# Levels 7/8 MUSIC Activity

## Exploring Compound Time and Rhythmic Phasing Using Steve Reich’s *Clapping Music*

### Introduction to Numeracy in Music

The Music curriculum is structured around four interdependent strands, which include content descriptors and elaborations, each of which involves making and responding (VCAA, n.d.-a, n.d.-b):

* explore and express ideas
* music practices
* present and perform
* respond and interpret.

When making and responding, students develop musical skills and knowledge through activities involving the practices of listening, composing, performing and additional learning to support these musical practices.

Although the nature of music itself is abstract, it is a uniquely aural art form that requires both creative and critical thinking (Crawford, 2020a). Music students develop skills that are “transferable across learning contexts and support development of literacy and numeracy capabilities” (Australian Curriculum, Assessment and Reporting Authority [ACARA], n.d.). Numeracy skills relevant to students’ understandings in Levels 7 to 10 Music (as preparation for Levels 11 and 12 Music) include the following competencies:

* Identifying and analysing how the elements of music are used in different styles and genres (e.g., understanding and comparing patterns in the elements)
* Manipulating the elements of music and stylistic conventions to compose music (e.g., using critical thinking and logical reasoning with creative expression to experiment with different musical combinations and compositional devices)
* Using aural skills, music terminology, and symbols to recognise, memorise, and notate music performed or composed (e.g., investigating rhythmic and melodic patterns through sequencing numbers to identify patterns or rules, such as using number groupings to identify simple or compound time)
* Working with spatial thinking and number (e.g., through shapes, scale, proportion and ratio as applied to the basics of acoustics; units of measurement between musical intervals; identifying structures within musical works)
* Considering mathematical concepts such as rhythmic and interval patterns, alongside aesthetic aspects (e.g., beauty, style)
* Calculating, estimating, measuring, planning and creating musical works (e.g., using measurement to determine shape of a piece/song; melodic, harmonic, rhythmic and lyrical patterns; chord inversions)
* Positioning, locating, and sequencing of musical elements with and without technology (e.g., making a time-based or time-aligned work, such as film music, program music or sound effects)
* Using technical skills to develop mathematical thinking (e.g., using fractions as related to time signatures, aleatoric music to develop probability, algorithmic composition to apply formal sets of rules to determine musical outcomes)
* Problem-solving through visuospatial reasoning (e.g., understanding and recognising spatial relations among musical events, time and space. Playing a musical instrument requires musicians to translate musical symbols into specific motor actions while simultaneously monitoring the auditory signals produced by their instrument. This complex process allows musicians to develop strong associations between visual musical symbols, motor commands, auditory signals, and temporal patterns.

In Music, students continue to develop their numeracy skills in practical and conceptual ways, enabling them to apply this knowledge and skill set throughout their lifespan. The most relevant sub-elements of the numeracy learning progression for Music are: Number Patterns and Algebraic Thinking, Measurement and Geometry (basic acoustics), Comparing Units (ratios, rates, and proportion), Interpreting Fractions, and Interpreting and Representing Data (ACARA, n.d.). By incorporating mathematical concepts, students are able to address issues in music making and responding.

### Developing Numeracy Understanding in Music

Numeracy encompasses knowledge, skills, behaviours, and dispositions (ACARA, n.d.). In Music, students engage with numeracy in multiple ways and contexts (e.g., using calculation, estimation and measurement knowledge and skills to collect and make sense of information). When students learn to read and write music notation, they draw on their knowledge of fractions (e.g., halving, quartering, accumulating fractional parts and re-imagining the whole).

Through engagement with music, students can use and extend their numeracy capabilities when considering “the structure and form of music works, pitch (intervals, scales and octave identification), harmony, tuning systems, concepts relating to beat, pulse, rhythm, metre and sub-division and acoustics” (ACARA, n.d.). Music making and responding involves learning to recognise and use patterns and sequences when composing, performing and listening. Reasoning and visuo-spatial skills can be developed through “singing, playing instruments and performing in ensembles” (ACARA, n.d.). Through analysing numerical data to research, interpret and evaluate evidence about musical works, students can determine how they are presented, performed, shared and appreciated.

