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## REGULAR COURSES

<https://www.punte.eu/punte-courses/>

**PUNTE**  
**2020-1-HU01-KA203-078810**

**Poly-UNiverse in Teacher Training  
Education**

- ❖ Eszterházy Károly Catholic University (HU)
- ❖ Partium Christian University (RO)
- ❖ Johannes Kepler University Linz (AT)
- ❖ J. Selye University (SK)
- ❖ University of Coimbra (PT)
- ❖ Poly-UNiverse Ltd. (HU)
- ❖ Subotica Tech – College of Applied Sciences (RS)
- ❖ Experience Workshop (FI)



This document belongs to one of the core Intellectual Outputs (IO3) of the PUNTE (Poly-UNiverse in Teacher Training Education) project, co-funded by the Erasmus+ Programme of the European Union. It contains the data of 3 HEI courses related to the Poly-Universe education tool, and the detailed description of a sample course with examples. This Intellectual Output is about the incorporation of results developed in the previous activities into regular teacher training education courses at the partner HEIs (disciplinary, methodological or general pedagogical teaching units). Note that these are all full semester courses (12-15 weeks, depending on the country specific regulations).

These courses has already been implemented at the partner institutions but they are also ready to be adapted, adjusted and implemented as standard parts of the teacher training practice in any higher education institution in Europe and beyond. We suggest the reader to visit the Poly-Universe website ([punte.eu](http://punte.eu)), where one can find further useful materials and contents to support students and teachers in the implementation of these courses (in English as well as in local languages).

We put special emphasis on collecting applications for the usage of Poly-Universe in a wide range of educational situations from early childhood education study programmes to higher levels. The variety of the institutes involved gave us a chance to reach a wide spectrum of methodological approaches for further development and research. In these courses we offer these applications as a teaching/learning toolkit to broaden the methodological repertoire of the future teachers.



[punte.eu](http://punte.eu)



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2020-1-HU01-KA203-078810 - Poly-UNiverse in Teacher Training Education - PUNTE

**Name of the course: Poly-UNiverse in Education**      **Code:** NBT\_MT173G2      **Nr. of credits: 2**

Type of lessons (lect./semin./pract./consult.) and number: **practice, 1 hour per week**

Method of evaluation (colloquium/practical mark/other): **practical mark**

Place of the course in the curriculum (which semester): **7 to10, any semester**

Frequency of offering the course: **yearly, in even semesters**

Language of the course (if not Hungarian): **Hungarian and English**

Prerequisites (if there are any): -

### Course description

#### Educational aims:

The aim of the course is to reveal how the Poly-UNiverse game can be used in an experience-based, enabling differentiated development teaching methods, for students of different levels of teacher training education (from special education to subject teachers). The course aims to construct a teaching-learning environment through which the students can realize that the Poly-UNiverse game is an appropriate tool for raising motivation, developing creativity and involving pupils with learning difficulties in teaching different subjects.

#### Competences to be developed:

##### a) knowledge

The students should get acquainted with the Poly-UNiverse toolkit and its artistic background. The students should learn about the pedagogical-psychological theories which give the base for using the game in teaching situations. The students should acquire those methodological tools and approaches with which they will be able to plan a teaching-learning unit using the Poly-UNiverse game.

##### b) skills/abilities

The students evolve in abstract, logical thinking, analytical skills, spatial seeing, problem solving, problem posing and model-making abilities through practicing with the Poly-UNiverse game on the course. The students' creativity can also evolve by inventing new exercises.

##### c) attitude

Fulfilling the expectations of the course should raise the empathy and tolerance of the students when teaching pupils with learning difficulties or special needs, regarding differentiated development strategies. The student should be engaged in teaching his/her own subject using experiential teaching methods. The student should be sensible for involving visual arts in teaching/learning procedure.

##### d) autonomy and responsibility

After the course the students should be able to work out a special topic (regarding his/her specification of planning a lesson) using the Poly-universe game independently.

#### Content of the course and its timing:

- 1 Introduction – Getting acquainted with the elements of the Poly-UNiverse game family, discussing the characteristics and the artistic background of it. Theoretical background of usage in teaching-learning procedures (self-study by e-learning materials). (2 lessons)
- 2 Poly-UNiverse and arts. Teaching-learning through arts. (2 lessons)
- 3 Using Poly-UNiverse in teaching geometry – methods, exercises, ideas. About spatial skills and their development. Using Poly-UNiverse in the development of combinativity – problems from the field of Combinatory. (2 lessons)
- 4 Development of abstract, logical thinking and analytical skills with the Poly-UNiverse game. Complex and interdisciplinary problems, where Poly-UNiverse can help modelling the solution. The theory of Problem Based





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Learning methods. Using Poly-UNiverse as a concrete/material representation form in problem solving – the role of different representation forms in learning procedure. (2 lessons)

- 5 Poly-UNiverse in a digital environment – using GeoGebra for solving problems connected to the game. The methodology of using ICT tools and material tools during the teaching/learning procedure. (2 lessons)
- 6 The role of games in teaching-learning in general. Presenting game-based teaching methods through Poly-UNiverse game. How can the Usage of the Poly-UNiverse game help in the development of pupils with special needs, special attention or learning difficulties? (2 lessons)
- 7 Presenting the students' projects – worked out individually, in pairs or small groups, where the using of Poly-UNiverse appears in a certain learning activity – and evaluation. (2 lessons)

### Teaching management:

- in 2 lessons per 2 weeks modules!
- The course will be held with attendance of the students aided by e-learning material.
- Tools used in the lessons: Poly-UNiverse game family, paper, pen, notebook, camera or smartphone.

