

# Moholy-Nagy Visual Modules - Research on Art Didactics Design Education in Secondary Schools, Let's Space Design!, 3<sup>rd</sup> Case Study – Space

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## **Abstract**

**Our objective is the development of the methodology of design culture education in Hungary which is including the selection of efficient improvement methods with the help of measurements and other evaluating procedures. We focuses on 10th grade students and two basic spatial skills which can mostly be improved upon by real displacement in space. Our methods consist of individual and group projects, and design tasks which focuses on exploring and researching several solutions and also on the procedure of solving the tasks. Student performance is measured with the help of nine tests, including tools designed to assess spatial perception and evaluate students' portfolio. Results of the measured group, which consisted of 70 secondary school students, are compared against control groups. The relevance in education is creating a system, which is currently in limited use in Hungary, that would rely on tested 'Design education' methods and tasks.**

## **Keywords**

**Design culture , design thinking, creative problem solving, spatial abilities, 3D modeling, interdisciplinarity, visualization and spatial operational skills.**

In my presentation, I would like to introduce my annual guidelines of teaching and learning, which is carried out within the Environmental Design module of the Moholy-Nagy Visual Modules. Its aim is to develop design culture's teaching methodology. The programme involved 36 10th grade students, who attend a special math class at Fazekas Mihály Primary and Secondary Grammar School. We were able to work with the pupils once a week, for 45 minutes. In our research, while working with 10th graders, we centre the improvement of the spatial perception with real-life, spatial exercises, which require 2 essential abilities: visual imagination (for example rotation, manipulation) and spatial orientation (up and down). The focus was on different solid shapes that are capable of showing the surface manipulation and created by rotating or scaling the object. We have done personal and group design exercises as well as projects. These projects concentrated on not only the possible solutions to the problem, but also the whole process. The design exercises start with getting acquainted with the plane shape and structure of the solid shapes and then transform the flat form into a 3D object. We were inspired by natural forms, our built environment and different geometric patterns. Our goal is to assess concrete, materialized results, in which the usability and the aesthetics are primary. The programme's educational significance is found in the differentiated teaching and learning, as well as in the spread of the tested exercises in Hungary, which are appropriate to teach design culture.

The first exercise of the teaching and learning programme:

### **I. Theme: Logic riddles (brain teasers based on folding)**

Duration: 3x45 minutes

We deal with one group of the brain teasers that are built on folding: the task is to group the signs, numbers, letters or forms on the paper in a specified sequence. The exercises include riddles that must be solved in 2D, but also that can be folded into 3D; both need a sequence of earnest, spatial operations.

There are several improvement goals. For example, to cognitively model spatial and other logic operations, to improve problem-solving thinking, to deepen the skills and knowledge of working with materials and tools (for instant folding paper); to use the new space arisen after the perforation of the surface, and to improve the skills of making shapes and forming space.

The primary commodity of these logic riddles is paper, on which the students can make sketches with drawing tools. It is possible to paint the surfaces and form perforated surfaces. The riddles' frame can be changed by cutting.

