# Mapping the Using 3D Printers and the Overview of Printed Models on the 3D Printers at Primary (Lower Secondary) Schools in the Czech Republic

Radek Nemec, Petr Vobornik

***Abstract*—** This article describes the results of the phone interviews across the Czech Republic at primary (lower secondary) schools focused on mapping the using 3D printers and the overview of printed models on the 3D printers at primary (lower secondary) schools in the Czech Republic. 3D printers are also increasingly found in primary schools. The findings of the research show that pupils at the elementary schools for creating 3D models use the free online software Tinkercad. They use Tinkercad because is a simple tool for 3D design and modeling based on a browser for everyone. It is can imagine anything and suggest it in Tinkercad within minutes. There is use the shapes as the basic building blocks of Tinkercad. In this software, pupils first use the basic shapes that they then edit. Examples include the Sun, the flower, the snowflake or the ring. Subsequently, pupils make by combination from the basic shapes and holes create various boxes. These objects are intended to be used by pupils as Christmas cookie cutters. For example, the heart, the star, or the human. Pupils also create pendants contain a name or different towers. More advanced pupils form more complex objects. It is a dice, a vase and various towers.

***Keywords*—** 3D Modeling Software, 3D Printers, Model, Construction, CAD, Education, Tinkercad.

## I. Introduction

3D PRINTERS are increasingly appearing in primary schools. Although still small, but appear. The price of 3D printers is steadily decreasing and becoming more and more effective. [1-5] This is also the reason why primary schools are beginning to acquire these 3D printers. Another reason primary schools start making 3D printers is because the shocks want to be modern. Schools do not want to lose their time and want to prepare pupils for today's world. [6-8]

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Teaching 3D printing in primary schools is primarily used as a complement to teaching in the form of a recreational course. [7-11] Figure 1, 2.

**Fig. 1** Teaching 3D printing

**Fig. 2** Teaching 3D printing

## II. Mapping the Using 3D Printers at Primary (Lower Secondary) Schools in the Czech Republic

### A. Research Methodology

The mapping the using 3D printers at lower secondary schools in the Czech Republic is based on the article Using Robotic Kits and 3D printers at Primary (Lower Secondary) Schools in the Czech Republic. [12]. Several results have been identified in this article. The article describes the results of the Czech Republic's interviews at primary (lower secondary) schools mapping using robotic kits and 3D printers. The results of the phone interview are the low-cost robotic construction kits and 3D printers. However, if a school has a 3D printer they use to create their own robots or replacing parts for robotics. Other results are in article Using 3D Modeling Software for 3D Printers at Primary (Lower Secondary) Schools in the Czech Republic and Use it for Create Simple Model [13]. In particular, this article deals with the findings of the Czech Republic's phone interviews at primary (lower secondary) schools mapping the 3D Modeling Software for 3D Printers. The article contains the second part. 3D modeling software for 3D printers for simple model. There is a lot of 3D modeling software for 3D printers. Most of them focus on professional 3D modeling. This is not useful for teaching 3D modeling at primary schools. There are also very simple software. Schools know about them and use them. The results of the phone interview are Tinkercad, SketchUp and Windows 8.1 / 10 build in 3D Builder software. This 3D modeling software is a typical example of simple software. To create a simple model, this simple software has just been selected. A simple model was created and created in each of this three software. Simple model of its mean creates a cup. The cup is mean hollow cylinder with torus.

Mapping the using 3D printers at lower secondary schools in the Czech Republic went way again calling into schools. They called the schools where 3D printers are used. During the phone call, it was determined what pupils create as models.

## III. Overview of Printed Models on the 3D Printers at Primary (Lower Secondary) Schools in the Czech Republic

Pupils at primary schools in the Czech Republic use the Tinkercad online tool to create models.

Tinkercad is a simple tool for 3D design and modeling based on a browser for everyone. It is can imagine anything and suggest it in Tinkercad within minutes. It is used by designers, hobbyists, teachers, and kids, to make toys, prototypes, home decor, Minecraft models, jewelry – the list is truly endless. There is use the shapes as the basic building blocks of Tinkercad. Every shape can add or remove material, and you can also import or create your own shapes. Grouping together are set of shapes you can create new models to work with. There is a build intricate shapes and create extremely detailed models. Shapes is import and extrude them into 3D models. [14, 15] Figure 3.

