

Music hearing with hearing-impaired friends

Korean teachers for STEAM education

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We wanted our students to grow up as compassionate people who can care for others. And our wish turned into this curriculum project. We also held meetings to seek advice from teachers who teach deaf people to understand the hardships of the deaf. The teachers of Science, Information Technology, Home Economics, Music, and Art explained the class goals, characteristics of each class composition, the flow of a combined curriculum, difficulties during classes and the solutions, and the changes in the students. We taught a project class for 250 students aged 13 years in regular class time for 22 hours.



consulting for advice



meeting between teachers



Curriculum flow

Teaching and Learning Guide Plan Development Session (Period)	Program Title	Program Topic
Home Economics (2hours)	Working with friends with hearing disabilities	Watch videos about musical performers with hearing disabilities and find ways to enjoy music together. Use earplugs to cover the ears and experience the difficulties of persons with hearing disabilities. Discuss how friends with hearing disabilities can sense sound.

Science (3hours)	Exploring the three secrets of sound	Understand that sound is a component of waves and use an application to learn about the three properties of sound. Groups will explore together to go through the process of finding the variables and drawing a conclusion on their own. Use Google to create a group report and present it.
Music (3 hours)	Turning sound into touch!	Think about how persons with hearing disabilities can sense music through the vibrations of an instrument and come up with a musical vibration that they can listen to. Create a percussion instrument using materials that students can easily find, play the instrument, and experience what a vibrational performance is.
Science (4hours)	Turning sound into light!	Learn to code so students can transfer the beat and music they experience into vibration and sound.
Art (2hours)	Listening to music through light - light art	Understand the expansion of senses by learning the elements and principles of sculpture and creating a light art that can maximize the effects of light. Use transparent plastic materials that are easily found in our lives to create light art and experience upcycling.
Information Technology (8hours)	Creating an emotional speaker and chatbot application	Collect the text data that express the various emotions of numerous students, and classify the emotions to experience how to code through text. Classify the emotions that students feel into a few categories and create an IA program that can differentiate them. Use the survey results that students like depending on their emotional mood, and combine the AI program and Entry to create an application that can recommend the music that students tend to listen to depending on their mood.



The experience of the teachers

■ Home Economics teacher's experience

I designed the class around the theme “Together with friends with hearing disabilities,” and the thought of how students could explore ways to communicate and share their favorite music with friends with hearing disabilities.

Before exploring the ways to deliver music and communicate, I thought about how students could sympathize with the difficulties that persons with hearing disabilities experience. Since it won't be easy for people who can hear to experience the difficulties, I thought about what would be the most effective educational experience in a short amount of time. I instructed the students to block their ears with earplugs and stand by themselves among other friends who are talking. The students seemed to understand the frustration, silence, or fear when someone can't hear any sound or has difficulty hearing, and they were better able to understand and sympathize with persons with hearing disabilities. The experience smoothly connected the students to think and question how persons with hearing disabilities could enjoy the music we always listen to, and how to deliver our favorite music to other friends. The students discussed the best ways to enjoy music together with persons with hearing disabilities in groups, and they came up with meaningful solutions while utilizing the scientific knowledge they learned. I also learned that as long as people are willing to work together with persons with hearing disabilities, everyone can share their favorite music and have a good time together.

■ Music teacher's experience

I worked with the Home Economics subject on the theme “Creating music to enjoy with friends with hearing disabilities.” On that note, we listened to Evelyn Glennie's performance while thinking about how to feel the music without hearing the notes with our ears, and planned an ensemble using the vibrations of the percussion instruments so friends with hearing disabilities could play together. The percussion instruments were created by exploring the various methods of sounds such as knocking, scratching, and rubbing objects, and objects with a sound suitable for an ensemble were chosen as instruments according to their pitch, volume, and tone. Each group composed a story based on the emotions and turned it into an ensemble piece with a 4/4 rhythm. While transforming a story into a 4/4 rhythm, I encouraged the students to express music freely by utilizing regular musical scores, artistic scores, or in words, regardless of their musical skills so that everyone could experience the process of composing music. At first, the students didn't consider the volume or tone when composing the ensemble, and they learned the importance of harmony in sound. This led to students looking for new instruments or finding instruments with a better harmony, and the musical composition process did get

delayed. I was also unsure about percussion instruments with a low volume as the friends with hearing disabilities might not be able to sense the rhythm properly during the ensemble. However, I realized that everyone could play on their own beat without hearing the music as long as the basic beat stays the same. The students actively participated in the entire process, solving problems on their own while crossing various subjects, and they learned the joy of composing and playing music together with friends.

■ Science teacher's experience

1) Exploring sound

Science class was taught twice a week and there was a lot to teach, so it's not easy once you stray away from the curriculum schedule. The science curriculum includes a lesson about exploring what sound is, so I utilized this to explore sound and how sound can change into other forms that can be sensed by persons with hearing disabilities. The curriculum recommends teaching sound around November, but I had to reorganize the curriculum in order to accommodate for the project with the teachers of other subjects. I reorganized the curriculum to teach the sound unit around June and July and taught the core concepts while changing the structure a bit.