### Requirements of the course:

- Active participation in the lessons and in the project work.
- Presentation of 1 chosen theoretical issue on the lessons.
- Working out a project and presenting it individually, in pairs or in small groups at the last lessons.

### Evaluation of the acquired knowledge:

- At the end of the semester an online test from the theoretical issues.
- Evaluation of the presented project according to given viewpoints (applicability, feasibility, meets the expectations of the curricula and methodological studies).

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### Compulsory bibliography:

- PUSE Methodology – Mathematics education based on visual experiments (<http://www.punte.eu/puse-methodology/>)
- Poly-UNiverse in teacher training – Methodological Study and Handbook for student teachers and in-practice-teachers <https://www.punte.eu/punte-study/>

### Selected bibliography:

- Symmetry: Culture and Science. (2020) Poly-UNiverse in School Education, Editor: György Darvas, Vol. 31., Nr. 1, 1-112
- Művészet/tudomány határterületek az alkotásban. Magyar Tudomány 2021/8. (Tematikus összeállítás). Vendégszerkesztők: Saxon-Szász János, Dárdai Zsuzsa

### Selected and compulsory digital material:

- <http://poly-universe.com/>
- <http://www.punte.eu/>
- <https://www.geogebra.org/m/ms8nznfym>
- [www.puse.education](http://www.puse.education)





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## **PUNTE Project course at Linz School of Education Johannes Kepler Universität Linz**

### **Course description:**

At Johannes Kepler University in Linz, the PUNTE Project course has been incorporated into two pre-existing courses, Informatics for teachers (Schulinformatik), and Computational thinking. Within these two courses, the PUNTE Project course was used for theoretical and practical education of teachers on unplugged coding. The course is offered online and face to face in accordance with the preferences of students but also the rules of Johannes Kepler University. Testing of knowledge about the application of the PUNTE Project course will be done through the development of student projects that include the application of Poly-UNiverse.c

### **Responsible lecturers:**

Dr Branko Andjic,  
prof Dr Barbara Sabitzer,  
Marina Rottenhofer.

### **The aims of the course are:**

- to educate students to be able to use Poly-UNiverse in a variety of ways when teaching,
- provide students with an understanding of the applied Poly-UNiverse for the development of exercises for computational thinking,
- provide students with an understanding of the applied Poly-UNiverse for the development of exercises for unplugged coding,
- to improve the critical thinking of students,
- to help students to use the electronic version of Poly-UNiverse.

### **The structure of the course:**

The course is structured as a semester course (duration: fifteen weeks) with five classes each week (2 lectures and three 45-minute activities).

The following parts of the PUNTE Project course have been incorporated in both of the above-mentioned teaching subjects:





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1. Exploration of the shapes of the elements of Poly-UNiverse sets and debates about their possible value in teaching and learning based on an appropriate theoretical foundation in introductory classes (duration: 1 week),
2. Poly-UNiverse methodology, geometry, and its teaching approach (with proper theoretical background) are discussed (duration: 1 week),
3. Connections of Poly-UNiverse methodology with computational thinking and its application in education (duration: 2 weeks),
4. Connections of Poly-UNiverse methodology with Informatics and unplugged coding and its application in teaching (duration: 2 weeks),
5. Preparation and development of student projects on the application of Poly-UNiverse methodology in educational activities (duration: 1 week),
6. Presenting student projects and providing feedback (duration: 1 week).

### Learning outcomes

After the course students will be able to:

- to use Poly-UNiverse sets in their future teaching,
- be able to use Poly-UNiverse when explaining computational thinking,
- implement Poly-UNiverse in teaching about the unplugged coding process,
- implement Poly-UNiverse in developing of critical thinking,
- use Poly-UNiverse sets in developing teaching and learning school projects.

### Evaluation:

At the end of the course, students will have tasks to develop an educational project that involves the application of Poly-UNiverse in teaching and education. Students will have the opportunity to present their projects, based on this work will be evaluated students' work.





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## **Applied Project (PUNTE Project course at SuboticaTech – College of Applied Sciences)**

At Subotica Tech – College of Applied Sciences (VTŠ), the course with title Applied Project is reserved for contents connected to projects. (Within this course, several professors can give lectures and organize courses to different groups of students, depending on students' interest.) In the following years, one of the possible choices will be the PUNTE project course created by VTŠ professors participating in PUNTE project. Applied Project is sixth semester obligatory course for the students of Technical Communication Management. It is a 6 ECTS point course. This year PUNTE project course is the only one possible choice for the students. Therefore, 12 students will participate in the course. Lectures and exercises will be held live at VTŠ. If the pandemic situation worsens, lectures and exercises will be held on the BigBlueButton platform with link: <https://bbb.vts.su.ac.rs/b/zol-6vx-rxv>.

### **Description of the Course: Applied Project (Application of Poly-Universe)**

#### **The aims of the course are:**

1. to construct and organize learning environments in a way that enables students to recognize Poly-Universe as a useful teaching tool and to develop their creativity which will help them to create new applications of Poly-Universe in teaching and learning.
2. to prepare the students to be able to apply Poly-Universe in teaching using different approaches,
3. to help students' learning and overcoming their learning difficulties connected to notions of the modules of the course,
4. to develop students' logical thinking,
5. to develop students' to be more tolerant and emphatic and to use inclusion,
6. to develop students' sense of art,
7. to help students to handle the electronic version of Poly-Universe.