The intimate relationship between music and mathematics predates the Pythagoreans, who deliberated over the connections between ratios and musical intervals (Pesic, 2013). Interdisciplinary contexts where content and concepts intersect and are made explicit in teaching and learning can result in powerful, authentic and meaningful learning (Crawford, 2020b). The impact and value of interdisciplinary learning lies in the potential for making connections not only across disciplines, but also within real-world contexts (Bazinet & Marshall, 2015; Law, 2018).

The diverse and rich links between music and mathematics include manipulating and combining the musical elements that relate to performing, composing and listening. Musical concepts (rhythm, melody, intervals, scales, harmony, tuning and temperaments) are directly related to mathematical concepts, such as proportions and numerical relations, integers, logarithms, arithmetical operations, and the content areas of algebra, probability, trigonometry and geometry (An et al., 2013; Harkleroad, 2006). Both mathematics and music involve the use of symbols to communicate and share ideas across times, locations and cultures. In both disciplines, students can learn conventions for reading, interpreting and writing these symbols. Students can discuss these ideas through performance and composition activities in which “different notation forms/systems such as graphic (semantic and non-semantic), spectrographic representation, culturally-specific notation, proportional notation, Western staff notation, interactive notation, historical and contemporary forms of tablature/TAB or types of chord notation” are explored (ACARA, n.d.).

Music can be harnessed by teachers to present mathematical problems in non-routine ways, providing students with opportunities to apply mathematical knowledge in authentic and meaningful contexts, connecting new knowledge to existing knowledge (Fllis & Fouts, 2001). In the past, educators have implemented several different instructional strategies to provide an interdisciplinary approach to teaching and learning music and mathematics, although the levels of integration have varied (An et al., 2011). Sellars (2018) proposed an integrated framework, designed to allow opportunities for reflection on social and cultural connections to the personal nature of numeracy. Goos et al. (2014) posited a numeracy development model that requires attention to real-life contexts; the application of mathematical knowledge; the use of representational, physical, and digital tools; and positive dispositions towards the application of mathematics.

Both Sellars’ (2008) and Goos et al.’s (2014) models closely relate to making and responding in Music, through the development of critical thinking and creative expression, to develop a unique musical voice within wider societies and cultures. Through explicit teaching and learning, teachers can highlight the interconnected nature of mathematical knowledge and skills with Music.

## Lesson Plan: Exploring Compound Time and Rhythmic Phasing Using Steve Reich’s *Clapping Music*

In this lesson, students become performing artists as they explore patterns in music and develop understanding of compound time and rhythmic phasing. Students work through the 12 pattern combinations found in Steve Reich’s (1972) famous minimalist piece Clapping Music. Students develop numeracy and music skills as they become makers of, and responders to, patterns in an authentic minimalist context.

In the Western art music tradition, the U.S. composers La Monte Young, Terry Riley, Steve Reich, and Philip Glass are credited with being among the first to develop compositional techniques in which a minimal approach was exploited. Minimalism is known today as one of the most significant musical styles of the late twentieth century, and its pervasive influence on the development and evolution of popular genres such as electronic, trance, and dance music is ever present. Although the theme of this lesson, Exploring Compound Time and Rhythmic Phasing, can relate to all four of the Music strands, the primary focus is on the strands Explore and Express Ideas, Music Practices, and Respond and Interpret.

Students apply their knowledge of pattern concepts and time while simultaneously analysing and exploring how patterns are formed through practical application (i.e., exploring the 12 pattern combinations). In the process, students use numeracy skills to identify patterns through discernible regularity in a group of numbers. Students sequence numbers to identify a pattern or rule (counts in different groupings, e.g., to identify simple or compound time). Students develop an understanding of the predictability and generalisations of repeating music elements and the principles of rhythm and phase shifting to then apply to their own patterns.

