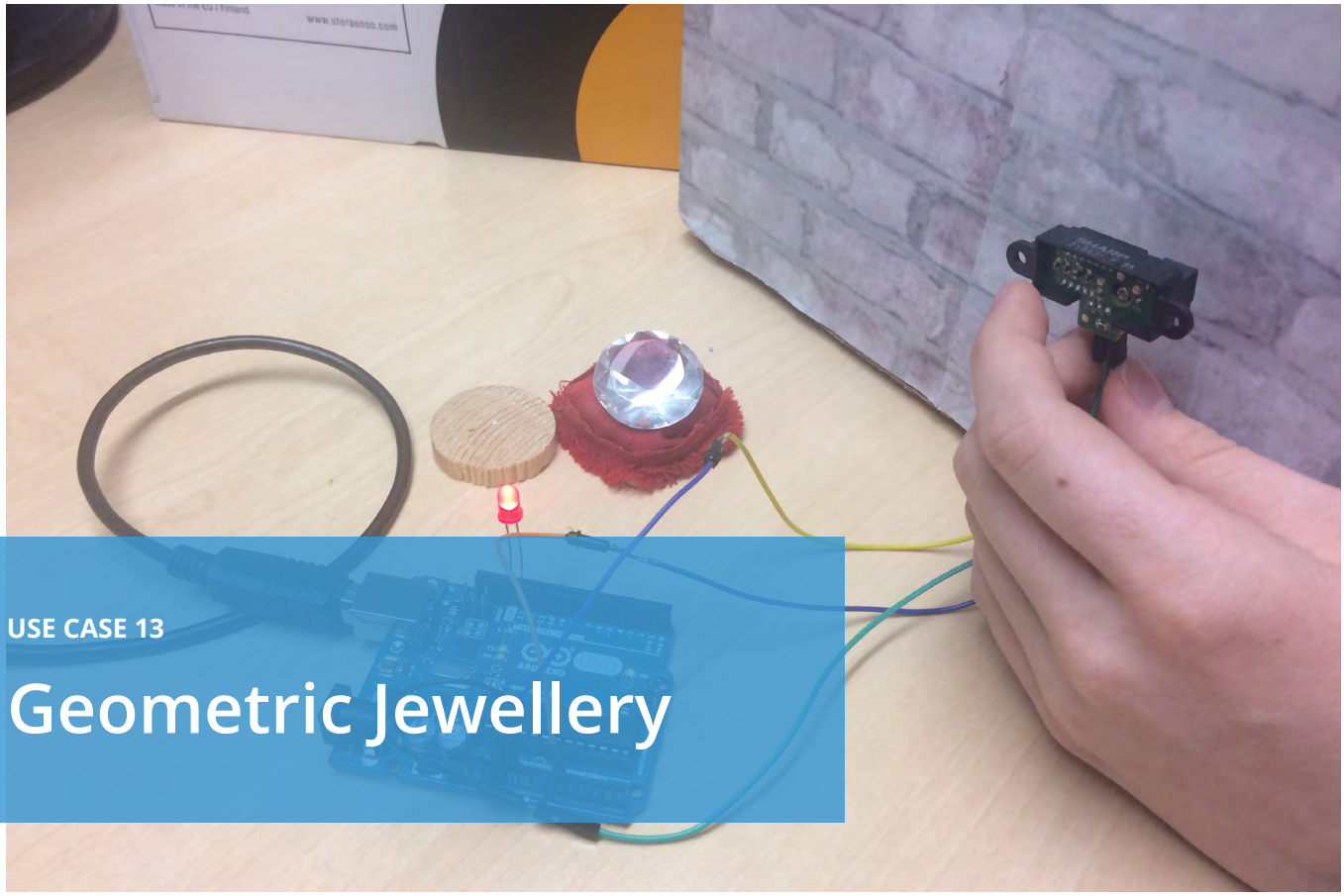

USE CASE 13

Geometric Jewellery

Age & Level

Sara, United Kingdom
Computing Teacher
30 years old

Sara is a 30 years old Computing teacher who has seen many changes in the subject over recent years. At the beginning of her teaching career, she was just tackling ICT skills such as Word processing, spreadsheets and databases. Now the subject has evolved to be much more focussed on Coding so she has had to spend a significant amount of time in the last two years acquiring these skills herself in order to effectively teach her students.

Primary Actor and Main Goal

Sara lives in the suburbs of London, at the moment she is very busy planning her upcoming wedding. Sara is very active and likes to swim and cycle whenever she gets the opportunity.

Sara recently moved to a new school and is keen to make an impact, in particular she wants to increase the number of students (and in particular girls) who choose to study Computing at GCSE (General Certificate of Secondary Education) level.

To do this she wants to introduce some new projects for the 11-14 year olds that will engage them more in the subject, in particular she wants to introduce more physical computing, combining coding with other technologies in order to programme real artefacts rather than just coding animations and games.

Topic and Content

At a recent meeting with other local computing teachers, Sara was introduced to some new software called Beetle Blocks, this was very similar to Scratch: a blocks based programming software that her students use at Primary school. Beetle Blocks includes the ability to extrude a path and export the mode for 3D printing. Sara thought this would provide a brilliant introductory project for her 6th grade of 14 years old students as they would be familiar with the code but be able to actually make a physical artefact by coding the design. She also thought it would appeal heavily to the girls, as it is a very creative activity.

Sara decided to use Beetle Blocks for a geometric jewellery project, this would have a number of additional benefits in that way that it would help the students to consolidate the work they are doing around angles in mathematics, the jewellery prints would be relatively small and quick to print and it should engage the girls more than some of the previous coding projects.

