

## BASIC AND HIGHER COGNITIVE PROCESSES IN MUSIC RESPONSES: SOME THOUGHTS FOR MUSIC EDUCATORS

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### ABSTRACT

*There is a cognitive element in music education which is often neglected or ignored, and teachers ought to address this in their teaching practices. Back in 1989, Reimer noted that the devalued condition of the arts in education stems from the misconception that arts have no genuine cognitive status for that is arts involvement with the emotional expression. If arts are solely regarded with how one is feeling at a particular moment, education of music would become rather irrelevant. Ever since, researchers have examined the scientific and cognitive elements related with music teaching and learning, and its ontological existence within the overall educational and scientific spectrum. However, the misconception of music relating mainly with the emotional realm of oneself remains a stronghold in many curricula, or perhaps rooted in the essence of several teaching approaches. In this position paper we approach music education from the standpoint that there exist cognitive processes involved in responses to musical stimuli. Teaching music involves defining a logical education problem and, thus, toward finding logical answers through a designative logical process. We will, therefore, recommend various strategies which, we hope, will enable fellow music educators to address the cognitive skills required to music development.*

### Keywords:

Music Education; Cognitive Processes; Cognition in Music; Classroom Pedagogy.

### INTRODUCTION

What is cognitive process of listening? Listening is the cognitive process whereby we attach meanings to aural signals. It is the active intellectual process of decoding, interpreting, understanding and evaluating messages. It is a mode of communication

just as important as the other modes like speaking, reading, and writing. Elliott's Praxial Philosophy (1995) sees listening as integral to musicianship, and coins the term "listenership" where listening is an active, rather than passive, cognitive process which is essential to musical understanding, and the internal construction of musical relationships and meanings. Teaching strategies are required to develop the students' ability to process and comprehend music, such as reflective listening techniques (Elliott & Silverman, 2018). Similar connotations to the cognitive processes in listening can be found in Gordon's concept of "audiation", which is defined as the process to understand and assign meaning to the musical sound. Audiation is highlighted as central to aspects of musicianship, including performing, improvising, composing, or reading and writing music, and that developing audiation skills is essential for meaningful, active musical engagement (Gordon, 2007). These cognitive processes can be divided into two categories, the basic cognitive processes that form the basis on which information is processed, captured and kept in the "system", and higher cognitive functions that are mental processes resulted from the mixture of information as processed from the basic processes (Li & Schmiedek, 2001). Responses to music are directly related to cognitive processes, and such responses are learned (Schellenberg, 2005). Thus, we examine the basic and higher cognitive processes as manifested in musical information processing, and we propose strategies which music teachers can utilise to facilitate musical experiences cognitively for primary school students.

## **COGNITION**

The ability to comprehend and produce musical skills, such as melodic patterns and rhythm, has been examined extensively and across multiple domains and fields of research. Gardner (1983) for example, proposes music as an independent intelligence and associated with the ability to appreciate music, thinking in sounds and patterns, and understanding of musical structures and language. The Neo-Piagetian school of thought has criticised the use of the term "intelligence" and Gardner as neglecting the impact of different modes of processing has on the various domains of intelligences. Other theorists use the words "abilities" and "aptitudes" to avoid the debate surrounding the definition of intelligence(s), where music holds, again, an independent role with relation to the cognitive processes, skills, and functions involved. For our study on how to approach teaching music, it is important to understand the reasons why an activity is taught, and how the activity is related to the students' musical and wider development. However, the correlation between cognitive skills and processes across various domains is also debated. Chomsky suggests that modal cognitive skills are being confined in skill acquisition, and not necessarily form part of a general cognitive capacity. Piaget, on the other hand, found each cognitive stage accompanied

by rapid advance skills acquisition as the new capacity is applied to the wider range of specific skills a child is engaged with. Domain specificity-generality theorists also hold opposing views with regards to whether skills involved in the process of one domain are “transferable” to another (Makris, 2019). Elements of both views may be required to explain cognitive development (see Hargreaves, 1986; Runco, 2001; and Plucker & Beghetto, 2004). We adopt to a middle-ground position and examine the basic and higher cognitive processes as outlined in the International Encyclopedia of the Social & Behavioral Sciences (2001). It is our understanding that there are certain cognitive processes at play which can develop certain cognitive skills; our pedagogical approach involves focusing on these cognitive processes, in order to cultivate meaningful participation in music activities.