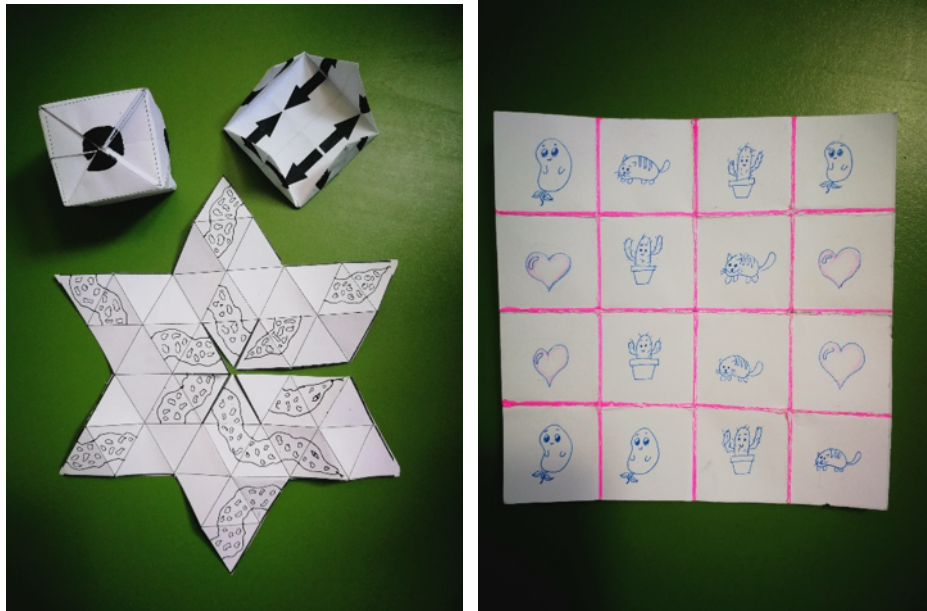
Our project includes personal and also group work, so it is important to harmonize the students' social skills. The autonomous personalities form a co-operative learning community by working together.

On the first occasion, the students form groups, where they severally solve different folding riddles. The groups score points with correctly solved tasks considering the chronological order.

Next time they severally make riddles that will be solved in class on the third occasion. The task also requires writing the description of the game. During the exercises, it is possible to hide a lot of other things: I asked a few students to make their (non-art-related) homework in a folding riddle, and then give it to the subject teacher to find the solution. One student wrote a calligram, while another put Pythagoras' theorem into a folding riddle.

On the third occasion, every single student in the groups receives four riddles made by the members of the class. One riddle is made by their own group so that they have to reproduce the solution. In the group competition, the winner is the group, who has most of the points by solving most of the riddles correctly. We also consider the chronological order.

Folding riddles can be hard to solve. It is recommended to differentiate the teasers by their difficulty and help the students step by step by giving little instructions during their discovery. Riddles based on shapes were more common than others. In case of 3D folding riddles, simpler solid shapes were working.



Among the individually made spatial riddles, there were exceptional ones, but their difficulty-level doesn't reach the hardest rank. Writing the description of the games seemed to be difficult for several students, thus their riddles are hard to understand.

It was an interesting experience on the third occasion when it came to solving the brain teasers made by the students: a few pupils couldn't even solve their own riddles, and it turned out that some of the teasers were impossible to solve because of few left out logic operations.

## **II. Theme: Do you know THODI? „THODI” (tetrahedron, hexahedron, octahedron, dodecahedron, icosahedron)**

Duration: 2x45 minutes

Our second topic is the THODI riddle, which is an acronym for five solid geometric shapes. While modelling known solid shapes, the students can develop their skills by building and mapping the real, solid shapes.

The improvement goals include cognitive modelling, making mock-up models of solid geometric or mathematical operations, wording the similarities and the differences during the analysis of the solid shapes, and recognising rulesets. (Euler's theorem) It is important to harmonize social skills: when learning together, the autonomous personalities form a co-operative learning community, and they deepen the skills and knowledge of working with materials and tools.

In the beginning, every student receives a table. They make a 3D drawing of the solid geometric shapes, and then, they write the number of vertices (V), edges (E), and faces (F) to the appropriate place. It is possible to check it during their work. The whole process requires 15 minutes. After that, the former groups rejoin, their task is to make a 3D model of „THODI”.

The 5 solid geometric shapes have to be materialized by making separate models from different primary commodities (straw, yarn, glue). According to the table, a certain number of straws are available for each group. The groups collect points by solving the tasks correctly considering the chronological order. The students can shape the geometric objects with the help of the bendable straws and the yarn. Scissors are necessary to cut the yarn, but the straws can be fixed without yarn, by slipping one in another.

It was quite hard for some students to make a 3D drawing of the solid shapes. There were several unsuccessful drawings, so after modelling, I gave back the tablet to make corrections. It was not difficult to count the vertices, edges and faces, only 1 or 2 mistakes had been made. At the end of the second lesson, while summarizing the results, the students were able to word the rules and to call up Euler's polyhedral formula.

