

## Motivation and Development – Using Poly-Universe Game in Teaching Mathematics and Other School Subjects

By Ilona Téglási\*

“Children learn as they play. Most importantly in play children learn how to learn.” (O. Fred Donaldson)

*Motivation and development of different skills are keywords in teaching mathematics all over the world – and how can we achieve these better than by playing? János Saxon-Szász, a Hungarian artist invented the Poly-Universe game. It is a game of arts and mathematics. In our presentation and paper we would like to introduce the artistic and methodological background of using the game in teaching different fields of mathematics on different ISCED levels. As well, in an international consortium (Poly-Universe in Teacher Training Education, Erasmus+ Strategic Partnership, 2020-1-HU01-KA203-078810) we have a research project on how to implement these methods into teacher training education through using the Poly-Universe game. After the first semester of pilot courses in our partner institutions we would like to present the experiences and outcomes of them – and to raise your interest in further development.*

**Keywords:** *game-based learning, teacher training, arts and mathematics, motivation*

### Introduction

Learning mathematics is hard work for most of the pupils in the world. Though they accept that mathematics is important for life, the majority of them do not like it. So a good teacher of mathematics has to catch every opportunity to make it more enjoyable and easier to learn. We have already learned from Dienes (1960) in the late 1960's and 1970's, that through games, many mathematical structures can be taught. Nowadays his ideas are getting more popular again. The world is changing so quickly that we have to realise that the development of skills and abilities are more important than the content of teaching. So we have started to think in competence based teaching strategies. The information nowadays is available for more and more people through the internet, so in the classroom not the teacher is the only source of knowledge. We use less frontal teaching methods and more cooperative teamwork in the classroom – thanks to Dewey (1960), Johnson and Johnson (1975), Cohen and Lotan (1997), and others. The educational approaches are changing consequently as we know more and more about the brain, memory, development of childrens' mental skills and personality. Anyhow, there are a lot of possibilities to make the learning of mathematics easier and more motivation for pupils – which can be equally good and effective. The aim of the

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present paper is to introduce a special tool for this purpose: the Poly-Universe game set, and the research project for introducing it into teacher training education.

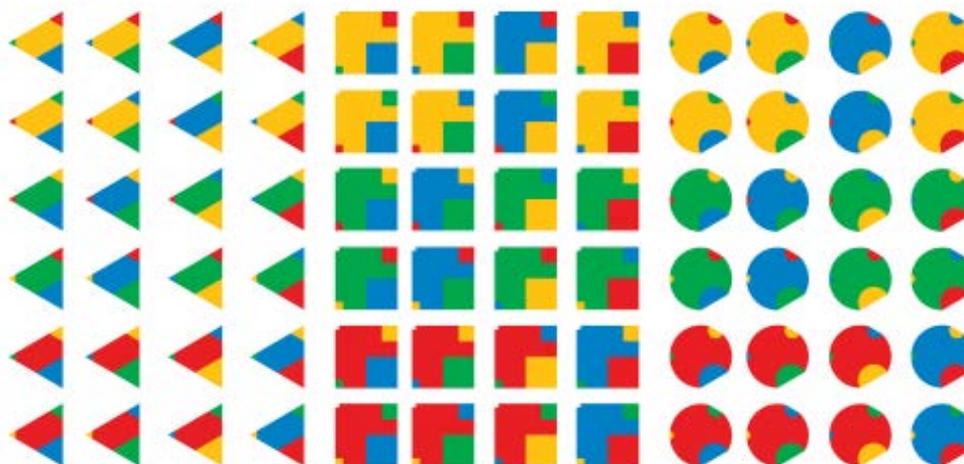
### The Game as an Educational Tool

The Poly-Universe game was invented by a Hungarian fine artist, János Saxon-Szász (<http://www.saxon-szasz.hu/>). He is an internationally known representative of the MADI artistic movement. In his constructivist geometric art there is an important role of rates, self-similar shapes, affine transformations. He calls these kinds of structures “poly-dimensional” (Darvas 2020). From this artistic background came the idea of the Poly-Universe game set, which was invented originally for creative artistic use. But it soon became clear that this game has got many connections to mathematics. The pure shapes, clear colours and the system of combinatorial varies makes it a perfect tool for using them in teaching mathematics (Figure 1).