This lesson is informed by an experiential learning approach (Dewey, 1938) and Crawford’s (2014) multidimensional/non-linear teaching and learning model. Using a constructivist framework, students construct knowledge and meaning through engagement with learning that is authentic, experiential, student-centred and holistic. Students become performing artists who share their music making and responding with the class.

### Prerequisite/Corequisite Knowledge: Music

Students need to have and/or develop the ability to:

* Comprehend that Western written music contains a time signature, which looks like a fraction and is found at the beginning of a piece of music. The upper number of the time signature represents the number of beats per measure and the lower number represents the time value of each beat.
* Understand that tempo (Italian for time) defines how fast the beat or pulse is and in turn the speed at which a piece is played, which is measured in beats per minute (bpm).
* Work with time signatures and rhythms in simple time.
* Explain how the beat of a piece of music in simple time can be broken down into two-part rhythms. Simple time signatures are the easiest to count, because a one-two pulse in a piece of music feels the most natural to a listener and a performer.
* Use basic rhythm grids to identify simple rhythmic patterns in common simple time signatures, such as 4/4, ¾ and 2/4.
* Perform a continuous steady beat (rhythmic ostinato) in simple time using body percussion or clapping.
* Perform in a group or ensemble situation in class.
* Compose rhythms using simple time signatures and rhythms.
* Understand compound time signatures where the beat is broken down into three-part rhythms. The top number is evenly divisible by three (with the exception of time signatures where the top number is three), and each beat is divided into three components, creating a one-two-three pulse. Having already been introduced to the 6/8 time signature, the focus of this lesson will be the 12/8 time signature.

### Background Mathematical Skills and Understandings

Teachers of Music are not expected to teach the mathematical knowledge and skills that students will draw upon when engaging with this activity. The students will have learnt and should be adept with the required mathematical knowledge and skills to complete the activity. According to the Victorian Curriculum: Mathematics, the required mathematical knowledge and skills should have been developed in earlier years of schooling, that is, by the end of Level 6.

For this activity, the background mathematical skills and knowledge are:

* Knowledge of repeating and other types of patterns
* Ability to create and copy patterns
* Knowledge of the concept of time and units of time
* Ability to measure and compare elapsed time [students may need some assistance in transferring this knowledge to a rhythm grid]
* Ability to interpret and construct displays of data.

## Lesson Description

This lesson could be extended across 2–3 lessons depending on the level of detail in which musical concepts are explained and explored, and how the learning activities are unpacked. Extension ideas are provided for this purpose, as well as to cater for learning differentiation.

Teachers should familiarise themselves with Steve Reich’s (1972) Clapping Music piece and the background and context. Developing understanding of the brief historical background will enable a rich discussion about the role that this piece may have played in societal and cultural contexts. The discussion may include the evolution of minimalism that has had a significant influence on popular music genres and hybrid genres and styles. Background information about the piece is provided below:

* Instrumentation and the elements of music: The piece has no melody, harmony, instruments, or voices as it is composed solely using rhythm. The piece consists of two performers clapping throughout with no instruments or voices. The two clapping performers can choose whether they want to clap with cupped or flat hands, but both performers must do the same.
* Tempo, rhythm, and metre: The piece is based on a version of the traditional African bell rhythm, which has a 12/8 time signature and is thus in compound time. The piece has a quick tempo and should be performed at approximately 180 bpm. The piece should last around 5 minutes. It is recommended to play the piece quite slowly to begin with, increasing the tempo progressively. Stress to students that rhythmic accuracy is more important than speed.
* Musical structure: The structure of the piece is similar to a rhythmic theme and variations. Each performer begins by clapping their given pattern. They perform the same one-bar rhythm in unison with the number of repeats fixed at 12 repeats per bar, which is recommended on the score.
* Cultural connections: The fundamental rhythmic pattern used is known as a group of trochees. A trochee is a rhythmic grouping consisting of a long note followed by a short note. This “ancestral” rhythm has a strong metric time-keeping character. The trochee is a common Afro-Cuban drum pattern, also found in disparate areas of the globe. For example, it is the conga rhythm of the 6/8 time Swing Tumbao. It is common in Latin American music, Chilean Cueca, and the Cuban Coros de Clave; it is also found in Arab music, such as the Al Táer rhythm of Nubia; and it is also a rhythmic pattern of the Drum Dance of the Slavey Indigenous people of Northern Canada (Colannino et al., 2009).

