Music Mobile: An Application to Teach Music to Special Education Elementary School Students

A Technical Report submitted to the Department of Computer Science

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Caroline Bell

Fall 2023

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Brianna Morrison, Department of Computer Science

Music Mobile: An Application to Teach Music to Special Education Elementary School Students

CS4991 Capstone Report, 2023

Caroline Bell
Computer Science
The University of Virginia
School of Engineering and Applied Science
Charlottesville, Virginia USA
clb2hr@virginia.edu

ABSTRACT

Early education relies on technology to make learning more accessible and easier for its students; however, a gap exists in the catalog of special education applications, with a specific lack of music special education apps. Using Xcode, I developed a Swift-based application entitled Music Mobile, that teaches music to special education elementary school students, including note recognition, rhythmic understanding, and instrument identification. Testing shows that students who use this application become proficient in musical skills, which leads to an increased understanding of other academic subjects. Not only does this enable them to participate in making music with others, but it also increases overall classroom collaboration and participation. Future development should include expanding the functionality of the application and maintaining the existing features based on customer reviews and feedback.

1. INTRODUCTION

As a computer science and music major, I am always searching for opportunities to combine these two seemingly unrelated fields. Technology is continually being developed to enhance the arts. Musicians can read and compose music using programs and music instruction can be adapted for those with disabilities. In the same realm, the arts, specifically music, can enhance technology, especially computer science. As I have expanded my knowledge of computer science and coding, I have found that the patterns are not so different from the patterns one finds in music. Computer science requires people who think well and have a "mathematical brain," but it also requires creativity. "Studies even show that children who play instruments are able to complete complex mathematical problems better than peers who do not play instruments" (Brain Balance, n.d.). I attribute my success in my STEM courses and career to my early introduction and involvement in music.

I have always been interested in special education, witnessing classmates of mine using individualized learning plans, as well as working with a classroom of special education elementary school students during my senior year of high school. The benefits of using technology in the special education classroom are numerous. Teachers and researchers have found that special education students exhibit greater independence, less anxiety, improved connection with their classmates, natural and more effective communication, and increased academic performance when using tools such as education applications (University of Texas Permian Basin, n.d.).

Though special education students can use the same tools as their general education peers, there is still a need to prioritize application design with special education students as key stakeholders. The creation of my application,

Music Mobile, will utilize methods that consider how special education students benefit from technology and what they need to obtain the full advantages of technology as an educational tool.

2. RELATED WORKS

The catalog of educational applications has expanded immensely as the number of users has increased "from 185 million users in 2019 to 270 million in 2020" (Wylie, 2023). There have been a few applications that have specialized in helping special education students. The leading special education student assistant app is *ChoiceWorks*, marketed as a learning tool for those with learning disabilities. This app helps to foster "a child's independence, positive behavior, and emotional regulation" at home and school (Assistive.co, n.d.). This application is a perfect example of using technology to support those with learning disabilities and make their lives easier. The use of clear images, limited words, accessibility features, and easy and fun-to-accomplish tasks are pivotal features to help the app's audience of special education students.

Khan Academy is the most popular general education application, used by students of any age. Khan Academy has become a replacement for typical, in-person lectures, as well as a tool for assisting students in refining their learning at their own pace. It has been found that "students given one-on-one attention reliably perform two standard deviations better than their peers who stay in a regular classroom" (Thomson, 2011).

Khan Academy has become a means to giving students one-on-one attention at any time, using features such as game-like rewards, individualization, and connection with their teachers and parents. Khan Academy has expanded into a sub-app called Khan Academy Kids, a free education app for 2-7-year-olds. It expands upon the foundation of Khan Academy by including an array of lessons, individual profiles for each child, parent progress access, and the use of characters and themes that are attractive to that age range (Newman, 2020). All the lessons have been created with the help of educators who specialize in elementary education.

3. PROJECT DESIGN

Music Mobile is an application that teaches music fundamentals to elementary school students, designed to best assist special education students. Music Mobile contains two main components, which can be accessed from the home page, as seen in Figure 1: educational videos and games that solidify the child's knowledge. Essential special education design principles used in the development of Music Mobile include a straightforward design, simple interface, ease of use, and no pop-up windows (Baharuddin, 2019).