**Figure 1.** *The Three Shapes of the Poly-Universe Game Sets*



The novelty of the game comes from the scale shift symmetry of the three basic shapes (triangle, square, circle) and the colour combination system (red, blue, green and yellow). In one set we can find all variations of the colours on the parts of one element. The rate of the parts on every shape is 1:2:4:8. So it is easy to count that the different elements have got 24 variations each shape – that’s what the game sets consist of (Figure 2).

**Figure 2.** *The Elements of the Three Poly-Universe Game Sets*

This simple system of attributes and the aesthetic design makes this game useful for teaching different fields of mathematics from geometry to combinatorics and probability theory. Besides this it is a game of art and creativity, so it can also be used as a motivation or a special viewpoint for complex mathematics lessons, planned with STEAM methods. See more about the game: <http://www.poly-universe.com/>.

Based upon several experiences at conferences and school workshops, between 2017-2019 the Poly-Universe Ltd. company in consortium with partner schools from Hungary, Finland, Slovakia and Spain realised an ERASMUS + project to develop a new visual approach for mathematics education based on Poly-Universe games. Within the project the partner schools tried out in different educational levels and fields of mathematics (from elementary school to upper secondary level and mathematical talent care) how the games can be used for motivating the students, for developing their mathematical competences. During the 18 months of the project the partners (teachers and students together) discovered many applications for using the game in teaching mathematics and arts in an experience-centred visual way. The main objective of the project was to work out a new visual mathematics educational system, the PUSE Methodology.

The result of this project is a collection of tasks from elementary school education (ISCED1) to secondary school education (ISCED3) in the following fields of mathematics education:

- Geometry and measurement.
- Combinatorics and Probability calculations.
- Sets and Logic.
- Graphs and Algorithms.
- Complex and Visual tasks.

The PUSE Methodology book is an impressive publication beginning with the description of the game, the background of the game and more than 300 tasks

(worksheets for students and teachers) (<http://www.poly-universe.com/puse-methodology/>) (Saxon et al. 2019). On the dissemination events of the PUSE project the participants spread these methods and practises and made available EU-wide in school education. The webpage of the project still exists, so that every teacher interested in this game, method and approach can find and adapt it to his/her own teaching practice.

### **Poly-Universe in Teacher Training Education (PUNTE)**

After finishing the PUSE project, a demand arose in the coordinators to continue and extend the development they'd started. It has been seen from the start, that there are so many possibilities in the Poly-Universe game that the PUSE Methodology is not a closed system. There were many unsolved problems, and more tasks that could not belong to any of the chapters of the book. So we've tried to find the best continuation of the work done before. For that, we have been looking for partners in the field of teacher training high school education who are interested in using new innovative methods. We think that the best way to reach changes in the teaching practice in schools is to start changing the methods in teacher training education. If we show new possibilities and approaches for future teachers, it might be a fruitful start to reach our target: make school practise more playful, joyful and experience centred, while a real development of skills and abilities realises in pupils.

So for continuing the work we have applied for an Erasmus+ support for our plans with the following partnership:

- Eszterházy Károly Catholic University, Eger, Hungary (consortium leader)
- Partium Christian University, Oradea, Romania
- University of Coimbra, Portugal,
- University J. Selye, Komarno, Slovakia
- Poly-Universe Ltd., Budapest, Hungary
- Johannes Kepler University, Linz, Austria
- Experience Workshop Ltd., Jyväskylä, Finland
- Technical College of Applied Sciences, Subotica, Serbia (Figure 3)

**Figure 3. Partnership of the PUNTE Project**



Finally we have succeeded in winning the grant, and started working in the “2020-1-HU01-KA203-078810 Poly-Universe in Teacher Training Education (Erasmus +, Strategic partnership)” (PUNTE) project in autumn 2020.

The ultimate aim of PUNTE project is to develop, test and disseminate new innovative pedagogical methods, build a new educational framework for improving transversal skills and stimulate a kind of visual paradigm shift in teacher training

higher education in various fields of teacher training programs in the partner institutes.