The performer with clapping Rhythm 1 repeats their rhythm continuously without change. The performer clapping Rhythm 2 shifts the whole pattern a quaver forward after 12 repetitions. This technique is called phase shifting. As the phases move out of sync with one another, a polyrhythmic texture is created. The process continues until both performers are synchronised once more, clapping the same rhythm in unison.

Given that this lesson is designed to initiate explicit learning and thinking of mathematical concepts as related to the Music curriculum, the following resources may be useful in providing further background context:

Haack, J. K. (1998). The mathematics of Steve Reich’s Clapping Music. In R. Sarhangi (Ed.), *Bridges: Mathematical connections in art, music, and science: Conference proceedings* 1998 (pp. 87–92). <http://archive.bridgesmathart.org/1998/bridges1998-87.pdf>

Hartenberger, R. (2016). Clapping music. In *Performance practice in the music of Steve Reich* (pp. 153–167). Cambridge University Press. <https://doi:10.1017/cbo9781316584965.014>

Rutherford-Johnson, T. (2013, March 27). The influence engine: Steve Reich and pop music. *New Music Box*. <https://nmbx.newmusicusa.org/the-influence-engine-steve-reich-and-pop-music/>

Please note that the mathematics and its relationships to the rhythmic patterns in the Clapping Music piece can be discussed in quite complex terms due to the rhythmic phasing. As such, this lesson can easily be modified for Music elective classes in Levels 9 and 10 or even senior secondary Music. However, the focus of this lesson is Levels 7 and 8, and the topic is taught more simplistically for this reason.

1. Clap the basic rhythm (Pattern 1) from Steve Reich’s Clapping Music several times. Doing so will enable students to develop a sense of the rhythmic pattern and the ostinato.
2. Have a whole-class discussion about the rhythmic qualities of the first pattern. Question prompts could be:
	* Is there anything different about this rhythm compared to others you have heard before?
	* What time signature can you hear and why? (Have students identify if the rhythm is in simple or compound time and break down the divisions of the beats.)
3. Once the time signature of 12/8 is revealed, assist the students in setting up a rhythm grid. Provide an example on the projector/SMART Board.
4. Working in pairs, students will use the rhythmic grid to notate the rhythmic pattern (i.e., place dots/note heads representing notes in each of the squares to represent individual beats) to develop an understanding of the rhythmic structure.
5. Play the rhythm several times. Leave appropriate space between each playing to ensure that students have time to discuss their rhythmic dictations in pairs. By this stage, the students should have figured out that the pattern encompasses a single bar.
6. Come back together as a class and ask for students to volunteer their rhythmic dictations and rationale for Pattern 1.
7. Students learn to play the basic rhythm (Pattern 1)

 Pattern 1:

 (Pattern 1 is the rhythmic pattern that forms the basis of Steve Reich’s Clapping Music in Western notation: See image at <https://doi.org/10.1371/journal.pone.0205847.g001> from the article: Duffy, S., & Pearce, M. (2018). What makes rhythms hard to perform? An investigation using Steve Reich’s Clapping Music. PLoS ONE, 13(10), 1–33. <https://doi.org/10.1371/journal.pone.0205847>)

 Show the students Pattern 1 on the projector/SMART Board. Teach students the rhythm and clap it as a group, very slowly at first, increasing the speed/tempo gradually. A loud metronome or metronome app is recommended to keep a consistently steady beat or pulse while the students clap. The teacher can also keep the beat/pulse on a loud drum.

