It's Complicated: Exploring the Relationship Between AI and our Music Classrooms of the Future

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Introduction

As artificial intelligence and ground-breaking new advancements in science spawn the sixth wave of technology, transforming our lives as we live them, one cannot help but wonder what implications this has on the field of music. Indeed, no industry has been exempt from the far-reaching changes that technology has brought forth — music and education are no exception. In this essay, we will examine the profound and far-reaching impacts that artificial intelligence (henceforth referred to as AI) technology will have on our future music classrooms. We firstly will define what today's secondary school music classroom looks like, then begin a thorough evaluation of currently-existing AI approaches to music pedagogy. Next, we will analyze these AI-based learning approaches as case studies, discussing their current abilities and effectiveness. This detailed and systematic approach allows us to finally conclude the impact of AI-based learning approaches in our very own music classrooms of today, and of the future.

Defining our Music Classroom

The musical experience is introduced firstly in elementary school, where students are exposed to musical instruments — typically recorders and keyboards — as well as choral singing. As students graduate and move into secondary school education, they are given the choice to pursue a fine art — whether it be Visual Arts, Writing, or of course, Music. Under this label of "Music," we see courses centred around ensemble performance, which includes orchestra, choir, concert band, and jazz band. Depending on the funding and resources available for the school, some or all of these programs may be offered. For the purposes of this essay, non-standard Canadian curricula, such as Advanced Placement courses or the International Baccalaureate Diploma, will not be discussed. Rather, our music classroom is defined as "a place of learning in Canadian secondary school institutions that enables young musicians to learn and develop their ensemble performance skills."

The Reality of Artificial Intelligence

Upon hearing the term "AI," it is not uncommon for a hypothetical scenario to pop into mind — hyper-intelligent robots becoming self-aware and enslaving the human race. This is primarily due to the improper portrayal of AI in pop culture, with many movies depicting highly exaggerated and unrealistic doomsday scenarios. Indeed, prior to properly researching the highly fascinating field of this technology, I harboured many misconceptions surrounding AI. Here, a concise explanation of AI and its function will be provided to establish the foundational information that will allow us to review and analyze upcoming case studies accurately.

Firstly, we must define artificial intelligence. The term refers to "the simulation of intelligent human behaviour in machines." Artificially intelligent machines ideally will use its ability to learn and modify new behavior to achieve a specific goal through the best means possible. The skills of AI can be broken down into three steps: learning, reasoning, and self-correction. *Learning processes* of AI are designed to acquire large amounts of data and detect patterns in the environment, creating instructions for itself that turns the data into actionable information. This provides the machine with step-by-step instructions for completing a specific task. The set of instructions is created through the *reasoning process*, which enables a computer to choose the right instructions that will achieve a favourable outcome. Lastly, the algorithm is continuously refined through *self-correction*, which fine-tunes instructions to produce the best possible result. While the mechanisms of artificial intelligence sound dry and unartistic, that is not to say AI cannot serve a creative purpose — scientists at SONY CSL Research Lab have created the world's first-ever AI composed song, "Daddy's Car." Certainly, AI's potential impacts on the music industry are far-reaching and limitless. However, in the context of music education, the applications of AI include training pre-service student teachers as they work towards teaching certificates, as well as providing personalized feedback to students outside of the classroom. We will now examine these AI-based learning approaches in detail.

Case Study #1: *FirstClass*

In 2016, music professor Dr. Ann Clements of Penn State University developed *FirstClass,* a virtual reality classroom featuring AI "students." The AI-driven virtual classroom is used to train pre-service student teachers that will become our music teachers of the next generation. The virtual classroom accurately simulates conditions found in a real-world classroom, with the exception that the students are all AI, of course. According to Kyle Bowen, director of Teaching and Learning with Technology (TLT) at Penn State, "This technology provides students with an immersive experience where they can make meaningful mistakes in a low-stakes environment. Through repetition and practice in a virtual classroom, future teachers can find their voice and make the most of their time in the live classroom."

FirstClass has been tested by a pre-service student majoring in music education, Brandon Buterbaugh. The pre-service student teacher practiced their teaching skills and techniques by interacting with AI students. Tasks involved taking attendance, making eye contact, and engaging with students who became disinterested or disruptive. Buterbaugh tested three introductory modules offered by *FirstClass:* Line of sight, student greetings, and proximity control. Each module focused on developing a specific aspect of Buterbaugh's teaching ability. After completing the three modules, Buterbaugh taught a lesson to the AI students, who were given a yes-or-no assessment at the very end of class to determine their proficiency in the new topic. This assessment was *FirstClass's* method of evaluating Buterbaugh's teaching ability. Buterbaugh commented on this assessment, stating: "Based on how well I did, that is how well the virtual students answered the questions. Their score on the test was really my score for how well I did teaching the lesson."

