



USE CASE 18

SOUNDS AND WAVE

Primary Actor and Main Goal

Julia is a music and art teacher in Berlin. She is very fond of her job and really likes to teach her students aged 14-16. She plays piano since she was 5 years old, later also she learned violin and guitar. Her husband is working in a science centre and for some time they were discussing that they would like to do a project together but until now there has never been any occasion so far.

One day she is hearing her colleague, Frank, complaining that his students are rather uninterested in the new topic: waves. Julia is astonished, since she experienced that this class of the 15-year-old students is usually fairly motivated. She proposes to him a joint lecture, since waves and sound is closely connected with each other. Frank happily agrees.

Topic and Content

Already the following week, they prepare the lesson plan for their joint lecture, covering all major steps in an investigating learning scenario. The students are supposed to explore, ask questions and identify problems in playing string instruments.

Soon most of the students have identified the related knowledge and background (the sound as wave of a pattern of disturbance caused by the movement of energy travelling through a medium), key features of sound, different forms of waves and how to calculate velocity.

Age & Level

Julia is a music and art teacher in Berlin. She is very fond of her job and really likes to teach her students aged 14-16. She plays piano since she was 5 years old, later also she learned violin and guitar.

Julia experiences with the students different shapes and forms of music instruments and identifies the minimal features for an instrument. One of them is the monochord.

The monochord is a string plucked on both of its sides and can be considered as the progenitor of the guitar. It consists of two parts: the body and the string.

They motivate the students to use their imagination to create a hypothesis on how one could investigate the dependency of the sound produced by a simple monochord. The students research on the website and one website, that has been pointed out as one source by Julia, is of special interest for them: it experiences the different strings, placing different sets of weights and calculate the value of tension in combination of hearing the sound connected to it.

Julia and Frank have the impression that the students feel more engaged to the topic and understood well the topic of sound and waves, and when she explains her husband at home about the latest lecture, he informs her about a project that a group of his colleagues and he are just experiencing with Arduino. At some point Julia develops the idea that the students could build an own monochord, experience the calculations of tension and sound in real life needed for programming the Arduino when creating their own melodies.

Description of Environment and Possible Pre-conditions

She sees the opportunity to start a project with her husband, involving also the crafts teachers, since she understands that there is also quite some crafting and also programming to do.

When talking with both, her husband as well as the crafts teacher agreed to help. Julia is lucky to have the crafts teacher on board. Up till now he did not have fixed the next project, so he is quite fond of the project. It is quite a challenge to find the time to plan and organize the activity.

They decide to launch the project 3 weeks before the 'project day', that the school does every year, since they think they can have sufficient time. Still, they need to integrate some of the hours already beforehand in the curriculum. Also there will be quite some costs for material and devices, but in coordination with the headmasters office and the science centre, Julia acquires the necessary funding.

Preparatory work

Together, they prepare a list of material they need and order six Arduinos.

Description of Activity

They divide the students into 6 groups and each group should craft one monochord with one string. While Julia's husband is preparing a file for the student on how to set up the technical parts and the programming, the crafts teacher starts to co-design and build the construction with the students that would allow the mechanism increasing and lowering the tension of the string.

The task of the student is to program the Arduino in that way that each string can produce different sounds by changing the tension. The Arduino should recognise the tone and adjust the tension via the construction to the desired tone.

Once the student have tested their constructions of controlling the tension with the Arduino and get the first sound, they are really motivated and see in practice how tension and sound is connected. But so far, the tones are only by chance. Thus, Julia gives each group the task to program an own composition.

Some of the groups start to experiment and defining the tones by trial and error. Soon the students realize using this method would take really much time to define each note. Four of the groups decide very soon to go back to the website they initially used to define the tones and that would help them to calculate the necessary tension. Still for some groups it is more difficult to agree on the easiest way to find the right tensions.

They have split up and while some are already composing different melodies convinced that they first need the melody, others are still struggling with finding ways to get the right tones. Julia realizes that some of her (usually good) students struggle a lot with the fact that they have to steer their own learning process since they come often to her asking for detailed instructions.

On the other hand, other students seemed to gain a lot on self-confidence when finalizing the task, proudly presenting their own composition of a simple melody. Two of them even support the other two groups. At the end, the four groups managed well to produce an own melody, while the other two groups have only managed to determine the tension and tones, since they ran out of time.

Description of Activity

Especially one group became really engaged and were asking Julia's husband if they would be allowed to visit the science centre and combine all the 6 strings from the groups, like a guitar. Thus they would be able to let the Arduino play fully automatically a melody.

The science centre is offering some opening hours for students and they agreed that the students may attend during these hours and continue working on the project.

Other Stakeholders and their possible Interests

Especially one group became really engaged and were asking Julia's husband if they would be allowed to visit the science centre and combine all the 6 strings from the groups, like a guitar.

Thus they would be able to let the Arduino play fully automatically a melody. The science centre is offering some opening hours for students and they agreed that the students may attend during these hours and continue working on the project.

Success and condition

One month later, Julia's colleague told her that all the students were able to answer the questions of their exams on waves, tensions and sound correctly and that some students even were going more into details than asked.

He is also considering another project with Arduinos, but on a less difficult scale in case he finds something that fits to the next year curriculum.

Two months later, the final Arduino guitar is presented during the school opening day, where several parents and new students are really astonished about the construct.