creative coding

curriculum

created by

bits4kids

Het Fluoriet
Computational thinking en programmeren

BRG KEPLERSTRASSE GRAZ

TRAKŲ VOKĖS GIMNAZIJA

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Purpose of the document

The purpose of this document is to provide schools with the information on how to use Creative Coding (code'n'stitch) with their students. In the later featured Creative Coding units pupils can design their own embroidery patterns and code them.

- Which age groups:
  Creative Coding can be done with students aged 8 and over, there is no upper age limit

- Which schools:
  suitable for all types of schools

- Which school subjects:
  Handycrafts, informatics, programming lessons, maths etc.

Introduction

Computers are present everywhere around us, in our smartphones, cars, medical devices, and even in washing machines. They have become indispensable in our daily lives. Digitization is the most significant change observed in various aspects such as the economy, the workforce, and communication. It profoundly influences our coexistence. The education system faces the significant challenge of preparing the next generation for this transformation. The focus should be on developing children's understanding of connections, overarching structures, interpretation, and criticism (cf. bmbwf, 2018). It is not only important for children to learn how to operate a computer but also to understand how it functions. By teaching children programming, we can empower them to go beyond mere consumption and actively engage in the digital world.

Computational thinking (CT) refers to the thought processes involved in formulating problems so their solutions can be represented as computational steps and algorithms. In education, CT is a set of problem-solving methods that involve expressing problems and their solutions in ways that a computer could also execute. It involves automation of processes, but also using computing to explore, analyse, and understand processes (natural and artificial).

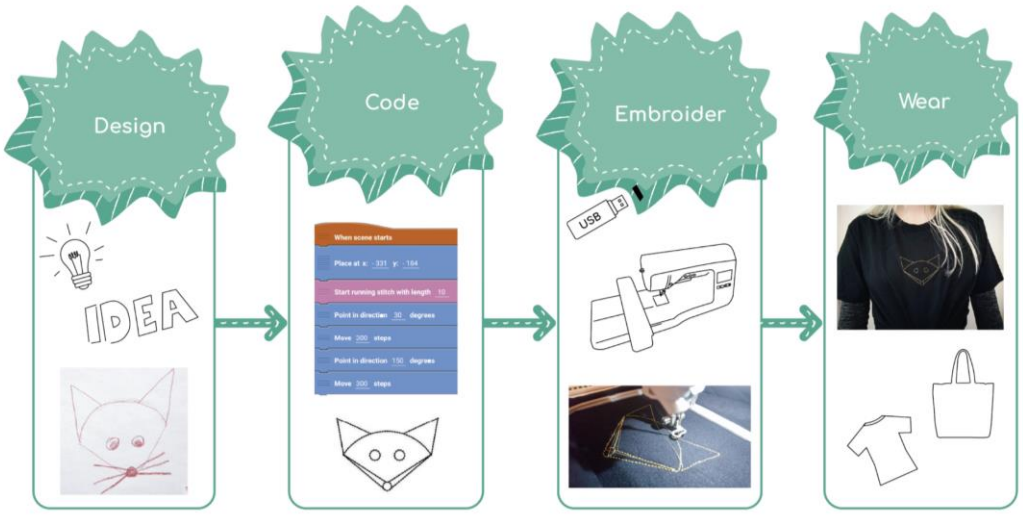
Many schools are embracing the use of learning robots to teach computational thinking, recognizing the substantial benefits of this innovative approach. Integrating learning robots into the curriculum provides students with a hands-on, interactive way to develop computational thinking skills. These include problem decomposition, pattern recognition, algorithm development, and data analysis. The real-world application of these theoretical concepts makes them more tangible, fostering deeper understanding and engagement.

Incorporating creative coding into this mix introduces an additional layer of creativity to the learning process. As an instructional tool, creative coding encourages students to generate and implement original ideas, fostering innovation and enhancing their problem-solving capabilities. Through the process of designing, testing, and refining their code, students not only learn the technical skills involved in programming but also develop a mindset of experimentation and iterative learning.

Furthermore, the interdisciplinary nature of creative coding helps bridge the gap between various subject areas, including mathematics, engineering, computer science, arts and handicraft. It encourages students to understand and appreciate the interconnectedness of these different disciplines in a broader context.

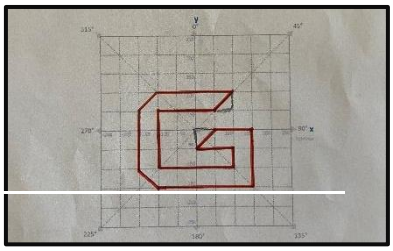
Creative Coding

Creative Coding combines designing, coding and using an embroidery machine to make something unique. There are four steps in the Creative Coding process:
"Design," "Code," "Embroider," and "Wear."



Design

In the first step, the pupils create a design. This design is a simple pattern made up of geometric shapes and can represent, for example, the letter G. The design is drawn on an already prepared coordinate system (see “My Design”).



Code

The design is subsequently programmed using the "Embroidery Designer" app which is available for Android and iOS. This app utilizes the block-based programming language called "Catrobat".

Embroider

The completed program is sent to an electronic embroidery machine, which then embroiders the design according to the programmed instructions.

Wear

At the end of the project, the children have their finished project outcome, which is usually a bag featuring their self-designed and programmed pattern. Through the embroidery process on the fabric, Creative Coding becomes a making activity, combining creativity and technology.

The Genesis of Creative Coding - A Story of Innovation and Inclusion

The project Code'n'Stitch originated as a FEMtech initiative, conducted by the Austrian Research Promotion Agency (Forschungsförderungsgesellschaft Österreich) in collaboration with the Technical University of Graz, and industry partners, bits4kids and apfelbutzn. Spanning from 2018 to 2020, the project's central mission was to delve into a gender-inclusive approach to coding.

The educational tool of choice for this endeavor was the Pocket Code app, a product of the Austrian open-source project Catrobat, initiated at Graz University of Technology. Pocket Code – a block-based programming environment - fosters a fun, interactive environment for programming, directly on mobile devices.

In a bid to captivate and engage the interest of young women aged 9 to 15, the app was enriched with the capability to program embroidery machines. This addition allowed users to bring their unique patterns and designs to life on fabric, embellishing t-shirts, pants, or bags with their custom artwork. Thanks to Pocket Code, and later the App Embroidery Designer (spin off of Pocket Code), embroidery machines became a suitable tool, for creating your own patterns in a school environment by using a visual programming language.

Learning Objectives

Computational thinking

Computational thinking is a foundational skill set that involves problem-solving using computer science concepts. Here are some common learning objectives associated with teaching computational thinking with Creative Coding (CC):

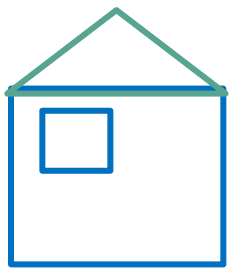
There are four main principles of computational thinking:

Problem Decomposition

Students should learn to break down complex problems into smaller, more manageable parts (Step-by-step plan to solve small problems).
Decomposition in the Creative Coding Project:
Students must break down their drawn design into individual (small) patterns such as circles, squares, semicircles or lines. The complex design is revised, simplified, and dismantled until it can be implemented well.

Pattern Recognition

Understanding and identifying patterns, trends, and regularities.
Pattern recognition in the Creative Coding Project:
Creative coding provides an interactive platform for children to enhance their pattern recognition skills. As they design and code, they begin to identify repetitive geometrical patterns such as squares, circles, and semicircles, among others. For instance, by understanding and coding a circle, they can apply this knowledge to recognize a semicircle as half a circle, and thereby code it effectively.
Beyond individual shapes, creative coding encourages children to identify opportunities to streamline their work. They learn to recognize recurring patterns where loops could be implemented in their code to create these repetitive designs more efficiently.