1. Ask different student pairs to lead the class in maintaining the rhythmic ostinato pattern.
2. Students learn to play Pattern 2 using the same steps as Pattern 1. (You could include the dictation of the Pattern 2 rhythm before moving on to learning how to play the second pattern.)

Pattern 2:

10. Have a class discussion about the differences between Pattern 1 and Pattern 2. Question prompts could be:

* From listening to both rhythmic patterns, what did you hear?
* If you compare rhythmic Patterns 1 and 2, has anything changed from the first to the second? If so, what?
* Please explain what rhythmic phasing might be.

(Pattern 2 is the rhythmic pattern that forms the basis of the phasing pattern by moving one beat from the beginning of the original pattern to the end, creating Pattern 2. This rhythmic phasing continues to encompass the 12 patterns. For example, see Patterns 3 and 4.)

Pattern 3:

Pattern 4:

Use this opportunity to briefly discuss the compositional technique rhythmic phasing and the composer’s intentions. Links can be drawn to how rhythmic phasing has influenced popular music genres. Cultural links can also be made to the trochee, which is a common Afro-Cuban drum pattern. (At this point, students could complete a small research task to explore what these terms and compositional techniques are. Students could compare and evaluate their findings.)

11. Although this next section can be done without the assistance of technology, using technology does make learning the Clapping Music piece even more interactive. As such, it is recommended that the *Clapping Music* app be used. The free *Clapping Music* app by Amphio Limited and Queen Mary University of London is designed for use with an iPad device. You can find out more about the app from the composer Steve Reich here: [https://londonsinfonietta.org.uk/clapping-music-app](https://londonsinfonietta.org.uk/clapping-music-app%20)

You can download the *Clapping Music* app for free from the App Store here: [https://apps.apple.com/app/id946487211?ls=1](https://apps.apple.com/app/id946487211?ls=1%20)

Open the *Clapping Music* app and display it on your projector/SMART Board. To save time, it is recommended that the following settings are set up prior to the lesson:

* Select ‘Tap To Play’ and ‘Practice Mode.’
* Select ‘Settings’ (the cog symbol at the top right of the screen), scroll down, and slide the ‘Tempo slider’ all the way to the left.
* Under ‘Transitions,’ select the number of times you would like each rhythm to repeat before it switches to a different pattern. (A minimum of five times is recommended.)
* Select the arrow at the top-right side of the screen to return to the Practice Mode list of patterns and select only Pattern 1 and Pattern 2 at this stage. Leave the other patterns unchecked.

12. As the students have already learnt to play Pattern 1 and 2, they are ready to perform as a group. Select ‘Play’ at the bottom of the ‘Practice Mode’ screen. The app will perform Pattern 1 once as an introduction and then the students can clap the rhythm that is displayed on the screen. After five repetitions (or whatever number you chose), the pattern will change to Pattern 2. Please note that in ‘Practice Mode,’ the app will change the patterns automatically based on the parameters that were selected.

13. Once the students are comfortable playing Patterns 1 and 2, divide them into two groups and have the first group clap Pattern 1. The second group starts performing Pattern 1, switches to Pattern 2, and then back again to Pattern 1. Then, swap the groups over so that each group has an opportunity to experience playing the rhythmic phasing and develop an understanding of two-part rhythms.

14. Have a class discussion about what happens when rhythmic Patterns 1 and 2 are performed together. Play the performance of Steve Reich’s Clapping Music by London Sinfonietta Percussionists David Hockings (Clap 2) and Toby Kearney (Clap 1): [https://www.youtube.com/watch?v=liYkRarIDfo&t=66s (3:41)](https://www.youtube.com/watch?v=liYkRarIDfo&t=66s%20(3:41))

* A brief discussion about polyrhythms could be introduced at this stage.

To facilitate this discussion, play the short interview about Clapping Music with Percussionists David Hockings and Toby Kearney: [https://www.youtube.com/watch?v=xtou64vkSUU](https://www.youtube.com/watch?v=xtou64vkSUU%20) (4:27)

Through discussion, students should be provided with opportunities to analyse and compare performers’ interpretations and discuss how the composer’s intentions are communicated.

