

POLY-UNIVERSE & LÉNÁRT SPHERE: MANIPULATIVES FROM HUNGARY

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Short description of the Workshop Groups: organizers, aims and underlying ideas

Tools for Participants: *In order to enhance the experience, we recommend participants to have the following tools available during the workshop (they are not required): laptop or tablet, two oranges, coloured pens or markers that can mark the oranges, rubber bands, toothpicks, bottle caps.*

Hungary has a strong tradition of using games and manipulatives to develop concept building and problem solving in mathematics. This stems from the work of Tamás Varga, but there are constantly new developments in this trend (Vancsó et al, 2018). The workshop presents online adaptations of two such tools: the Lénárt Sphere developed in 1986 by István Lénárt (Lénárt, 1996), and the Poly-Universe set developed in 2009 by János Szász Saxon (Saxon & Stettner, 2019). Both tools are used with 6-18 year-old students and in teacher training.

The aim of the Lénárt sphere is to explore analogies and differences between the plane and the sphere, and get a first hand experience on comparative geometry education for all levels. (Lénárt & Rybak, 2017). Participants will study basic ideas of geometry on the plane and on the sphere, for example straight lines, and circles. Comparison and contrast make concepts understandable and thought-provoking even for those who are indifferent or hostile towards mathematics. Euclidean monologue transforms into a dialogue, a drama between two approaches to geometry. Besides introducing the Lénárt Sphere with spherical rulers, compasses and protractors, we will work with everyday objects such as oranges and rubber bands, which can be used in online and in person classrooms. Independent investigation, peer discussion and self-made discovery prevail over passive acceptance of definitions. Comparing different geometries may help students understand how relative and human all axioms and theorems of science are, and help them develop tolerance and understanding of those who are different in their cultural or social backgrounds.

The aim of the Poly-Universe session is to explore the various educational aspects of a tool that originates from art, and which connects multiple subjects and mathematical topics. The novelty value of Poly-Universe lies in the scale-shifting symmetry inherent to its geometric forms and a colour combination system. As part of the EU Erasmus+ PUSE (Poly-Universe in School Education) project 2017/19 an international team of educators, teachers and students designed tasks for using the tool in mathematics education for primary, middle and high school students and in teacher training (PUSE Methodology book, Saxon & Stettner, 2019). These tasks are visual, hands on and analytic at the same time, so they require both right and left brain functions, and they are centred around motivation, experience, interaction, problem solving and creativity. The tasks are connected to the topics of Geometry & Measurement, Combinatorics & Probability, Sets & Logic, Graphs & Algorithms, Complex & Visuality.

In the workshop participants will have the opportunity to try out and discuss the e-learning platform of the Poly-Universe set, which is an online application for manipulating the set and solving visual mathematics tasks.

Vancsó, Ö., Beregszászi, E., Burian, H., Emese, Gy., Stettner, E. & Szitányi, J. (2018). Complex Mathematics Education in the 21st Century: Improving Combinatorial Thinking Based on Tamás Varga's Heritage and Recent Research Results In: E. W. Hart, & J. Sandefur (Eds), *Teaching and Learning Discrete Mathematics Worldwide: Curriculum and Research Cham* (pp. 111-134). Germany: Springer

PUSE (Poly-Universe in School Education) METHODOLOGY – Visual Experience Based Mathematics Education 2019; Edited by János Szász SAXON & Dr Eleonóra Stettner PhD; Published by Zsuzsa Dárdai, Poly-Universe Ltd; Electronic version[PDF]: www.poly-universe.com; ISBN 978-615-81267-1-7

Lénárt, I.: Non-Euclidean Adventures on the Lénárt Sphere. First edition: Key Curriculum Press, Berkeley, California, 1996. (Second Edition 2013) 224 pp.

Lénárt, I., Rybak, A.: Hungarian Perspectives – Comparative Geometry in Primary and Secondary School. Chapter 5, pp. 107-124. In: *The Pedagogy of Mathematics: Is There a Unifying Logic?* Editors: Paul Webb and Nicky Roberts. MISTRA and Real African Publishers, Johannesburg, South Africa, 2017.

Planned structure:

Insert the planned structure of the workshop in the table below. You can insert rows if needed.

Planned timeline	Planned activity	Working format /Responsible person
5 mins	Introduction	Lecture / Szász
40 mins	Ball Geometry Activities	Interactive / Lénárt
40 mins	Poly-Universe Activities	Interactive / Dárdai, Saxon, Stettner, Tóth
5 mins	Wrap-up	Discussion / Szász

Venue requirement:

N/A