ACTIVITY 05

3D Map of Slovakia

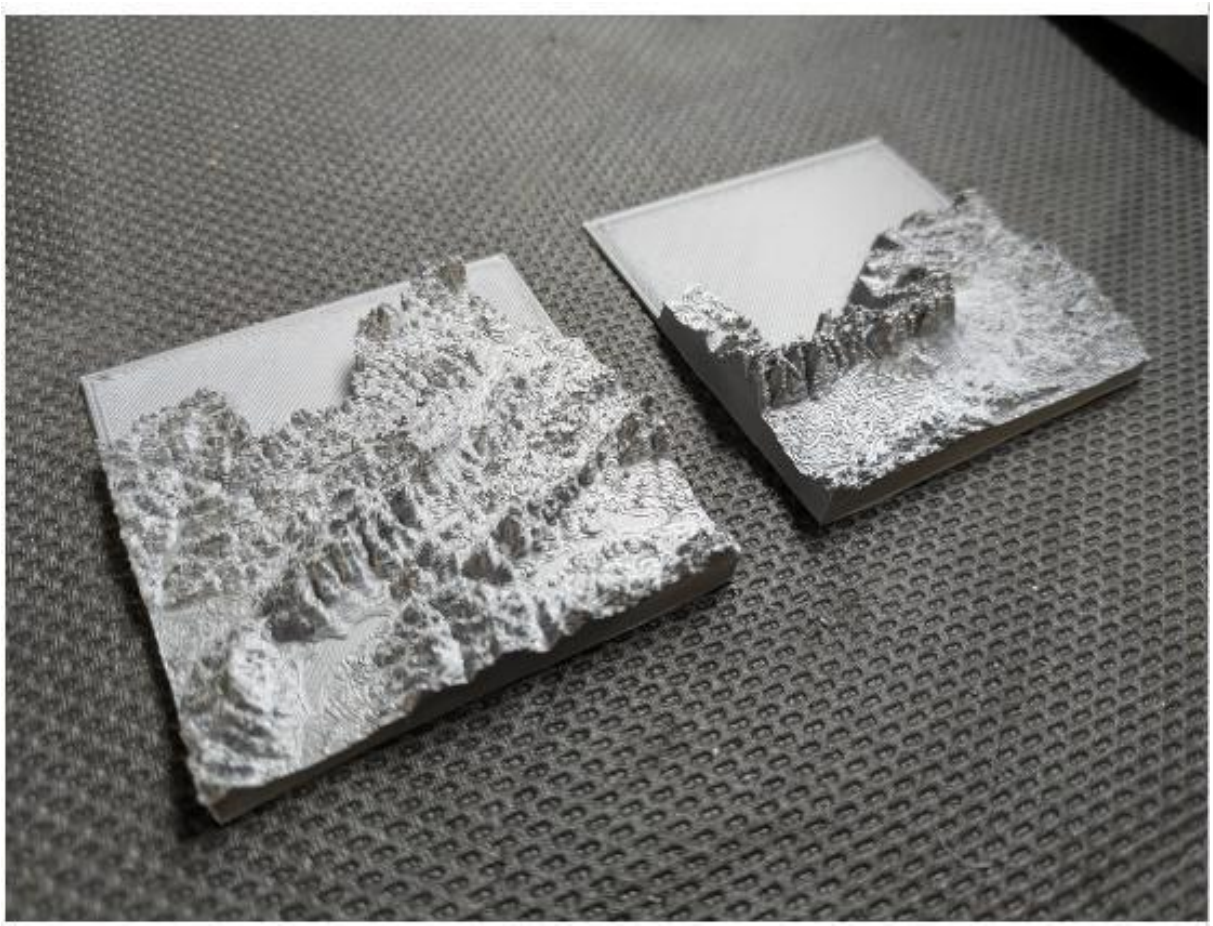

Illustration from the activity

Teaching Planning Tool - 3D Modelling and 3D Printing (STEAM)