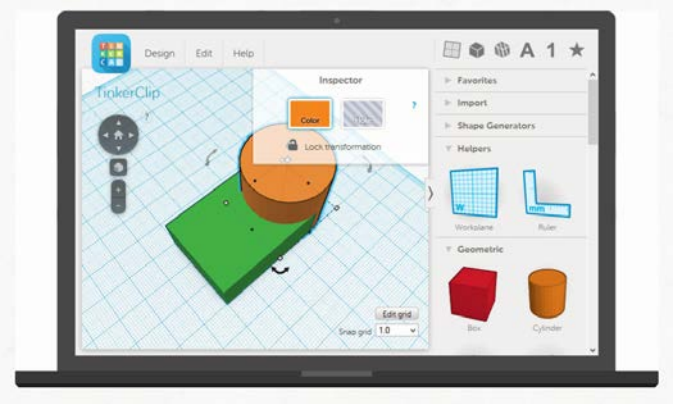


**Fig. 3** Tinkercad [14]

Pupils gradually try to create various models. There are many basic shapes in Tinkercad. Figure 4.


**Fig. 4** Tinkercad – Basic Shapes [14]

First, they learn about these basic models in the program and modify them. The modification consists only in resizing. Just printing these basic shapes is beneficial to them and interested in them. Examples include the Sun (figure 5), the flower (figure 6), the snowflake (figure 7) or the ring

(figure 8).

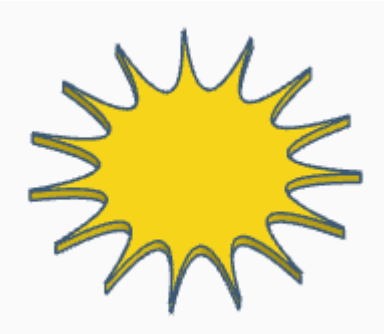

**Fig. 5** the Sun

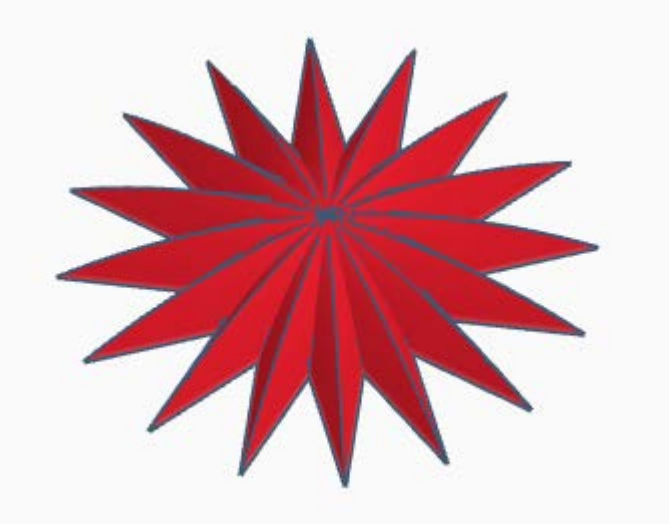

**Fig. 6** the flower

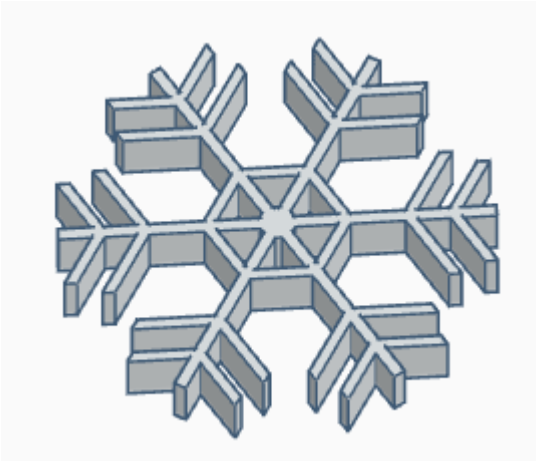

**Fig. 7** the snowflake

**Fig. 8** the ring

Subsequently, it tries to modify the objects by creating a duplicate from the basic form. The duplicate object shrinks and changes to a hole. These objects align and group precisely. This creates only the outline of the thin-wall object. These objects are intended to be used by pupils as Christmas cookie cutters. For example, the heart (figure 9), the star (figure 10), or the human (figure 11).