#### **The structure of the course:**

This is one semester course (duration: fifteen weeks) with 5 classes a week (2 lectures and 3 exercises of 45 minutes each).

The course is structured in following modules:

1. Introductory classes- exploration of the shapes of the elements of Poly-Universe sets and discussions about their potential usefulness in teaching and learning based on appropriate theoretical background (duration: 1 week),





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2. Geometry and the methodology of its teaching (with appropriate theoretical background) when the Poly-UNiverse is used (duration: 1 weeks),
3. Combinatorics and the methodology of its teaching (with appropriate theoretical background) when the Poly-UNiverse is used (duration: 1 weeks),
4. Informatics and the methodology of its teaching (with appropriate theoretical background) when the Poly-UNiverse is used (duration: 1 weeks),
5. Developing logical thinking by using Poly-UNiverse with appropriate theoretical background (duration: 1 week),
6. Complex, interdisciplinary problems where Poly-UNiverse sets are used (duration: 2 week),
7. Using Poly-UNiverse as concrete representations in solving problems (duration: 1 week),
8. Electronic version of Poly-UNiverse and how to use it in teaching with appropriate theoretical background (duration: 1 week),
9. Games in teaching and learning when we use Poly-UNiverse sets with appropriate theoretical background (duration: 1 week),
10. How can using Poly-UNiverse sets help disabled students' learning and their communication to one another and how can it help students and their teachers to be more tolerant and to use inclusion (duration: 1 week),
11. Poly-UNiverse and art (duration: 1 week),
12. Presentations of students' work and ideas about using Poly-UNiverse sets in teaching and learning and discussions about them (duration: 3 weeks).

### Learning outcomes:

After completing the course the student should be able to use Poly-UNiverse sets in their future teaching.

### Evaluation:

The final grade is the grade of the student's presentation. In the presentation students present their ideas and possible application(s) of Poly-UNiverse.

### Contents of modules:

1. During the introductory classes, through exploration of the elements of sets and through playing and dealing with them (spontaneously or guided by teachers) students can recognize some possibilities of using Poly-UNiverse sets in teaching and learning and can discuss them. Through these activities students will get some ideas of Poly-UNiverse applications or new variations for existing applications and can easily understand theoretical background.
2. Firstly, students deal with geometric figures which can be constructed using Poly-UNiverse sets and with their properties. With help of their teachers the students formulate and solve





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simple and more demanding problems connected to these figures. The students and the teacher discuss the methodology of teaching these contents.

Secondly, students deal with geometric transformations in the plane using Poly-UNiverse sets and with their properties. With help of their teachers the students formulate and solve simple and complex problems connected to these transformations. They also discuss the methodology of teaching these contents.

Thirdly, students calculate perimeter and area of geometric figures which can be constructed using Poly-UNiverse sets and the area and volume of geometric solids which nets can be constructed using Poly-UNiverse. They also formulate similar problems and discuss the methodology of teaching them.

3. Basic concepts of combinatorics like permutations with and without repetitions, variations within without repetitions and combinations without repetitions are explained by using Poly-UNiverse sets. Permutations and variations without repetitions are introduced. After that variations with repetitions and combinations without repetitions are explained. The poly-UNiverse set is used to improve recognition of permutations, variations and combinations.
4. The aim of the Informatics module is to use Poly-UNiverse in teaching programming in Python and coordinate geometry. Basic concepts of Python programming language and some libraries in Python are introduced. The Turtle Python's library is used to draw given patterns. While writing the program for drawing a given pattern built by Poly-UNiverse set, students will intensively use their coordinate geometry knowledge, and broaden their knowledge in Python programming.
5. The Poly-UNiverse set is used to exercise tasks which will improve logical thinking of students. The students will be encouraged to introduce them to exercises for developing and improving logical thinking.
6. Students deal with complex, interdisciplinary problems where Poly-UNiverse sets are used. The students learn to analyze the problem and the connections among different parts of that problem. They try to create that type of problem and discuss the possible methodologies of teaching them.
7. Students learn about using concrete and visual representations in teaching and then solve different types of problems where the elements of Using Poly-UNiverse sets are used as concrete representations. The students formulate such types of problems and discuss the possible methodologies of teaching them.
8. Through using an electronic version of Poly-UNiverse the students explore its characteristics. They analyze and compare them with the characteristics of classical Poly-





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Universe sets. They try to formulate the advantages and disadvantages of using the electronic version of Poly-UNiverse and to collect problems for which this version of Poly-UNiverse is useful.

9. Students learn about using games in teaching and learning. They play different games using Poly-UNiverse sets for learning notions of different fields and for students' development. Then the students analyze the games and try to create new ones or to modify the rules of the games they played. Through discussion students try to improve the characteristics of the games and try to find more applications for using Poly-UNiverse sets through games.
10. Students learn about inclusion and its importance in education. In concrete examples they learn how to use Poly-UNiverse sets to create an inclusive learning environment which can help disabled students' learning, communication and collaboration. In order to be more inclusive and tolerant the students play games using Poly-UNiverse sets, where their eyes are closed to feel what the world looks like in the sense of the visually impaired students. Then the students discuss their experiences and feelings.
11. The students can see some photos of pieces of art which are inspired by Poly-UNiverse or where the elements of Poly-UNiverse sets are used as pieces of which the piece of art is constructed. Inspired by these, the students try to make something new and discuss their work.



