

# POLY-UNIVERSE

in Pre-School and Lower Primary  
EDUCATION



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# EARLYPOLY

## METHODOLOGICAL STUDY

Handbook for pre-service and  
in-service educators and students

**POLY-UNIVERSE**  
in Pre-School and Lower Primary Education

**EARLYPOLY**  
**Methodological Study**  
Handbook for pre-service and in-service  
educators and students

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## INTRODUCTION

The EARLYPOLY Methodological Study aims to introduce the world of the Poly-Universe educational tool and to assist kindergarten educators, lower primary school teachers, and others involved in the education of children aged 3–10 in using the Poly-Universe tool effectively and creatively in both kindergarten and lower primary education.

The manual was prepared within the framework of the EARLYPOLY Erasmus Partnership project, involving partners from France, Finland, Transylvania and Hungary. Therefore, beyond the methodological foundations, we can also see outstanding international examples in the Study Book. Such is the early childhood competence development in the well-known Finnish education system, while through the centrally important French example we can glimpse an educational work that takes place within a fundamentally non-formal educational setting with artistic aspects and creativity in the focus.

The Poly-Universe toolkit itself was born as a result of a kind of artistically motivated concept, but it became clear early on that it could open up new perspectives in many areas of educational work, both in formal and non-formal educational environments. Due to this origin, the present Study Book puts emphasis on approaching the STEAM areas as an organic whole, with special attention to artistic aspects. Another highlighted area is the presentation of harmony with nature, the common points between nature and creativity, and nature and abstraction, and the role of the Poly-Universe tool in the completion of this area in educational work. The central theme of the volume is also the facilitation of the kindergarten-school transition, where the Poly-Universe tool family has extraordinary potential, as it can be used excellently at both educational levels, so children get to know a tool in kindergarten that they will later encounter during their primary school work.

The volume is the third part of a series, just as the project itself is the third stage of an international cooperation. The first volume of the series, which was born within the framework of the Poly-Universe in School Education (PUSE) project, discusses the role of the Poly-Universe game family in mathematics education in upper grades. A separate methodological manual related to this volume discusses the principles and possibilities of introducing the Poly-Universe tool into teacher training, thanks to the Poly-Universe in Teacher Training Education (PUNTE) Erasmus Partnership project. The topic of the present volume, completing the spectrum of public education, is the use of the Poly-Universe tool in the teaching and upbringing of the 3-10 year old age group.

The volume also includes an extremely rich and structured database of good practices, thus facilitating the implementation of the principles discussed here into practice. All of these, as well as the previous volumes mentioned, can be downloaded free of charge from the project website.

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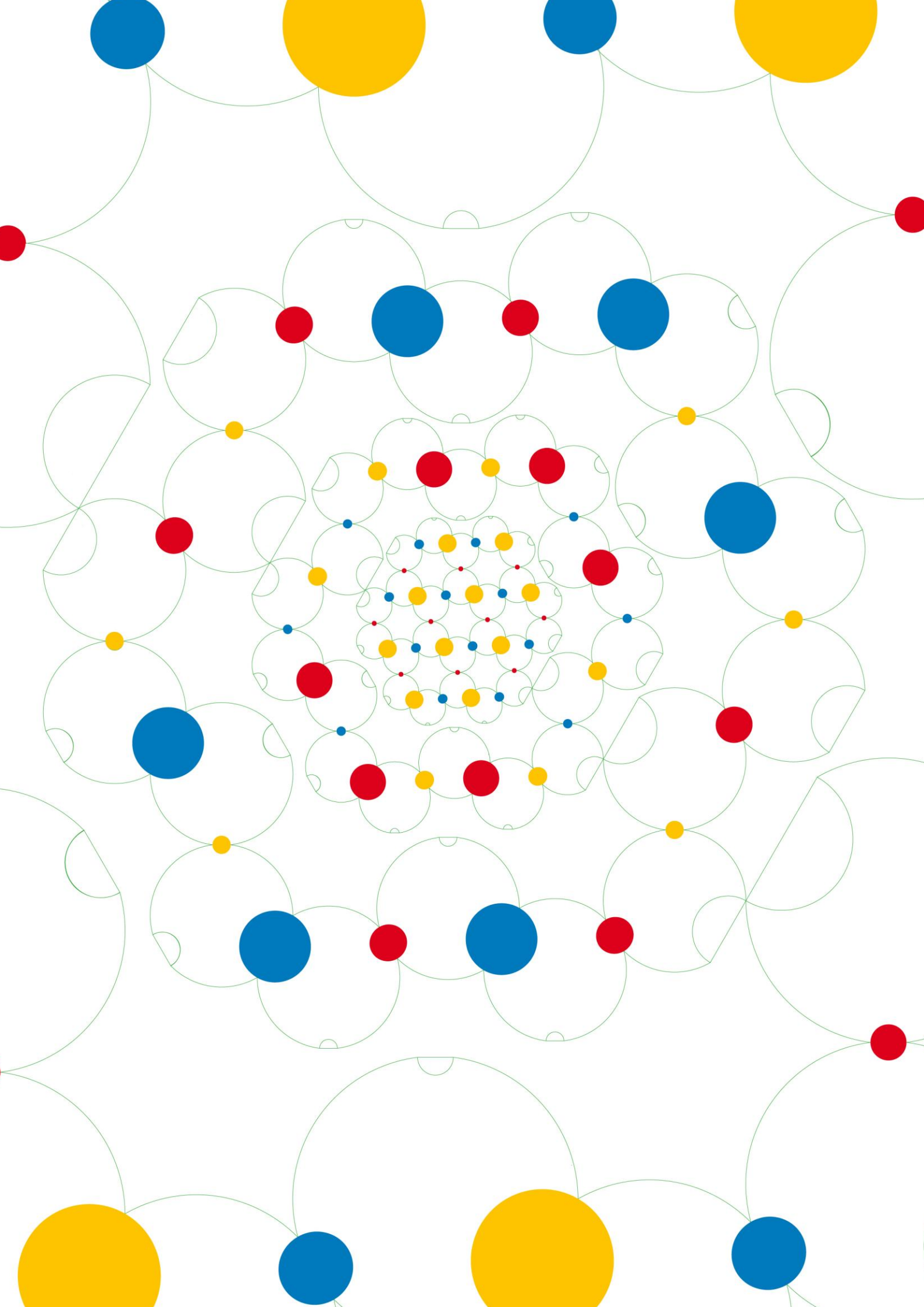
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## KINDERGARTEN-SCHOOL TRANSITION SUPPORT

Kindergarten is usually a public educational institution for children aged three to six. Traditionally, they provide care and development for children in different age groups, as well as preschool preparation. Nowadays, mixed-age groups are becoming increasingly common, resembling the sibling environment within families rather than the age-graded groups of the past. Kindergartens are regulated by various documents. These documents provide for the planned development of the child from the moment of entry until the moment of departure.