Part 1: Conceptual Planning (General Information)

Title of the Thematic (STEAM) Unit

3D Map of Slovakia

Authors / School / Country:
Comenius University Bratislava, Faculty of Education, Slovak Republic

SUBJECT	Craft and Technology Education (Man and the World of Work - Technology)
YEAR	Grade 4 (primary education, ages approx. 9-10)
NUMBER OF LESSONS	2 x 45 minutes
DIDACTIC OBJECTIVES	Support technical thinking and the meaningful use of a 3D-printed teaching aid; introduce the principle of 3D printing and the geography of Slovakia through a 3D model.
SPECIFIC OBJECTIVES	The student understands 3D printing as a layering process; explains the difference between a 2D map and a 3D model; describes the basic steps of preparing a model for printing; sets basic print parameters under guidance.

Note

This activity follows the project's national (SK) pre-primary/primary layout. This page summarises it in the common STEAM template format; the full original activity (procedure, STEAM links, cross-curricular connections, reflection and photo documentation) follows on the next pages.

3D Map of Slovakia

Educational Area	Man and the World of Work – Technology
Subject	Craft and Technology Education
Grade	4th grade (primary education, approx. age 9–10)
Total Time	2 × 45 minutes

CROSS-CURRICULAR THEMES

Personal and Social Development

Developing collaboration during joint planning of model adjustments, communication when deciding on print parameters, and reflection on the outcome of the work.

Media Education

Working with a digital model and software as a creative tool.

Regional Education and Traditional Culture

Deepening knowledge of the territory of Slovakia, its shape and divisions through a 3D model.

STANDARDS

Content Standard

The student becomes familiar with the properties of technical materials (e.g. plastic), works with a simple technical model and uses appropriate working procedures and digital tools in its preparation and realisation.

Performance Standard

The student carries out a simple technical task using digital technologies, works with materials and technical devices according to instructions and follows health and safety guidelines throughout.

Didactic Objective

To support students' technical thinking and guide them towards the meaningful use of teaching aids in the educational process.

SPECIFIC OBJECTIVES

Cognitive Objectives

- The student understands the principle of 3D printing as a material-layering process.
- The student can explain the difference between a 2D map and a 3D model.
- The student can describe the basic steps of preparing a 3D model for printing.

Affective Objectives

- The student actively engages with the 3D map of Slovakia.
- The student collaborates with others when setting parameters and assembling the map.
- The student respects safety rules when working with the 3D printer.

Psychomotor Objectives

- Under teacher guidance, the student sets basic 3D printing parameters.
- The student handles the printed map pieces and assembles them into a whole.
- The student uses digital tools appropriately, following teacher instructions.

STEAM CONNECTIONS

S	Students observe the behaviour of PLA plastic material during heating and its solidification during cooling in the 3D printing process.

T	Students become familiar with the function of the 3D printer and basic settings in the slicer software.
E	Students analyse the construction of the 3D map model and, under teacher guidance, carry out simple adjustments and preparation for printing.
A	Students aesthetically process and visually arrange the individual parts of the 3D map when assembling it.
M	Students work with the scale of the model, compare dimensions and orient themselves in the spatial relationships of the individual map parts.

TEACHING ORGANISATION

Teaching takes place in the classroom using a computer and 3D printer. Students work in a designated workspace, observe the teacher's demonstration with the digital model, and then participate in joint activities and individual work on a worksheet and reflection.

Organisational Forms

- Whole-class teaching – the teacher explains the principle of 3D printing, demonstrates work with the model and leads the discussion.
- Group work – students collaborate on model analysis, parameter setting and assembling the printed map pieces into a whole.

Teaching Methods

Discussion, demonstration of slicer and 3D printer workflow, instruction, observation of the printing process, STEAM method, model work, reflection.