## PUNTE Interdisciplinary Course — Application of Poly-Universe in Education

The aim of the course is:

- 1 to construct and organize learning environment such a way that enable students to recognize Poly-Universe as a useful teaching tool and to develop their creativity which will help them to create new applications of Poly-Universe in teaching and learning.
- 2 to prepare the students to be able to apply Poly-Universe in teaching using different approaches,
- 3 to help students' learning and overcoming their learning difficulties connected to notions of the modules of the course,
- 4 to develop students' abstract thinking, logical thinking, analytical thinking, spatial thinking, and student's skills of problem-solving
- 5 to develop students' to be more tolerant and emphatic and to use inclusion,
- 6 to develop students' sense of art,
- 7 to help students to handle the electronic version of Poly-Universe.

The structure of the course

This is one semester course (duration: fifteen weeks) with 4 classes a week (2 lectures and 2 practices of 45 minutes each).

The course is structured in the following modules:

- 1 Introductory classes- exploration of the shapes of the elements of Poly-Universe sets and discussions about their potential usefulness in teaching and learning based on appropriate theoretical background (duration: 1 week), compulsory,
- 2 Geometry and the methodology of its teaching (with appropriate theoretical background) when the Poly-Universe is used (duration: 3 weeks), compulsory,
- 3 Combinatorics and the methodology of its teaching (with appropriate theoretical background) when the Poly-Universe is used (duration: 2 weeks), compulsory,
- 4 Informatics and the methodology of its teaching (with appropriate theoretical background) when the Poly-Universe is used (duration: 3 weeks), compulsory,
- 5 Developing abstract thinking, logical thinking and analytical thinking by using Poly-Universe with appropriate theoretical background (duration: 1 week), optional,
- 6 Complex, interdisciplinary problems where Poly-Universe sets are used (duration: 2 week), optional,
- 7 Using Poly-Universe as concrete representations in solving problems (duration: 1 week), compulsory,
- 8 Electronic version of Poly-Universe and how to use it in teaching with appropriate theoretical background (duration: 1 week), optional,
- 9 Games in teaching and learning when we use Poly-Universe sets with appropriate theoretical background (duration: 1 week), optional,
- 10 How can using Poly-Universe sets help disabled students' learning and their communication to one another and how can it help students and their teachers to be more tolerant and to use inclusion (duration: 1 week), optional,
- 11 Poly-Universe and art (duration: 1 week), optional,
- 12 Presentations of students work and ideas about using Poly-Universe sets in teaching and learning and discussions about them (duration: 1 week), compulsory.

Table of compulsory and optional modules is given in Table 1.

*1. Table: Compulsory and optional modules*

Modules	Module's type
1. Introduction	compulsory
2. Geometry and the methodology of its teaching	compulsory
3. Combinatorics and the methodology of its teaching	compulsory
4. Informatics and the methodology of its teaching	compulsory
5. Developing logical thinking	optional
6. Complex, interdisciplinary problems	optional
7. Poly-Universe as concrete representations in solving problems	compulsory
8. Electronic version of Poly-Universe	optional
9. Games in teaching with Poly-Universe	optional
10. Helping disabled students' in learning and communication with Poly-Universe	optional
11. Poly-Universe and art	optional
12. Presentations of students work	compulsory

#### Evaluation

The final grade is the average of the grade on the exam at the end of the semester and the grade of students' presentation. The examination consists of simple questions to test basic understanding and knowledge. On the presentation student present his/her ideas and possible application(s) of Poly-Universe.

#### Content of modules:

- 1 During the introductory classes, through exploration of the elements of sets and through playing and deal with them (spontaneously or guided by teachers) students can recognize some possibilities of using Poly-Universe sets in teaching and learning and can discuss them. Through these activities students will get some ideas of Poly-Universe applications or new variations for existing applications and can easily understand theoretical background.

Exploration of the shapes of the elements of Poly-Universe sets and discussions about their potential usefulness in teaching and learning based on the appropriate theoretical background (duration: 1 week)

In the first 30 minutes the students explore the elements of different Poly-Universe sets and spontaneously build different two- or three-dimensional geometric shapes. The students present their creations to the other students and explain.

After that the students working in small groups must answer the following questions:

1. According to their shapes how many different Poly-Universe sets exist, and which are they?
2. Which colors are used for coloring tiles?

3. How many colors are used for each tile?
4. Is there any rule in coloring tiles for each Poly-Universe set?
5. Can you formulate one rule for coloring all tiles?
6. How many different tiles are there in each Poly-Universe set? Explain your answer.

All groups present, explain, and discuss their answers to the other groups and try all together to formulate the correct answers.

The students read and discuss the chapters about constructivism and games from our book.