Kindergarten is where children have their first real, long-term experiences in a community. Children from different backgrounds have different abilities and needs. Kindergarten is where children first experience a sense of belonging, cooperation, and community outside of their families. This is why emphasizing community building in nursery school is important, so that the principles of democratic and cooperative learning are already established by the time children start school. It is particularly important to be adaptive and differentiated, meaning that activities are organised in individual and group settings so the content, methods, and time frames are adapted to the child's abilities.

The pre-school education programme (National Basic Programme for Pre-school Education/ÓNOAP) builds on the diversity and uniqueness of children, through social interaction to develop their abilities, and tries to support them in the learning and teaching process. The ÓNOAP also includes among the most important general tasks of pre-school education the satisfaction of the physical and psychological needs of pre-school children, including the development of a healthy lifestyle, emotional education and socialisation.

The preschool years and the nursery's education and development programme play a crucial role in school success. The emotional relationship with the kindergarten teacher and the regularity of daily routines have a significant impact. It is at this age that children lay the foundations for their success in school, in which the development of cognitive domains, including the motivation to learn (Józsa et al., 2025), plays a significant role, making them more willing to try to solve unfamiliar situations and problems with a strategy they have not yet practised.

This motivation, like all development in kindergarten, is best supported through experiential learning. When this intrinsic motivation is strong, the preschool child's engagement with the environment is stronger. Of course, to do this, a well-trained and motivated kindergarten teacher must be involved in planning and implementing this sequence of activities with the children. This motivation to learn can manifest itself in intellectual, motor and social domains (Józsa and Liao, 2017). The stronger the environmental influence, i.e. the more motivating the preschool environment, the better the child can develop in each of these domains. To do this, we need to provide challenging tasks, varied tools and space to try, even if we know they won't succeed at first.

We therefore constantly seek to present children with problem situations that encourage them to find solutions, individually or cooperatively, while also striving to develop according to their individual abilities, which means that differentiation is also a constant feature.

Play is a fundamental activity in the learning process for young children. For children, experimentation is a form of play in which everyday objects or materials can become tools for discovery. During this period, free play is a key activity in the nursery and in the family, as it is the best time to observe the characteristics of children's personalities, but it is also the time when carefully selected toys can support children's development. We can incorporate these games into any activity, whether it's a language activity, a visual arts activity or an active exploration of the outside world. The mathematical experience (Kissné Zsámboki, 2023) is also validated as part of everyday life in parallel games that can be performed in a differentiated way (quantities, numbers, relations, shapes, sets), to which the Poly-Universe can be very well linked. We promote the recognition of cause and effect relationships and logical thinking by providing a stimulating environment.

In other words, the aim of pedagogical work is to make education as effective and efficient as possible. To this end, several alternative education programmes have been developed (Waldorf, Rogers, Green Kindergarten), which are dominated by an activity-based approach. The Poly-Universe game can be used in any kindergarten with traditional or alternative programmes as a developmental supplement to facilitate the transition from kindergarten to school.

Preparation for school in kindergarten takes the form of complex development. In this case, during the course of a morning, children are involved in an activity through a motivational activity. This active phase is preceded by a parallel play activity after the child's arrival at nursery school, which can prepare the children for the day's programme. The activity has a complex impact on the children's intellectual, emotional and motor development. In this way, the nursery is not a small "school", but the children learn to stay there during the activity, develop in several areas in parallel, increase their concentration time and learn to persevere in the activities.

This complex development is also reflected in the layout of the nursery classroom, where every object can be transformed into something "magical". The layout of the nursery room is not as constrained as a school classroom. All this motivates the development of individual pathways, if the nursery is willing to work according to the objectives of the ÓNOAP.

However, we see that the social environment of kindergarten and, of course, school strongly influences the skills that a child entering kindergarten or school will bring to the next stage. A growing body of research suggests that the pre-school period plays a very important role in this (Józsa et al., 2025), perhaps in many cases more so than the foundation stage of school.

The Poly-Universe is a set of personal development activities that can be supported through play, involving complex pedagogical methods aimed at increasing opportunities. Since a methodological guide to the use of play in primary schools was drawn up several years ago, we have a wealth of experience which provides a good basis for implementing it in nursery schools. In addition, there are many similarities in the way preschool and primary school children relate to learning:

- the child becomes proficient in most things by being active and constantly doing,
- is self-actualising, likes to achieve what he has imagined,
- imaginative, often following individual paths, not yet bound by rules,
- moves from solitary to cooperative activities, which anticipates the development of cooperative learning situations,
- is characterised by a strong emotional charge, which is individual and motivating,

- is based on his own experience, building on his prior knowledge and experience,
- they are strongly motivated by the pleasure of discovery.

You might think that learning support is better in school than in nursery school, but it is not. The emphasis is on different methods and different goals. The primary aim of pre-school learning is to develop the competences of the pre-school child, where the pre-school teacher builds on the child's prior experience and knowledge to create an environment that supports learning. This is still based to a large extent on spontaneous, imitative activities, using the method of discovery and experience. In this way, we can say that children become active participants in their own development and learning processes.

The annual work in the kindergarten can be planned taking this theme into account, differentiating the depth of each element in the different age groups. It is advisable to acquire the appropriate tools, logic and strategy games for each element. Later on, the children themselves can make simple games with the help of the teacher, so that both the making and the further use of the tools are part of the activity.

