
Designing a mobile phone-based music playing application for children with autism

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Abstract

Music therapy has proven to be beneficial to children along the autism spectrum disorder in areas such as speech, social interaction, vocabulary comprehension, self-care skills, and many more. There also have been a lot of technological interventions that have been designed and developed to cater to the diverse needs of children with Autism. As mobile phones become

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more and more pervasive, there is a huge potential for them to provide a classroom like an environment to children at home to practice music and eventually, learn. In this paper, we present findings of design approaches from a qualitative study conducted at the invitation of Hitham Trust in Chennai, India. Observing participants teaching and learning music, along with interviews with different stakeholders equipped us with an enriched understanding of the environment and how a technological intervention such as mobile phone-based application could contribute towards the design of a music playing application to continue practicing listening and singing music at home and extend the student-teacher relationship. We conclude with our plan to continue this work in future.

Author Keywords

Autism; Music; Learning; Assistive technology; mobile application; Participatory Design

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

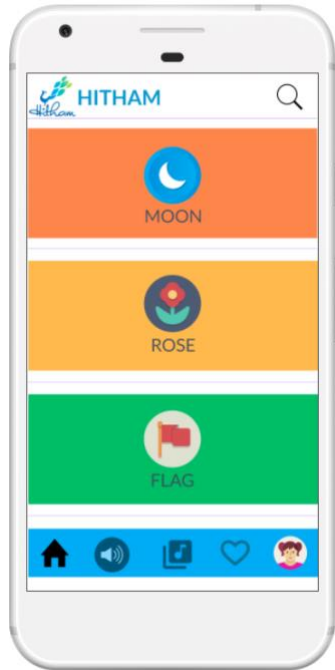


Figure 1: Interface of the mobile phone based application for children with autism. This image shows the home screen with a list of three songs with their corresponding images as well as with associated text.

Introduction

Music therapy, as a therapeutic intervention, has shown impressive results for children along the autism spectrum disorder in areas of improved interpersonal skills [5], appropriate social behavior [3], and enhanced cognitive skills [5]. A number of music and multimedia apps (iOS and Android) are now available providing a diverse range of music experiences. Many of these apps are user-friendly and allow children to learn from the material they offer [4]. However, such apps do not always work for children with special needs. Also, for teachers, especially music teachers, it is difficult to deliver lessons in a way that works for children with diverse physical and cognitive challenges. Although there is some evidence available which supports the use of mobile technology especially the usage of touch interface by children with cognitive disabilities to better inform about their reaction or understanding through gestures [2]. Hence, there is an increasing need to conduct research and design mobile phone-based technological interventions that cater to the varied needs of children with autism by enabling teachers to tailor instructions. This would allow them to reach a larger number of students than possible through traditional classroom settings and instruments [4]. Our study aims to contribute to the on-going research towards designing easy-to-use, intuitive, and personalized music learning and playing applications for children with autism.

This work is a collaboration between the Hitham Trust an NGO based out of Chennai, India and the E-Health Research Center, International Institute of Information Technology, Bangalore, India. Hitham has been teaching children with autism Carnatic music, the classical music system of South India for almost ten

years now. They engage with children who either show inclination towards music or engage with music deeply.

Methods

Our user research method comprises qualitative research and participant observation to understand the needs of children with autism spectrum disorder (ASD).

We started off with our initial fieldwork, visiting a classroom of 12 children aged 4 to 9, coming to learn to sing Carnatic music. During participant observation, we observed children's behavior inside the classroom right from when they enter the classroom until they leave the place. We strictly focused on observing and capturing children's facial expressions when the teacher would give instructions about songs, or when they would move to a new song. We observed their expressions when they would be unable to comprehend the lyrics and find themselves lost.

Children with autism are different in terms of their engagement levels, their attention span, and interest in activities, and so they show a varied set of emotions. This makes it difficult to take note of each child. Therefore, we randomly selected a few of them to focus on and clicked pictures of others as they engaged in the classroom activities.

The aim of participant observation was to understand the two-way process of learning, both for the teacher and the children. We observed teaching styles using visual supports such as imagery to build a context around the song, and we observed children's way of engaging in the activity with the help of the imagery.