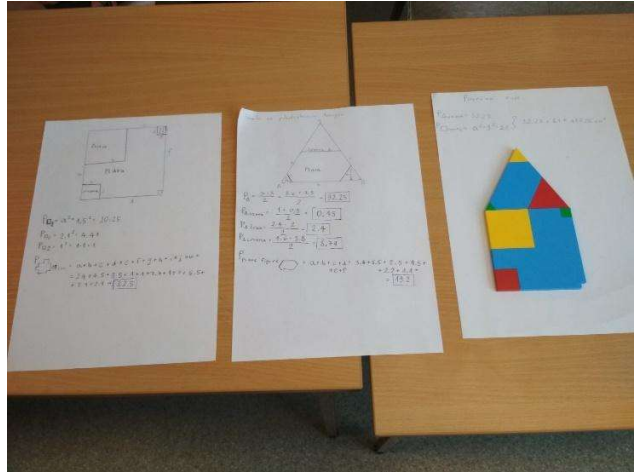
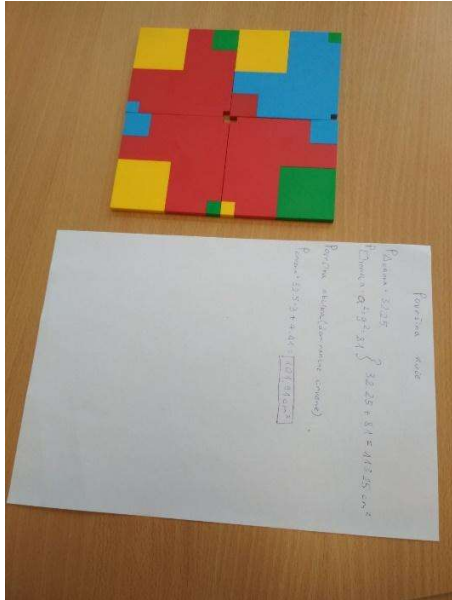
Considering the students' experiences with playing with Poly-Universe tiles the students formulate potential usefulness of Poly-Universe tiles in teaching and learning.

Their teachers urged their discussion and help them by posing supplementary questions.

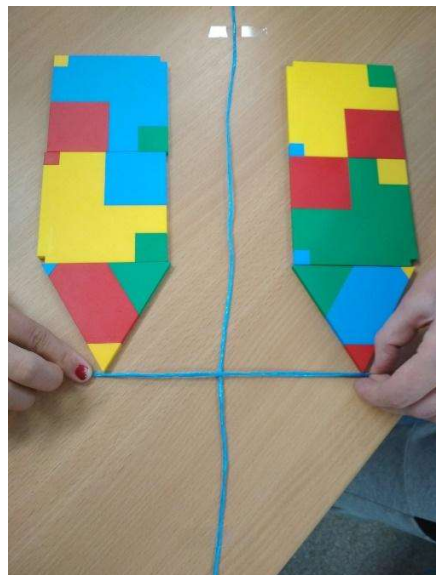
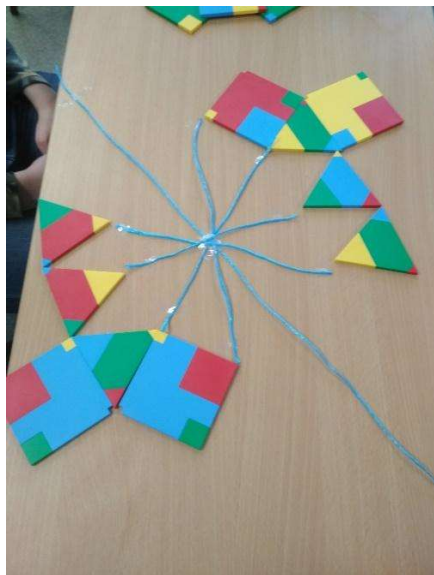


- 2 One week students deal with geometric figures which can be constructed using Poly-Universe sets and with their properties. With help of their teachers the students formulate and solve simple and more demanding problems connected to these figures. The students and the teacher discuss the methodology of teaching these contents.  
 One week students deal with geometric transformations in the plane using Poly-Universe sets and with their properties. With help of their teachers the students formulate and solve simple and complex problems connected to these transformations. They discuss also the methodology of teaching these contents.  
 One week students calculate perimeter and area of geometric figures which can be constructed using Poly-Universe sets and the area and volume of geometric solids which nets can be constructed using Poly-Universe. They also formulate similar problems and discuss the methodology of teaching them.

The students must recognize all geometric shapes which appear on the Poly-Universe tiles. They must measure the dimensions of that shapes and have to calculate the perimeters and areas of that geometric shapes.



Working in small groups the students must make appropriate “pictures” of different geometric shapes by reflections and point reflections using tiles of Poly-Universe. They use some pieces of string to show the appropriate points. In the end, students have to formulate the properties of the reflection and point reflection.



- 3 Basic concepts of combinatorics like permutations without and with repetitions, variations without and with repetitions and combinations without repetitions are explained by using Poly-Universe sets. In the first week, permutations and variations without repetitions are introduced. In the second week, variations with repetitions and combinations without repetitions are explained. The poly-Universe set is used to improve recognition of permutations, variations, and combinations.

The aim of this module is to use Poly-Universe in teaching basic concepts of combinatorics.

Duration of the module: 2 weeks with 4 classes a week (2 lectures and 2 practices of 45 minutes each)

The structure of the module:

1. week:

- lectures: introducing permutations (without and with repetitions)
- practices: tasks which use Poly-Universe for better understanding the concept of permutations with and without repetitions

2. week:

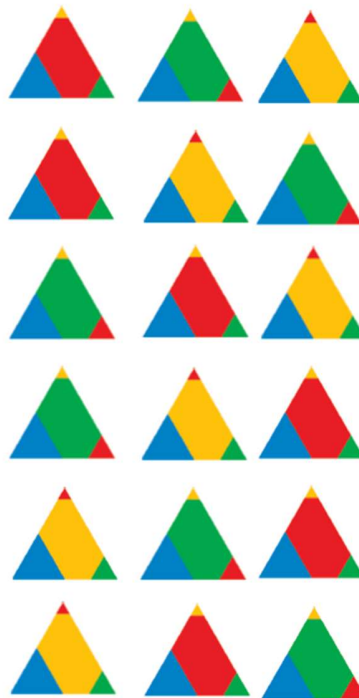
- lectures: variations without and with repetitions, combinations without repetitions
- practices: tasks which use Poly-Universe for better understanding the concept of variations with and without repetitions and combinations without repetitions

Condition on who can choose this module: every students can attended the module.