Children entering kindergarten at age 3 usually come to the world of kindergarten with different social backgrounds and abilities. Many parents do not yet have access to nursery care, so nursery school becomes a place of separation from parents, which can trigger very strong emotions. This is when parents really start to compare their children's abilities with their peers in their age group. In each area of development, children are expected to do different things from one age group to another, but the outcome is determined by the level of school readiness.

We briefly present a non-exhaustive list of the school readiness requirements that the Poly-Universe game can be used to develop and include some examples of good practice exercises to demonstrate how to use the game. The game is very versatile and can be used in many different ways to ease the transition from pre-school to school, so a single task can be used to develop young children's skills in several areas.

### **1. Physical fitness:**

- a) Ability to immerse in games: constructive games lasting more than 30 minutes, following rule games, ability to use game types in a complex way. Good practice: 2\_Observation\_Memory / Kovesi\_OBS\_216\_EN.
- b) Ability to coordinate movements: climbing, jumping, alternate leg activities, walking on equipment, knowledge of directions. School-ready if use of right-left concept is appropriate. Good practice: 6\_Motion\_Rhythm / Juhasz\_MOT\_607\_EN.
- c) Combined eye-hand, eye-foot coordination: throwing with small ball, bean bag into ground target, suspended target, ball rolling and driving. School-ready if ball control is sure and the aim is relatively accurate from a distance.
- d) Fine movements: cutting, tearing, spatial creation, using scissors, touching the fingers, lacing, touching, pencil gripping. Ability to blindly name selected objects, cut shapes, stay within line, pencil grip adequate. Good practices: 6\_Motion\_Rhythm / Juhasz\_MOT\_610\_EN; 5\_Logical\_Maths / Czinkiné\_LOG\_503\_EN.

## 2. Psychological fitness:

- a) Self-assessment: failure tolerance, monotony tolerance, self-image, problem-solving, rule-following, task awareness. School-ready if motivated to perform the task correctly, rule-following, differentiated, able to perform the task regardless of interest. Good practice: 2\_Observation\_Memory / Czinkiné\_OBS\_201\_EN.
- b) Social development: social relationships, conflict management, relationship building, cooperation. Easily develops relationships, takes initiative with peers and cooperates in a reciprocal way. Good practice: 3\_Nature\_Harmony / Saxon\_NAT\_305\_EN.

**3. Language development:** social communication, vocabulary, speech, sentence formation, metacommunication. Rich vocabulary, formal, grammatically correct, adequate use of situational or contextual speech. Good practice: 7\_Tale\_Role play / Czinkiné\_TAL\_701\_EN.

## 4. Development of cognitive functions:

- a) Attention, observation: stretching the attention span, visual and auditory attention, imitation, copying. 15-20 minutes of focused attention, divided, selective, intense, sustained. Ability to discriminate identity-difference. Ability to echo melodies. Good practice: 6\_Motion\_Rhythm / Juhasz\_MOT\_605\_EN.
- b) Perception: time, space, visual, tactile and kinaesthetic perception. Good practice: 6\_Motion\_Rhythm / Juhasz\_MOT\_603\_EN.
  - Orientation in time, days, weeks, months, seasons.
  - In space, in plane (below, above, next to, between, in front of, behind, right-left).
  - Visual: identity-difference, shape-shape, colour shades, perception.
  - Finding the spatial position of objects.
  - Gestalt vision (seeing related objects as a unit).
  - Sequence, uniformity, visual rhythm, part-part, observation of changes.
  - Drawing shape and form, and blindfolded form.
  - Memory: memory length, verbal memory. Ability to recall long term memories, stories, sayings and tales.
- c) Thinking functions: the ability to think by analogy (ability to analyse – synthesise) and logically in all activities: mathematics, the outside world, music, etc. For example: number and quantity concepts, sequences, series, plane and spatial geometric shapes, measurements and units of measurement, symmetry, inanimate processes, water, living things, environmental education elements. Good practice: 6\_Motion\_Rhythm / Kelemen\_MOT\_608\_EN; 1\_Colour\_Form / Students\_COL\_103\_EN.

Some school-leaving requirements are not exhaustive:

- sets up before-and-after chronology well, pairs images accurately, uses related concepts well,
- it also identifies the quantity beyond a range of 10 and is accurate to a range of 10,
- identifying series and serial numbers, recognising geometric shapes of sphere, cube, rectangle, cone, cylinder, using them conceptually, recognising circle, square, triangle, rectangle, hexagon, pentagon,

- from the outside world: recognises the state of matter, uses concepts correctly,
- knowledge of living organisms, including habitat, conceptually differentiates between the more familiar domestic, wild and zoo animals (birds, reptiles, beetles). Knows their care processes.
- Know the basic rules of the road for pedestrians and cyclists, know the meaning of some basic signs, know the meaning of pedestrian and car traffic lights.
- From music, the concepts of steady, two-beat, rhythm, syncopation are known.

Play is the best way to achieve the above goals, because "play is the most basic activity of the preschool child and remains a fundamental psychological need when entering school." (Böddi et al., 2019, 42), i.e., play should continue to determine school activities (Kósáné, 2001). The success of the transition from kindergarten to school is multifactorial. By introducing complex development for the lower school, the two institutions would become closer, the pedagogical environment would be more similar, cooperation would become more continuous and active by having similar methodological approaches, which would greatly help the smooth transition. The use of the Poly-Universe kit in kindergarten and school could provide continuity for children in the transition phase.

Activity-based learning is nothing other than project-based, innovative learning through observation and direct experience, with a focus on such learning processes.

The projects are offered by the kindergarten teacher (based on children's interest, curiosity, current events, previous experiences), and after selecting them, we divide each project into themes and activities. Activities are not separated, complexity is kept in mind and constructive learning is favoured, embedded in differentiated, parallel play activities. Children are constantly provided with hands-on experiences in which they become active participants according to their interests, thus supporting the development of their competences. Their confidence is supported by providing experiences of success and concrete, personalised positive reinforcement. This can be a form of knowledge delivery that can also make the learning process more successful in the lower school.