Dr. Clements stresses that *FirstClass* is not designed as a replacement for in-person student teaching in a real-world classroom. Rather, the technology is meant to help pre-service student teachers understand and prepare for situations that may occur in the classroom, allowing them to gain practical experience in the world of music education.

In the case of *FirstClass,* it appears that AI technology can be used in a creative new application — teaching future music teachers. Through simulating students and challenges that are found in teaching a real-world class, *FirstClass* displays the promising and very positive impact AI may have on the music

classroom. While the opportunity to gain teaching experience is invaluable towards a future teacher's growth and development of teaching skills, there is no doubt that pre-service student teachers face difficulties accessing this kind of real-world classroom experience. Exams and high-stakes testing in secondary schools can last weeks, a time during which the classroom is entirely barred off to student teachers looking to improve their abilities. However, *FirstClass* presents a unique and innovative solution to this problem — the virtual classroom will allow student teachers in training to put pedagogical theories into practice. In this low-stakes yet realistic classroom, the student-teacher will be able to improve their teaching ability, which will ultimately benefit the classroom of human students the teacher will work with in the future.

Case Study #2: *Tonara*

A prevalent issue in high school music classrooms is the high pupil-teacher ratio. One music teacher may be in charge of over 30 young musicians, making it difficult to give detailed, personalized feedback. Students are expected to learn their individual parts at home, assembling in the music classroom to rehearse and develop ensemble skills. This responsibility is made complicated by the fact that sometimes, students merely do not have the time or drive to practice. Oftentimes, even when students do practice at home, the music teacher is never there to correct mistakes or offer advice. Therefore, a young musician may use the wrong fingering, or sing out of tune, or make a rhythm mistake over and over, without even realizing it. *Tonara*, an AI-powered music tutoring software, attempts to solve this problem.

In July of 2018, *Tonara* announced the launch of its new startup — *Tonaro 360.* This desktop and mobile app features an AI-based scoring system that listens to how a student plays, then scores their performance by comparing it with a recording that the teacher has assigned or uploaded. *Tonara 360* uses AI machine learning to quickly detect errors in tone, rhythm, and technicality, providing feedback for what students need to improve on. The teacher is also able to access a student's performance progress through the "Teacher's Zone" feature — here, a music instructor will be able to listen to a student's recordings, give assignments, and send feedback. When examining the evidence of *Tonaro 360*, results speak in favour of

the AI learning platform as well. During the stage of beta testing, music teachers reported up to a 68% increase in practice hours among students using *Tonaro 360*.

In a statement by *Tonara* CEO Ohad Golan, he stated: "Playing music has the unique ability to inspire those playing and listening, however, the process for teaching and learning how to play is broken. By using technology to help teachers more easily provide feedback and guidance to students, as well as providing students with the right environment to learn how to play music effectively, we are fixing music education by bringing joy back into the process, encouraging and supporting students to pursue their dreams of becoming musicians."

Indeed, it appears that *Tonaro 360* and it's AI-based learning approach seems to yield many benefits in terms of outside-of-class practice. The capabilities of the platform can address and provide a solution for issues regarding lack of personalized feedback or productive at-home practice sessions. Thus, the evidence and data allow us to safely conclude that *Tonaro 360* yields benefits in regards to student incentivization and increased amounts of at-home practice.

Conclusion and Discussion

As we examine two of the most prevalent emerging AI-based technologies in music education, we see a common thread begin to emerge: AI may be able to prepare incoming student teachers to enter the music classroom, as shown through *FirstClass's* virtual students' simulation which prepares pre-service student teachers for the real-world classroom. And AI may be able to increase student practice times *outside* the music classroom, as shown through *Tonaro 360's* instant feedback and tips for improvement, which prepares students for rehearsal in the real-world classroom. However, within the music classroom, there is little to be improved upon. Within the music classroom, teachers and young musicians work together to create beautifully expressive performances cultivated throughout months of practice and hard work. Within the music classroom, humans, not machines, remain in the spotlight, working tirelessly to sing and play to the best of their musical ability. Our evidence and case studies demonstrate that while AI can work backstage to improve musicians and music teachers, it cannot truly replace the music classroom. It

cannot virtually simulate the magic of a successful performance, nor the human connections created in the music classrooms that we cherish for years to come. It remains an immovable fact that AI, while a useful tool to supplement secondary school music education, cannot truly replace the music classroom that we, as young musicians, know and love.

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