**Fig. 9** the heart

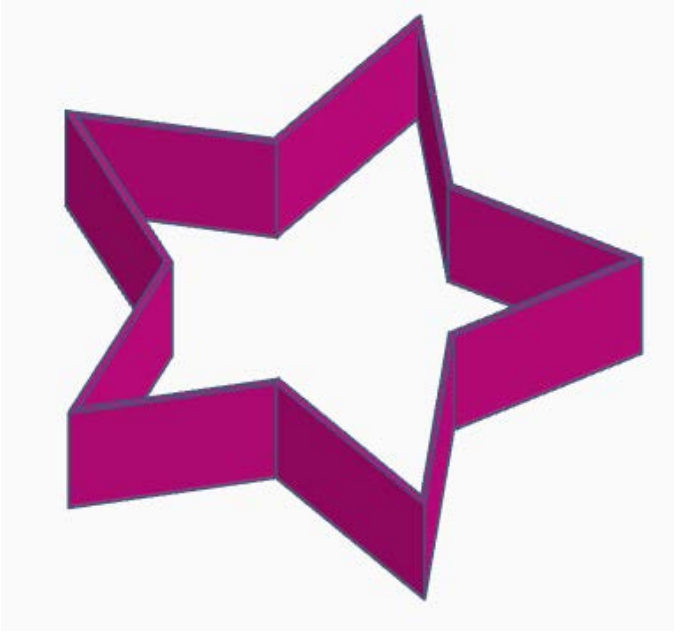

**Fig. 10** the star

**Fig. 11** the human

At Christmas, pupils also create different decorations for the Christmas tree. Here, for example, pupils created a Christmas tree-shaped ornament. For the creation of this Christmas tree, pupils used 4 triangles, a rectangle to demonstrate the trunk and a hollow cylinder for hanging. They set the same height for all objects, and all objects aligned and created a group. Figure 12.

**Fig. 12** the Christmas tree

Pupils also create different boxes. Boxes make basic shapes. They use the basic shape, set the desired dimension. They make a duplicate of this object. The duplicate object will shrink and move slightly higher. They transform this object into a hole. Both objects align and create a group. This creates a box. The basic box consists of rectangular (figure 13). This box may have a cap. The cap must be dimensioned to fit the box. It must be bigger. Figure 14. In addition to a rectangular box, these can be heart shaped boxes (figure 15) or a star shaped box (figure 16).