The Poly-Universe kit is the best way to strengthen thinking functions. The main goal of developing logical thinking is to integrate playful, experiential methods into education that help children develop their logical, thinking and problem-solving skills. And here the emphasis is on "playful", since play is the main activity of children. It is a kind of natural learning process in which experiential learning is an essential element. It is important that it should be a voluntary activity in which thinking and learning skills are developed (Kissné Zsámboki & Varga, 2023).

The following annual themes are recommended for primary school, which can be well linked to good practices with play:

1. The theory of problem solving and how to develop it in practice.
2. The role of visuality in the development of thinking – arts for the development of thinking.
3. Game-based approaches.
4. Game-structured approaches.
5. Develop creativity and reflectivity.

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## USING MANIPULATIVES AND CONSTRUCTION GAMES IN MATHEMATICS TEACHING

The tools used in the learning process are those that promote a deeper understanding, support learners in making connections between knowledge and enable them to work with new information in meaningful ways. They offer flexibility and autonomous control and help learners to formulate creative ideas. It is important to stress, however, that they are not sufficient by themselves: to be used effectively, they need to be embedded in targeted teaching tasks, with the active guidance of the teacher. This raises the question of how the use of the latest digital technologies and smart tools, such as maths apps, fits in with the existing pedagogical experiences and traditional approaches, especially for pre-school and primary school children. Can these tools provide the same experiential learning as tangible, concrete games and activities? Or do they complement them, adding new dimensions? In the 21st century, it is almost universally accepted that the use of these digital tools has become inevitable and that the development of digital literacy requires their early involvement. However, the question remains: what proportion of traditional games should be present and how can they be integrated?

The following provides a brief theoretical overview of how mathematics appears in the world of young children, what age-specific characteristics influence their experiences, what activities and games contribute to the development of mathematical thinking and what tools support and mediate this process.

### 1. Mathematics in Early Childhood: Learning Through Play

Even though the conceptual framework of mathematics is fundamentally abstract, it can still be established in early childhood with an appropriate pedagogical approach. To achieve this, it is essential to start from the child's age-specific characteristics, using concrete, motor-based activities and real-life actions. The concept of play-based learning is strongly supported by constructivist learning theories, particularly the views of Jean Piaget and Lev Vygotsky. According to Piaget's theory, 5–6-year-old children are in the preoperational stage of cognitive development, where learning can be effectively supported through the use of tangible, hands-on tools—what he referred to as "manipulatives." A playful approach—especially one based on objects—fits ideally with this developmental stage. Based on Piaget's theory, the internalization of such operations makes the child's active, hands-on play particularly significant in mathematical education (Zsámboki & Horváthné, 1998).

Vygotsky's theory of social interaction further reinforces the importance of play: during play, children not only learn but also help one another, engaging in a supportive process where peers or the teacher provide assistance. While play-based learning is fundamentally learner-centred, the teacher also plays an important role in guiding the learning process when necessary. Knowledge acquisition occurs step by step, making it effective and child-friendly.

The learning process is built according to the 5E model: Engagement, Exploration, Explanation, Elaboration, and Evaluation. Games appear during the "Elaboration" phase, when children already

possess basic numerical and operational concepts that they can apply through play. Each game begins with rules that are easy for children to understand and follow.

Drew's (2023) learning theory explains how the learning process takes place, outlining a clear set of principles that teachers can use to support student learning. It is a framework that explains how people acquire and retain knowledge. It systematically describes how individuals process and respond to new information.

In this study, preschool teachers used games in teaching and learning to achieve the competencies expected from preschool children. The games were used to encourage learners to engage in learning and actively participate in classroom discussions. Therefore, play helps preschoolers absorb, process, and retain knowledge by following the instructions of each game.



Figure 1: Preschool Tools (source: Internet)

In early childhood, the teaching of mathematics should primarily be based on the child's own activities, play, personal experiences, and real-life situations. The goal is not merely the transmission of knowledge, but the creation of engaging experiences, motivation, and the development of a positive attitude—through tools that support successful learning (Dienes, 2015, p. 47).

During preschool activities and early primary school lessons, the use of teaching tools is especially important, as learning at this age is primarily based on experiences. Children gain fundamental knowledge by creating and experimenting with mathematical models of real-world problems—knowledge that can later serve as a foundation at more abstract levels (Pálfalvi, 2007).

A child's personality is shaped through activity—similar to a living organism that does not begin functioning after development is complete, but rather develops through its functioning (Lénárd, 1971). The involvement of the hand and concrete actions does not signify lower-level thinking; on the contrary, it offers an opportunity to attune to abstraction and to gradually generalize (Szendrei, 2005, p. 319).

The natural way of learning mathematics is through real-life, everyday activities. This experience must be lived through first, before placing it into a formal learning framework—an idea also supported by Freinet (1982). As early as around the age of two, children begin to demonstrate thinking during their activities with manipulatives, constructive play, and functional use of objects.

At this stage, they are only capable of mental operations within the framework of actions directed toward real objects. These experiences become visual memory traces which, when recalled, gradually lead to the development of basic thinking operations—initially on the concrete level, and later on the imaginative level (Zsámboki & Horváthné, 1998).

The foundation of Montessori's pedagogy (1964) is that the child discovers the world through their own senses. Her didactic tools consist of practical and enjoyable activities that support the understanding and internalization of concepts.

In Bruner's theory (1973), three levels of knowledge acquisition are distinguished:

The enactive level is based on concrete, physical actions, which is especially important in early childhood education.

The iconic level supports deeper understanding through visual images and imagined situations.

The symbolic level uses mathematical symbols and linguistic codes. However, it is important not to introduce a level too early, only when the children are ready for it. Since children's levels of development can vary significantly even at the same age, we must also ensure a smooth transition, even using different levels in parallel.

One of the main pillars of Tamás Varga's complex mathematics teaching method was also the use of tools, which made it possible to model and experiment with real-world problems (Pálfalvi, 2007).

Visual representations —such as drawings, diagrams, and models— can be especially helpful for understanding problems. It is important that learners become consciously familiar with their use from an early age. Their application is not only beneficial for students who progress more slowly, but essential for all learners throughout the learning process (Wittmann, 1998).

