What do Fractions Sound Like?

A Self-Study of Pre-service Teacher Task Design

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Self-Study Context

Fractions in Elementary Mathematics

Previous literature has explored the connections between music and part-whole reasoning in fractions (Azaryahu et al., 2021; Courey et al., 2012; Jones et al., 2013, Lovemore et al., 2022). As described in Lovemore et al. (2022), the study of fractions can be difficult for students to grasp, as fractions can be represented and applied in a variety of different ways.

Similar to the approach taken by Lovemore et al. (2022), our approach to task design involves examining fractions through measurements of length and part-whole relationships. However, the measurement of length in this particular task pertains to a singular 'bar' or 'measure' of music. This will be symbolized through the use of a number line.

Steffe and Olive (2010) noted that when working with fractions through the use of number lines, students are able to engage in the process of intuitive subdivision. Further, Steffe and Olive (2010) described how students used visual estimation to perceive the length of a unit and divide it into segments. For the purpose of this task, students would use this approach to place music notes onto a number line that is symbolic of a 'bar' or 'measure' of music.

Research Methodology

As a pre-service teacher, my purpose for this research project was to document the process of designing a mathematical task. Specifically, I developed a task that focused on introducing students to part-whole relationships in fractions through the use of music. To accomplish this, I used a self-study research methodology throughout the development process, documenting pivotal moments that occurred during task-design. In order to explore the possible connections between music and mathematics, I had to reflect upon the beliefs that I had acquired as a result of my lifelong experience with music and dance. Subsequently, I was able to recognize opportunities for growth and therefore, adapt my task for the context of the classroom in order to strengthen my practice as a pre-service educator (Chapman, 2008). This task stemmed from my teaching philosophy which places emphasis upon the need to create multiple opportunities for students to explore mathematical content in the classroom (Chapman, 2008). It is my intention to share my learning process as a pre-service teacher in order to create a task that can be used and expanded upon when exploring fractions in the elementary classroom.

Results: Realizations for Teachers

Resulting Task Structure:

For this task, the goal was for students to have multiple opportunities to explore and make connections between music and mathematics. In order to make comparisons between the symbolism of music notation and part-whole reasoning, the structure of the task includes:

1. Listening to the length of the 'bar' of music
2. Embodying the rhythm through percussion
3. Drawing a number line and placing the notes according to the rhythm at-hand
4. Constructing the rhythm using cuisenaire rods as a physical manipulative

Realizations for Teachers

- This task is meant to provide elementary educators with an alternative approach to teaching fractions in the classroom. As evident within the Government of Alberta (1989) Music curriculum, students in Grade 2 learn how rhythmic patterns consist of varying divisions of a beat (p. 4). Through incorporating music, students have the opportunity to apply part-whole reasoning in a way that promotes cross-curricular instruction.
- This task also provides an opportunity to incorporate elements of STEAM education into the classroom. Through exploring part-whole relationships in fractions through the context of music, students are encouraged to engage in critical thinking that involves making connections between the disciplines of mathematics and the arts. Specifically, students can be encouraged to perceive music and its' mathematical qualities. This provides another real-world example for real-world application of part-whole reasoning.

Resources

Metronome

Cuisenaire Rods

Lesson Plan

References

The Task

Grade: 2
Subject: Mathematics
Learning Outcome: Interpret part-whole relationships using unit fractions [LO:3]
Big Ideas:

- Students will identify parts of a whole and represent the fraction through rhythmic percussion, number lines, and cuisenaire rods.
- Students will begin to explore equivalent fractions through the use of music written in a 2/4 time signature.

Instructions:

The following instructions explore how connections between the symbolism of music notation and fractions can be introduced in the classroom. Using a metronome, students can be introduced to this task through the use of quarter notes in a 2/4 time signature.

Note. It is recommended that the metronome is set to around 80 bpm (beats per minute).

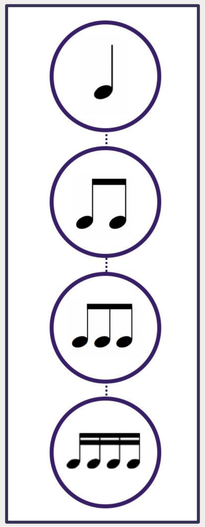
1. First, students will identify the 'whole' in this particular context. In the context of music, the 'whole' is a 'bar' or 'measure' of music. While listening to the metronome, students will count the number of 'ticking' sounds. Once a 'ding' is heard, the 'whole' or 'bar' of music has occurred.
2. Next, depending on the resources available in the classroom, encourage students to embody the rhythm through the use of percussive instruments or movements.
3. Use this as an opportunity to demonstrate how each 'beat' in the 'bar' of music is equal length (time).
4. According to what they hear, ask students to represent each of the two musical beats by drawing them on a number line on a sheet of paper.

5. Finally, ask students to construct a visual representation of the part-whole relationship through the use of cuisenaire rods.
6. Discuss the resulting part-whole relationship with students.

Differentiation

Music Term	Music Notation	Fruit	# of Syllable(s)	# of ____ per 1 Beat (Claps, Taps, Shakes)
Quarter Notes	♩	Pear	1 "Pear"	1
Eighth Notes	♫	Apple	2 "A-pple"	2
Triplet(s)	3	Strawberry	3 "Straw-be-rry"	3
Sixteenth Notes	𝅘𝅥𝅯𝅘𝅥𝅯𝅘𝅥𝅯𝅘𝅥𝅯	Watermelon	4 "Wa-ter-me-lon"	4

Equivalence



Future Implications

For implementing this task in the classroom:

- Working with a 2/4 time signature, students can explore equivalence of fractions by exploring the symbolism of the following types music notation: eighth notes, triplets, and sixteenth notes.
- To expand upon this task, students can apply this knowledge to music written in different time signatures: 3/4, 4/4
- Through the use of music, this task can be expanded upon in order to explore part-whole reasoning in fractions in elementary education for both Division 1 and 2 students.

For mathematics education:

To effectively design tasks for the classroom, pre-service mathematics teachers need experiences in modifying, evaluating, developing, selecting, and sequencing tasks and the opportunity to reflect on those actions.