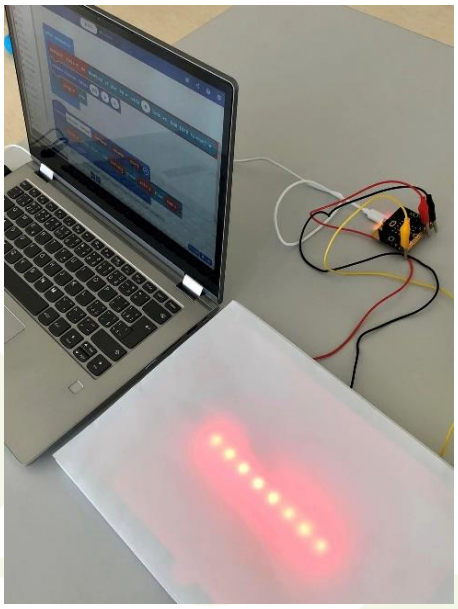
Physics as you do not know it. Optics.



School subjects
Physics
Age of students
12 -16
Aim of the activity
The main aim is to enhance the abstraction skill of participating girls by representing the colours by the triplet of integers. The presented activity was focused on mixing colour and models of mixing colours in computers (CMYK, RGB) aiming to offer the point of view of various STEM fields (physical principles of additional and subtraction model, the CMYK and RGB schemes for computers, hexadecimal system for reporting the colours in RGB). For this activity girls are collaborating in teams of 3-4 and are developing their team working and communication skills.

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Background
The activity was part of a summer school with focus on optical principles and properties of colours. Investigating illumination and its impacts of ergonomics were closely looked at in their appliance in interior design and marketing. Topics included geometrical optics and its application in medicine, especially ophthalmology, as well as photometrics.
Activity
The girls are asked whether they like to draw and paint and what are their experience with mixing colours. Later, they are asked whether they have already used any graphic editor in the computer. If so, if they set their own colours and how the same colour can be set in various software. **Input**: how are the colours remembered and represented in the computer. **Task**: 1. set the RGB code of given colours (micro:bit) 2. what is the colour with the given RGB code (micro:bit and GeoGebra) 3. Hex colour: hexadecimal representation of RGB code (pen and pencil, micro:bit and GeoGebra) 4. CMY(K) coding (GeoGebra) 5. Relation between RGB and CMYK (GeoGebra) 6. Complementary colours (GeoGebra, micro:bit) The participating girls are given a problem to solve (set the RGB code of given colours). First, they use the computer connected to BBC micro:bit with block-base environment connected and diodes emitting the light of the set colour. They try to insert any numbers and observe the results. Then they change one basic (red, green, blue) colour and observe how the light changes (0 red means blue/green and full red means red/pink, violet). Then they try out mixing the colours and explain how the model works. After that they use the tablet with GeoGebra sheet where they can set the numbers and see the resulting colours on the screen. They are asked to predict the colour according its RGB code in predict-test-explain mode and verify or disprove their prediction by micro:bit and GeoGebra. The hexadecimal system is introduced, mark-up and programming languages (e.g. HTML). The Hex coding is also the reason why the levels of red, green and blue range from 0 to 255 (ff in hexadecimal system) and how many possible colours (224) can be coded. In desktop publishing the CMYK is more used. The printers' cartridges and toners are also CMYK. The CMY representation are introduced in the same way as the RGB (represent the colour, read the colour, use the GGB to investigate the changes), but only using GeoGebra.

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Then the relation between colour and its complementary colour (considered as harmonic) is investigated.
Time necessary
45 minutes
Learning outcomes
Participants are able to: • find the RGB and CMY representation of the given colour, • predict a change of colour based on the change of one component, • find the hex code for the colour.
Materials
tablet with GeoGebra sheet, computer connected to BBC micro:bit with block-base environment connected and diodes emitting the light of the set colour. This is a common equipment in Slovak schools.

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