Based on cognitive psychology research, two main assumptions can be made regarding representations. First, that there is a close connection between internal and external representations—manipulation of external representations (e.g., objects, pictures) can give insight into internal cognitive structures. Second, the relationships between different internal representations can be modelled through the connections between external representations (Ambrus, 2000).

The use of manipulative tools enables direct experience, promoting learners' active participation in the knowledge acquisition process (Clements, 1999). These tools are especially important in early childhood, when understanding is based on sensory and motor experiences as well as on visual thinking. Preschool children can only grasp geometric concepts to the extent that they are able to perceive them through their senses, manipulation, and emotional-volitional engagement (Zsámboki & Horváthné, 1998).

It is advisable to implement hand-based manipulations using real, physical materials, as these significantly develop children's sensory perception, memory, imagination, and spatial awareness. Although digital tools are increasingly present in education, we believe that the online environment cannot fully replace activities based on tangible, concrete experiences. Manipulative tools may include: cardboard, fabric, plastic, pencils, food, cutlery, cans, bottles, ropes, caps, rubber, twigs, leaves, stones, flowers, seeds, and other materials. Debrenti and László (2020) transformed well-known, classic card games into educational games and used them to develop mental arithmetic skills in second-grade primary students. These paper-based cards proved to be an effective tool,

promoting development compared to traditional practice methods. The experimental group showed significant improvement compared to the control group. After the intervention, the children in the experimental group were able to perform the correct mental calculations in a shorter time than the control group as a result of the ten hours of play.

However, several researchers (Clements, 1999; Moyer, 2001; Swan & Marshall, 2010) emphasise that manipulative tools alone do not guarantee a true understanding of mathematical concepts. Learners must be able to reflect on their activities and actively explore the concepts themselves. In this process, the role of the teacher is especially important, as they can help connect the mathematical relationships between concrete tools and abstract symbols (Van de Walle et al., 2009).

A study conducted with adults working in technical fields revealed that their career paths could often be traced back to early childhood experiences. Many interviewees mentioned that the role models at home and the supportive attitudes of their families greatly influenced the direction of their interests. Several participants highlighted that as children, they often received logic, memory, or construction toys, which later influenced their career choices as well (Olasz, 2021).

Debrenti (2025) found that incorporating chess into both primary classroom instruction and leisure activities is valuable, as it enhances mathematical and strategic thinking while also fostering character development and the overall growth of elementary students' personalities.

Based on all of this, it can be concluded that the types of toys and tools a young child encounters are far from insignificant. Early experiences and play memories not only support cognitive development but may also have a long-term impact on the child's interests, learning attitudes, and even future career choices.



Figure 2: Middle Group Preschoolers Using the Poly-Universal Tool (source: own photo)

## 2. The Development of Spatial Awareness and Its Importance in Mathematical Thinking

When examining the development of spatial awareness, Piaget (1970) identified three distinct stages. In the first stage, the child learns to distinguish objects based on their shape and distance, recognizing both isolated and grouped characteristics. At this stage, two-dimensional perception predominates, and spatial skills typically develop between the ages of three and five.

In the second stage, the child becomes capable of imagining three-dimensional objects from different viewpoints and perceives their movement and spatial transformations. However, at this stage, interpreting unfamiliar or complex shapes can still be challenging.

In the third stage, the child develops the ability to visualise spatial relationships, sizes, and distances, and to perform operations based on internal maps, such as rotation, reflection, or assembly.

The initial development of spatial thinking is primarily based on movement, action, tactile, and other sensory experiences. Later, symbolic cognition gains increasing importance —through language, gestures, maps, and models—, which enable the child to surpass the limits of direct sensory information (Clements, 1998; Newcombe et al., 2013).

It is important to emphasise that spatial operations related to the second and third stages—such as perceiving space, forming mental images, and mentally manipulating them—can still pose challenges even in adulthood. This is because solving spatial problems requires complex cognitive processes involving multi-step operations and the coordinated functioning of various cognitive abilities, such as visual memory, comparison, and integration of perspectives.

Although mathematics education generally pays considerable attention to developing different abilities, the proportion of geometry content—which particularly supports the development of spatial awareness—is unfortunately decreasing. This is problematic given that PISA assessments highlight the strong demand for spatial skills in solving many applied mathematics tasks. Items classified under the “space and shape” category measure eight different types of spatial thinking operations, which are also key for practical problem-solving:

- Estimating the area of a floor plan
- Mentally rotating a building
- Calculating the surface area of a roof (imagining a 3D shape from 2D projections)
- Perceiving spatial situations and relationships
- Estimating areas and distances
- Mental viewpoint changes
- Mental transformations (imagining paper folding) (Babály, 2020)

## 3. Opportunities and Research Directions in the Development of Visual-Spatial Abilities

The study of visual-spatial abilities has received increasing attention in educational sciences and cognitive psychology research in recent years. Currently, these investigations focus mainly on two age groups. One target group consists of preschool and early primary school children, where researchers aim to uncover the main stages in the development and formation of spatial perception. The other group includes young adults entering higher education, where studies primarily examine deficiencies in spatial skills and opportunities for their development.

International research findings indicate that spatial perception can be effectively developed up to the age of 18, as well as among young adults, particularly through targeted, well-structured training programmes. The evaluation of these programmes typically involves pre- and post-testing. The extent of performance improvement is largely determined by the duration of the programme and the frequency of sessions, while the types of tasks used and the learning environment have less influence on the outcomes.

Nevertheless, a challenge in this field is the relative scarcity of long-term (longitudinal) studies focused on the development of visual-spatial abilities, as well as limited data from qualitative research methods (e.g., observations, interviews, case studies), which could provide deeper insight into the developmental processes and individual learning paths of students (Babály, 2020).

The national curriculum aims to develop skills such as planar orientation, spatial visualization, spatial reasoning, and the ability to identify geometric figures across various contexts (Debrenti, 2016). Regarding activities that promote the development of visual-spatial skills, it is important to highlight that not only formal educational settings play a role, but non-formal and informal learning contexts can also have a significant impact. Research suggests that the following types of activities can indirectly but importantly contribute to the development of spatial thinking: construction play, craft and DIY activities, computer games, sports and arts.