To encourage the students to explore on their own during class, I assigned groups to explore the properties of sound using an app. The students controlled the variables to draw conclusions about how the type, speed, and size of sound changes. Then, the students had to create group presentations using a Google presentation that could be shared online while face-to-face classes were not possible because of COVID-19. Through the presentations, the students learned about the properties of sound and what factors are necessary for persons with hearing disabilities to sense sound. The students did have difficulty understanding what variables were and how to control them, but I gave feedback for each group, and the students could watch the activities of other groups to learn about the concept of variables and train their skills about how to design an experiment.

2) Arduino and coding

For students to create an LED light that blinks according to music, they had to learn how to use Arduino and coding. But most students have never used Arduino before, and some schools don't conduct any classes on electrical currents. Moreover, only about 20% of students knew about block coding. I instructed the students on the basics of using Arduino and breadboard and used Tinkercad to teach coding. Tinkercad is a program that can simulate Arduino, and the block coding that students were used to and created was changed into text coding. In addition, the written code can be simulated right away, so it's possible to check for errors immediately. Because of time restrictions, I was unable to teach them complicated coding

techniques. I taught them simple codes on how to turn on and off LED lights and switch the lights in sequence and order. The students used the code they learned to assemble Arduino so that the LED lights would flicker according to the music. It wasn't easy to teach this to students who didn't understand the series and parallel circuits of light bulbs. But after learning the basics for an hour and repeated trials using the simulation program, the students understood series and parallel circuits and wrote a code on their own. Unfortunately, it's not possible to completely code 4 minutes of music, only part of the score is translated into code and repeated. But the students were excited that the code they wrote could actually switch lights on and off and seemed curious about the physical aspect of computing. There were some difficulties going over the basic theory in the beginning, but I saw great improvements after the students understood the principles through repeated lessons.

■ Information Technology teacher's experience

I conducted a project to create an emotional speaker program utilizing an "information" text classification model. The students collected and classified words representing emotions, created data files for each label, and applied the AI to use the text classification model they trained and created a program. When a word is inputted, the AI recognizes the emotion contained in it and expressed the results as audio and visuals.

In the previous class, students learned the concepts of machine learning and supervised training. The goal of the project was to let students experience the process of computer training first-hand by collecting, processing, testing, and modifying the data and program themselves. As such, when the training model students created weren't as effective, they were guided to analyze the reasons and how to modify the data instead of focusing on the wrong result itself.

I thought about how to provide the word data file to students at first. If the class collected and shared data together, there would be a lot of data that isn't organized and neat, and that wouldn't result in a properly classified data file. If I intervened to organize a modified file, then there would be no point in students going through the error themselves. I decided to divide words into two large categories, positive and negative. The class collected the data together, and the collected and unorganized data was classified by groups of two or three to create labels that satisfy the standards. Each student created a different data file resulting in different training model results, and students went through a meaningful experience analyzing and giving feedback to each other.

Based on this experience, I conducted a project creating a chatbot that recommends songs according to the emotions for the Information Technology free semester. The students applied a training model that classifies emotions to an App Inventor program. The resulting chatbot answers with a song according to the emotion contained in an inputted word and also links to

a YouTube video of the song. Rather than focusing on learning all the visual elements and features of numerous blocks, I planned a simple UI so the students could experience the numerous features by following the teacher's instructions. The students first loaded the teacher's work on their tablet to experience what kinds of UIs are available before moving on to actual activities. They had some difficulty programming apps at first, but the students were easily interested since they were able to utilize the speech recognition, internet, and camera features of the mobile device.

■ Art teacher's experience

"What should we do to provide a visual experience similar to listening to music for persons with hearing disabilities?" I designed a class with that theme in mind and had the students create a light art piece that expands the senses as if music can be heard through light. [Synaesthesia is a condition that joins or merges senses that aren't normally connected together.]

In order to understand the expansion of senses, students learned about the works of Nam June Paik that visualized (soundless) music and the works of Kandinsky first. They watched the "Play a Kandinsky" Google Arts & Culture video to understand visualizing auditory senses. Next, they were divided into groups to research and create light art to express music visually. The focus was to connect with the techniques learned from the previous period. During Information Technology, the students entered a code to transform sound into light signals and how to utilize LED lights with an Arduino breadboard. To maximize the visual effects of the breadboard, PVC materials with a high light reflection were used to create the artwork, and the resulting lighted work was made into a video.

At first, the students had difficulty creating a light art piece that resembles music by transforming the pitch, melody, and rhythm of sound into visual elements such as color, shape, and form. But I kept asking questions. "What color does this music remind you of?" "How about expressing the rhythm of the music as a line?" "Think about the strength of the tone and relate it to the size of a structure." I could see that the students became more interested in planning their work through repeated questions. I also had them train their critical thinking and problem-solving skills by working and constantly revising a project through several steps instead of trying to finish a work in one attempt.

I hope that students were able to understand that all our senses are available to the world and that there are multiple ways to interact with the world even if some senses are not available to us. Furthermore, I hope they will grow up into talented individuals who can understand that any differences between others are not mistakes, and learn to live the world with an open heart and mind.