Didactic Materials

3D printer; computer with slicer software; STL file of the map of Slovakia; PLA filament; worksheet; printed parts of the 3D map of Slovakia; projector (for model demonstration); optional short instructional video about the 3D printing process.

CROSS-CURRICULAR CONNECTIONS

Craft Education – Civics / Geography

Creating the 3D map of Slovakia naturally links craft education with civics, as students work with the geographical shape of Slovakia and its divisions. During the design and preparation of the map, they reinforce knowledge of Slovakia's position, shape and regional divisions. Spatial imagination, orientation skills and understanding of geographical relationships are developed.

Craft Education – Computer Science

A strong connection arises with computer science, as students work with digital technologies and simple tools for preparing the 3D model. Students become familiar with basic principles of digital design and learn to understand the connection between the digital environment and the real-world result. Digital competences, algorithmic thinking and problem-solving skills are developed.

Craft Education – Mathematics

Creating the 3D map connects with mathematics, particularly in the areas of geometry and spatial relationships. Students work with shapes, sizes and proportions of the individual map parts, recognise the relationship between the whole and its parts, and develop logical thinking and precision. Estimation, comparison and understanding of dimensions in space are strengthened.

Craft Education – Natural Science

The connection with natural science lies in working with materials and technologies. Students become familiar with the properties of materials used in 3D printing (e.g. plastic), their behaviour during processing, and the importance of safe use of technical devices.

CONTEXTUALISATION AND PROBLEM FRAMING

The topic of creating a teaching aid – a map of Slovakia using 3D printing – is meaningful because it connects civics content with practical technical activity and modern technologies. It addresses the problem of the low clarity of two-dimensional maps and passive learning, since students actively participate in creating a three-dimensional map.

Key questions:

- How is a teaching aid created using 3D printing?
- What is the difference between a 2D and a 3D map of Slovakia?
- Why is the map divided into individual pieces?
- How can technology make learning easier?

Student outputs:

- Works in a group to prepare 3D printing from a finished STL file.
- Correctly sets basic print parameters in the slicer.
- Selects appropriate filament for printing the teaching aid.
- Follows safety guidelines when working with the 3D printer.
- Reflects on the progress and outcome of the group's work.

METHODOLOGICAL PROCEDURE

Evocation

At the start of the lesson, the teacher aims to arouse students' curiosity and interest in the topic through a concrete, experiential approach. The teacher presents the finished 3D puzzle map of Slovakia, first shows it to the students and then gives it to them to hold, disassemble and explore.

Open questions for discussion:

- "How is this map different from the map in your textbook?"
- "What material do you think it is made of?"
- "How do you think it was made?"

After the initial exploration, the teacher explains that the map was first designed on a computer and then printed using a 3D printer. Students are asked whether they would like to know how such a map is created and whether they think they could create it themselves.

Before beginning work, students are briefed on basic safety rules:

- Do not touch the hot parts of the printer (nozzle, heated bed).
- Do not operate the device without the teacher's permission.
- Remove finished prints only after the printer has cooled.
- Keep the workspace tidy.
- Work step by step according to instructions.

Understanding

After the introductory motivation, the teacher divides students into smaller working groups. Each group is told that their task is to prepare the 3D map of Slovakia as a puzzle for printing using the 3D printer. The teacher first introduces the overall workflow and explains the basic principle of how the 3D printer works. The individual steps are described: from selecting the base map of Slovakia, through dividing it into individual pieces in the slicer.

Students work with a finished STL file of the map of Slovakia. After completing the adjustments, the model is exported to STL format, which is needed for print preparation. Students then work in the slicer, where they jointly set print parameters:

- Filament type: PLA (most common)
- Layer height: approximately 0.2 mm
- Infill: 15–20 %

Guiding questions during the work:

- "How might the number of pieces affect the assembly of the map?"
- "What effect do individual settings have on the quality of the final product?"

After correct print preparation, the actual 3D printing of the individual map pieces takes place. In the final phase, students jointly carry out a final inspection of the printed pieces and prepare the map for use in the classroom as a teaching aid.