#### **4. The Importance of Developing Constructive Skills in Early Childhood Education: Construction Play**

The importance of developing constructive skills is already emphasised in the preschool period, as experiences and learning acquired before school have a long-term, comprehensive impact on a child's later development (Barnett, 2011). In the history of educational use of construction and building play, the pedagogical work of Friedrich Fröbel is indispensable. Fröbel (n.d.) believed that play in childhood is the highest form of self-expression because it allows children to freely express their innermost thoughts and feelings. Through direct exposure to the world during play, children develop their knowledge of the world. His ideas about learning through nature and the significance of play became widespread worldwide. Play is not idle behaviour but a biological necessity for discovering how things work. It is an enjoyable activity but biologically purposeful. Fröbel's goal was to channel children's natural playful energy into concrete activities that help them understand their experiences better; thus, kindergarten play should be used as a learning activity in preschool education. He developed a system of play tools called "gifts," accompanied by detailed methodological guidelines. "In Fröbel's kindergarten, knowledge acquisition did not happen through speech and intellectual exercises, but through action, activity, and creation" (Szabolcs & Réthy, 1999, p. 364). Most of Fröbel's play materials were monochromatic, indicating that the emphasis was on understanding structural relationships between geometric elements, thereby fostering the development of analytical and interpretive spatial thinking.

Maria Montessori's pedagogy, in contrast, emphasises the importance of spontaneous activities based on sensory experiences. Montessori highlights the significance of learning through discovery and self-initiated play. This practical approach enables children to develop a deep understanding of concepts through exploring and manipulating materials. The use of Montessori materials places special focus on experiences related to visual, tactile, thermal, and weight sensations, as well as auditory effects, allowing for complex sensory development.

From the 1950s onward, construction and building play experienced a renaissance. It was recognized that these types of play contribute to the development of mathematical, physical, and chemical literacy, as well as logical thinking. During this period, the United States government supported the integration of such tools into school curricula to establish a foundation in natural sciences and mathematics (Hewitt, 2001).

Current educational trends also favor the use of construction and building play, as playful learning, active experiential learning, and knowledge construction have become supported pedagogical goals. McKnight and Mulligan (2012) emphasise that these types of play can capture children's intuitive and informal knowledge, providing opportunities for differentiated mapping of thinking and skills. Their research examined children's spatial problem-solving abilities through open-ended tasks.

However, when introducing a new play material into the teaching-learning process, a key question arises: how can the balance between the developmental impact of the play and the play experience itself be maintained? Children do not necessarily prefer to play with what has the greatest developmental potential. Therefore, researchers are increasingly focusing on the possibilities of game-based learning and methods for integrating various types of play into formal education (Babály, 2020).

In today's toy market, numerous construction, building, and logic games aimed at developing spatial abilities are available. Traditional construction toys are generally classified into three main categories:

1. construction elements displaying symbols, letters, and words;
2. simple, abstract (geometric) shapes;
3. models and architectural structures.

Each category serves a distinct function, although overlaps frequently occur among them (Hewitt, 2001). The first group of toys can facilitate the integration of conceptual and visual thinking, while models and scale replicas enhance the perception of proportions and scale. A separate category is occupied by logic and puzzle games specifically designed to develop mental spatial skills—such as mental rotation and transformation. These games can be effective not only in early childhood but also throughout school age. Nonetheless, in domestic educational practice, they are mainly used regularly by special education teachers, speech therapists, and less frequently by kindergarten teachers, primary school teachers, or language instructors, meaning their full potential often remains underutilized (Babály, 2020).

The Tangram belongs to the second category and is one such game that supports cognitive development in early childhood. Tangram is a Chinese puzzle consisting of seven flat shapes: five triangles, one square, and one parallelogram. The goal is to arrange all seven pieces to form various figures, ensuring that none of the pieces overlap. Tangram is not only entertaining but also enhances logical thinking, visual memory, and spatial perception. Originally from China, the game dates back to the Tang dynasty. It became popular in the West during the 19th century and remains one of the most well-known puzzle games. Tangram is easy to play; its colours are attractive, and it optimally develops the ability to recognise geometric shapes.

During learning, adhering to the rules is important. For children aged 3 to 4, a beginner's version of Tangram, consisting of one triangle, one rectangle, and one square, can be used.

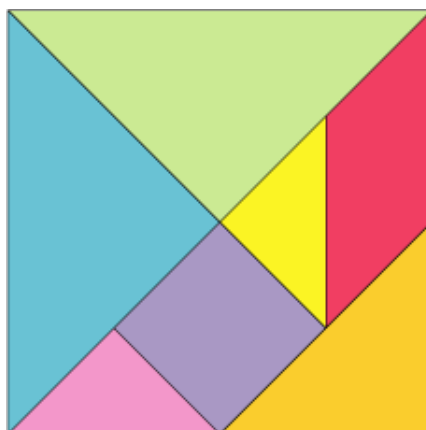


Figure 3: Tangram (source: Internet)

## 5. The Principles and Tool System of Montessori Pedagogy in the Context of Mathematical Education

At the turn of the 19th and 20th centuries, new trends emerged in educational practice. The development of these approaches was driven partly by criticism of classical pedagogy and partly by the growing body of research in child psychology. During the formation of alternative pedagogies, the work of outstanding educators who consciously stepped outside traditional teaching frameworks and introduced novel perspectives to education became influential. Among the most well-known figures are Celestin Freinet, Rudolf Steiner, Peter Petersen, Helen Parkhurst, and Maria Montessori (Szabó & Thalmeiner, 2015).

### Principles of Montessori Pedagogy

In Montessori learning, the child is the central component, while the adults' role is to prepare a communicative environment and support the child's need for independence. Montessori education aims to nurture children into fully developed adults by emphasizing their innate potential.