### **BASIC COGNITIVE PROCESSES**

**Perception** is the mental operation in which the system is interpreting sensory information. In music, this process would be responsible to processing musical sound (information), and assigning meaning to the input.

**Attention** marks the focusing mental resources on a specific stimulus. In music, attention is a key element to responding to conducting gestures in order to reflect changes in, for example, dynamics or speed.

**Information processing** is associated with how the brain encodes/decodes? and organises information. Structure and organisation are crucial in activities related to music performance, for example understanding similarities between melodic and rhythmic patterns in a piece of music in order to inform the performing techniques or phrasing.

**Memory** involves the process of storing and retrieving information over time. Here we observe short-term memory that is, holding small amounts of information briefly, and long-term memory that is, retaining knowledge and experiences over extended periods. Memory function holds true in many facets of music, either on the foreground or manifested in the background. For example, eventually learning and practising pieces by-heart for performing without attention to the musical score and in order to focus to the performative elements of such experience.

### **HIGHER COGNITIVE PROCESSES**

**Thinking** refers to the manipulation of information to inform decision-making, problem-solving, and forming concepts. Information processed by the basic cognitive processes are recalled to collectively allow judgements and deductions to be made, and learning to occur. In music, such modes of thinking have directly or indirectly been associated with improvisation, seen as real-time decision making.

**Executive Functions** are mental processes which regulate the behaviour and thoughts to achieve a goal. These are manifested through planning, inhibition, flexibility and self-monitoring, and decision making. They are seen to be paving the way towards medium or long-term goals, and thus avoiding sudden goal changes. Such functioning is crucial to music practising, especially when focusing on instrumental technique, as it often takes time for the relevant benefits to unfold.

**Learning** is an expansion from attention and memory mentioned before, as it depends on our ability to engage actively and meaningfully with a musical activity and store information that will be retrieved in our memory.

**Language** is key for communicating complex ideas and regulating behaviour. Language is not necessarily oral, but it could include other modes of communication. Music reading and writing have been vastly researched with regards to the similarities with language, which we could attribute to many modes of musical literacy. Performing and composing, as mediums to communicating ideas, require a great understanding on interpreting the musical meaning of a piece of music, while similar connotations are observed in aural and auditory processing relevant responses to music. Understanding music as “language” is crucial in participating in meaningful musical activities.

**Creativity** consists of modals which influence the ability to generating new ideas and developing new strategies, as a reflection of, and directly associated with, the previously obtained information. Bloom’s Taxonomy (1956) theorises the creative process as the last step classified to tracking learning objectives. The student is expected to put together a pattern of elements of the knowledge to had been learnt in the previous steps, in order to generate, plan, and produce new “knowledge” or simply, new ideas. In music education, creativity often manifests through composition and improvisation (Odena, 2011), which we view as the epitome of cognitive mechanisms to produce new musical ideas and strategies as a result of processing previously learnt information. Creativity is a crucial domain which could be valuable to our understanding on how humans perceive, process, and produce music.

**Motivation** refers to the internal driving force to engage in activities on a given topic and devote one’s time, in order to sustain goal-directed behaviour. There is an element of mental stimulation and enjoyment in the motivation processes, which is in line with further theoretical framework, for example, Csikszentmihayli’s concept of ‘flow’. This psychological condition, or flow, becomes a motivator for creative practice without any limitations from cognitive skills or abilities (Odena, 2012).

## **MEANING, LISTENING, AND PERCEPTION**

Many theorists have examined the relationship between perception and the cognitive element of responding to musical sound, with “knowing about” music seen to be

providing further insights on “knowing of” (Reimer, 1989; also see Meyer, 1956). More recent studies have examined this notion with comparing the musical responses of musically trained and untrained participants. Tan and Kelly (2004) asked a group of musically trained and untrained participants to drawing to mark while listening, and the study showed a tendency for the musically trained to reflect on the intra-musical properties of music (pitch, timbre, etc.) resulting to abstract representations, while the musically untrained tend to map the extra-musical properties (such as individual arousal of emotion), resulting to pictorial representations. Peretz and Zatorre (2005) further the distinction of the responses by distinguishing between music perception (e.g., pitch, rhythm, timbre) and music-related emotions. Additionally, the musically trained have been found to be outperforming the musically untrained in the consistency of responses to cross-modal mappings (pitch-height/loudness-thickness correlations). Whilst some researches attribute the asymmetry in such responses to evolution and as a result of primitive grouping mechanism in the brain – for example, accelerating objects would pose greater threat than objects which decelerate - it is rather evident that they are learned responses that directly affect understanding and perception (Eitan & Granot, 2006; also see Küssner & Leech-Wilkinson, 2014).