15. You can continue to teach each of the 12 patterns in the same way and use the app to help students learn and perform them. In ‘Practice Mode,’ you can try different combinations of patterns (as few or as many patterns as you like). At this stage, students should have an opportunity to choose and experiment with different patterns in combination.

16. When the students can play a number of the patterns accurately (At least five patterns are suggested), challenge them by increasing the speed/tempo.

17. If there are enough iPad devices for the students to use, let them utilise ‘Performance Mode,’ which can be set as easy, medium, or hard. These options are much more difficult and involve all 12 patterns. Note that if you use shared iPads, you can set up more than one user in the Clapping Music app, which will allow students to keep track of their individual progress.

18. In groups of three, students can peer assess each other’s rhythmic accuracy.

* Can students perform a rhythmic ostinato in time to the app or a metronome? Do students speed up or slow down? If so, does this happen immediately or progressively?
* Can students play the Clapping Music rhythms accurately in time to the app or a metronome? The benefit of using ‘Practice Mode’ in the app is that it will automatically assess rhythmic accuracy.
* Can students perform contrasting patterns simultaneously? If not, what are some strategies that students can develop to practise this skill?

19. Students compose their own clapping piece in groups of four using compound time. Instrumentation can include clapping and body percussion. These pieces must have a minimum of two rhythmic patterns and a maximum of four rhythmic patterns. One pattern must be a rhythmic ostinato. Each group must notate their pieces using rhythm grids and Western musical notation with a time signature and a tempo indication in bpm. Dynamics can be introduced as an expressive element. Musical scores can be written by hand or using technology.

20. Each group performs their piece to the class and explains the relationship between the musical and mathematical processes. Students should identify how the elements of music (namely rhythmic patterns) have been used in the Clapping Music piece and compare them to the compositional devices used in their piece. (Extension activities could include each group teaching the class how to perform their piece and/or each group leading in the rhythmic dictation of the patterns in their piece.) Peer assessment can be used to evaluate the critical and creative thinking applied to compositions as well as the performance elements and ensemble work.

Further ideas for extension activities that involve clapping or body percussion to explore rhythmic patterns in performance can be developed using the following suggestions:

* We No Speak Americano ft. Cleary & Harding (Clapping and body percussion as focus) [https://www.youtube.com/watch?v=iANRO3I30nM](https://www.youtube.com/watch?v=iANRO3I30nM%20) (2:19) Performed and choreographed by Suzanne Cleary and Peter Harding
* Send My Love - Adele - Patty Cake cover (Clapping as accompaniment) <https://www.youtube.com/watch?v=nz7SMVYMT6k> (4:00)
* I’ll Think of You – Patty Cake Cover (Clapping as accompaniment) [https://www.youtube.com/watch?v=QZpGe5rNJkI](https://www.youtube.com/watch?v=QZpGe5rNJkI%20) (2:04)
* Anna Kendrick - Cups (Pitch Perfect’s “When I’m Gone”) (Percussion as accompaniment) [https://www.youtube.com/watch?v=cmSbXsFE3l8](https://www.youtube.com/watch?v=cmSbXsFE3l8%20) (4:21) (Film reference to Pitch Perfect - Beca’s Audition – 1:16 <https://www.youtube.com/watch?v=weqDCGg0GYs>)