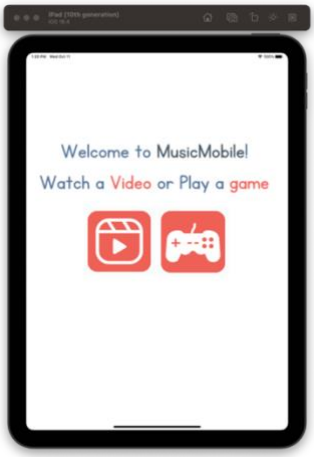

Figure 1: Music Mobile Home Page

3.1 Educational Videos

Most educational websites and applications use videos as a means of teaching new concepts to their users. Khan Academy has been able to supplement in-person lessons with company-made videos that have led to increased user academic success and concept understanding. Music Mobile uses educational videos to introduce fundamental music concepts, such as vocabulary, instrument

identification, and music theory. All the videos are hosted on one page, where users can click on one of the buttons to watch a specific video. The videos were chosen specifically to teach the skills necessary for the games, explained in section 3.2.

3.2 Music Games

Games are often used in educational applications to test and solidify a child's understanding of the material in a friendly, engaging way. Music Mobile has three games to teach a few fundamental music concepts. Like the videos, the games are hosted on one page with the user being able to tap on the respective game's button to begin. The first game asks students to identify the notes on a treble clef staff, which is the foundation of reading music. The basic interface of the game is shown in Figure 2.

Figure 2: Identify the Notes

The second game, shown in Figure 3, tests to see if the user knows the difference between various instruments in a classical orchestra. When the user begins the game, a quick excerpt is played, and the student must guess what instrument is making the sound. Once the student guesses correctly, another excerpt is played. This process continues until the user guesses all the instruments.

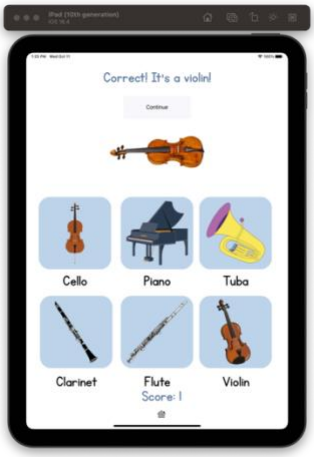

Figure 3: Identify the Instrument

The final game asks the user to identify various music terms based on their definition, as shown in Figure 4. The user selects the answer by tapping the word he or she believes is the right answer.

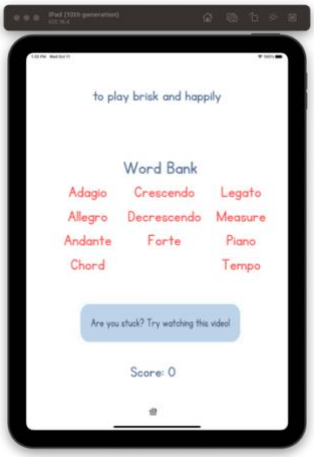

Figure 4: Identify Music Terms

3.3 Design Needs of Special Education Students

Certain design considerations are necessary when developing an application for special education students. Music Mobile displays the use of a variety of these techniques. First, the fonts used are simple and easy to read, as fancy and elaborate fonts can be confusing for most special education students. Another feature is providing immediate correction if the wrong answer is chosen. For example, if in the game "Identify the Note" students choose B when

the answer should be G, they will be told the correct answer so they can associate the correct answer with the image they see. Finally, the Music Mobile interface is quite simple and straightforward, as can be seen from previous figures. This ensures that the student is not distracted by unnecessary text or images, nor will become frustrated by components of the application they might not be able to understand.

4. RESULTS

To date, Music Mobile has not been tested with special education students. It has, however, been tested and shown to professors and educators who work closely with special education students. The simplicity of the application was pleasing to the testing audience. One professor stated "I think simplicity is important for most students with disabilities. If they have executive functioning deficits (which many do), the simple interface reduces distraction. If they have cognitive deficits, the simple interface is also a win as abstractions or complex interfaces are less likely to be understood" (Angelique Wynkoop, personal communication, July 31, 2023). This affirms the emphasis on designing Music Mobile for special education students and proving its success. The testers also appreciated that this application fills a gap in the special education, as well as the general education, application catalog.