We propose a praxial approach to developing the cognitive skills that influence perception, that is the ability to understand and respond to changes in pitch, rhythm and dynamics through active music performance. We urge teachers to employ some sort of whole class ensemble teaching (WCET) practices in which the students would be asked to engage in this practice either vocally or instrumentally, or a combination of both. The students should be asked to perform and reflect changes to pitch (moving higher or lower), rhythm (going faster or slower), and dynamics (performing louder or softer) to mark to the conducting gestures of the teacher. At the beginning, the teacher must instruct students to start performing in *unison* on a given note, however the rest of the activity should remain free from any musical notation or other constraints to allow the students to focus on reflecting the musical changes in sound. However, some further musical properties could be introduced the more students engage with the activity and develop. For example, when students are observed to be getting more comfortable responding to changes in rhythm and dynamics, the teacher can choose to introduce *accelerando/rallentando* or *crescendo/decrescendo*. Other concepts such as time signature could gradually also be introduced. We propose that this should become an everyday activity in the musical classroom in the form of a “warm-up” session or lessons’ closing remarks. This practice aims to be informing the cognitive processes of perception and attention, whilst some further cognitive processes could indirectly be developed as secondary educational goals, for example, learning and information processing. Finally, when the teacher observes that students’ ability to

respond to such performing instructions, they could be introduced in other composing practices they might be engaging, as means to inform the language cognitive processes.

### **MOVING IMAGE AND DIEGESIS**

In the previous section, we have observed how the perception of auditory processing is shaped in relevance to the level of engagement in musical activities and the knowledge involved. Here, we suggest using moving images as a form of developing how students assign meaning to sonic information, which, even though is also relevant to perception, it also directly informs creative activities in music and the students' ability to thinking about the information processed, creativity, and the aural understanding of the musical language. Where we have focused above in students responding to musical contours, we elaborate on the aesthetic and emotional meaning of music by assigning meaning through visual representation. In film *diegesis* (from the Greek διήγησις, *diēgēsis*, meaning "narration" or "narrative"), Gorbman argues, music must follow and illustrate the visual images, and associates music diegesis with setting the mood and context of the picture (Gorbman, 1987). This notion is furthered to suggest such musical connotations to music which is related specific to characters (Kalinak, 1992), a technique in music composition known as *leitmotifs*, or more commonly, theme songs. They were firstly introduced by Wanger, and later been adapted to composition for picture and moving images. Two of the greatest examples of the use of *leitmotifs* in music scores for film can be seen in John William's score for *Star Wars* and Howard Shore's score for *The Lord of the Rings*, where not only characters but also locations, topography, and narrative events, are assigned meaning and mood by having their own music theme. We therefore believe that teaching students to compose with *leitmotifs* is a fundamental tool to support assigning meaning to music information. We suggest that teachers create a bank of examples with specific music connotations to introduce several concepts of *leitmotifs* in order to help students internalise the connection between the mise-en-scène and music, to the extent of aural preceding the visual. Anyone who has watched *Star Wars: The Empire Strikes Back* must remember the shivers down the spine upon the *Imperial March* theme underscoring the imperial fleet of the destroyers and the camera reaching the deck on which we see Darth Vader; which of course comes second to music, with the aural preceding to the audiovisual conception of the mood of the scene. The theme connotes a strict, disciplined, imperialistic and somewhat less humanistic environment of *Star Wars*'s galactic empire which is under the influence of the "bad guys", and informs the narrative perception and emotional engagement of the viewer with the visual action. Examples from *Star Wars* may be used, however, we believe the teacher should retain freedom to consider alternative examples - with perhaps social context and cultural