### **III. Theme: Designing and modelling a parasite installation, making a presentation**

Our third topic requires a more serious design. Thus, students have more time to complete the task.

Duration: 5x45 minutes

The pupils got to know a method to build mock-up models through building „THODI”.

The task is to design a parasite installation using solid shapes (THODI) to one of three Hungarian locations (optional):

- The square before the school: 1082, Budapest, Horváth Mihály Square
- The building of MOME Z and its surrounding area: 1111, Budapest, Bertalan Lajos Street 2
- 1075, Budapest, Madách Imre Square

It is possible to juxtapose, to rotate into each other, to put together, or to truncate the solid shapes.

After selecting the location, the task is to work out a fictive frame story, which explains why the installation is there. The designed shapes have to fit in the imaginary story. Having drawn a few variations, the next step is to make a design plan from the most sympathetic sketch.

However, we practice using methods of spatial depiction and different perspectives by drawing design plans; the most outstanding part of the task is to model the design plans in scale. RF 1:100

After taking photos of their work, the students make a presentation in which they show their notions in 5 minutes.

We use the school's IT room during our project.

The improvement goals include developing problem-solving skills through interpreting the connections between the shape and its function. Observation of the visual environment, interpretation of the sight, selection of the appropriate point of view. Comparison of buildings considering different viewpoints, getting acquainted with trends in the history of architecture. Comparison of planned and formed environment, and the connections between the shape and its function. Becoming familiar with structural principles. Application of different illustrational conventions, deepening the students' knowledge, as well as learning new things. Deepening the skills and knowledge of working with materials and tools.

During the design, the methods and forms of work were the following:

On the first occasion, we learned the phrases in an interactive way (the meaning of the word parasite, parasite architecture, conceptual plan, statics etc.). The projected slides showed inspiring images with architectural and fine artistic examples, as well as conceptual plans. We practised analysing basic statical problems. Then, every student chose a location from the ones mentioned above and started making a research. We used digital appliances. They made analysing sketches and wrote the important details in footnote. The students individually wrote the fictive background story, on which they build up the concept of the installation. I asked for three different graphic sketches of the materialized shapes. Our goal was to use „THODI” – namely to connect solid shapes with each other, to truncate, to duplicate, to scale shapes etc. – to plan the spatial parasite installation. The environment played a major role in the design, the students had to consider the chosen location's features.

At last, I had asked the pupils to select one conceptual plan, which was worked out more carefully (design plan). They made a model from the chosen plan.

After the consultation, three groups dealt with modelling.

a) one group use paper and other materials to build the mock-up model

b) one group built the mock-up model using LEGO

c) one group make a model in Blender (which is a free, open-source code, 3D creation suite)

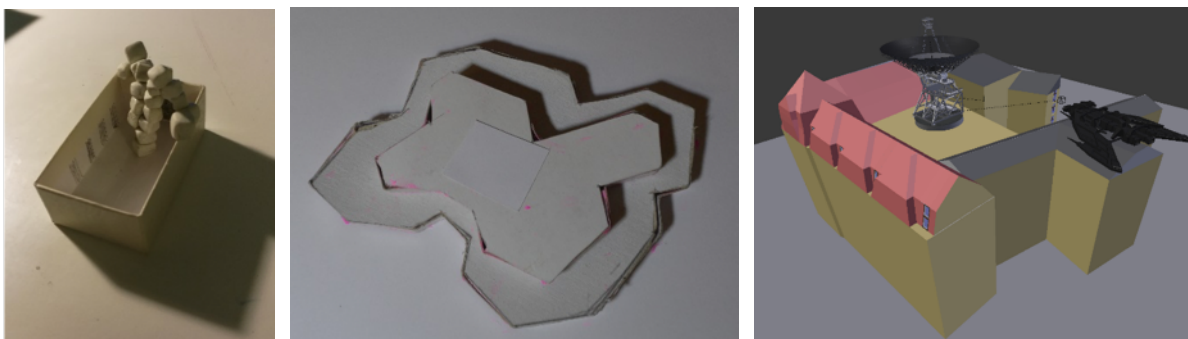
The students used paper, plasticine, skewers, plastic and other (even waste) materials, as well as LEGO and software during their work.