Description of Environment and Possible Pre-conditions

The school computing suite is equipped with 20 PC's, with a reasonable internet connection. There is also class sets of Arduino Unos and MicroBits.

The Computing department does not have a 3D printer, but there is an Ultimaker in the Technology department. Sara speaks to them and finds that it is not used all of the time. As the 3D printing element of the project would only take place in the final week, she persuades the Technology department to let her borrow the 3D printer for a week in order to allow the students to 3D print their work.

Sara is hoping that once the Computing department experience the 3D printing and the positive benefits of this technology that she will be able to persuade them to invest in one for the department in future.

The Beetle Blocks software is cloud based so all that is required is for the students to access it through the UUI and log into their own student accounts.

The Cura slicing software has to be installed on the PCs. Students do not have the required permissions to install software on the PCs so the school IT technician was required to download and install the Cura slicing software onto each PC prior to the project commencing.

Preparatory Work

In addition prior to the start of the project, Sara created a set of student accounts in Beetle Blocks and prepared login detail slips for her students. Sara also created a few example Beetle Blocks designs and 3D printed them so that she could show students some possible project outcomes.

Description of Activity

To introduce the project to the students Sara first shows them some of the 3D printed examples she prepared - a ring, a bracelet and a pendent. She asks the students how they thought they might have been made, then explains that they have been 3D printed. In pairs the students are tasked with researching 3D printing and to find some other examples of 3D printed jewellery and fashion accessories.

The students share their experiences. Then Sara demonstrated the 3D printer printing one of the jewellery designs and explains how it worked.

Sara then introduces the students to Beetle Blocks, the students log into their students' accounts and follow a quick tutorial to learn the basics of the software. Sara demonstrates a few of the different programming blocks and the different outputs from them.

In pairs, students are then left to design an item of jewellery, Sara observes that the students work in different ways to achieve this. Some students sketched their ideas first then tried to find a way to program Beetle Blocks to produce their desired outcome. Others delved straight into Beetle Blocks, experimenting with different code sequences to see what effects they produced, then they edited the code and/or combined different code segments to create a design that they liked. Some students produced flat designs using only the X, Y plane however many of the groups managed to progress into using the Z plane to create more three-dimensional designs.

The students generally worked well in pairs as it allowed them to collaborate on the design, share ideas and problem solve together to debug and edit their code to get the design outcome they wanted.

Sara demonstrates how to export a design from Beetle Blocks as a .STL file and import it into Cura, she also points the students to the Cura tutorials in the UUI where they could learn about the various aspects of the software.

The students save, export and slice their designs. As the designs are all quite small, Sara asks one of the student groups to combine several designs onto a single build plate in Cura so that 5-6 items could be printed at the same time. This speeds up the printing process as Sara could start printing a set in the morning then another set in the afternoon, she does not have to keep returning to the printer to print the next design every 20 minutes. In all a whole class of 30 students, work was able to be printed this way in less than three days so that the students could take them home. Sara also prints duplicates of each design to keep for a classroom display.

Other Stakeholders and their Possible Interests

Following the project, the Art department is very interested to see the 3D printed Jewellery designs produced by the students. Viewing the end products instantly gave them ideas for how they could incorporate 3D printing within their art curriculum and design courses. This has opened up discussions between the two departments of how they might both make contributions from their individual department budgets to purchase a 3D printer that can be shared between the departments, as neither department would need all year round access to the printer.

The school leadership team has also expressed an interest in having the 3D printer on display at open-evenings, they believe it would produce a wow factor amongst potential students and their parents and may contribute to encouraging more students to apply for the school.

Success and Condition

The project was a great success as all the students, girls and boys were very engaged with it, they liked the challenge and the creativity of having to code their own design. Their coding skills developed much further as they were coding to solve a problem and get an outcome that they wanted. The additional benefit was that they were able to physically make their designs and had an end product they were proud of and wanted to take home.

Failure and Conditions

Reflecting the activity, Sara realised that there were two main problems that the students encountered, first of all if the students tried to scale their designs in Cura, this often didn't work very well and the model became faulty and would not print. Therefore, to bypass this ad hoc issue Sara encouraged the students to resize their models within Beetle Blocks by changing the "move block" distances until the model was the size that they wanted before exporting the .STL file. This way the model did not need to be resized in Cura.

Another issue was that as the prints were very small and detailed the print quality was not as good as Sara expected, with quite a bit of stringing. After consulting the Ultimaker user community forums that has been pointed at in the UUI, Sara tried slowing the print down, she did this by using the manual printer controls to changing the print speed to 50% and also reducing the nozzle temperature to 190°. This worked really well and the prints were a much better quality.

Barriers/Facilitators

Sara also consults the UUI learning analytics and is able to see how much time each pair of students used in the different phases of their work. This helps her also to understand in which phases the students need more support and or more explanation for future projects. As the designs were relatively quick to print and used very little filament, the cost to produce them is small. Sara realizes that the project could be extended into a business enterprise project with students printing multiple copies of a variety of designs and selling them at the school fair. As Cura gives the amount of material used per print, this can be used to calculate the production cost of each piece allowing students to determine their margins, selling price and calculate the profit. Students could take on management roles within the business, further building teamwork and collaboration.

Variation

Discussing the project with her colleagues, Sara has understood that this process has potential to be used for a range of different projects. One example would be to code and 3D print mathematical manipulatives such as 3D shapes or other designs to demonstrate mathematical principles for example transformations such as rotation and translation.