## Table 1: Links to the Victorian Curriculum – Music

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| Strand and Sub-Strand (if applicable) | Content Description (Code) | Elaboration(s) |
| * Explore & Express Ideas
 | Develop music ideas through improvisation, composition and performance, combining and manipulating the elements of music (VCAMUE034) | [Adapted Elaborations]Manipulate specific elements such as pitch or timbre to create intended effects in composition and performance.Manipulating their voices and/or instruments through timbre and expressive techniques to convey intended style, considering safety, correct posture and technique.Experimenting with different types of notation to communicate and record ideas. |
| * Music Practices
 | Create, practise and rehearse music to develop listening, compositional and technical and expressive performance skills (VCAMUM035).Structure compositions by combining and manipulating the elements of music and using notation (VCAMUM036). | [Adapted Elaborations]Exploring and manipulating the elements of music within given parameters to create a personal interpretation.Using listening skills to experiment with ways of achieving cohesion and balance in ensemble performances and make choices to communicate the composer’s intentions.Combining and manipulating the elements of music to imitate a range of styles (in this case minimalist music).Exploring ways to combine and extend music ideas within specific forms…to create an ensemble work. |
| * Respond & Interpret
 | Analyse composers’ use of the elements of music and stylistic features when listening to and interpreting music (VCAMUR038). | [Adapted Elaborations]Identifying the elements of music aurally and then discussing how these elements, performance techniques and composition devices are used and manipulated.Identifying how the elements of music have been used in the piece, and compare them to the compositional devices used in their piece.Analyse and compare performers’ interpretations and discuss how each communicates the composer’s intentions. |

## Table 2: Links to the 21st Century Numeracy Model (Goos et al., 2014)

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| Aspect of the Model |  How This Aspect is Addressed by the Lesson |
| **Attention to Real-Life Contexts*** Citizenship
* Work
* Personal and Social Life
 | Students will develop an understanding of how patterns can be identified, evaluated and applied in authentic, real-life musical contexts through critical listening, performing and composing. Students will use mathematical processes to learn how to play rhythmic patterns in music and understand how these patterns can form the basis or structure of a piece. Students will engage with rhythm in personally meaningful ways by developing interpretations of music and communicating the composer’s intentions in performances. Students are provided with opportunities to apply this knowledge to their own pieces, which are representative of an authentic musical genre and style. Performing in ensembles and working on group compositions enables students to develop important personal and social development skills. |
| **Application of Mathematical Knowledge*** Problem Solving
* Estimation
* Concepts
* Skills
 | Students will develop skills in problem solving by using mathematical processes to identify rhythmic patterns and complete rhythmic dictations. Evaluation skills will be used to identify numeracy elements such as beats, time signatures, and tempo/speed in bpm. Students will develop skills in comparing and creating different types of rhythmic patterns using rhythm grids and other forms of musical notation to describe the division of beats. Students will practically apply the acquired mathematical knowledge and skills (i.e., time and pattern concepts) that performing artists and composers can employ in a particular musical genre and style (i.e., the minimalist context). |
| **Use of Tools*** Physical
* Representational
* Digital
 | Students will learn rhythmic patterns, as well as manipulate and experiment with different combinations for the *Clapping Music* piece using a dedicated app designed to do so. By using the app, students will be able to clap in time with the constantly shifting pattern and progress through all of the variations, developing an understanding of the rhythmic phasing technique and the role of the ostinato pattern. Students must notate their pieces using rhythm grids and Western musical notation (which are representational tools), including a time signature and a tempo indication in bpm. Musical scores can be written by hand or using technology (e.g., Noteflight, MuseScore, Sibelius). |
| **Promotion of Positive Dispositions*** Confidence
* Flexibility
* Initiative
* Risk
 | Students will develop the confidence and ability to interpret, analyse and compare rhythmic patterns in a given context. Students make informed decisions through critical listening and analysis by engaging in making and responding in Music. Rhythmic dictation is used to develop understanding of compound time and two-part rhythms. Students experiment as creative risk-takers in manipulating the elements of music and stylistic conventions to compose music. Students also combine critical thinking and logical reasoning (i.e., concepts of time and pattern identification) with creative expression to experiment with different musical combinations and compositional devices (i.e., rhythmic phasing), to develop their own Clapping Music-inspired pieces. |
| **Critical Orientation*** Interpreting Mathematical Results
* Making Evidence-Based Judgements
 | Students make and respond in Music using creative and critical thinking. By employing mathematical concepts and processes, students develop the ability to identify, compare and analyse rhythmic patterns, rhythmic phasing, compound time, and tempo/speed that are applied in performance and composition contexts. Students apply their knowledge and experience of learning Steve Reich’s Clapping Music as an evidence base to drive their own critical and creative decisions that contribute to new and innovative musical ideas, interpretations, compositions and performance practices. |