Examination: the students should introduce interesting tasks for explaining basic concepts of combinatorics.

Some exercises:

Find all permutations of triangles with the base color red, green, and yellow. How many of such permutations exist?

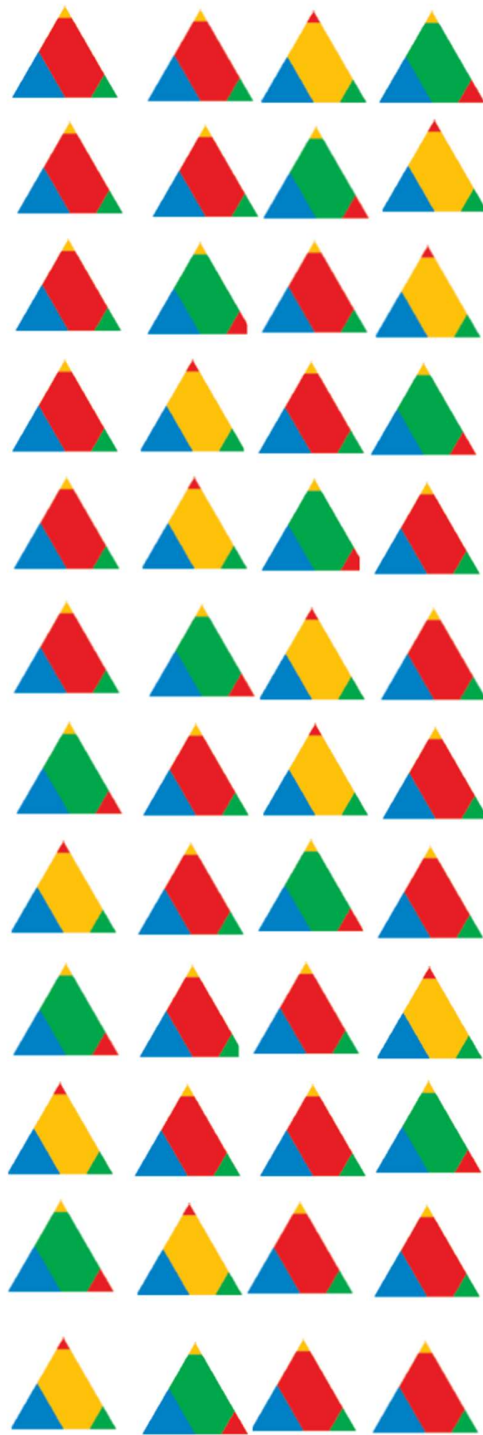


Find all permutations of triangles with the base color red, green, blue, and yellow. How many such permutations exist?

If there are four colors of the Poly-Universe game family: red, green, yellow, and blue, how many triangles are in the Poly-Universe game family with a red base color?

If there are four colors of the Poly-Universe game family: red, green, yellow, and blue, how many triangles are in the Poly-Universe game set?

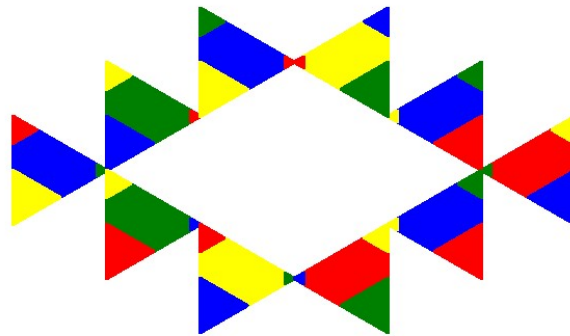
Find all permutations of two triangles with the base color red, and one triangle with the base color green, and yellow. How many such permutations exist? We assume that two triangles with the base color red are the same.



- 4 The aim of Informatics module is to use Poly-Universe in teaching programming in Python and coordinate geometry. Basic concepts of Python programming language and some libraries in Python are introduced. The Turtle Python's library is used to draw given patterns. While writing the program for drawing given pattern built by Poly-Universe set,

students will intensively use their coordinate geometry knowledge, and broaden their knowledge in Python programming.

Write a Python program using the Turtle library which will draw the following pattern made from Poly-Universe:



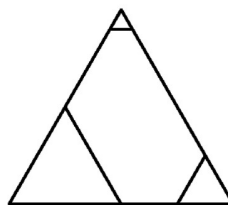
Turtle graphics is a popular way for introducing programming to kids. It was part of the original Logo programming language developed by Wally Feurzeig, Seymour Papert and Cynthia Solomon in 1967. The turtle package is a pre-installed Python library that enables users to create pictures and shapes by providing them with a virtual canvas. The onscreen pen that you use for drawing is called the turtle and this is what gives the library its name. In order to draw a picture by Turtle library, intensive use of coordinate geometry is required.