The main technical and methodological tools of this educational framework are based on the revolutionary educational tool, the Poly-Universe game. In the last 10 years, this game was tested by thousands of teachers and students belonging to different age groups (6-18) in hundreds of institutions and events (school workshops, conferences, art & mathematics festivals, museums) throughout Europe. As we've mentioned before, our project is also based on the highly successful predecessor project PUSE (Poly-Universe in School Education), where this game was introduced to various forms of school mathematics education. The PUSE project, although it was very successful in quantitative and qualitative terms as well, was evidently not able to enforce systemic change and did not reach the level of higher education. The aim of the PUNTE consortium is to make some significant steps further. Our objectives are as follows:

- Collect best practices of applying Poly-Universe in various fields of school practise (different subjects, formal and informal pedagogical situations).
- Create and test a theoretical and practical methodological framework of improving transversal skills by Poly-Universe.
- Introduce this pedagogical framework to regular teacher training higher education and stimulate methodical paradigm shift through this method;
- Develop, adjust and publish open source teacher training materials supporting various forms and paths of teacher training higher education (distant learning, modular forms, blended learning etc.).
- Disseminate the results in the European Higher Education Area and involve policy makers to further support long-term systemic change in this field.

Although the most obvious field of application of Poly-Universe is in arts and mathematics education, we definitely follow a deeply interdisciplinary approach – we strive to find and develop pedagogical aspects through which this tool can also be applied in several other fields, including the entire spectrum of STEAM and beyond: Physics, Geography, Computer Science, Economy, but also in Communication and Literature.

Since Poly-Universe has proved successful in the development of a large variety of age groups, our methodological approach is planned to be as comprehensive and inclusive as possible. The educational portfolio and methodical research of the applicant institution (Eszterhazy Karoly Catholic University) and members of the consortium actually cover the entire spectrum of teacher education, from preschool teachers to upper secondary level. The project also intends to develop cross-cutting key competences of future teachers at all levels, which, in the long term, can support the development of these competences at every level of the education.

Moreover, the consortium pays special attention to inclusiveness. Techniques and methods to support educators in teaching students with special needs and

pupils with various social backgrounds are also in the forefront of our cooperation. These methods can further support societal inclusiveness in education.

Some of the planned activities:

- Desk research:
  - collection of best practices;
  - joint development of methodological and pedagogical tools.
- Test and improvement, including mobility activities:
  - short- and long-term mobility of educators to introduce and test various aspects of the developed teacher training methods;
  - organisation of joint project meetings and training where educators can further be trained.
- Dissemination and communication activities:
  - in-house and out of consortium multiplier activities (presentations and workshops in other higher education institutions and schools, meetings with policy makers etc.);
  - communication of the results to the wider audience (info-days, Researcher's Nights, local and international conferences, publications etc.).

To reach our targets the following intellectual outcomes are being developed:

- IO1: PUNTE Methodological Study – Handbook for pre-service and in-service teachers and students.
- IO2: Framework and curricula of PUNTE methodological courses for pre-service teachers, students of teacher training education.
- IO3: Task repository for collecting new applications of using Poly-Universe in a wide spectrum of school subjects, for formal and informal teaching/learning situations, for inclusive education also.

## **Intellectual Outcomes of the Project**

### *Methodological Study*

This study is meant to be the base of our PUNTE methodical courses. For this purpose, we have summarised the theoretical, methodological, artistic background of using the Poly-Universe in teaching for different specialisations of teacher training education: preschool teachers, elementary teachers, teachers of special needs children, teachers of lower and upper secondary levels (mathematics and other subjects). The authors of the study are experts from our partner institutes,

researchers and educators from various fields of teacher training education: psychology, pedagogy, subject methodology, computer sciences, fine arts, mathematics.

In the first part of the study we present those teaching-learning theories, which are behind the method:

- Constructivism in pedagogy.
- Problem solving in Mathematics teaching, Bruner's learning and representation theory.
- The Dienes-Varga method.
- Inquiry-based strategies in mathematics education.
- Philosophy of STEAM education.
- The role of games in learning.
- Visuo-spatial skills and their development.
- Motivation and engagement on learning.
- Inclusion in education.

Most of these themes are parts of the students' regular training system. We selected especially those theories that have got the most connection to our goal: introducing the Poly-Universe game into their teaching practice.