Algorithmic Thinking

Learning to develop a step-by-step series of instructions, which when performed step by step in the correct order, lead to a predetermined goal.

Algorithmic Thinking in the Creative Coding (CC) Project:

When the self-designed patterns are programmed, the children establish a precise sequence of work steps and use loops to repeat certain processes. When programming in the CC Project, structured, step-by-step work is mandatory.

Abstraction

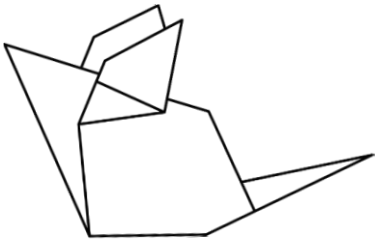
Simplifying the problem by removing unnecessary details.

Generalizing different problems by omitting the differences. Finding a solution that is useful for different problems by omitting specific differences.

Abstraction in the Creative Coding Project:

Filter out the most important features in the design/pattern and program them first. Find out what's important. Only then are further details programmed.

Example: with a fox head you need the head first, then you can add eyes and ears.



There are also some related (but not "main") attributes and skills of computational thinking:

Errors / Mistakes

Identifying, analysing, and fixing errors in an algorithm or solution. Debugging and resolving errors. Develop problem-solving ability.

Error/Mistakes in the Creative Coding Project:

During the project students may face errors and problems. They need to find the problem and try different solutions.

Errors are important in programming. Recognizing, finding and fixing errors - an essential part of programming

Loops and functions are less error-prone (less code - clear, faster to fix)

Repetition

A loop causes something to be repeated.

Loops in the Creative Coding Project:

During the instruction part of the project all students learn the function of a loop and use a loop to program a square and a circle. They then can choose to use loops in the coding of their design.

Basic Concepts of Programming

Children can grasp a wide range of programming basics, especially when presented in a kid-friendly manner. Here's a list of fundamental programming concepts that children can learn with Creative Coding (some depends on age):

Algorithms

These are step-by-step instructions to solve a problem. Kids can understand this concept through activities like following a recipe or playing games that require specific sequences of actions.
Algorithms in the CC Project: see Computational Thinking / Algorithmic Thinking

Sequencing

In programming, a sequence refers to a set of instructions that are executed in a specific order, one after the other. It's one of the three fundamental control structures in programming, alongside selection (conditionals) and iteration (loops). In the Creative Coding project, we need sequences and loops.
Sequences in the CC Project:
Creating a pattern in coding requires a structured sequence of instructions to achieve the desired design. Typically, the sequence unfolds as follows:

Initiate the Pattern Creation:
Begin with a start event or trigger to initiate the coding process.
Specify the Design Elements:
Define the type of stitch to be used.
Choose the desired colour or set of colours.
Pattern Encoding:
Lay down the programming instructions meticulously. This ensures the elements of the pattern appear in the intended manner and order. By adhering to this sequence, you ensure the pattern materializes as envisioned, blending both the artistic and technical aspects seamlessly.

Loops

A loop is when instructions are repeated a certain number of times. Activities like clapping hands repeatedly or singing repetitive songs can illustrate this concept.

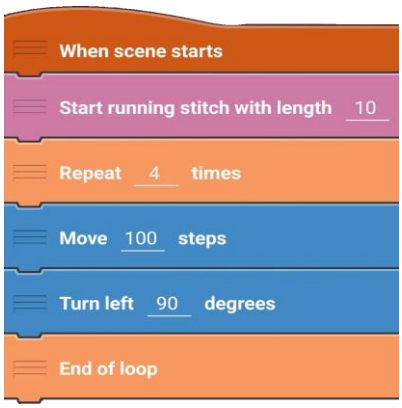
Loops in the CC Project:

Loops play an essential role in creative coding projects, offering the ability to repeat certain actions or generate patterns systematically. Here's how loops can be utilized in a creative coding context.

Symmetric pattern

A square has four sides of equal length. No matter in which corner you start, if you move around the square, you'll encounter these four sides sequentially, each the same length.
In coding, a loop is a mechanism that allows us to repeat a set of instructions a specific number of times. Think of it as a repeat button on your music player; when you press it, the song plays again from the start. A loop in programming works in a similar way; it repeats the code inside it.
Since a square consists of four sides of equal length, it means we'll be performing the same action four times: drawing a straight line by moving a few steps forward and then making a right-angle turn. Instead of writing this instruction four times, we can use a loop to repeat it.

To draw a square using a loop:
a. Start at a corner.
b. Draw a straight line for the length of one side.
c. Make a 90-degree turn (a right angle).
These steps need to be repeated four times to complete the square.



Repetitive Patterns

Loops can be used to create regular and repetitive patterns, such as drawing multiple instances of a square or circle.

Creating Complex Structures

Loops can be utilized to combine multiple simple shapes or patterns to form more intricate designs.

Variables

These are storage locations in programming that hold data. Kids can understand variables through activities involving containers holding specific amounts of items (like marbles or candies).

Variables in the CC Project:

For advanced projects, variables play a crucial role when it comes to making projects dynamic, interactive, and customizable. You can use a variable to decide how many corners the pattern should have, i.e. triangle, square, pentagon, ... Also, the size of your pattern can be easily adjusted with a variable.

Debugging

This is the process of finding and fixing errors in code. Children can be taught to troubleshoot issues in their design, helping them understand the importance of finding and correcting mistakes.

Events

In many programming languages, actions can be triggered by events. Kids can understand this through cause-and-effect activities.

Events in the CC Project:

The most important event block in den CC Project is the „when scene starts“ block. You need this block as a starter block so that the following blocks can be executed.

Preparation and technical framework

A friendly warning first: You and your students will make mistakes in design, coding and embroidery. That's normal. Finding and subsequently solving errors is a recurring process in the world of algorithms.

Setting

The Creative Coding project can be incorporated into the regular curriculum or offered as an elective. In either scenario, it is essential to designate enough time for the project, with a requirement of 6-10 hours.

Pre-Arrangement

- Learn how to code with scratch / preliminary exercises with scratch with the pen extension.
- Learn how to code in Pocket Code.
- Learn how to use the embroidery machine.
- Design and prepare your design/pattern for coding.
- Embroider your design as an example piece

Equipment

Must have

- embroidery machine (for stitching)
  - Brother Innov-is M280 Disney (cost in 2024: 949 €)
    - + cheap
    - + small / light
    - - only 10x10cm embroiderable surface
  - Brother Innov-is 870 Special Edition (cost in 2024: 1435 €)
    - + electric embroidery foot
    - + 26x16cm embroiderable surface
    - - bigger / heavier
- accessories: embroidery needles, embroidery backing, embroidery and bobbing thread
- fabric, bags, gym bags etc.
- sewing scissors
- Android tablets or smartphones (for coding)
- USB stick (to transfer the coded pattern to the embroidery machine)
- WLan

Nice to have

- worksheet “My Design” (Link)
- A visualizer or dongle to connect the phone/tablet to the beamer (to explain the first steps of programming)
- Instructional Flashcards (Link)
- PowerPoint “Presentation -Creative Coding for students”(Link)
- embroidery machine carrying case
- more embroidery hoops
- fabric scraps for testing

Background Knowledge

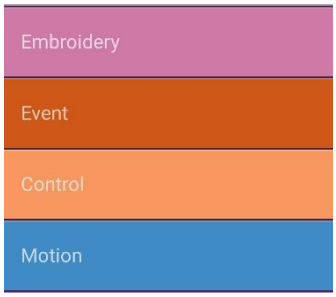
Catrobat programming

Catrobat is a block-based programming language used by the App Embroidery Designer which is used in the Creative Coding project. It provides a user-friendly and accessible method for children and teenagers to learn programming and mobile app development. The initial version of Catrobat was developed in 2011 under the leadership of Wolfgang Slany at the Institute of Software Technology at Graz University of Technology. The project received funding from the European Union and has since grown. To this day, Catrobat is used to promote education in the field of computer science and programming for children and teenagers. The programming language is block-based, making it ideal for beginners and children (cf. Catrobat, 2022).
See also: https://wiki.catrobat.org/bin/view/Main/