## References

An, S., Capraro, M. M., & Tillman, D. A. (2013). Elementary teachers integrate music activities into regular mathematics lessons: Effects on students’ mathematical abilities. *Journal for Learning through the Arts: A Research Journal on Arts Integration in Schools and Communities,* 9(1), 1–19. <https://doi.org/10.21977/d99112867>

An, S., Ma, T., & Capraro, M. M. (2011). Preservice teachers’ beliefs and attitude about teaching and learning mathematics through music: An exploratory study. *School Science and Mathematics Journal,* 111(5), 236–248. <https://doi.org/10.1111/j.1949-8594.2011.00082.x>

Australian Curriculum, Assessment and Reporting Authority (n.d.). *The national numeracy learning progressions, Numeracy learning area advice, The Arts: Music.* <https://www.australiancurriculum.edu.au/media/4107/numeracy-music.pdf>

Bazinet, R., & Marshall, A. M. (2015). Ethnomusicology, ethnomathematics, and integrating curriculum. *General Music Today*, 28(3), 5–11. <https://doi.org/10.1177/1048371315573566>

Colannino, J., Gómez, F., & Toussaint, G., T. (2009). Analysis of emergent beat-class sets in Steve Reich’s Clapping Music and the Yoruba bell timeline. *Perspectives of New Music*, 47(1), 111–134. <https://doi.org/10.1353/pnm.2009.0014>

Crawford, R. (2014). A multidimensional/non-linear teaching and learning model: Teaching and learning music in an authentic and holistic context. *Music Education Research*, 16(1), 50–69. <https://doi.org/10.1080/14613808.2013.812627>

Crawford, R. (2020a). Beyond the dots on the page: Harnessing transculturation and music education to address intercultural competence and social inclusion. *International Journal of Music Education*, 38(4), 537–562. <https://doi.org/10.1177/0255761420921585>

Crawford, R. (2020b). *Critical and creative thinking: Developing metacognition and collaborative learning in the curriculum: Critical and creative thinking curriculum*—*Final project report*. Monash University.

Dewey, J. (1938). *Experience and education.* Simon and Schuster.

Fllis, A. K., & Fouts, J. T. (2001). Interdisciplinary curriculum: The research base. *Music Educators Journal*, 87(5), 22–68. <https://doi.org/10.2307/3399704>

Goos, M., Geiger, V., & Dole, S. (2014). Transforming professional practice in numeracy teaching. In Y. Li, E. Silver, & S. Li (Eds.), *Transforming mathematics instruction: Multiple approaches and practices* (pp. 81–102). Springer.

Harkleroad, L. (2006). *The math behind the music*. Cambridge University Press.

Law, J. (2018). Music and numeracy. In M. Sellars (Ed.), *Numeracy in authentic contexts: Making meaning across the curriculum* (pp. 317-340). Springer.

Pesic, P. (2013). Euler’s musical mathematics. *The Mathematical Intelligencer*, 35(2), 35–43. <https://doi.org/10.1007/s00283-013-9369-5>

Sellars, M. (2018). Teaching and learning for numeracy competence. In M. Sellars (Ed.), *Numeracy in authentic contexts: Making meaning across the curriculum* (pp. 23–36) Springer.

Victorian Curriculum and Assessment Authority. (n.d.-a). *Music: Learning in Music.* <https://victoriancurriculum.vcaa.vic.edu.au/the-arts/music/introduction/learning-in-music>

Victorian Curriculum and Assessment Authority. (n.d.-b). *Music: Structure*. <https://victoriancurriculum.vcaa.vic.edu.au/the-arts/music/introduction/structure>