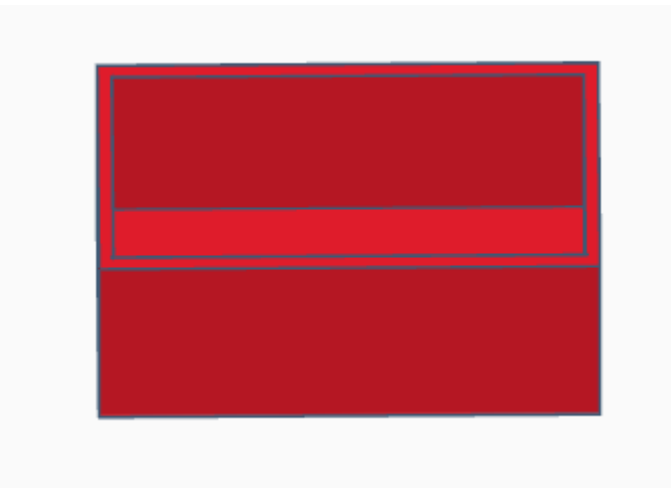

**Fig. 13** the box

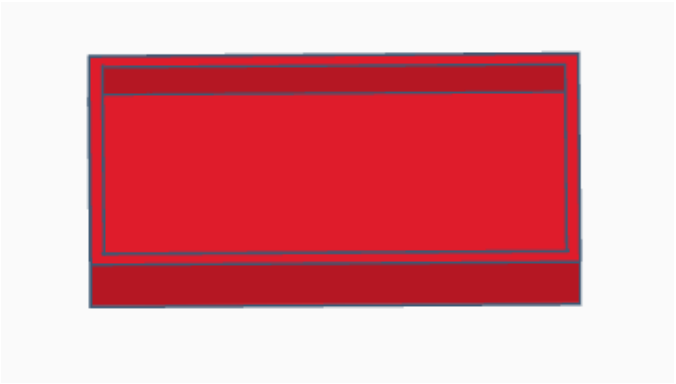

**Fig. 14** the cap on box

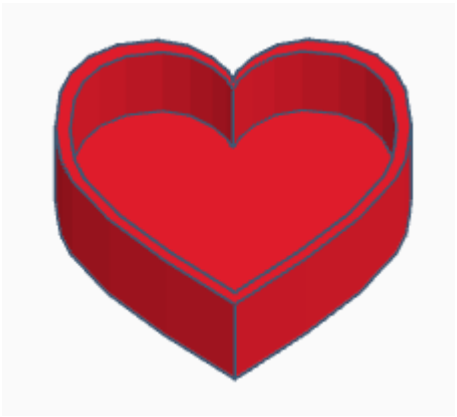

**Fig. 15** the heart-shaped boxes

**Fig. 16** the star-shaped boxes

Other models can be key pendants. These pendants contain a name. A name is an object that is either above the base object or inside. Figure 17 and 18.


**Fig. 17** the pendant


**Fig. 18** the pendant

More advanced pupils form more complex objects. It is a dice (figure 19), a vase (figure 20) and various towers (Figures 21-23).