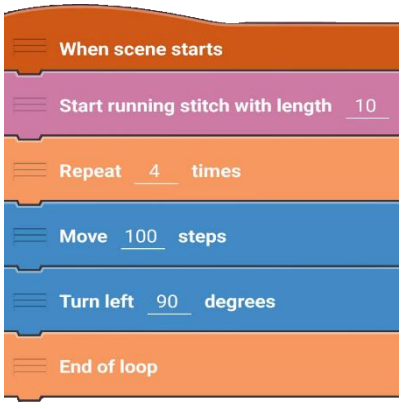
Basics

Block-Based Programming

In block-based programming, individual commands or instructions are connected in a specific order and executed sequentially. Block-based programming languages offer several advantages over text-based programming languages, particularly for beginners. Block-based programming languages are visually appealing and require little to no knowledge of a programming language. Programs like “Scratch” also use block-based programming. Like in Scratch, the blocks in Catrobat are categorised. Blocks from different categories have different colours. The picture shows some of these categories (Embroidery, Event, Control, Motion).



Example:
To create a square, the blocks simply must be strung together:



Drawing your design & transmitting in coordinate system

Information about programmable patterns

Some designs are difficult to program. Therefore, it is important to create realistic designs so that students are not disappointed when trying to code their design! Given the time available for the workshop, this is about **abstraction** and **reduction**. This means that students must create a design that is as schematic as possible.

Good pattern	Difficult pattern
	
• Straight lines • circles • half circles • quarter circles	• curved lines • filled patterns • ovals • too many single objects • a lot of different lines (>20) • blurred lines

Possible Requirements for students

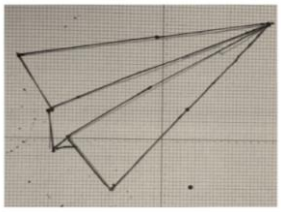
The following specifications are helpful when creating the designs. At the same time, however, they limit the creative process. It is advised to only use the specifications when the need arises.

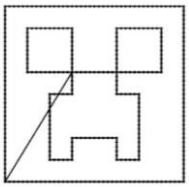
- A maximum of 15-20 individual elements. So, for example 12 lines and 4 circles
- Use geometric shapes, such as straight lines, circles, quadrats…
- Use lines, circles, semicircles.

Think simple first, fewer details! If there is time, something can always be added.

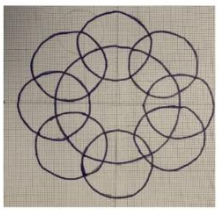
Programmable vs. non-programmable patterns

programmable patterns

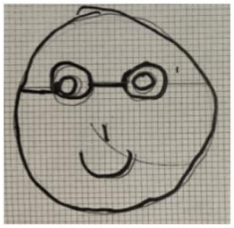




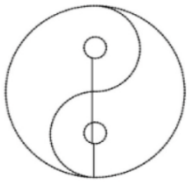
Only straight lines



Only circles

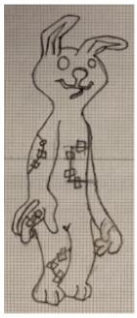


Only circles and straight lines

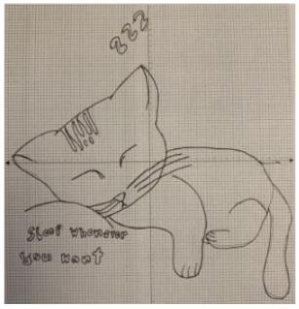


Only circles and half circles

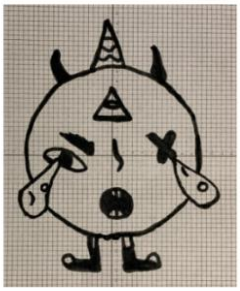
Non-programmable patterns



Too complex

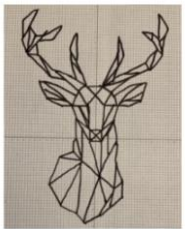


Too many curves

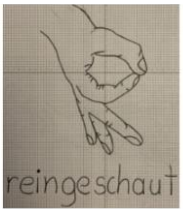


Too many filled areas

Too complex

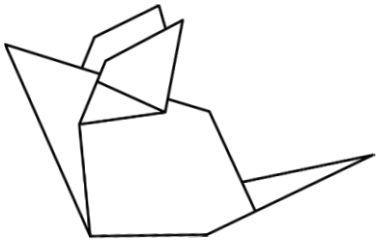
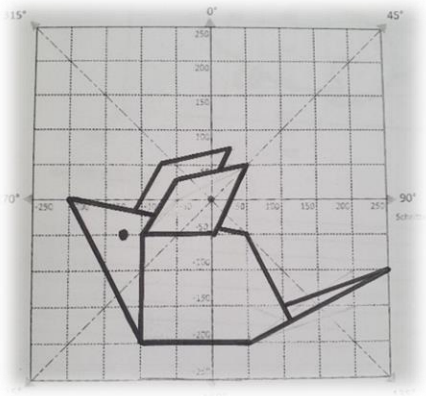
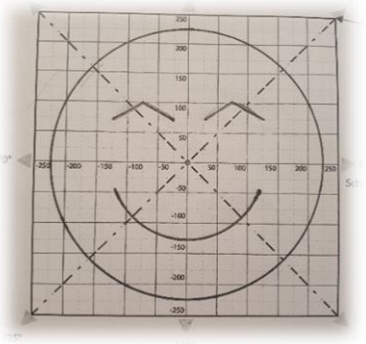


Too many lines



Too detailed

Transmitting the pattern in a coordinate system

Idea	geometric figure	embedded in coordinate system
		
		

Tips and Tricks:

- Keep in mind which fabric you want to create (e. g. bag, key chain) → how big should your design be? If you create a key chain, your design should only take up half of the space in the coordinate system. In general, your design should not be bigger than the coordinate system in the Worksheet "My Design", since the maximum of this square (500x500 steps) will create a pattern in size of 10x10cm.
- It is also advisable to draw the design in a way that the corners of the pattern meet corners of the coordinate system → it is easier to read coordinates then → reading coordinates is important for programming.
- You can make the process easier for the kids, if you go through coordinates together and write them down.

Before programming

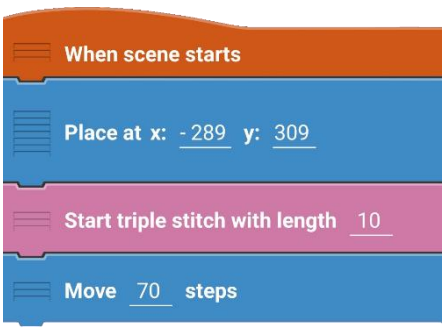
Stitches

Before you start programming, you should decide, which type of stitch you want to use for your design. You can also use more than one. Here are three different stitching types:

Running stitch

Zigzag stitch

Triple stitch



How to start a pattern (video)

Follow this QR Code to a short video on how to start a pattern in Embroidery Designer.

https://vimeo.com/manage/videos/888662672

Multicolour objects

If you want to have different colours in your design, you must divide your design into different objects. You should think about this before you start programming.

https://www.koala-online.at/tutorials/rainbow-english/

Teach how to code

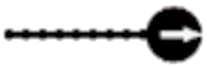
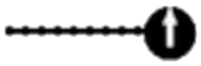
Programming logic on blackboard

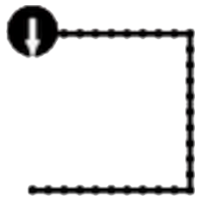
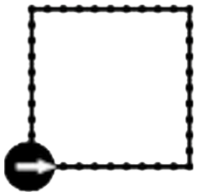
Game:

A game in which someone embodies the embroidery machine which gets commands from students. This is highly recommended as a start to programming.

