers

Student Activity (10 minutes):

1. **Class discussion prompt**: *How do computers store and play audio?*

Activity 2: New Sonic Pi commands (additive and subtractive synthesis with sine, sawtooth, triangle waves and audio effects) **(30 minutes)**

Activity Overview: Students are to create their own synthesiser sounds from fundamental waveforms and use basic audio effects (reverb, echo etc.).

New Sonic Pi syntax to introduce in this activity (click for example code):

synth: (sine, square, saw, tri) attack release sustain decay. E.g. synth :sine, note: :c4, attack: 2, release: 1, sustain: 2, decay: 2

```
with_fx :reverb do
play 60
sleep 1
end
```

Suggested Teacher Instruction Sequence:

1. Introduce students to the idea of harmonics in different instruments with Google Chrome experiments spectrogram https://musiclab.chromeexperiments.com/Spectrogram/
2. Introduce students to synthesis with https://musiclab.chromeexperiments.com/Oscillators/ https://musiclab.chromeexperiments.com/Harmonics/ to explore different kinds of oscillators → Give students two minutes to experiment with this interactive
3. Demonstrate how to make a new instrument synthesizer with `synth: (sine, square, saw, tri) attack release sustain decay.` E.g. `synth :sine, note: :c4, attack: 2, release: 1, sustain: 2, decay: 2`
4. Demonstrate how to add audio effects reverb and echo (there are many more). E.g:

```
with_fx :reverb do
  play 60
  sleep 1
end
```

Suggested links and resources to facilitate activities:

- Google Chrome experiments spectrogram https://musiclab.chromeexperiments.com/Spectrogram/
- Synthesis with https://musiclab.chromeexperiments.com/Oscillators/ https://musiclab.chromeexperiments.com/Harmonics/ to explore different kinds of oscillators

Student Activity (20 minutes):

1. Students experiment making their own synthesizer individually separate from their own projects
2. Students integrate experiments into their own composition
3. Students experiment with audio effects in their individual project

Notes to the Teacher:

(none)

Activity 3: Reflection of progress so far and class discussion of selected listening examples **(10 minutes)**

Activity Overview: Standups as per lesson #2 and #3. Students also get a chance to demonstrate their composition to class (only volunteers) listen to each other's work and give constructive feedback.

Suggested Teacher Instruction Sequence:

→ standups

→ class demonstration of individual projects only for those that volunteer

→ Students get 5 minutes to listen to each other's work and give constructive feedback feedback

Student Activity (15 minutes):

1. [Standups] Give students 2 minutes to think of what to say and who is going to go first
2. Commence standups. Tell students that they will be completing a reflection diary at the end of the lesson and they can use the information they talk report in their stand-up for this
3. Give students 5 minutes to listen to each other's work and give each other constructive feedback
4. Ask students if there is anyone who would like to play their composition so far to the class (only willing volunteers)

Notes to the teacher:

- As per lesson #2
- Remind students about giving helpful and constructive feedback

Activity 4: Student time for group projects **(20 minutes)**

Activity Overview: (none)

Teacher Instruction:

(none)

Activity (20 minutes):

Student instruction similar to Activity #2 with their group projects

1. Students experiment making their own synthesizer separate from their own projects in their groups
2. Students integrate experiments into their group composition
3. Students experiment with audio effects in their group project

Notes to the teacher:

(none)

Wrap-up activity: Quiz and reflection **(15 minutes)**

Activity Overview: All students to complete a quiz containing 10 questions on music and programming - as well as a few reflective questions on this lesson (all students will complete this each lesson).

Student Activity (10 minutes):

- Students individually complete the quiz and reflection on the key concepts in this lesson within 10 minutes linked here. (PDFS)

Administrative Details

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