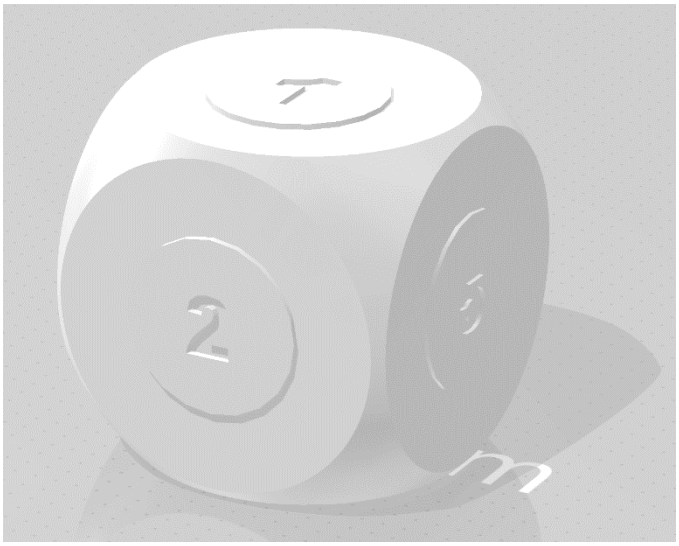

**Fig. 19** the dice

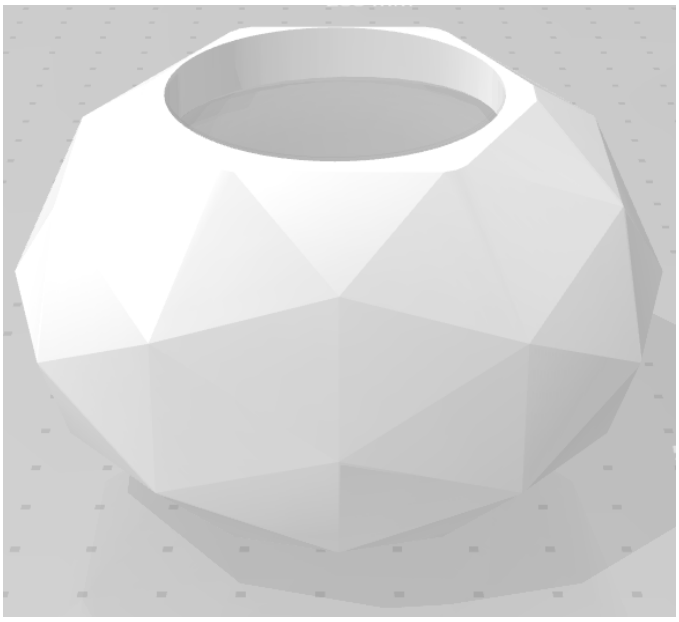

**Fig. 20** the vase

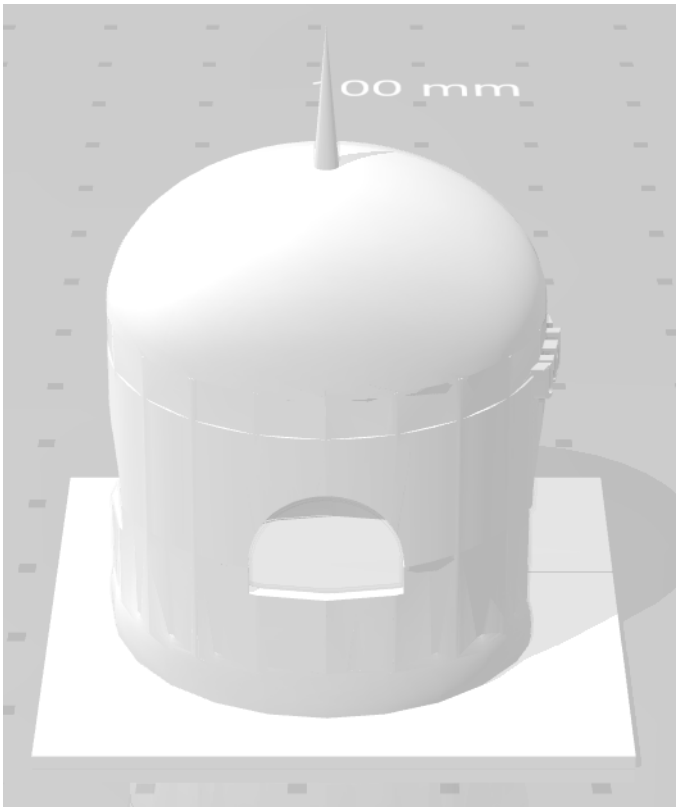

**Fig. 21** the tower

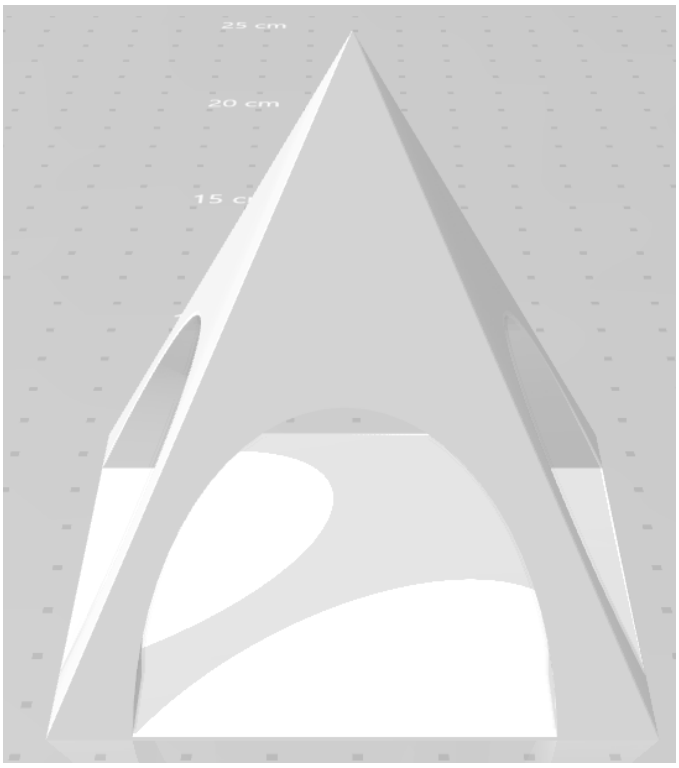


**Fig. 22** the tower

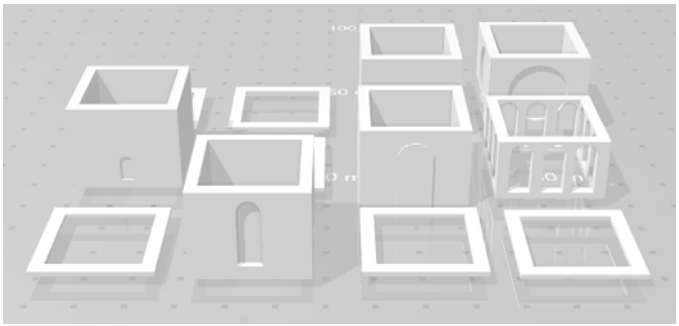

**Fig. 23** the tower

## IV. Conclusion

3D printing is still a new industry and it is good that it also goes to primary school. This allows pupils to create 3D objects and then print them in three dimensions. This gives the students the design and construction principles of any object. Pupils modify the basic shapes, further modify them, combine them together, combine them in different ways, thereby increasing their creativity. This is evidenced by the objects they have designed. They are different boxes, the pendants, the dice, the vase, the towers.

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