The second chapter is about learning-teaching through art, because we think that it is crucial to understand the mentality behind the game (Saxon and Dárdai 2019). So we can learn from the following topics in this chapter:

- "Teaching to see" – a dimension change in geometric art and education.
- Fundamentals of geometric art in the 20th century and its correlations to pedagogy.
- Art Concrete and the MADI movement.
- "Let it play" – the role of geometry in education.
- Dimension Pencil – an imaginary tool for changing pedagogical approach by János Saxon-Szász.
- About the Poly-Universe elements: triangle, square and circle – and the philosophy of the game.
- Friezes, rosettes and Poly-Universe - symmetry groups in different patterns from rosettes to the traditional Portuguese tiles.

The third part of the study is about the methodological background – to present the most important teaching-learning strategies for the realisation of the application of the Poly-Universe game (Nagy and Révész 2019). This part is more practical, with concrete proposals:

- Cooperative learning and its benefits.
- Playful learning and guided play.
- Gardner's multiple intelligence theory combined with Bloom's taxonomy: the activity matrix.
- Creativity in general and in mathematics education.

- Holistic approaches and creative learning in the Finnish education system.

At this point we have reached the second main aim of the PUNTE project: working out the framework of university courses based on these theories and strategies. So the next chapter deals with the place and tools of Poly-Universe in teacher training:

- About Poly-Universe in formal and informal learning contexts.
- The fields of using Poly-Universe in teacher training education.
- The framework of PUNTE methodological courses – a proposal.
- Dynamic GeoGebra applications inspired by Poly-Universe – involving online tools.
- Poly-Universe digital game interface – developing a new e-learning platform.

At the end of our study we show about forty concrete tasks for using Poly-Universe in the following subjects:

- Mathematics (beyond the previous PUSE Methodology book).
- Arts.
- Interdisciplinary approaches.
- Inclusion.

These tasks are not just for illustrating the wide spectrum of the usage of the game, but also for the purpose of giving hints for the students, to start thinking about new applications and awaken their creativity.

It would not be fair, if I did not mention the co-editors and the co-authors of this book, so let me list them: Branko Anđić (JKU), Bettina Bakos (JKU), Maria de Graça Bidarra (UC), Anikó Bordás (EKCU), Andrea Bordás (PCU), Zsuzsa Dárdai (PU), Edith Debrenti (PCU), Zoltán Fehér (JSU), Kristóf Fenyvesi (EW), Miklós Hoffmann (EKCU), Ladislav Jaruska (JSU), Zoltán Kovács (EKCU), Zsolt Lavicza (JKU), Zoltán Papp (VTS), Vanda Santos (UA, on behalf of UC), Gordana Stankov (VTS), János Szász Saxon (PU), Eleonora Stettner (PU), Eva Ubrich (JKU), Maria da Piedade Vaz Rebelo (UC), Ilona Téglási (EKCU).

And special thanks to János Szász Saxon for the fantastic layout, and to the Líceum Publisher of the Eszterházy Károly Catholic University for taking care of the publication procedure (Figure 4). The whole study can be downloaded from the project webpage: <http://www.punte.eu/punte-study/>.

**Figure 4.** The Front Page of the PUNTE Study

### *PUNTE Courses*

The main aim of the courses 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 realise that the Poly- Universe game is an appropriate tool for raising motivation, developing creativity and involve pupils with learning difficulties in teaching different subjects. As the specialties of the students are different in the different partner institutes, when planning the content of the PUNTE courses we were cogitating a modular structure, to be able to choose among the modules and adapt them to the requirements of the users (Table 1).

**Table 1.** Modules of the PUNTE Courses and Their Types

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

During the completion of the course we expect the following competences of the students 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 and abilities

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

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 students should be engaged in teaching his/her own subject using experiential teaching methods. The students should be sensible for involving visual arts in teaching/learning procedures.

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. The students should be able to reflect on a task or a lesson plan where the Poly-Universe game was used: effectiveness, conformance to the awareness of the curriculum, appropriateness, meeting with children's needs, realisation differentiated development of children (Publications Office of the European Union 2002).