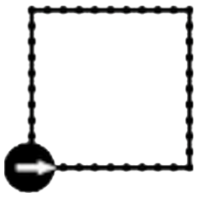
1. A square should be draw on the blackboard by giving coding commands like “Move _ steps” or “turn _° left” to the teacher. Guide the students step by step in building the process of a running stitch. Begin with questions like, "What happens first when a fabric is fixated in the machine? A stitch is started. What should it do next to create a line? Move. And so on." Write down the key commands on the board: Start stitch, Move 10 steps, Turn left, Turn right, Repeat, Point in the direction.
2. In the second part, designate a volunteer to act as the embroidery machine, and have another student write the script. As an initial task, you can begin by stitching a line on the board, and then gradually progress to creating a square. Encourage students to use hand signals to indicate what should happen next. Allow room for mistakes (and have the "machine" execute them) so that students can adapt and refine their thought processes.
3. In the third part, collectively review the completed script and highlight the repetition when creating a square, making it a perfect opportunity to simplify using loops. Hence, work together with the students to create the square using the Repeat block.

In this activity, the board is divided into 2 parts.

code	pattern
1. Start stitching 2. move 100 steps	
1. Start stitching 2. move 100 steps 3. turn left 90 degrees	
1. Start stitching 2. move 100 steps 3. turn left 90 degrees 4. move 100 steps	
1. Start stitching 2. move 100 steps 3. turn left 90 degrees 4. move 100 steps 5. turn left 90 degrees	

1. Start stitching 2. move 100 steps 3. turn left 90 degrees 4. move 100 steps 5. turn left 90 degrees 6. move 100 steps 7. turn left 90 degrees	
1. Start stitching 2. move 100 steps 3. turn left 90 degrees 4. move 100 steps 5. turn left 90 degrees 6. move 100 steps 7. turn left 90 degrees 8. move 100 steps 9. turn left 90 degrees	

Now work together with the pupils and introduce the concept of loops to shorten the code.

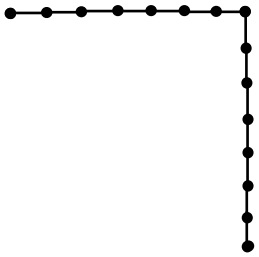
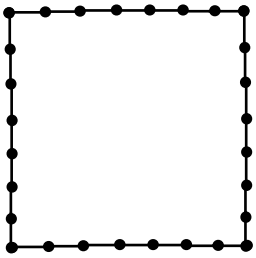
1. Start stitching 2. Repeat 4 times 3. move 100 steps 4. turn left 90 degrees 5. end of loop	

From the first stitch to a cherry

Now pupils will get their first hands on experience with coding in the Embroidery Designer App. This chapter is important as it allows students to apply previously acquired knowledge, when programming on the blackboard, to writing a functional code. Additionally, they learn how to easily create circles or segments of circles.

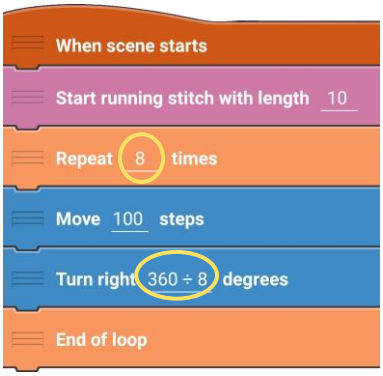
Step one: create a square

To help pupils understand the code for embroidering a square, it is recommended to break down the project into simple steps. First start with a line. Then program a corner. At this point pupils may notice that some blocks of the code are repeated. This is when you can explain why it is advisable to use a loop.

Blocks	Pattern
When scene starts Start running stitch with length 10 Move 100 steps	
When scene starts Start running stitch with length 10 Move 100 steps Turn right 90 degrees Move 100 steps	
When scene starts Start running stitch with length 10 Repeat 4 times Move 100 steps Turn right 360 ÷ 4 degrees End of loop	

Step two: Circle

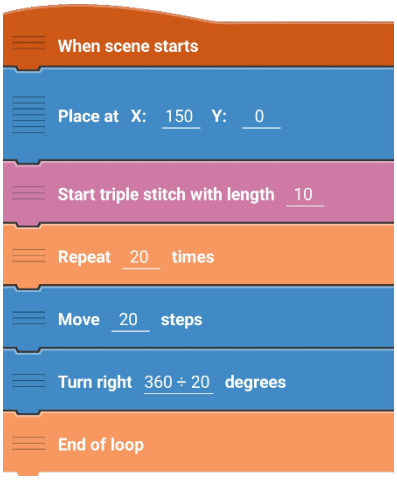
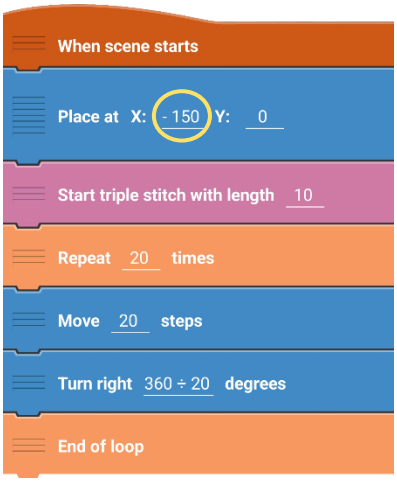
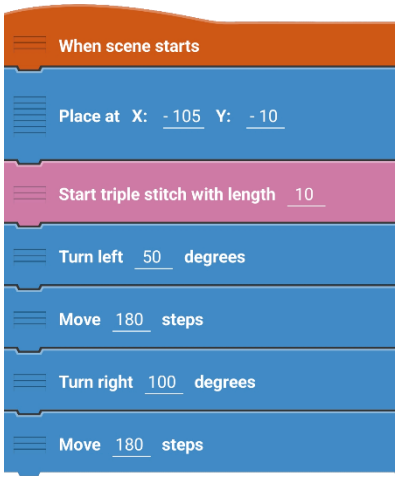
If you have programmed the square, you can easily make an octagon (or any other polygon) out of it.



You only need to change the number in the loop and the degrees. To embroider a polygon, always divide 360 degrees by the number of angles.

After creating an octagon, students can try to create a polygon with 20 angles. They will notice that the figure looks almost like a circle. That's when the students could realise that a circle is just a polygon with infinite angles.

Step three: Cherry

Program a circle and use coordinates to change placement.	Copy the circle and use coordinates to change placement.	Program the stem and use the coordinates to change the placement.
		

How to code a pattern (video)

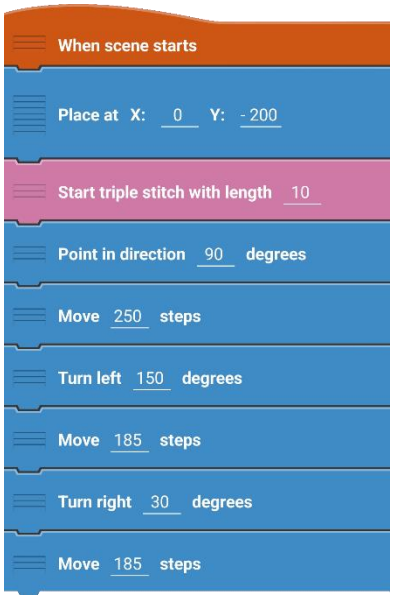
Follow this QR Code to an introduction on how to code a pattern in Embroidery Designer.