Maria Montessori's pedagogical system is based on the child's autonomous activity. She believed that children develop best when they have the opportunity to engage independently at their own pace. In traditional school practices, children are often passive recipients, whereas the Montessori method encourages active participation, exploration, and creation. This approach also motivates learners to work at their own speed and find success in their achievements, rather than seeking external recognition or rewards.

The teacher's role in this system is not to transmit knowledge but to create a supportive environment. Montessori developed various educational tools designed to encourage children to engage in activities and enable independent learning. The essence of the method is that children work with materials appropriate to their developmental level, gradually building their personality based on internal motivation. Freedom and choice are central elements, with the teacher observing attentively and intervening only when the child's development requires it (Németh, 1998).

### Overview of the Montessori Tool System: Mathematical Developmental Tools

Maria Montessori developed a complex system of educational tools focusing on various developmental areas. One of the largest groups comprises sensory development tools, which

enhance touch, smell, sight, shape perception, as well as temperature and weight perception. Additionally, cosmic education tools play a key role, laying the foundation for geographical and natural science knowledge. Physical education, music education and literacy teaching also utilize their own specialized materials.

Particularly noteworthy is the group of tools related to mathematical education, which are especially effective in establishing number concepts and practising basic arithmetic operations. One of the greatest advantages of Montessori materials is that children experience learning as a playful, hands-on process (B. Méhes, 1997).

Montessori pedagogy places special emphasis on grounding number concepts and the playful practice of fundamental mathematical operations. Numerous tools are available to support the understanding and practice of addition and subtraction within the number range of 0 to 10. This section presents six tools particularly suitable for first-grade children.

### a) Red-Blue Rods

The Red-Blue Rods (see Figure 4) are among the simplest Montessori tools used for teaching mathematics. These wooden rods alternate between red and blue colours at one-decimeter intervals. The shortest rod measures one decimeter, while the longest rod is ten decimeters (one meter) in length.

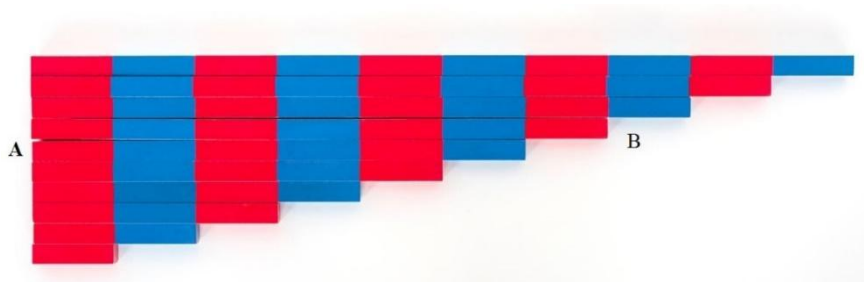


Figure 4: Red-Blue Rods

The child places the rods one above the other according to their length. The very first rod is the shortest, labeled as 1. This is followed by the next red-blue rod that is one unit longer; the child counts its alternating coloured segments, which represents 2. The child repeats and practices arranging the rods by size. They discover that the longest rod consists of 10 units. When counting the rods placed on side A, the child counts 10 units, and similarly, when running a finger along the stepped side B, the child also counts 10 steps. This discovery encourages further exploration and activities (Gutec, 2004).

This tool is very simple yet offers versatile usage possibilities. Initially, the child learns to differentiate the concepts of longer and shorter using the rods before they start learning to count. Subsequently, the rods help in developing the concept of numbers and play an important role in learning addition and subtraction. They are also useful for introducing measurement units, such as the decimeter and the meter.

During the development of the number concept, the child discovers that two shorter rods can be combined to form a rod equal in length to the 10-unit rod (10 decimeters), thus practising number decomposition. The child also notices that every rod starts with a red segment, but not all rods end

with a red segment. From this, the child infers that rods ending with a blue segment represent even numbers, while those ending with a red segment represent odd numbers (B. Méhes, 1997).

### b) Sandpaper Number Cards and Operation Symbols

The sandpaper number cards (see Figure 5) consist of numerals cut out from sandpaper and mounted on cardboard sheets.



Figure 5: Sandpaper Number Cards

The child traces the contour of the numeral with their finger, which helps them memorize its shape better, as they not only see but also touch and feel it (B. Méhes, 1997). For this reason, these tools play an important role in learning the writing and recognition of numerals. They are similar to the cards used for teaching letter writing. These cards are introduced to the child step-by-step. The educator presents them by saying, for example, “This is one,” “This is two.” Subsequently, the child is asked to select the requested card from the set, e.g., “Give me the six.” The numeral and quantity tools can also be used in conjunction with other Montessori materials, enabling the child to understand that the numeral two corresponds to two objects (e.g., two discs) (Gutec, 2004).

### c) Numbers and Counters

The numbers and counters set (see Figure 6) consists of a two-compartment box. One compartment contains red cardboard cut-out numbers from 1 to 10, while the other compartment holds 55 red counters.



Figure 6: Numbers and Counters

The basic operation that children perform with this tool is to place the numbers side by side in ascending order, then place the counters under the numbers in pairs. This task is more challenging than using the red-blue rods or the bead rods, because the counters are not connected as a unit but

must be grouped individually according to the value indicated by the number. When the counters are placed in pairs, it becomes clearly visible which numbers are odd, as there will always be one counter left alone in the centre for odd numbers. The literature mainly discusses this paired arrangement, but this tool can be used in various other ways as well (B. Méhes, 1997).

#### d) Bead Rods

The bead rods (see Figure 7) are also very simple yet versatile tools. They consist of larger beads strung on a wire, forming rod-like shapes.



Figure 7: Bead Rods

In the classic Montessori toolset, each bead rod corresponding to a number has its own colour as follows: 1-red, 2-green, 3-pink, 4-lemon yellow, 5-light blue, 6-purple, 7-white, 8-brown, 9-dark blue, and 10-golden (B. Méhes, 1997).

#### e) Addition Teaching Stripe Board

The additional teaching stripe board is essentially a grid board (see Figure 8), consisting of 18 columns and 12 rows.