Supplementary Activity – Simple Experiment During Printing or Cooling

While a selected map piece is being printed or while the printed parts are cooling, the teacher can carry out a simple observation of the properties of PLA plastic before and after heating.

Observation before heating:

The teacher shows the filament in its original form and asks: "What is this material like before heating?" Students: "It is hard, firm, holds its shape."

Observation during and after heating:

Teacher: "What happens to the plastic as it passes through the heated print head?" Students: "It melts, it becomes soft." The teacher explains that heat makes the plastic malleable and it can be deposited in layers; when cooled it solidifies into a new shape.

Comprehension questions:

- "Why does the plastic harden again after cooling?"
- "What happens if a plastic layer is too thin?"
- "How does layer thickness or infill affect the strength of the model?"

Closing Activity

The teacher returns to what was learned. Reflective questions:

- "How does a 3D printer work?"
- "What needs to be set before the actual printing?"
- "What is the difference between a 2D map and a 3D model?"
- "Why is it important to set the layer height or infill correctly?"

Students examine the assembled 3D map of Slovakia and briefly express: what they learned that day; what was interesting; what they found easy; what was more challenging and why; what they would do differently next time.

The finished 3D map of Slovakia can be:

- Used as a teaching aid in subsequent lessons.
- Displayed in the classroom as a joint project.
- Used when revising content about Slovakia.

Following the group discussion, students individually complete a worksheet to consolidate their knowledge of the 3D printing principle, the material used, print parameters and safety when working with technical equipment.