At the Eszterházy Károly Catholic University we have worked out and run the course with the following content and schedule at the 2nd semester of the 2021/2022 academic year:

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 model the solution. The theory of Problem Based 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 games. How can the Use of the Poly-Universe games 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 use of Poly-Universe appears in a certain learning activity – and evaluation. (2 lessons)

The course was held with attendance of the students and aided by e-learning material. For the e-learning platform we have used the Moodle system of the Eszterházy Károly Catholic University (<https://elearning.uni-eszterhazy.hu/login/index.php>). We've used this platform to disseminate the theoretical knowledge of the course, and for an online communication between the educators and the students, and also to upload the students' works and projects, and finally the evaluation of the course. The participants of the course were students of the following specialisations: teacher of special needs children, elementary school teacher, secondary school teacher of mathematics, arts, geography, informatics, physics, chemistry, physical education (in different pairs of subjects). On some multiplier events the description of the course had taken the attention of some in-practice teachers of mathematics, so we have also announced a short, intensive course for part-time students of teachers of mathematics.

During the lessons we have used the Poly-Universe game family, paper, pen, notebook, scissors, glue to process the theoretical background and to construct new tasks and games. The students have worked in groups of 3-5 members on all lessons, and we took special attention on forming heterogeneous groups of them (regarding their specialities and interests). We have also used cameras and smartphones to take photos and short videos about the students' activities.

The requirements of the course for the students were:

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

The students had to choose a special topic to work out till the end of the course in pairs, small groups or individually. The evaluation of the acquired knowledge and competences took place through a presentation of their project

work, according to given viewpoints (applicability, feasibility, meeting the expectations of the curricula and methodological studies). These final presentations and the description of the students' projects have been uploaded to the e-learning platform of the course.

For the evaluation and quality assurance of the PUNTE project during the semester we've observed some lessons (at the beginning, in the middle and at the end) according to the following guidance:

- Information about the lesson/session (date, place, duration, number of participants, topic of the activity).
- Description of the activities through detailed answering of some questions (How did the activity begin? What did the teacher do? How did students get involved? What was the task proposed? How was it developed? What were the materials used? How were they used? Did the students reproduce models or did they create new ones?)
- Analysis of the reproduction process: How was the reproduction developed? Which were the strategies used? Did the students start with all materials or do they choose piece by piece? Was it an intuitive copy? In case that a new model is produced, analysis of the new model.
- Analysis of the students' behaviour: How did the students continue work? Did they collaborate? Did they share materials while developing their own product or did they develop the task together? Did students ask questions?
- Reflection on the session: positive and negative aspects, difficulties, engagement, development, successfulness, effectiveness, suggestions for improvement.

To evaluate the pilot courses in the partner institutes we have used a post questionnaire after each course. The main part of it was an Intrinsic Motivation Inventory Questionnaire (<https://selfdeterminationtheory.org/intrinsic-motivation-inventory/>) (Plant and Ryan 1985). We have used the following subscales of the original test, and modified slightly the items to fit the specific activity, the university PUNTE courses:

- Interest/ Enjoyment
- Perceived competence
- Effort/Importance
- Pressure/Tension
- Perceived choice/autonomy
- Value/Usefulness

Beyond the intrinsic motivation we have added some more statements referring to the specific course to be able to improve them:

- It was easy to start using Poly-Universe.
- It will be easy to use the Pol- Universe in mathematics.

- The Poly-Universe can be used in different scientific areas.
- The Poly-Universe can be used in different educational contexts, e.g., formal, non-formal, informal.
- Poly Universe can be used to implement games in education.
- With Poly Universe, I know how to plan and implement interdisciplinary activities.
- I think that in the future I will be able to do activities similar to the ones done in the PUNTE module.

For the scoring of the questionnaire we have used the Likert-scale from 1 to 5 (1 – the statement is not at all true for me, 5 – the statement is fully true for me), attending to the scores of the reverse statements too.

As in the main aims of the PUNTE project we have put special attention on the development of transversal skills, in the post questionnaire we've asked the students to point out, which of the following can be developed in the children through playing/learning activities with Poly-Universe by their opinion:

- group work
- creativity/creative thinking
- critical thinking
- understanding
- problem solving
- sharing/cooperation
- concentration/attention
- innovative thinking
- decision-making
- autonomy
- responsibility.

In addition, for the improvement of the pilot courses we have asked four questions to give a chance to the participants to explain their ideas about the Poly-Universe course by answering with a few sentences:

- What did you enjoy most during the course activities?
- What were the difficulties for you?
- What have you gained most from the course and why is it useful for you?
- What are your suggestions for improvement of the course?