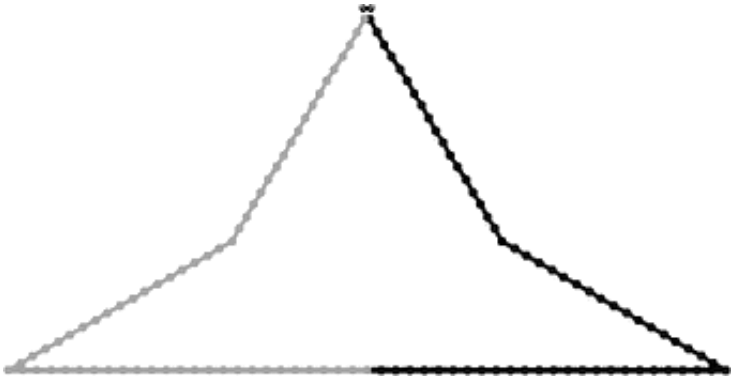
https://vimeo.com/manage/videos/893492074

Programming Techniques

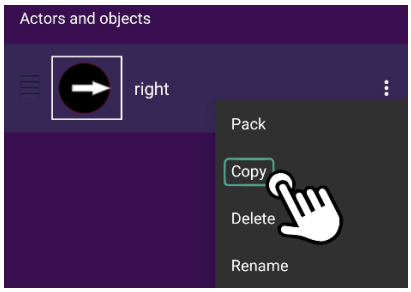
Mirroring

- The right or left pattern can be mirrored to the other side.

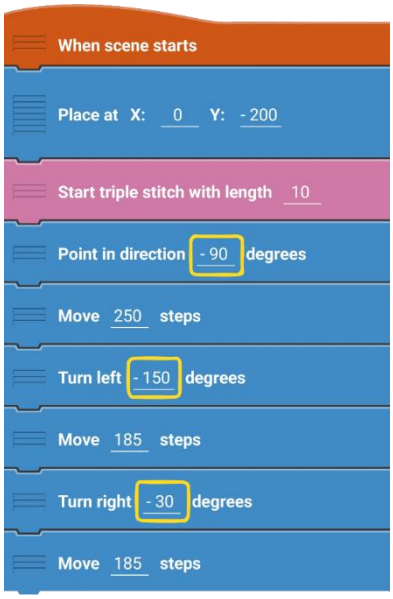




- Copy the object which contains the code of the right side of the pattern.



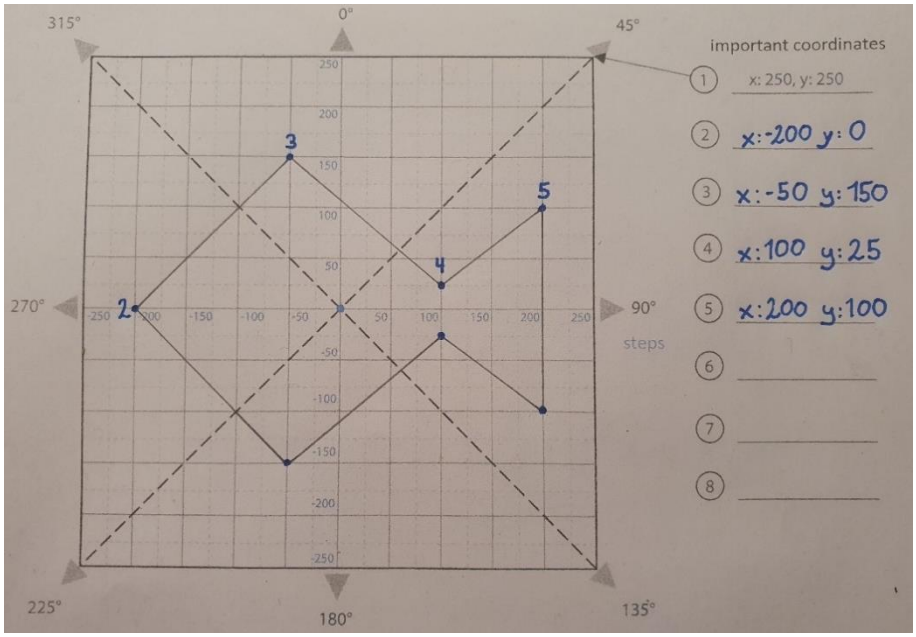
- Prefix all degrees with a minus sign. Depending on if the mirror is in the X- or Y-Axis you will have to prefix all y-coordinates (if mirror is X-axis) in the “Place at x: y:” blocks with a minus sign or all x-coordinates (if mirror is Y-Axis). In this case the mirror is the Y-Axis so we would have to prefix all x-coordinates. The only x-coordinate in this example is “x: 0” so we do not need to change it.



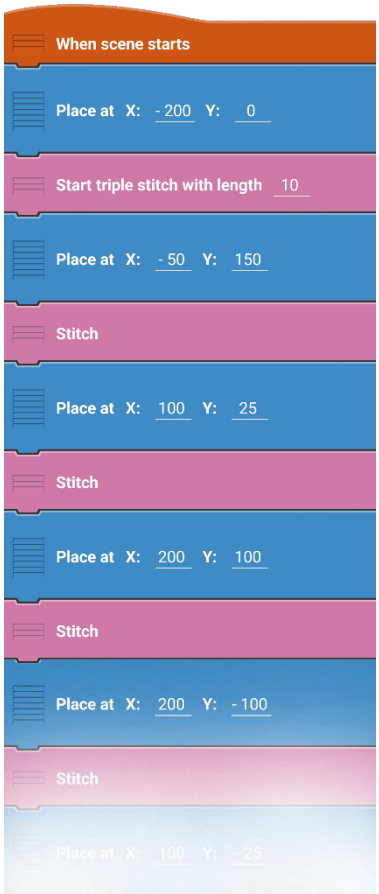
Coordinate Hopping

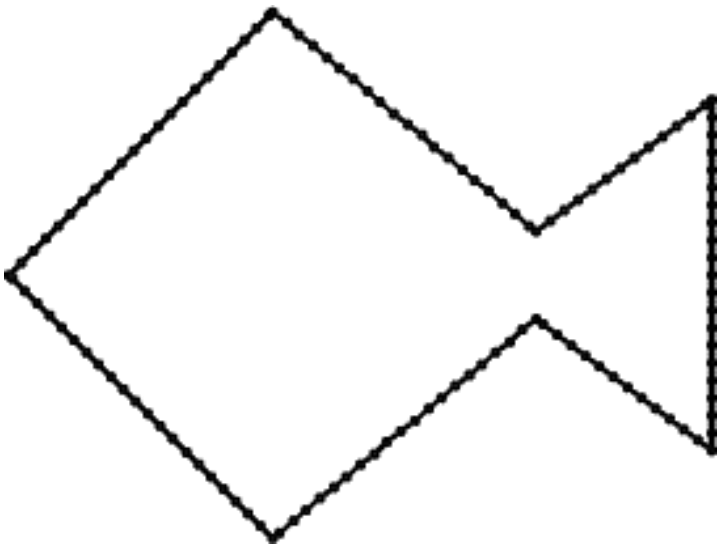
A pattern can also be created by just jumping between coordinates. The embroidery machine will stitch lines in between.
Attention! – Coordinate Hopping can only be done with the **running and the triple stitch**.

- For Coordinate Hopping it is important that pupils draw their pattern properly in a coordinate system and maybe even note important coordinates.



- Use single stitches (“Stitch”) after every coordinate to prevent inexact hopping as the stitch length is always defined by the start block (here: Start triple stitch with length 10). If the stitch length between two hoops is in this case not a multiple of 10 the last stitch would be at the last multiple of 10 and the stitching would maybe end too soon.