Duration of the module: 3 weeks with 4 classes a week (2 lectures and 2 practices of 45 minutes each)

The structure of the module:

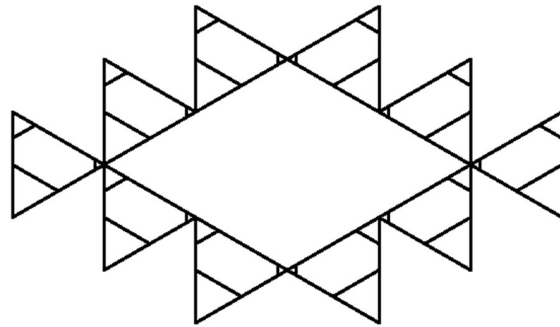
1. week:

- lectures: introducing Poly-Universe and the main goal, loops in Python
- practices: introducing the Turtle library in Python, some basic commands in Turtle and auxiliary task: draw the following pattern in Python using Turtle library:



2. week:

- lectures: defining function in Python
- practices: auxiliary task: draw the following pattern in Python using



3. week:

- lectures: coloring shapes in Python's Turtle library, random number generator in Python's
- practices: solving the main task
- Discussion of students thoughts, their ideas and possible applications of Poly-Universe sets in informatics

## PYTHON LIST METHODS

By - @codes.learning

INPUT	METHODS	OUTPUT
	<code>.append(▲)</code>	
	<code>.insert(1, ▲)</code>	
	<code>.pop(1)</code>	
	<code>.remove(■)</code>	
	<code>.reverse()</code>	
	<code>.sort()</code>	
	<code>.index()</code>	3
	<code>.count(■)</code>	2
	<code>.clear()</code>	
	<code>.copy()</code>	

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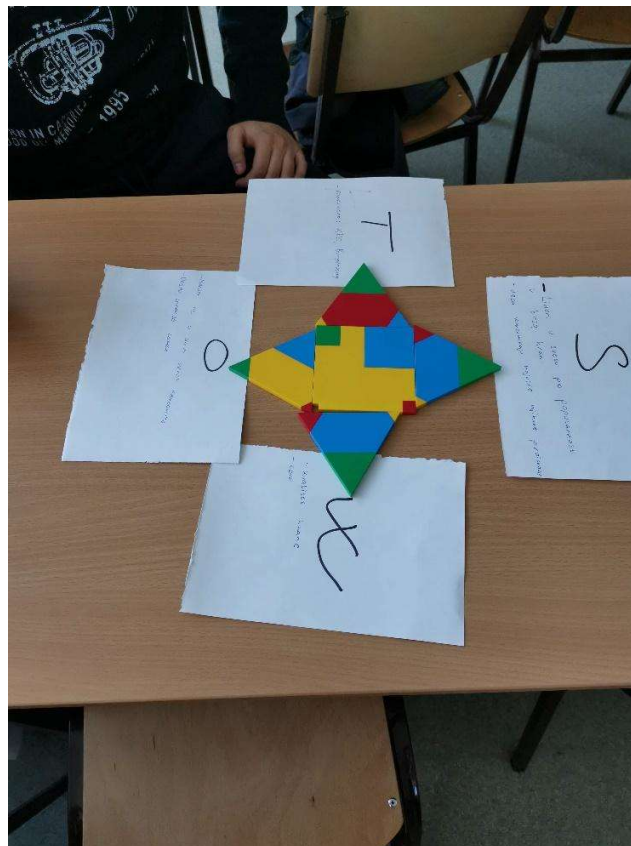
- 5 The Poly-Universe set is used to exercise tasks which will improve logical thinking of students. The students will be encouraged to introduce their own exercises for developing and improving logical thinking.

The structure of the module:

1. week: introducing Poly-Universe, tasks for improving logical thinking

Exercise:

The problem is making SWOT analysis (Strength, Weakness, Opportunity, Threat) for given company. The objective of the exercise is to place the correct shape with correct layout. Participants have to make and notice strengths, weaknesses, opportunities and threat. Next step is to present their observations to opposite team and to compare their conclusions. The winner of the game is the team with less objections from opposite participants.



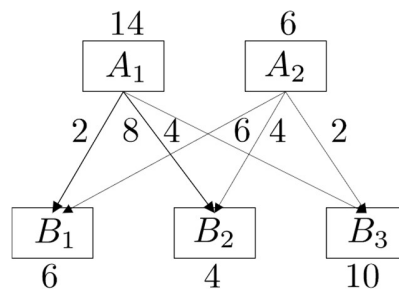
- 6 Students deal with complex, interdisciplinary problems where Poly-Universe sets are used. The students learn to analyze the problem and the connections among different parts of that problem. They try to create that type of problems and discuss the possible methodologies of teaching them.

The structure of the module:

1. week: Some complex, interdisciplinary problems. Can we solve these problems with Poly-Universe game family?
2. week: Poly-Universe game family and the transportation problem

Exercise:

Two bread c, make the daily bread in a city. The capacity of the bread factory  $A_1$  on the daily basis is 14 bread boxes, while the capacity of  $A_2$  is 6 bread boxes. The bread is delivered to the three bakeries of the city  $B_1, B_2$  and the  $B_3$ . The demand of bakery  $B_1, B_2$  and the  $B_3$  is 6, 4 and 10 bread boxes, respectively. The transportation costs per bread box from  $A_1$  to  $B_1, B_2$  and  $B_3$  are respectively 2, 8 and 4 money units. From  $A_2$  to  $B_1, B_2$  and  $B_3$  are respectively 6, 4 and 2 money units. Determine the initial basic feasible solution of the given transportation problem.





	$B_1$	$B_2$	$B_3$	
$A_1$	$\frac{2}{6}$	$\frac{3}{4}$	$\frac{4}{4}$	<del>14</del> <del>8</del> <del>4</del> 0
$A_2$	6	4	$\frac{2}{6}$	<del>6</del> 0
	6	4	10	
	0	0	<del>4</del>	0

- 7 Students learn about using concrete and visual representations in teaching and then solve different types of problems where the elements of using Poly-Universe sets are used as concrete representations. The students formulate such type of problems and discuss the possible methodologies of teaching them.

Duration: 1 week.