presuppositions as often advised by several approaches to music pedagogy, or similar – as long as the music diegesis is clear and related with a given emotion. We suggest to focus to feelings related to drama and action (fast paced music and hard accented music, with orchestral instrumentation and big volume of sound), or love and affection (somewhat slower and softer music), abstract and mythical concepts (here music could reflect a sense of *grandiose* and many examples exist in the library of science fiction films), and comic sounds (music with micky-mousing techniques, animation is definitely an option here). We advise the teachers to explain the concept of *leitmotifs* and narrate some examples to the students at the beginning, following up with more examples discussed in the classroom by allowing students to identify (i) the feelings associated with the music, and (ii) how this is related to the picture. This activity could be elaborated with follow-up lessons where the teacher employs assessment (albeit, informal) as a tool to examine individual student responses to the chosen excerpts. We suggest a simple test using no more than five (5) examples in a mixture of *leitmotivic* music for a character, a location, an event and mood of the film. The test must outline the key observations anticipated, and instruct students to, (i) identify the feeling (or potential multiple feelings, yet, the chosen examples should remain clear) associated with the music they hear, (ii) the musical properties which allowed them to reach to such conclusion (here we anticipate responses such as music is fast and accented, or slow and *legato*), and (iii) what the students think that music is attempting to narrate as related to a character, mood, etc. We anticipate that these practices are valuable to cultivate informative associations between music and meaning, with view to cognitively inform the auditory responses to music, and developing cognitive functioning in processes such as perception, information processing, thinking, and learning, whilst some secondary processes could be also observed.

### **CREATIVITY AS COMPOSITION: MOVING IMAGE AND DIEGESIS**

We have chosen to discuss the following suggestion separately, with view that this forms a sequel activity to the previous one, yet not necessarily a part of, due to potential limitations in time or resources to achieve the desirable teaching/learning outcome. We have discussed how students can learn about the cognitive element of assigning meaning to music through the use of *leitmotifs* in moving images, and we find the process of composing as a valuable assessor of the knowledge obtained previously. This is why we suggest a project-based learning approach to instructing students to work in groups and create a character, an event and a location, followed by a short story with a specific “mood” – essentially, to create their own mini storyline. The students will be expected to compose a short musical excerpt to accompany the story, involving both the intra and inter-thematic properties of music, and record their music

in the available DAW software (digital audio workstation) or choose to perform their music live and while their story video is played. Each group will then present their project and structurally discuss, (i) the background of their character, (ii) topography information about the location, (iii) the event unfolding, and (iv) the mood, and they should be urged to explain how their music reflects each point of discussion musically. The teacher here becomes the facilitator, they give clear instructions and outline the expected outcomes, while posing certain questions (problems) for students to find solutions for through this activity. Beyond creative cognitive processes, such practices are anticipated to motivate and inspire students, which is often observed in technology-based strategies with relation to greater engagement in the classroom and student curiosity.

### **VOCAL CALL & RESPONSE**

Using voice as a performance tool in education has been in practice since the very early stages of when humanity had established voice as more than just a communicative instrument - *from the Kaluli people in Papua New Guinea singing in rituals (for example, see gisalo) and the social context with which they reflect their environment and habitat, to choir singing in certain schools, to Kodály and Curwen, etc.* – but rather one of the most natural and cost effective mediums of musicing in classroom pedagogy. Several studies have examined the correlation between the use of voice (albeit, not only for its musical properties but first and foremost humanly) and cognitive functions and processes. It is beyond the benefits of this suggestion, however, to elaborate on the matter here. We view participating in the classroom vocally as a greatly accessible process and tool, and thus, making suggestions below on how it can be taught with relation to the basic and higher cognitive processes. We propose call & response as the basis towards manifesting the use of voice to transmitting information, and this way teachers are in control of a duality we seek in music education (musical, yet knowledgeable and cognitive).