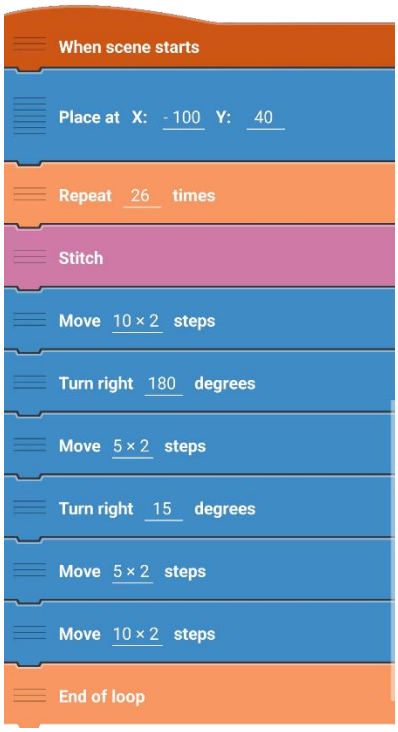


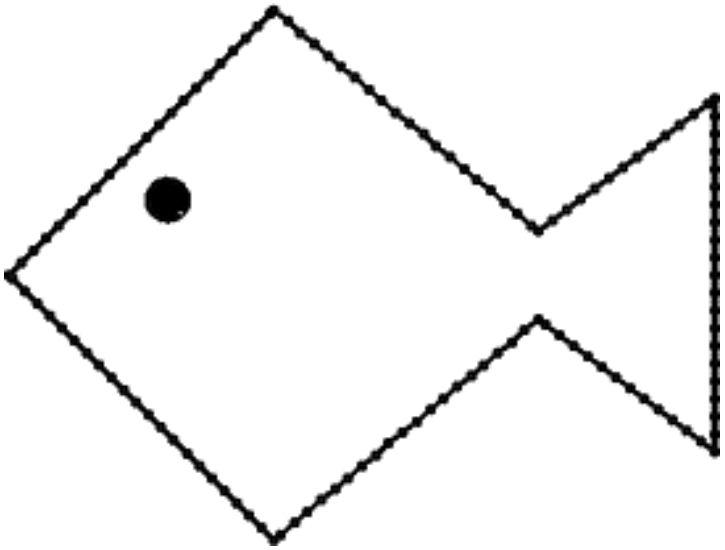


Create a dot

Sometimes pupils want to create an eye for an animal or a dot for other patterns. In general, it is important to not strain the fabric by stitching multiple times into the same needle hole. This code ensures that it is avoided.

Example (eye for a fish):





By multiplication of all steps with the same number (0.2 -3) you can adjust the size of the dot.

Embroider

Export your design (video)

Follow the QR Code or the Link to a short video on how to export the pattern from Embroidery Designer to transfer it to the embroidery machine:

https://vimeo.com/883038712?share=copy

Embroider the pattern (video)

Follow the QR Code or the Link to an introduction on how to embroider a pattern with an embroidery machine:

https://vimeo.com/883037389

How to select a fabric

Important keywords on how to select the right fabrics for an embroidery machine:

Elasticity:	**Do not use fabric that is too stretchy**. Tell pupils to bring something made from 100% cotton or buy bags or gym bags for this project.
Size:	Be aware that you must secure the fabric in an embroidery hoop. The fabric has to be bigger than the hoop and you cannot stitch a pencil cases or things you can't fixate inside it.
Thickness:	If a fabric is too thick the needle from the embroidery machine can get stuck in it. We suggest 300 g/m^2 as an upper limit.

Tutorial on how to stitch keychains

https://www.koala-online.at/tutorials/keychain-english/

FAQ / sources of errors

Design

The students draw a design, which has filled areas. Is this possible?

No, this is not possible. You can only run a zigzag stitch around the edges of the area pupils want to fill. A piece of fabric can be embroidered instead of the panel filling. Before you start stitching put a fabric in the desired colour over the fabric the pattern should be put on. Afterwards cut of the excess fabric.

Students draw a very complex design. What should I do?

The easiest way is to transfer curves into corners.
You can ask Google about geometric figures or Cliparts (e. g. “geometric fox”)

students draw their design in just one quarter of the coordinate system. Is this a problem?

In this case, the embroidered design will be very small. You can change the size of the design directly on the embroidery machine, but it’s not possible to make big changes (just a few millimetres).

Code

I can’t find a button for saving my design. How can I do this?

The program in embroidery designer is saved automatically. You don’t have to take any extra steps for it.

How long is one step?

10 steps are about 2mm long.

How can I exit the formula editor?

Click on the arrow in the left upper corner.

How can I exit a started program?

Push the “previous” button on your phone twice.

In my design, I would need to stitch over a line multiple times. Is that possible?

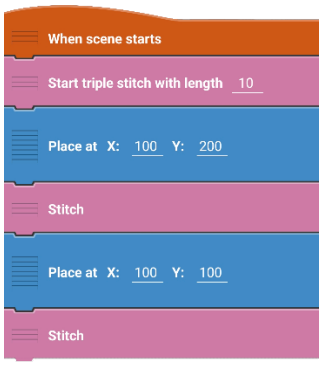
This is not a good idea. The embroidery machine can be damaged and the fabric might tear.

The design on the phone doesn't look like on paper. What are possible reasons for that?

- Kids forget a "place at x:_ y:_" block → you can write down each coordinate with the kids together and compare it with the code.
- Check the +/- signs in front of every number (a mistake in the signs changes the position of the coordinates completely)
- Sometimes it helps if you disable certain parts of the code to identify the part causing the issue.
- Shrink the needle icon with the block "Set size to _" to get a closer look at your pattern. The icon can cover problems within your coded design.

The stitch passes one coordinate twice, but on your design, these points are not exactly the same. What is the reason for that?

The exact ending point of the stitching line depends on the stitching length. You can either make the stitching length shorter or you can insert the block "Stitch" after every coordinate.



I want to change the name of my project. How can I do this?

Click on the three points next to the project name. Then click on "Rename" or "Project options". You can change the name both ways. Note, that you should not use special characters.

Zigzag stitch looks broader on the app than it should in real life.

Use the App "Stitch pro" to monitor your design.

Which stitch should I use for coordinate hopping?

You cannot use the zigzag stitch. All other stitches are possible.

In embroidery designer, I can see lines which I didn't program and shouldn't be stitched.

Only lines with little knots on it are stitched. Lines without these knots are not stitched.

Which length and width should I choose?

Running stitch and triple stitch: The length determines the space between the stitches. We recommend a length between 5 and 15.
Zigzag stitch: The length determines the density of the stich. We recommend a length between 2 to 10. The width determines how wide the stitch is. We recommend a width between 5 and 25.

Which kind of stitch should I use?

This depends on the density of the pattern.

The design is not in the middle of the coordinate system. Is this a problem?

This is not a problem; the embroidery machine places the pattern in the centre. But: It is important that the design is not bigger than the embroidery loop.

How can I transfer a whole project to another phone?

Click on your project.
Next to the project name you will find three dots.
Go to project settings.
Export your project via “export project”.
Save it as a .catrobat file on your device and send it to someone else.

My design is distorted after I sent it to another phone.

This happens when the screen sizes of the two phones are different. You can still export it normally to the embroidery machine.

How do I know how big my design is?

You can check the exact size of your design with the app “Stitch pro”.

Problems with downloading the Embroidery App

- iPhone
  - Download the App Pocket Code not the App Embroidery Designer
  - Activate the Embroidery bricks (look at settings/embroider)
- Android
  - Not possible to download it from the Play Store

    Activate the developer options on your device and download the app as an .apk from the internet (google search – „install .apk on android“)

Is there an alternative to Embroidery Designer?

You can use Turtle Stitch. It is a web-based application for personal computers.

Embroider

I want to embroider the design in different colours, but it doesn't work.