Examples:

Representing a chemical reaction:



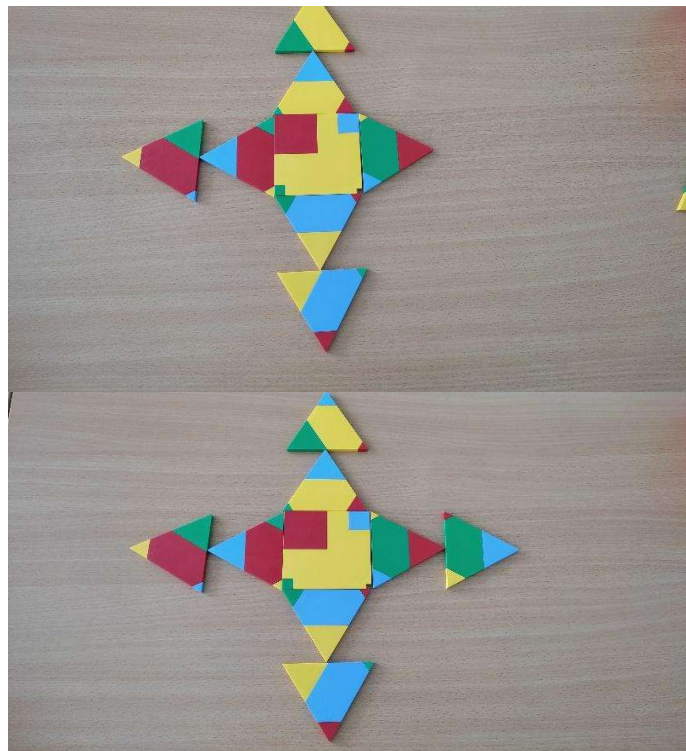
- 9 Students learn about using games in teaching and learning. They play different games using Poly-Universe sets for learning notions of different fields and for students' development. Then the students analyze the games and try to create new ones or to modify the rules of the games they played. Through discussion students try to improve the characteristics of the games and try to find more applications for using Poly-Universe sets through games.

Games in teaching and learning when we use Poly-Universe sets with the appropriate theoretical background.

Duration: 1 week.

Example:

Two tables of 16 squares (4 in each row and column; wool strings are taped to the sides to allow players to touch them) of different types (different shapes) of tiles are used by two players. Each player has his own table, and he/she can only see his/her table and cannot see the other player's table. The first player has placed some tiles on some squares of his table (only tiles of the same shape placed on top of each other can be placed on each square). The second player asks questions (to the first player) that can be answered with yes or no. His/her goal is to figure out where the tile positions are on the first player's table. When he/she hits something he/she places the same tile(s) on his/her table on the same square (square in the same row and column as on the first table).



- 10 Students learn about inclusion and about its importance in education. On concrete examples they learn how to use Poly-Universe sets to create inclusive learning environment which

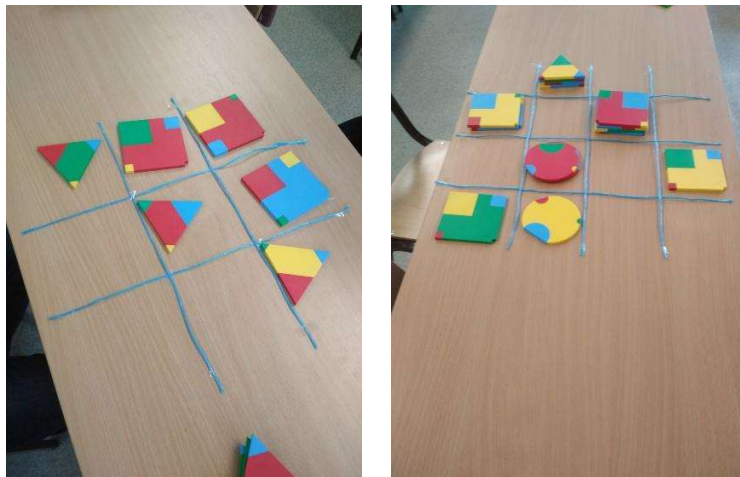
can help disabled students' learning, communication and collaboration. In order to be more inclusive and tolerant the students play games using Poly-Universal sets, where their eyes are closed to feel what the world looks like in sense of the visually impaired students. Then the students discuss their experiences and feelings.

How can using Poly-Universal sets help disabled students' learning and their communication with one another and how can it help students and their teachers to be more tolerant and to use inclusion?

Duration: 1 week.

Modification of XO game:

A table of 9 squares (3 in each row and column; wool strings are glued to the sides which make it possible for players to touch them) of two different types (different shapes or sizes) of tiles is used by two players (each of them uses only one type). The players alternately place their tiles on the table. The aim is to put three in a row horizontally, vertically, or diagonally.



Continue the chain

12 tiles of similar shape from each of three different sets are used. One of the players put one tile on the table. The chain can be continued (in four directions if the first tile is a square, in three directions if the first tile is a triangle and in two directions, if the first tile is a "circle") by putting another tile in such a way that two sides of the tiles touch each other. The winner is the person who plays his last tile.

Building a bridge across the "river"

The game is played in small four-number groups with two sets of poly-universe sets and with a drawing of a river for each group. The aim is to build a bridge across the "river" without any pillars. The winner is the group that finishes the bridge first.

- 11 The students can see some photos of piece of art which are inspired by Poly-Universe or where the elements of Poly-Universe sets are used as pieces of which the piece of art is constructed. Inspired by these the students try to make something new and discuss their work.