PHOTO DOCUMENTATION

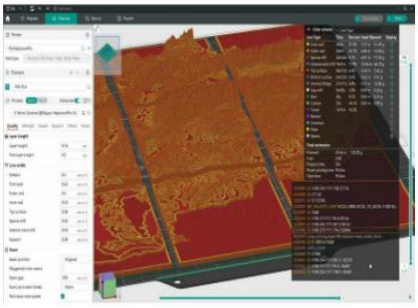

Fig. 74 Layer preview and print parameter settings in the slicer

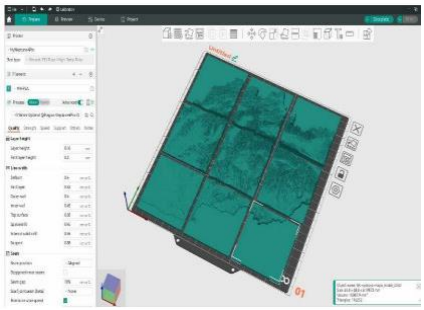

Fig. 75 Dividing the 3D map model into print pieces in the digital environment

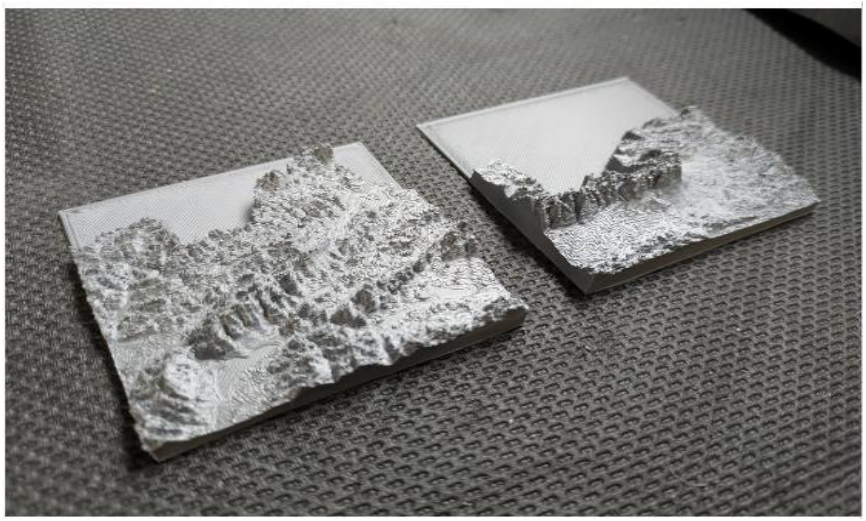

Fig. 76 Detail of the relief of the 3D map of Slovakia after printing

Fig. 77 Assembled relief of the 3D map of Slovakia from printed pieces

USE OF THE TEACHING AID IN PRIMARY EDUCATION

The 3D puzzle map of Slovakia is a clear and interactive teaching aid with wide applicability in primary education. Its main advantage is the possibility of actively involving students in learning through manipulation, exploration and creative activity. Through its three-dimensional form, it provides students with better spatial perception of the shape of Slovakia and its geographical structure than traditional two-dimensional textbook maps.

The aid is particularly suitable for:

- Learning basic geography of Slovakia – students learn about the overall shape of the territory by assembling the map; distinguishing regions and their positions becomes more comprehensible.
- Developing spatial orientation – students learn to determine the position of regions relative to the cardinal directions, perceive the relationship between the whole and its parts, and gradually build a mental map of Slovakia.
- Developing fine motor skills – manipulating the individual map pieces requires precision, hand-eye coordination and patience, especially important for primary school pupils.
- Cooperative learning in groups – students learn to cooperate, divide tasks, communicate and find solutions together.
- Introduction to modern technologies – students gain basic awareness of how teaching aids are created using 3D printing and recognise the practical use of technology in education.

Cross-curricular potential: primarily in Civics/Geography (geographic knowledge); Craft Education (technical skills); Mathematics (shapes, sizes, spatial relationships); and Visual Arts (aesthetic and creative processing of the map).

REFLECTION

The lesson focused on introducing students to the principles of 3D modelling and 3D printing, and deepening their understanding of the shape and structure of Slovakia through working with a 3D model. In the motivational section, the 3D printer was presented, its operation explained, basic print parameters introduced and the workflow in the slicer demonstrated.

Since only one 3D printer was available, printing was carried out as a demonstration during the lesson and most map pieces were prepared in advance. The activity was realised within Craft Education with cross-curricular links to the area of Man and Society. During the lesson, students took turns working with the digital model, observed the printing process and then collaborated on assembling the map. This ensured a smooth flow of teaching while enabling the active involvement of all students.

Throughout the work, ongoing support was provided, individual steps were explained, safety rules were reminded, and students were guided when setting print parameters. Students had the opportunity to discuss the suitability of settings (layer height, infill, model scale) and gradually acquired the basic principles of working with a digital model.

After printing or using the prepared pieces, students collaborated on assembling the map of Slovakia. The activity supported their spatial orientation, ability to distinguish the position of individual parts of the territory and understanding of the country's relief. Students showed great interest in the activity, especially during the actual printing, when they could observe the gradual layering of material.

Despite organisational limitations (limited number of devices), the implementation of the activity is assessed positively. Students acquired basic knowledge of the 3D printing process, connected technical activity with content about Slovakia, and developed their digital, technical and spatial competences.

For the future, it would be beneficial to ensure more devices or additional computer workstations so that students can work more intensively with the digital model. This would increase the level of their active engagement and deepen understanding of the 3D modelling process.

Co-funded by the European Union

3D STEAM

This material was developed within the framework of the Erasmus+ KA2 project named Accelerating STEAM-related Knowledge and Skills via 3D Modelling and 3D Printing (reg. no. 2023-1-CZ01-KA220-HED-000160664).

OSTRAVSKÁ UNIVERZITA

JOHANNES KEPLER UNIVERSITÄT LINZ

UNIVERSITY OF JYVÄSKYLÄ
FINNISH INSTITUTE FOR EDUCATIONAL RESEARCH

UNIVERSITÉ DU LUXEMBOURG

COMENIUS UNIVERSITY BRATISLAVA