After construction and documentation, the pupils made a 5-minute-long digital presentation in which they introduced the chosen location, the frame story and the plan.

With the help of a projected visual evaluation sheet, every student individually evaluated his/her achievement after work. Their self-evaluation and my evaluation sheets were collated. There were no huge differences, even though few students greatly overrated or under-evaluated their achievement.

My reflection to the task was the following: the use of the spatial modelling application provides freedom for students, whose creativity is pulled back by the graphic expression. Several pupils had learned how to use the software, and they showed images rendered from different perspectives. It was a great experience to rotate the 3D models in the application.

We made the presentations using Canva website (<https://www.canva.com/>). My aim was to divert the student from the ordinary schemes of the presentation making programmes and to avoid unreadable slides because of the badly chosen letter size and colour. Everybody enjoyed trying, using and customizing new presentation templates.





#### **IV. Theme: Map reading, interpreting plain view, planning routes to the destination**

Duration: 1x45 minutes

The students formed pairs and received a colourful map of Paris subway and a Paris city map. Their task was to plan routes from A to B with the help of the maps answering the test questions. The pairs had 20 seconds to answer them.

I had chosen the Kahoot! application to complete the test. I constructed the test considering the questions' difficulty, thus we went from the easy ones to more difficult, multiple choice questions. The correct answers could be found by reading the map.

The Kahoot! application works on smartphones. When working in pairs, one mobile phone was necessary, as well as the teacher's laptop and the projector.

The improvement goals are to interpret visual signal systems, plain views, orientation and scales, but also to execute spatial and temporal cognitive operations.

Before loading the app Kahoot!, I cleared-up the rules and introduced how the game works. The students got an entering code to start the game, and the pairs could log in with their nickname. The players had 20 seconds to choose the correct answer. The system counts the points and immediately gives a feedback.

#### **V. Theme: Design the installation of Yona Friedman's exhibition**

Our fifth big topic was to complete the task of the Metropolitan Complex Drawing Competition, which was written by the Visual Community of Fazekas Mihály Primary and Secondary Grammar School. Garamvölgyi Béla, Mészáros Zsuzsanna and Póczos Valéria were the members of the community and the jury (<http://rajz-new.fazekas.hu/>).

Duration: 3x45 minutes

Every student receives a printed copy of the description. The task was the following:

Design the installation of Yona Friedman's exhibition.

### **Frame story – details**

- a) Yona Friedman's exhibition is temporarily located in the hall of Fazekas School.
- b) The hall has 3 major social functions: it is the school's gallery, a busy meeting venue and there's also a separate buffet.
- c) The installation's materials and colours are optional, the artwork can be solid, or made up of a strong screen, even a smooth fabric. You're allowed to use each of them when planning.
- d) We would like to present Yona Friedman's plans/drawings on 25 A0 size (841x1189 mm) tableaus that will be placed on the exhibition's installation.
- e) So as to help in understanding the plans/drawings and in facilitating the reception of Friedman's spatial experience, we exhibit 10 mock-up models. These are placed in transparent acrylic boxes size 600x800x300 mm.
- f) Pay attention to the natural, given lights during the planning and working out your concept.

### **Planning viewpoints – what do we want from you?**

- 1) Carefully examine his artworks, observe the used shapes and the structures.
- 2) What could be his concept, and what kind of thoughts could guide him?
- 3) What's your impression about the works (thoughts, feelings)?
- 4) Imagine that you are in his place, and design an installation that is suitable for him.

