Developing Computational Thinking in Middle School Music Technology Classrooms

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ABSTRACT

To engage diverse populations of students who may not self-select into computing courses, a curriculum for a middle school music technology + computer science course that addresses learning standards for both subjects was developed and deployed. Students who engage with the curriculum learn modern music production techniques and computational thinking concepts. This is through a mix of traditional approaches to music technology education (digital audio workstations) and computational approaches via a culturally relevant learning platform that introduces students to coding through music production and remixing. This poster reflects on the last two years of curriculum design and deployment, teacher training, and student and educator engagement and feedback to provide insight into the teaching (and learning) of computational thinking in the music technology classroom.

CCS CONCEPTS

• Applied computing → Sound and music computing; • Human-centered computing → Participatory design; • Social and professional topics → K-12 education; Computational thinking.

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KEYWORDS

music, computing, middle school, interest formation, persistence, broadening participation

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1 INTRODUCTION

Although computational thinking has become an essential skill in today's technologically advanced workforce, the engagement and retention of underrepresented groups in computer science is lagging. In the latest Gallup/Google report on Computer Science Education, only 31% of girls agree that computer science is important to learn [3]. While interest in computer science has increased among underrepresented minorities, access to dedicated courses lags that of white students [3]. As recently as 2016, only 1% of high schoolers in Georgia completed a course including computational thinking skills. To address this, in 2019, Georgia passed legislation requiring all middle and high school schools to offer computer science courses by 2024. In this poster, we describe a researcher-practitioner partnership between a research university and a K-12 school district to create, deploy, and study the potential of integrating computer science education into the curriculum of a middle school music technology course. The integration of computational thinking with music technology

classes is an educational method used in several computing education platforms to increase engagement in computational thinking [1, 2, 4]. By using a computer science + music framework, it is our hope to broaden participation by expanding availability to CS and engaging students in CS education who may not self-select into more traditional computing courses. In the following sections, we outline the curriculum framework, describe the methodology and results of an initial research study.

2 CURRICULUM

The curriculum for this project leverages both traditional music production software, in which we linked critical elements of music technology to computational thinking principles, and a widely used computational music platform, EarSketch, previously developed by some of the authors. With EarSketch, students write code to programmatically generate music using an interface design similar to traditional music production software (Figure 1). The curriculum combines existing materials from the Georgia State curriculum for middle school beginning music technology courses with materials created by a team of music technology and computing education researchers and practitioners specifically for this project. One example of a lesson developed for this curriculum involved students creating musical rhythms with code. With this lesson, CS concepts, including functions and strings, were used. The lesson involved a progression from developing rhythms in a DAW to mapping these rhythms into strings through a rhythm-generating function in EarSketch.

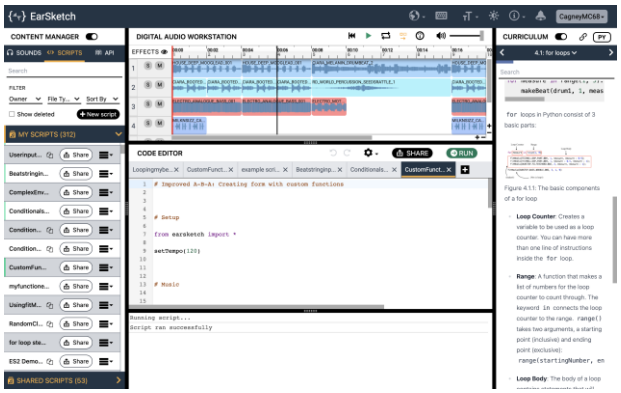

Figure 1. EarSketch Interface

3 METHODOLOGY

During the 2022-2023 academic school year, we conducted a preliminary study in two middle schools, enlisting the help of two music technology teachers, each acting as a practitioner partner at their respective school. Earlier, in the spring and summer of 2022, the teachers participated in professional development to learn EarSketch [5], the music+CS learning platform used in parts of the curriculum. They worked directly with the research team to collaboratively create the curriculum described in the previous section for their beginning music technology courses. Students in all sections of the beginning music technology class at both schools were invited to participate in a research study that included a pre- and post-survey and four focus groups with a subset of consenting students.

4 RESULTS

Our analysis suggests that a) students not already interested in music technology or programming do not connect with the material as well as students with prior interest; b) music technology educators require targeted training and support in pedagogical content knowledge in computing; and c) greater intentional connection between music and computer science throughout the curriculum has the potential to spur further student engagement. Following this study, we updated the curriculum by adding more diverse representations of professionals in the music and computing industries and developing a lesson on music in the digital age that connects to a wide range of student interests. We updated the professional development materials by providing revised educational materials with extensive scaffolding. Additionally, we offered teacher support through an online community and morning professional development sessions during the school year. We delivered the main aspects of the professional development to a new cohort of five middle school music technology teachers in the summer of 2023, and they – along with the original two teachers – all began implementing the new curriculum in their classrooms in August 2023. We are currently conducting an expanded study with these seven schools in both the fall 2023 and spring 2024 semesters, in which we are collecting quantitative and qualitative data similar to the prior year.

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