If you want to use different colours, you need to have objects. Every object can be embroidered in another colour. You might have to reprogram the design. Use the copy function to copy your whole object and delete certain parts.

The flash drive is not recognised by the embroidery machine.

- Wait a little longer. Maybe the flash drive was not plugged in long enough to connect properly.
- Your flash drive might be damaged – try another one.

The thread broke and the embroidery machine stops in the middle of the design.

Reinsert the threat, go back a few stitches and start the stitching again.

The bobbin thread is empty.

Do not stop the program. Remove the embroidery hoop, change the thread, insert the hoop again, go back a few stitches and start the stitching again.

Your file is not shown on the embroidery machine, although you can see it on your flash drive.

- The file name contains special characters or emoticons.
- The design might be too big → Check the size with the app "Stitch pro".

How can I make a design smaller or bigger?

Steps in „Move _ steps" blocks and coordinates must be multiplied by always the same factor (x2 for twice the size, x0.5 for half the size)
You can also make small changes (about 5mm) on the embroidery machine.

The thread is always breaking. What can I do?

- You might use a wrong kind of thread. It is important to use threads which are made for embroidery machines.
- You might have to service your embroidery machine. Scraps of the bobbin thread could cause the problem. You also might have to oil the machine.
- You might not have inserted the threat or bobbin thread properly.

There are knots forming under the fabric.

- Check the bobbin thread.
- Untie the knots.

I stitched the fabric together unintentionally.

- Stop the embroidery machine.
- Unpick the thread (carefully) with a thread snipper or a scissor.
- Embroider again.

The bobbin thread is used as top thread (bobbin thread gets pulled up).

You might have inserted the bobbin wrong. Check the signs on the embroidery machine on how to insert the bobbin.

The embroidery machine wants to stitch beyond the embroidery hoop.

The embroidery module was moved manually after you started the machine. Turn the machine off and on again.

Teaching Methods

Interdisciplinary Teaching

Subjects involved in the CC Project:

- **Art (drawing lessons)**, for drawing and designing the pattern.
- **Informatics (computer science, digital skills),** for learning how to code/program and coding the self-designed pattern.
- **Handicrafts (technical and textile works),** for stitching the coded pattern with the embroidery machine.

Interdisciplinary teaching refers to an approach that integrates concepts, methods, or perspectives from more disciplines to provide a deeper understanding or solve complex problems. There are several reasons why interdisciplinary teaching is important:

- **Real-world Relevance**: Real-world problems don't fit neatly into one academic subject. They often require knowledge and skills from various fields. Interdisciplinary teaching mirrors this reality, preparing students to tackle complex issues more holistically.
- **Engagement**: Interdisciplinary projects often revolve around current issues or real-world problems. This relevance can boost student engagement and motivation.
- **Flexibility and Adaptability**: As the world changes rapidly, people need to be flexible in their thinking and adapt to new situations. Interdisciplinary teaching fosters these skills.
- **Breaking Down Silos**: In traditional schooling, subjects are often taught in isolation. Interdisciplinary teaching breaks down these barriers, allowing students to see connections between various fields of knowledge.
- **Developing Communication Skills**: When students engage in interdisciplinary studies, they often need to communicate their ideas clearly to people from different backgrounds. This enhances their ability to articulate complex thoughts and work in diverse teams.
- **Innovation**: New ideas often arise at the intersection of disciplines. By blending fields of study, students may come up with innovative solutions and ideas that wouldn't be apparent within a single discipline.

While interdisciplinary teaching has many benefits, it's essential to implement it thoughtfully. Effective interdisciplinary instruction requires careful planning, collaboration between educators, and a curriculum that genuinely integrates rather than superficially combines subjects.

Units

Unit 0 – KickOff (Introduction)

Subject (in interdisciplinary teaching)

All teacher involved in the process:

- **Art (drawing lessons)**, for drawing and designing the pattern.
- **Informatics (computer science, digital skills),** for learning how to code/program and coding the self-designed pattern.
- **Handicrafts (technical and textile works),** for stitching the coded pattern with the embroidery machine.

Duration

15 to 20 minutes

Content

Information about the Creative Coding process

Preferred skills

None

Needed equipment

Essential

- PowerPoint presentation: “Presentation Creative Coding for students” on a beamer (“Presentation - Creative Coding for students” in English)
- example piece, e.g Embroidered bag to show around

Nice to have:

- Creative Coding Flashcards

Lesson goal

All involved teacher and pupils have gained an insight into the creative coding process.

Lesson plan

Content	Duration
Preparation: All involved teacher together: Design and create an embroidered bag/shirt for demonstration. Put the PowerPoint Presentation “Creative Coding Presentation for students” on the beamer.	
Introduction and explanation: **Information on the Creative Coding process** Use the PowerPoint “Creative Coding Presentation for students” to explain to students: ● What is Creative Coding? ● How does the process of Creative Coding work? (see “basics”)	10 min

Unit 1 – Design

Subject (in interdisciplinary teaching)

Art (drawing lessons), for drawing and designing the pattern

Duration

Two to four class hours

Content

- How to create a programmable design
- Design the pattern on paper

Preferred skills

A pre knowledge on the coordinate system is helpful when drawing the design

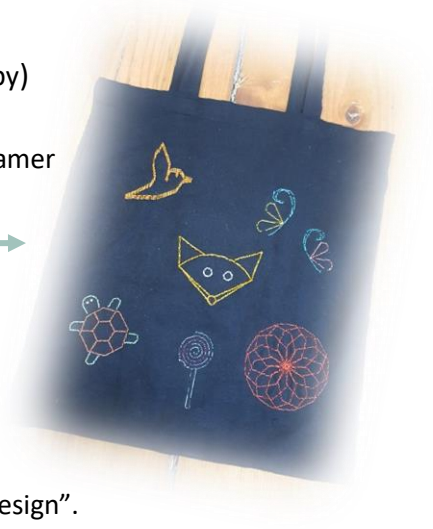
Needed equipment

Essential

- Paper, pencils, ruler, circle, (dividers)
- Worksheet “My Design” for each student + extra sheets (hard copy)

Nice to have:

- PowerPoint: “Presentation Creative Coding for students” on a beamer
- Creative Coding Flashcards
- Example piece to show around
- Computer or smartphone for research (for logos, pattern, …)



Lesson goal

Each student has drawn a programmable design on the worksheet “My Design”.

Lesson plan

Content	Duration
Preparation: Create an embroidered bag/shirt for demonstration. Print the worksheets “My Design”. Put the PowerPoint Presentation “Creative Coding Presentation for students” on the beamer.	

Introduction and explanation:
Information on the Creative Coding process
Use the PowerPoint “Creative Coding Presentation for students” to explain to students:
• What is Creative Coding?
• How does the process of Creative Coding work?
• What is a pattern?
• What should be considered to code it? (see "programmable patterns")
• What is the advantage of a symmetrical pattern? (see “Loops”)
• How to draw geometric patterns and connected geometric figures? (see **coordinate hopping** in chapter “Programming Techniques”)
• How to transmit it in a coordinate system? (see “transmitting pattern into coordinate system”)
• What different stitches does the embroidery machine have? (see “Stitches”)
  ○ Running stitch
  ○ Triple stitch
  ○ Zigzag stitch
• Discuss colour selection
	15 min

Work Phase I: Design a pattern on paper • Collect design ideas: Create different sketches on paper, without using a ruler or compass. • Internet research on design: What can be improved/simplified? • Discussion with the teacher on the design's programmability. Where can it be simplified? Is there a possibility for mirroring? • Is there another child with a similar design - then collaboration can be done.	~ 30 min

Work Phase II: Finalize design in a coordinate system • Learn how to get your pattern in a coordinate system. • Draw the final idea on the worksheet "My Design."	10 min
Conclusion Volunteer students can show their design. The final worksheet is handed to the teacher.	10 min
Outlook The teacher gives a short outlook on the next lesson. The next lesson is an introduction to Catrobat Programming. Students will use a block based programming language to code their first program on a smartphone or tablet.	5 min

Unit 2 - Introduction to Catrobat Programming

Subject (in interdisciplinary teaching)

Informatics (computer science, digital skills), for learning how to code/program and coding the self-designed pattern.