- you get some floor maps of the hall (you can use them to organize and compose the space, to fix your ideas as well as to try them)
- you only have to hand in the final floor map with your layout

5) Steps of planning or your final plan must include:

- graphic analysis (make a few small sketches of Yona's works, pay attention to the recurring elements)
- smaller illustrations of 3 ideas at least, from an optional perspective (totally different and/or variants of a theme)
- worked-out, colourful drawings of your favourite idea (front and side view, plain view, design plan from the most adequate perspective – this should be the biggest drawing on the paper, a background is recommended)
- if necessary, type the scripts, descriptions or explanations with capital letters

Handouts: A4 size printed sheet with Yona Friedman's pictures, floor map, description

Submission: A3 size plan, and a floor map that shows well the final layout

Tools, materials: pencil, colour pencil, water-colour, felt tip pen, brush pen, drawing pen, ink

### **Improvement goals**

This topic makes it possible to form a problem-sensitive, reflecting, active and initiative attitude, as well as to identify with the role of a designer. The issued inspiring materials served as stylistic, conceptual and compositional markers, emphasizing the spatial expression.

The primary goal is to improve cognitive modelling of spatial logic operations and problem-solving thinking.

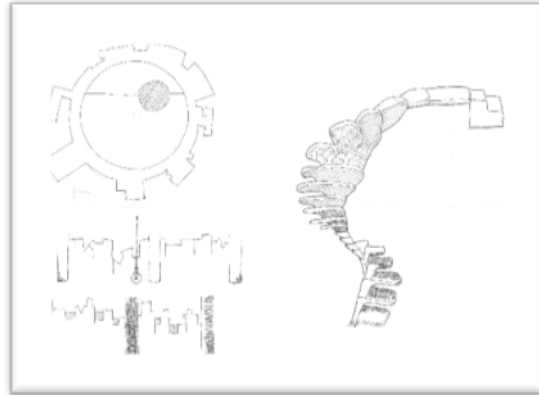
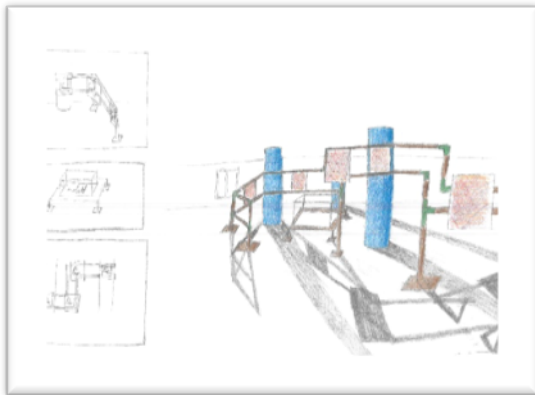
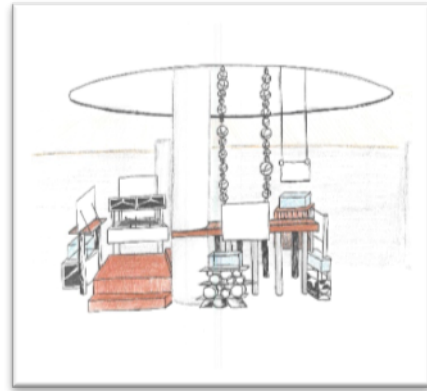


it.

I had explained the task in spoken word, and then, the students asked questions in connection with the interpretation of the task. They received the description, the floor map and the inspiring pictures. It was quite hard to draw the composition on one paper because it was made up of several illustrations (planning procedure and design plan). The spatial illustration seemed to be difficult, but it wasn't impossible, furthermore, the students enjoyed it. At first, the axonometric illustration was more common than the one or two point perspective, which we had used before. In the beginning, the students were more likely to think in 2D (plane), the idea of spatial construction didn't crop up. The personal consultations gave momentum to the planning procedure. I called their attention to the open slab in the designing location, thus more students thought of using the gallery also.



The open slab in the designing location



## VI. Theme: Drawing a catoptric anamorphosis I

Duration: 1x45 minutes

The word anamorphosis is a phrase in History of Art, which means a distorted projection requiring the viewer to use special devices or occupy a specific vantage point to reconstitute the image. The word is derived from the Greek prefix ana (back), and the word morphosis (change). It was first used by Gaspar Schott -a German Jesuit- in his book titled *Magia Universalis* in 1650.