The process begins with establishing a “ritual” – a more appropriate notion here would be a WCET warm-up session – in which the teacher cultivates the use of voice as instrument. Of course, material is key here. We propose using the notes we teach first on the recorder – B (SI or TI) – A (LA) – G (SO/SOL) – on which we will be making a sequel and correlated suggestion further below and via similar means. Using this three-noted pattern, we look to engage students by generating their own melodic patterns. These should be made to display in the classroom throughout the activity and/or school year, however we propose mitigating the number of patterns available to allow mnemonic cognitive processes to form. This is mathematically achieved and preset by placing limitation rules of minimum 2 and maximum 3 or strictly only 4-note

patterns, and depending on the level and year of the students. A maximum rule of three would suggest 12 patterns, or 81 for 4-note melodic patterns. Once this has been established, we place the teacher as the *maestro* who chooses to perform a given melodic pattern generated (the call), with the whole classroom ensemble imitating by performing the same melodic pattern (the response). The teacher must be in a position to provide technical, sound, and performative instructions and observe to confirm if all students are responding accordingly and wholeheartedly. This activity aims to creating an auditory bank of melodic patterns created by the students, and for the activity to relate to the four basic cognitive processes involved, repetition via a form of warm-up singing session/practice in the classroom is essential, or maybe, at least, recommended.

This activity could be furthered in line with Swanwick/Tillman *Spiral of Musical Development* (1986), and with view of student development and progression. On its simplest forms, we can build up this activity by simply adding another note – F (Fa) – adding a fourth note and expanding the melodic bank we have achieved. With a limitation rule of minimum 2 and maximum 4 notes (no repetitions allowed), the students are able to increase the number of melodic patterns in the bank by generating 60 new motives. Despite its connotations with the basic cognitive processes, the teacher can also expand practice beyond simply performative, by the means of *Solfège* and hand gestures to remark the notes while singing to support processing information according to learning and language processes. Finally, additional notes may be introduced, albeit without generating and displaying any further melodic patterns in an attempt to mitigate the volume of information amount to be processed. However, we propose expanding the vocal vocabulary by simple step-motion singing patterns to include C (Do) and D (Re). Manipulating the expanded pattern, the teacher might find valuable extracting a 5-note melodic pattern with view to introduce students to the pentatonic scale; in this case we are looking into an F major Pentatonic Scale which can inform further singing accompanied by hand gestures, and by assigning a note to each finger.

## **THE RECORDER IN IMPROVISATION**

We could argue that the activity of improvisation is regarded with cognitive elements of interplay between rhythmic and melodic dexterity, and harmonic understanding, which require executive skills. These could be achieved via repetition, elaboration, and advancement of melodic patterns and musical ideas. There is also a certain element of muscle memory and reflexes involved, which are developed through systematic practising and music rehearsing. Such traits are directly related to the improvisational activity, for example electric guitarists use the term “guitar licks” to explain such pre-

rehearsed melodic and rhythmic material which function as auditory banks. The sonic character of such passages is stored in memory and muscle memory, hence worth the sonic outcome is anticipated and intentional. The performer employs executive function related to active decision making, deduction, and problem-solving to decide which anticipated sonic outcome is relevant to the particular diegesis; improvisation here is viewed as a means to story-telling similar to composition, however, unfolding in real-time. Simply put, and electric guitarists for example, would have performed and rehearsed such “licks” in countless occasions, and decision-making is at play when deducting to performing an anticipated sonic outcome as part of the story unfolding. For Balkin (1990), there is a clear distinction between creativity and spontaneous actions, emphasising that the product of creativity involves a separate action from the creative process. Many curricula deploy improvisation as the vehicle to fostering creativity but it is unclear whether this notion consists of the process or product. Additionally, we ought to address that domain-specificity theorists propose a ten-year rule in engaging with the multifaceted spectrum of the creating process to become an expert in a specific domain (Bloom, 1985), whilst more recent theorists suggest an even greater number of years required to master a domain (Kaufman & Kaufman, 2007).

However, most curricula would naturally not be in a position to allow such time to achieve mastery of creative skills. With this view in mind, we propose a teaching practice with which the product becomes improvisation, but not the process. Literature suggests strong correlation between improvisation and cognitive functioning. Such mental processes while improvising expand beyond just the creative processing, for example executive functioning, thinking, and memory. Concurrently with the vocal call & response activity we had explored previously, we are adapting the same bank of melodic patterns generated by the students and displayed in the classroom, to form a second warm-up session as part of the everyday classroom activities, now becoming instrumental. This allows us to build on lesson structure and use material which have activated some cognitive processes previously, in order to mitigate the volume of information required to be processed by the students’ “system”, allowing for, perhaps, deeper, specific, and dominant cognitive processes to form with relation to improvisation.