Duration

Two to four class hours (depends on prior knowledge in programming)

Content

- How to use the "Embroidery Designer" app
- Creating simple figures with the "Embroidery Designer" app.
- Working with objects, using various blocks of the Embroidery Designer, applying the concept of loops.

Not part of this lesson (see preferred skills)

- Fundamentals and basic concepts of programming.
- Preliminary exercises in scratch

Preferred skills

A basic understanding of the coordinate system and prior knowledge in programming (e.g., Scratch) is helpful.

Needed equipment

- Tablets or smartphones.
- The "Embroidery Designer" app.
- A projector that can be connected to a smartphone or tablet.

Lesson Goal

The students applied the taught programming knowledge and programmed their first pattern.
They can use objects, work with different blocks of the "Embroidery Designer" app and have created their first programs with the help of tutorials.

Lesson Plan

Content	Duration
Preparation: Install the app "Embroidery Designer" on the used devices. Connect Smartphone/Tablet with a beamer. Teacher takes worksheets of pupils into the classroom.	
Introduction: Prior knowledge activation Talk about programming to build links between pupils' life and coding. ● Who has programmed before? ● What needs to be programmed? ● Do you know someone who has already programmed?	10 min
Explanation: The blocks Step by step the blocks are introduced. The teacher explains the block and draws the pattern on the board. (see "Programming logic on blackboard")	20 min
The app: The teacher shows how to use the app "embroidery designer" on the beamer. Each student has a tablet and follows the steps. 1. Open the app 2. Create a new project 3. Click on "example project" 4. Click on the needle 5. Delete the code 6. Add bricks and create new code Afterwards students recreate the square. (see "from first stitch to cherry")	15 min
Square → Circle The teacher instructs students to program a hexagon. Tipps: ● A square has four corners so we used the block "repeat four times". ● A square has an angle of 90 degrees. A full circle has 360 degrees. ● What should be changed to get a Hexagon? After they are finished, they each get a different task. For example: ● Program an octagon (8) ● Program a dodecahedron (12) ● … The more corners the polygon has, the closer it is to a circle. A 20 cornered polygon looks almost like a circle. To make the circle smaller students need to change the "Move … steps" to a lower number.	15 min

Cherry The teacher programs a design together with the students. The cherry is suitable for this. (see "from first stitch to cherry")	40 min
Explanation: coordinate hopping Some patterns may require coordinate hopping.	15 min
Tipps: The teacher shows the pupils how they can save time when programming. (mirroring patterns e.g. in the middle, see "Programming Techniques")	10 min

Unit 3 - Coding of the designs

Subject (in interdisciplinary teaching)

Informatics (computer science, digital skills), for coding the self-designed pattern.

Duration

Two to four class hours (depends on prior knowledge in programming)

Content

- How to code your own design with the app embroidery designer
- Debugging
- Improving your code (e.g. with loops or mirroring)

Preferred skills

Basic skills in block-based coding environment Catrobat

Equipment

- Tablets or smartphones.
- The "Embroidery Designer" app.
- Designs created by the students
- Flash drive, Laptop and Internet

Lesson Goal

The students have created their patterns with the Embroidery Designer.

Lesson Plan

Content	Duration
Preparation Have a look on the designs (Are they really programmable?) Have a look at the FAQs	
Introduction Review of programming in Embroidery Designer Overview of common programming techniques (e.g. coordinate hopping)	
Work phase: Students program their self-designed pattern It is recommended, that projects are named after students. The teacher hands out the design templates and discusses starting points and use of multiple objects for the particular pattern. Students program their own pattern with individual help from the teacher.	70 min
Conclusion ● Export the project (via Google Drive or e-mail) and transfer it to the embroidery machine using a flash drive. ● If wanted the projects can also be uploaded to the Catrobat Community (Maybe one account for each school -> tutorial: instructional flashcards) ● Students can continue the projects at home (on their own mobile phones). ● Some students can show their work	15 min
Outlook The teacher gives a short outlook on the next lesson. In the next lesson the self-designed programs will be stitched with an embroidery machine. Students who are not finished yet have time to finish their design. Students who finish earlier could help other students or could design and program a second pattern. Pupils should think about their colour choices of the fabric and the thread. Optionally: It is possible to bring a T-Shirt or bag from home (communicate the importance of a non-stretchable, tightly woven fabric -> 100% cotton)	5 min

Unit 4 – Stitching

Subject (in interdisciplinary teaching)

Handicrafts (technical and textile works), for stitching the coded pattern with the embroidery machine.

Duration

Two to four class hours (depending on the number of students and complexity of the patterns)

Content

- Share the project from mobile device (share with email account, load the program onto an USB stick and connect USB stick to embroidery machine, project.dst)
- Pupils must choose a fabric and a thread colour.
- Thread the thread and secure the fabric in the embroidery hoop (see "Embroider the pattern").
- Start the embroidery machine.

Preferred skills

none

Equipment

- Tablets or smartphones (with coded patterns)
- USB stick
- Laptop or computer to save the coded pattern (.dst-file) on a USB stick
- Internet excess on laptop and mobile devices
- Embroidery machine
- Fabrics (Bags, drawstring bags…)
- Embroidery backing
- Embroidery threads
- Bobbin thread
- Scissors, …

- **Nice to have:** App Stitch Pro for checking patterns for size and flushness of seam (Link)

Lesson Goal

The students know how to use an electronic embroidery machine.
The students have their patterns stitched with the Embroidery Machine.

Lesson Plan

Content	Duration
Preparation: Write the plan for the lesson on the board: 1. Finish your program 2. Choose colours for embroidery 3. Share your program to mail and put it on an USB stick (see "Export your design") 4. Stitching 5. Help other students or create another design Hint: This works quite well in station operation (fabrics and threads on one desk, embroidery machine and hoops on another). Write your mail address on the board so the pupils know where their projects must be sent to. Put the embroidery machine on a table and plug it in. The fabric and thread options should be on another table.	
Introduction: Todays plan The teacher discusses the plan for today with the students (patterns of pupils will be embroidered by the embroidery machine, helping others etc.).	5-10 min
Work phase I: Finalize the program, choose colours and send it to the teachers or a school mail address. • The students show off their design and program. They briefly explain how far they have come and what is still missing. • The students either choose a fabric on-site or use one they have brought with them. They also must pick one or more embroidery thread colours. • The teacher checks every student's pattern for missing code, size (mostly not bigger than 10x10cm -> send to App "Stitch Pro") and any special characters in the project or object names (see "FAQ"). • Pupils should follow the instructions in the short video on how to send their pattern via mail (QR Code to scan)	30-60 min
Work phase II: How to use the embroidery machine Show the embroidery machine and explain the various functions. A pattern is embroidered for demonstration purposes. • Explain how the embroidery machine knows what to do? • Clamping the fabric • Threading the thread Caution: no one touches the embroidery machine while it is working.	20 min

Work phase III: Students embroider their pattern Students embroider their pattern on the embroidery machine together with the teacher. 1. Pupils can thread the thread and clamp their fabric 2. The teacher loads the pattern on the embroidery machine and fixates the hoop in the machine. 3. Pupil can start the machine (pushing the green button) and watch. 4. Teacher can cut loose threads and hands the finished product to the student.	30-95 min
End: ● Tidy up ● Take a photo of the pupils with their projects.	15 min

Ideas for patterns