5. CONCLUSION

Music Mobile fills the gap of tools available to special education students by being one of the few applications that teach music to elementary school students, designed with the needs of special education students in mind. Music Mobile also counters the stigma that it is only the responsibility of educators and parents to make students with learning disabilities feel capable among their general peers. Developers creating applications and devices for elementary school students, such as myself, need to see special education students as potential stakeholders of their products. Music Mobile, originally designed to expand arts education in the special education sphere through technology, is also able to create a more inclusive environment among students and establish a greater connection between students with and without learning disabilities.

6. FUTURE WORK

The next step in assessing the results previously described is finding an ethical way to test Music Mobile with elementary special education students. The acceptance of this app as a useful tool in the special education classroom has only been confirmed by professionals in the special education field. The application has not been tested by any of the potential stakeholders (i.e., elementary school students). Before publishing this application to the App Store, I would like to come up with an ethical way to use special and general education students as testers of Music Mobile.

7. ACKNOWLEDGMENTS

I would like to thank my Capstone advisor, Professor Brianna Morrison, for all her assistance throughout my project. I am grateful for her support in my work and willingness to assist in bringing this dream project of mine to life. I would also like to thank the professors at the UVA School of Education who have provided feedback throughout the development of my application. Finally, I would like to thank Professors Alice Fox, Kathryn Neeley, and Rosanne Vrugtman for being consistent advisers in the process of writing my thesis.

REFERENCES

Assistive.co (n.d.). *Choiceworks App for iPad*. Assistive Technology. Retrieved

September 7, 2023, from https://assistive.co.nz/product/choiceworks-app-for-ipad/

Baharuddin, B. & Dalle, J. (2019). Transforming Learning Spaces for Elementary School Children with Special Needs. Journal of Social Studies Education Research, 10(2), 344-365. Retrieved September 13, 2023 from https://www.learntechlib.org/p/216580/.

Brain Balance. (n.d.). Correlation Between Math and Music Ability. "Correlation Between Math and Music Ability." Brain Balance, www.brainbalancecenters.com/blog/correlation-between-math-and-music-ability#:~:text=Performing%20Music%20Teaches%20Valuable%20Lessons%20to%20Students&text=Performing%20music%2C%20therefore%2C%20reinforces%20parts,who%20do%20not%20play%20instruments.

Newman, J. (2020, June 1). *COVID-19 made Khan Academy Kids vital for parents. Now it faces a cash crunch*. Fast Company. Retrieved September 7, 2023, from https://www.fastcompany.com/90511211/covid-19-made-khan-academy-kids-vital-for-parents-now-it-faces-a-cash-crunch

Thomson, C. (2011, July 15). How Khan Academy is Changing the Rules of Education. Wired Digital. https://d1wqtxts1xzle7.cloudfront.net/40764790/Khan_Academy_technology-libre.pdf?1450144479=&response-content-disposition=inline%3B+filename%3DKhan_Academy_technology.pdf&Expires=1694112014&Signature=fZ~AloKngZrXX5hbErxPp2mNmq~9~eoEzKu9~nMmF2r7n5cU5fyPLYRd6EpLM~cFwDyJF1~VBTrMC369WC0erdoj~vCmRdy18qy~irBT2TGekapo4aZgRm8fp2PjTI3WX5Uc3IClZ6wRK6hbuMTKh5Z4RkbYKZO0vSOs4cUKOWzblnG5ztwnkq2~5rHgK1VYo3fhWZD8CP7Vd2GQJZ9CvJ4euu-yOHIDpvoLUqO0Dt8AVhIjLmugNPcBOBIHscQtijp7VHLncFSaaD5oX7cB4Uqn44ZviFnwbJmE36iuM29SVX7E1mwuiGjkzFe0tfygZE-XWAa5YzdZx816lix3eA__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

University of Texas Permian Basin (n.d.). The Use of Technology in Special Education. Retrieved September 19, 2023, from https://online.utpb.edu/about-us/articles/education/the-use-of-technology-in-special-education/

Wylie, L. (2023, May 25). *Education App Revenue and Usage Statistics (2023)*. Business of Apps. Retrieved September 8, 2023, from https://www.businessofapps.com/data/education-app-market/#:~:text=There%20were%20455%2C000%20education%20apps,439%2C000%20apps%20available%20in%202021