The use of voice is natural and accessible, but instrumental dexterity requires practising beyond the performing activities in the classroom. Therefore, we require an instrument which students may have at both home and the school, to provide those willing to devote time to practice while the teacher involves the instrument in the everyday flow of the classroom and the studying material. Even though the recorder has been neglected, or perhaps overlooked, in the modern classroom, we explore the recorder as the key instrument to achieve our goal, which we believe is; (i) affordable

for every family or school to provide the students with, (ii) easy to carry from home to school and vice versa which benefits a possibility to having a musical instrument in every home with which students can practice and study for school, and (iii) relatively easy to play with and produce some sort of sound. We are now placing the teacher as the recorder *maestro*, with the technical, sound and performative instructions now require the teacher to possess certain skills in performing the instrument. We propose another WCET warm-up sessions where the teacher, again, initiates the call by choosing to perform a given melody and the students required to imitate the same melody on their recorders to respond. Upon developing the students to transition the level of vocally performing F major Pentatonic Scale as discussed before, we suggest to concurrently explore the same on the recorder. When instrumental dexterity (even if this involves just these 5 notes) is achieved, the teacher can further instruct the students to create new melodic patterns using the F major Pentatonic Scale. Mathematically, the amount of new melodic patterns to be processed becomes maybe one-too-many, and therefore are compromising with asking teachers to solidify a personal and relevant way of limiting the generation of new patterns as necessary for their specific classroom environment. Teachers would be aiming to explore these patterns in line with the notion of the “guitar licks”, which we propose to explore as divided in three key categories: (i) to utilise backing tracks in the key of F major, perhaps while exploring specific music genres such as folk, pop, blues, and rock, and promoting an improvisatory activity as part of the everyday classroom; (ii) introducing instrumental practising and studying via the use of practising the F major Pentatonic Scale melodic patterns as homework; and, finally, (iii) establishing a musically-oriented assessment (formal and depending from the relevant school policy and curriculum design flexibility, or informal) where students are called to improvise alongside a short backing track in the key of F major.

Focusing on the latter, we advise teachers to allow students to choose from the backing tracks used throughout the school year (or the certain period chosen, in which this activity is run), with the option to notify, or not, the students a week before. We see the choice as subject to age, level, the amount of time this activity had run, and type of assessment. If assessment becomes normal, the teacher can use to grading with associating to the patterns explored and how the student have executively chosen to demonstrate them, however if the assessment is informal this could be seen as rather irrelevant and unnecessary. We are aiming, though, to provide students with experiences involving executive functioning, thinking, learning and creating on the foreground, and while real-time decision making is informed by the basic cognitive processes in the background.

## CONCLUSION

In this position paper we approach music cognition as holding a crucial importance in the students' development, as well as placing music in a high position ontologically within education. Despite the important cognitive engagement associated with music learning, nevertheless, it is not uncommon to see limited emphasis, time and/or resources given to music. For many music holds a subsidiary cognitive value in education, however there are numerous research findings about the positive and broad impact of music in our lives. In this position paper we have shared our thoughts and made recommendations regarding the basic and higher cognitive processes and drew paradigms on how they can be utilized in music. We approach this paper as a guideline suggestion which could enable fellow educators who seek to contribute in similar conditions to music education and we are hoping that the musical activities we have suggested will be eventually reaching students. We firstly suggest a WCET model where students perform in unison and the teacher, as conductor, marks changes to the dynamics and speed of performance. The students are asked to reflect such changes performatively, in an attempt to engage the cognitive processes of attention and perception, and secondary also information processing, learning, and memory. We then explore how the use of *leitmotifs* in a composition project-based group assignment cognitively informs music listening/audiating and processes such as perception, information processing, thinking, and learning, whilst some secondary processes could be also observed. We provide a development path in which students firstly engage with the use of *leitmotifs* audibly, transitioning to creative practice through the use of DAW stations. Finally, we urge teachers to implement two WCET call & response warm-up sessions as part of the everyday classroom routines, one with the use of voice and another with using the recorder. Both share a bank of melodic patterns created by the students, and we further explore how this practice unfolds and manifests cognitive processes through spiral development. We conclude to argue that the recorder could be utilised to cognitively engage with processes similar to improvisation, with the option to introduce improvisation as assessment (either formal or informal).

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