



USE CASE 19

SOUND PICTURES AND MATHS

Primary Actor and Main Goal

He specifically wants to introduce the students to the topic of balance that refers to the visual weight of elements of a composition.

Topic and Content

Ken explains the students that it is a sense that the painting feels stable or 'feels right'. Imbalance causes a feeling of discomfort in the eye of the viewer. An artist to compose artefacts can deliberately use these elements for making the viewer feel 'right' or 'instable'.

Ken knows that this balance in art can be achieved in three different ways:

Symmetry, Asymmetry and Radial symmetry, in which elements are equally spaced around a central point, as in the spokes coming out of the hub of a bicycle tire. Ken asks his students to find examples in art for all three dimensions for the next lesson. Most of the students have very concrete examples and together they look at the examples and analyse the different symmetric or asymmetric shapes. Many of them also bring art examples that are inspired by Biology like flowers, spider webs or similar.

Analysing the different pieces, the students extract the different shapes and forms from the art examples. Soon they understand that art actually contains maths, by different shapes also when they are used in a row. Together they explore the calculation of different shapes and understand the connection between symmetric shapes and formulas for calculation of these shapes.

Age & Level

Ken is a 46 year old teacher for Maths, Physics and Art at a high school in a small village close to Delft, Netherlands.

He is looking for new ways to teach the principles of design in art to his 12 year old students.

Description of Environment and Possible Pre-conditions

Ken would like to further emphasize this connection between art and maths and looks for a project that would allow students to make their own artefacts with different mathematical shapes. On the eCraft2Learn website he discovers a project that builds a drawing robot reacting on sound.

Ken knows that this might be an ambitious project for the students as well as for him and considers thoroughly costs, necessary support, timing and integration into the curriculum. He estimates also how much time he would have to spend in order to have sufficient competence to build this drawing robot: he can do some programming, but he has never worked with an Arduino before, nor has he printed something in 3D.

Especially for the 3D printing, he is asking his IT colleague. When explaining his project, he is surprised that the IT teacher Robert is thrilled about the idea and offers his help also with the Arduino. In addition he is willing to dedicate some IT hours also for the 3D printing.

Preparatory work

Two weeks later, they have organized the needed materials and Robert has printed with the students a ball bearing caster, a chassis, two wheels, a pen holder, a servo bracket and a pen collar. Robert has soon understood that the printing takes some time, thus he has done the first parts with the students, but most of the time, he has started the printing by himself in spare time or breaks in school. In total the students have sufficient material to form 5 groups. They also prepared an instruction sheet for the students so that they can do a lot of work independently in the group.

Description of Activity

The students start to load the test firmware to the microcontroller. The test program just draws boxes so the students can check for proper direction and dimensions once it is running. They continue to install the different hardware parts. Several students have issues with their wheels since they are too tight and need to find a solution to insert the shaft. They attach the stepper backets, the caster and the breadboard and place the microcontroller and power switch on the board, connecting the power. The IT teacher needs to show the students on how to wire the headers and servo as well as the stepper. Finally the first students get the computer running and they can test and calibrate the robot. The robot can lower and raise the pen thus the pen needs to get adjusted as well.

The students start to explore with different commands to create several shapes and also letters. Next step is to program the Arduino so that it would draw one specific shapes depending on the sound (occourancy and volume).

Finally Ken and Robert see that all drawing machines work on sensing different noise: depending on the volume, the shapes are getting drawn bigger or smaller.

Ken has the final task for them to create a 'sound artefact' of their environment that contains either a radial symmetry element or a row of at least 6 mathematical shapes on an A3 paper.

The groups decide for very different 'environment' pictures: while some students set up their installation right next to the nearby street with lots of traffic, others choose the playground, some the nearby train station, others play their favourite song while the Arduino is drawing the sound picture.

The pictures resulted in many different creative art pieces, depending on the sounds, its volume and occurrence. The students compare their pictures: some environment pictures are filled with only few but big shapes, while others have many small shapes, one after the other. The student realize that sound is an elemental part of our living environment and that sound can get expressed on a very different way.

Other Stakeholders and their possible Interests

The end products are exhibited at school, explaining by a small text how these pictures were created. Also Robert has taken some pictures that he has printed out and pinned next to the pictures, so the viewers understand how these pictures were created.

The other teachers and students can see the outcomes and during the open day of the school, the students are allowed to bring their Arduino robots and demonstrate the partents and others potential students what they created. The major of the village is really impressed by this innovative teaching and invites the students to present their pictures also in the entrance hall of the municipal office, publicly available for the inhabitants of the village.

Success and condition

Ken as well as Robert have the impression that the learning goal was well achieved. Next to the understanding of balance in art, they explored also the calculation of shapes and learned how to programme an Arduino. Both teachers have also observed that the group work is also supporting 'soft skills' like team work, communication and in case of some students an improved self esteem and self-confidence.

Also a very high motivation of the students was observed by them. In specific Ken had the impression that his own role as a teacher changed, due to the fact that he had to admit to the students that he is not an expert, but at least able to support.

Failure and conditions

Discussing the end results, both teachers agreed that they have underestimated the time they need for compiling the project.

Extensions

Still, given the success of the project, Robert is considering continuing with the project in creating symmetrical objects in 3D for the next semester.