The students drew a distorted projection of a simple solid shape. I made a worksheet for them, and I explained the steps of the drawing. Every single student gets a cylindrical mirror. They are in need of a compass and a ruler to complete the task.

One student drew a distorted projection of a more difficult solid shape immediately. One

lesson was plenty enough to finish the exercise.

The improvement goals include the development of the students' ability to cognitively model spatial and geometric operations, as well as to interpret the appropriate angle of view of the catoptric anamorphosis. During the interpretation of the anamorphosis, the students get acquainted with examples in History of Art, and we talked about spatial distortions appeared in everyday life. To complete the task correctly, a demanding use of tools is necessary. The exercise could be more complicated if we consider cast shadow and tonal drawing.

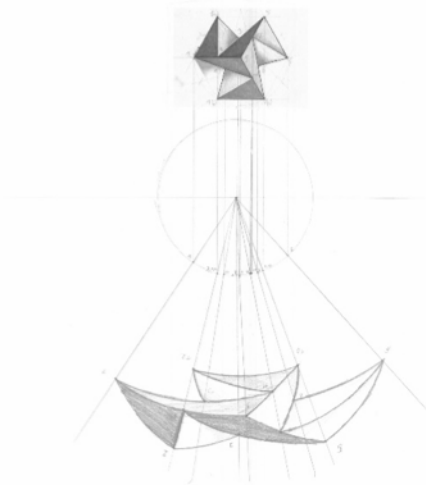
It was not difficult for the students to draw distorted projections of simple, geometric forms. The image appeared correctly in the mirror in every case.

## **VII. Theme: Drawing a catoptric anamorphosis II**

Duration: 2x45 minutes

On the next occasion, we dealt with more difficult geometric forms. The sample picture that was used in the anamorphosis exercise, couldn't be bigger, than the cylindrical mirror's circle diameter. It was harder for the students to scale the sample picture for the appropriate size, and not to exceed the stipulation. Then came the drawing of the distorted picture. I expected that the tones on the sample picture should be properly shown on the distorted drawing too, and on the reflective surface, the correct picture must appear, like on the sample.

Beside the first anamorphosis exercise's improvement goals, here, it was important to properly use the light-shadow contrast and tones, as well as to realistically illustrate the spatial view.