The students' engagement had a series of steps: replying to the welcome address of the teacher, responding to the song being taught, saying yes or no when asked about a song sung earlier, etc. We observed that every student had different ways of responding to the cues. Some students were highly responsive and attentive, such as looking into the eye of the teacher or the movement of her hands, the "taal" or beat playing on the system and adjusting their notes according to it, and easily transitioning from one song to another. However, some students seemed to understand the happenings in their surroundings but didn't express their emotions via facial expressions or hand gestures. Detailed field notes were taken of the classroom observations.

Following this, we interviewed the teachers and the parents of the children attending music sessions. Open-ended interviews were conducted at the same site as that of the music classroom to better understand their approach towards teaching music and especially to cope with diverse needs of each child in the classroom. Parents of students were separately interviewed in-person and on phone calls to know their experience of living with the kid, attending music lessons, and the child's encounters with different technologies. The interviews were 60-90 minutes long. Copious notes and recordings were taken of the interviews as well, which were further used to analyze all the data collected and figure out emerging themes for possible design considerations.

We then ideated based on the experiences of the Hitham team over the years, our observations and after analysis came up with various probable design solutions. The idea we chose finally was to build a mobile application which replicates the classroom environment for children at home to listen to music and practice singing. Since our analysis

showed children's exposure to technology through smartphones and a variety of applications they use such as YouTube, Google Search, and other learning apps, we decided to go with a technological intervention on similar lines – a mobile application that uses visual imageries enabling children with autism to use the app as well as supports receiving their inputs and feedback.

Our decision was also supported by the inputs of teachers and parents who work with children on a regular basis. However, children themselves were not included in this process, as suggested by previous research done in similar situations [1].

We started off with an initial design focusing on the functionality that the application will provide. This is explained in detail in the next section. Furthermore, we tested the working prototype with children in presence of teachers and parents and recorded their reactions. Teachers and parents also shared their observations and feedback which was taken into consideration for our second phase of the project.

In the second phase, we focused on redefining the interface of the application based on inputs from all the stakeholders.

Understanding the Context for Appropriate Design Approaches

Our interviews and observations helped us identify three key features of the solution we would build: mobile phone-based intervention, use of visuals, and using media (e.g. songs) that the children are already familiar with. We chose to use mobile phones because we observed how actively parents used them to teach their kids, and how they could offer customized

solutions for people with autism spectrum disorder. Visuals and media that children are familiar with from the classroom is crucial to mirroring the classroom environment so that they retain the associations they have already built.

In the first stage, we focused on getting the functionalities right, such as a music player that plays Carnatic music correctly. We added functions such as the play/pause button in a way that they were clearly visible. This particularly helped us experiment with users' preferences for the application. We moved to the next stage after getting feedback from teachers and parents in the first phase of testing for a few students. In the second stage, we focused on designing a simple, clean, and uncluttered interface that enables the children to play music in a better, easier, and more adaptable way.

In order to make the design more intuitive, we focused on using visual aids like the ones teachers use in the classroom. For example, we used small flashcards, each with the image of an object to which a particular song is associated. Teachers use these cards to inform children about the song they are going to sing or to get them to communicate their own choice of song. Since every teacher teaches a particular set of students, he/she uses a limited set of cards to build the associations with the songs. This implies that different children could be associated the same song with different images. Hence, another aspect of the application caters to the needs of teachers to customize the visual appearance of each song as appropriate for a student. Teachers, in this case, are provided with a

flexible system to either choose or upload images as per their choice. This, in turn, leads to a customized list of songs shared with each child.

Overall, the interface of the application has been designed to be minimal enabling first-time smartphone users also to use it without any confusion. The use of appropriate icons such as home, play and pause buttons, timer, etc. in a slightly larger size when compared to default size received positive feedback. Our key takeaway was that if the interface is easy-to-use, children would be more likely to try the application without any hesitation.

Future Work

Given our takeaways from the design approach followed, we propose to conduct a usability testing of the developed mobile based music playing application, first with a small pilot group, and then in a larger group. Since the core idea of the project is to extend the student-teacher relationship into the home environment, we aim to focus on the scalability aspect of the application too. Performance of the app in terms of responsiveness and downloading of content and the impact of this on usability for the children also needs to be evaluated. Finally, gamification model would also be added which might help in increasing the engagement and attention level of children with autism. We hope to overcome all the design challenges enabling both teachers and children with autism to benefit from this application and creating a larger social impact in the society.

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