The analysis of the answers for the whole questionnaire is just in front of the partnership, and planned to be published in the near future. As the courses will follow up in the partner institutes also in the next academic year, it is essential for us to draw the inferences from the pilot year, and improve the content, the learning environment and other circumstances as we can.

### 1. Task Repository

The third main intellectual outcome of the PUNTE project is meant to be a Task Repository for the application of the Poly-Universe game in various learning/teaching situations. The planned fields of the applications are:

- Mathematics
- Programming and algorithms
- Arts
- Inclusive learning
- Interdisciplinary approaches
- Language skills and communication
- Sciences
- Logic games

As well as in the previous PUSE project, in PUNTE there are several occasions for workshops with the Poly-Universe game (multiplier events, short intensive courses, project meeting days, conference workshops, etc.) we have many possibilities to collect the newly invented tasks and problems to be solved. Also the sessions of the PUNTE courses give the opportunity to create new approaches in the different modules and in the students' own projects. To collect these tasks we have created a template for describing a task or an activity with Poly-Universe. On this template there are some general information about the author, the recommended level of using it (ISCED1 to 5), the purpose of the task/activity (formal or informal learning/teaching, inclusive teaching, free time activity, etc.), school subjects (if relevant), the expected benefits of solving the task or doing the activity (UNESCO 1997). Of course, the largest part of the template is the detailed description of the task/activity with figures or photos included, and additional comments of the author for the future user.

The main aim of this Task Repository is to show and disseminate the wide spectrum of applications of the Poly-Universe game both in fields and levels. For disseminating these tasks, we have developed our own webpage for the PUNTE project: <http://www.punte.eu/>.

The collecting, analysing and evaluating of the tasks is still in progress, and that will be the third intellectual outcome of the PUNTE project. Having had many occasions to work with the game, we know that every time some new ideas and problems occur. Sometimes, we find the solution soon, but sometimes it takes a longer period to put an end to a special problem. We know that this Task Repository will never be finished. Besides the original aim, that is to collect the best practices, it is also to create a place where the new users can upload their new ideas – after a quality control by the experts of the area of the task/activity.

## Conclusion

The aim of the present paper was to introduce and describe a progressive initiation of widening the methodological preparedness of students in teacher training education Europe-wide through a revolutionary game called Poly-Universe. Our main target is to show how modern approaches of teaching/learning strategies can be involved in teacher training education, giving the theoretical base as well as an active, practical experiment to the students aided by an online learning platform.

As detailed above, the developments of the project (the intellectual outcomes) are partly finished, but some are in progress. The first result of the project is the PUNTE methodological study, which can be downloaded from the project webpage: <http://www.punte.eu/punte-study/>. The second outcome taking shape in university courses at the partner institutes has just come to end. During the summer of 2022 the first pilot courses will be evaluated and improved, modified if needed for the next academic year. The first impressions of the courses made by the educators are the following:

- The students were keen on taking part of the course.
- They liked working in groups, and discovering the different possibilities of the game. They have worked out chosen theoretical parts of the small groups also, with given literature and presented it to the other students. This kind of learning experience was also new and interesting for them, as they mentioned at the ending evaluation (“It was good that we have learned from each other, and not from the teachers.”).
- The teaching-learning environment of the courses were also an example for their future practice.
- Most of the participating students were very creative and innovative in finding out new applications with the Poly-Universe game. These applications will be ridged of the Task Repository of our project.

The third result of our project will be a Task Repository of special applications for using Poly-Universe in different pedagogical situations. This phase is still in progress.

So we cannot show a final result yet. But with this paper, we would like to raise the readers’ interest in this unique game, the Poly-Universe. This game is universal for developing childrens’ skills and abilities (problem solving, creativity, spatial seeing, algorithmic thinking, inductive and deductive thinking, analysing – just to mention a few). Also a wonderful tool to raise and keep pupils’ motivation for learning and their competence motivation. The target group of the project is university students of teacher training education – any specialisation – but our team is open to multiplying the methods to other areas of higher education also. So if the paper and the web pages raise your interest, don’t hesitate to contact us in the hope of future cooperation or dissemination.

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