### **VIII. Theme: Drawing of a catoptric anamorphosis III**

Duration: 3x45 minutes

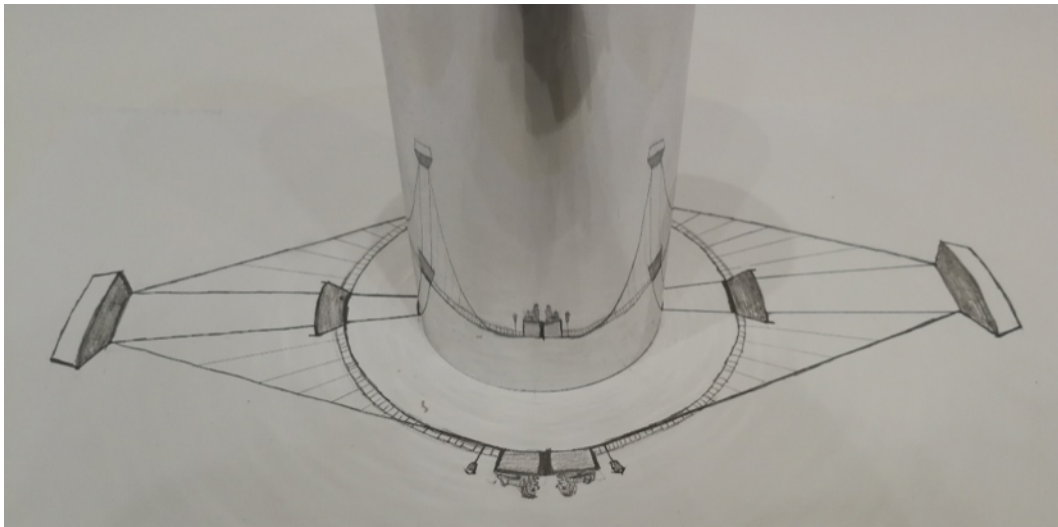
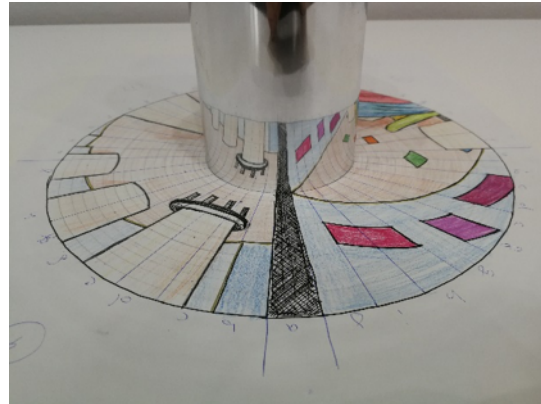
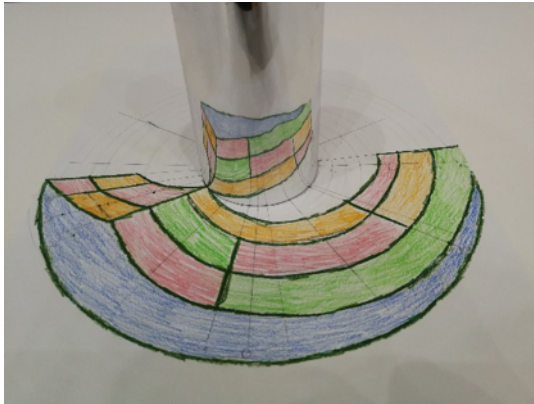
After drawing a distorted picture, the final work of the year-long series of tasks was the following: the students got back their plans for the installation inspired by Yona Friedman. Their task was to visualize their installation on the cylindrical mirror, like if the nearby view is projected on a spatial column. The students had to mark the place of the column on the received floor map. It was important to use colours in this exercise. The distorted picture had to look correct from the appropriate angle of view.

During the final work, the drawing of the distorted picture was done without a cylindrical mirror. In the end, we check the pictures using a cylindrical mirror.

Besides the things mentioned before, I see the pedagogical importance of this series of tasks in the following:

The Hungarian education teaches disciplinary subjects by mapping one-one discipline and without making the smallest pedagogical transformation. These subjects were fixed at the XIXth and at the beginning of the XXth century, following the classic structure of different





fields of science. The subjects use the logic, methodology, structure and approach of classic branches of science (maths, biology, physics, chemistry, geography etc.) in school education, starting from the elementary schools' 5th grade. The formation of these subjects generated revolutionary changes -for example, seeing the world's phenomena not only from a theological view, and creating demand for the cause-and-effect approach-, though it sets up boundaries in understanding the logical connections of the world. Since, our lives are out of the boundaries of science, considering either environmental or sociological phenomena. The meeting points and webs of sciences are probative aspects, which incline us to integrate into the system of too fetishized subject structures. These structures are inelastic and isolated, they map the cogniz-

able world in an unnatural way, and they can only handle new contents by creating new subjects. The solution could be the connections between the subjects. However, several didactic view and curriculum model can fit this notion, it passes the accepted scientific boundaries in each case.

Considering subjects whose aim is to develop a concrete practical or a special ability, it is possible to use an integrated curriculum.

### Design culture as a forum

In this procedure, the design culture can continue its organizational activity as a communicational platform and a common communication channel. In this case, design culture is not an underlying subfield of an existing special subject. The emphasis is on the flexible activities packed with transactions, that are searching for connections in the right context. Design culture's multidisciplinary approach and practical thinking fit in well with the pragmatic pedagogy, which brings „the ability to act” to the fore. The validation of design culture's approach can create co-operativity within the education system. This can lead to a positive interdependence between different special subjects while helping the active interpreting phase of learning. All of this serves the continuing and holistic development of our view of the world, that makes it possible to react to the interactions consciously.

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