Figure 8: Addition Teaching Stripe Board

The columns at the top of the board are numbered from 1 to 18, as shown in the picture. Numbers up to 10 are written in red, and the number 10 is followed by a vertical red line indicating the transition past ten. The numbers from 11 to 18 are written in blue. The board comes with a set of red and blue wooden strips of varying lengths corresponding to the numerical value they represent. This tool is suitable for practising addition, and through using the board, the child can also learn the properties of addition. (Ujhelyi, 2006)

### f) Subtraction tasks and differences

The set of tools for subtraction tasks and differences is very simple and, unlike the previous tools, is used exclusively for practising subtraction (see Figure 9).



Figure 9: Subtraction tasks and differences

It consists of a two-compartment box, with subtraction cards in one compartment and the differences in the other. The children's task is to match the subtraction problems with their corresponding results. The set also includes a table of differences, which allows for self-checking (Olson, 2015).

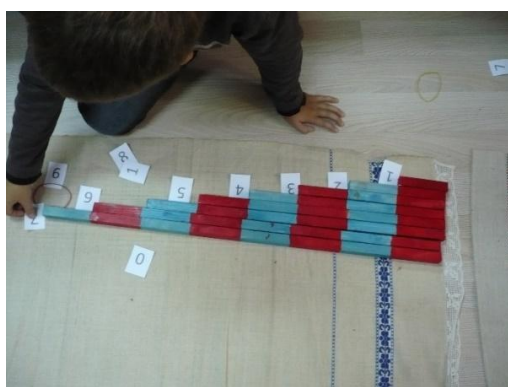


Figure 10: Red-Blue Rods in Use

## 6. The Dienes-Varga Method: Teaching Tools and Dienes Blocks

Zoltán Dienes worked with hundreds of teachers and thousands of children worldwide to promote understanding and enthusiasm for mathematics. He travelled nearly the entire world, advocating his methods which emphasise that play is the most effective tool for teaching mathematics. One of Dienes' core principles was that mathematical learning can begin much earlier than previously thought, especially if combined with games, manipulative tools, dance, and storytelling. His famous saying was: "Give me a mathematical structure, and I will make a game out of it." He believed that the thought process of children under 12 is fundamentally constructive, and therefore most children are not yet capable of understanding abstract problems that rely on analytical thinking. For this reason, he placed playfulness, movement, music, singing, and storytelling activities at the centre of teaching. He emphasised the importance of children experiencing learning within their own physical and intellectual environments.

Dienes viewed mathematics education as a tool for the complex development of personality. Instead of competition, he encouraged group collaboration and shared play. He was among the first to openly state that in learning, differences among children are not only gradual, but also qualitative. He held that every child reaches a concept through different paths, so grouping by ability does not necessarily create homogeneous groups.

Moreover, Dienes further developed the theory of meaningful learning. He demonstrated that rote learning is less applicable in mathematics because the focus is on structure rather than content. He saw the essence of mathematical thinking in open-ended, infinite thinking.

According to him, learning is based on three types of play:

1. Preparatory games (free exploration)
2. Structured games (guided observation and experience)
3. Practice games (application and reinforcement)

Dienes divided the process of concept formation into six stages:

1. Free play
2. Playful activity
3. Searching for common features
4. Representation
5. Symbolisation
6. Formalisation

He also emphasised the principle of mathematical variability. The essence of this principle is that a concept should develop in children's minds not through a single example, but through many different concrete representations (perceptual variation, multiple concretizations).

He was firmly convinced that construction should precede analysis, since analytical thinking becomes conscious only later, around the age of 12.

### Teaching Tools and Dienes Blocks

Dienes developed numerous playful teaching tools that encouraged thinking not only for children, but also for adults. His best-known invention is the Dienes block (also known in English as Dienes Multibase Arithmetic Blocks), which aids in understanding positional number systems. He believed that the decimal system can only be truly understood if learners are also introduced to other number systems.

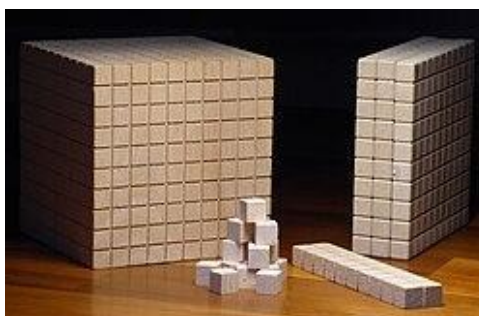


Figure 11: Dienes Blocks (source: internet)

The Dienes logical set is also excellently suited for the playful foundation of set theory and logical thinking, as it consists of elements with various shapes and properties. The elements are classified by:

- Shape: squares, circles, triangles
- Colour: blue, red, yellow, green
- Size: small or large
- Surface: hollow or solid



Figure 12: The Dienes logical set (source: internet)

### **Zoltán Dienes and the Methodology of Playful Experiential Mathematics Education**

One of the most important challenges of modern mathematics education is to ensure that mathematics does not appear to learners as an abstract, dry science, but rather becomes a vivid, exploratory learning process. The pedagogical work of Zoltán Pál Dienes and Tamás Varga was aimed at achieving this goal. Their key effort was to spread mathematics education based on playful, experiential learning that builds on children's natural curiosity, their need for movement and play. Zoltán Dienes, mathematician and educator, aimed to transform learning mathematics into a joyful, creative activity. He believed that children's thinking is constructive, and therefore, during learning, active experience and discovery should take precedence over the mere transmission of fixed knowledge. According to him:

1. The teacher is a guide, not a knowledge transmitter.
2. The source of knowledge is the child's experience, not the teacher's lecture.
3. Internal motivation is crucial, not external rewards.

### **Dienes' Four Pedagogical Principles**

1. The Principle of Dynamics: Ensures continuity and gradual progression in learning. Learning stages: free play → structured play → practice/analysis → symbolisation → formalisation.
2. The Principle of Constructivism: The child reaches mathematical concepts through their own constructions and active engagement.
3. The Principle of Mathematical Variability: Concept formation is more effective when children encounter many variations of a given concept.
4. The Principle of Perceptual Variability: A mathematical concept becomes understandable and learnable through multiple perceptible representations.

### **The Six Stages of Concept Formation (Dienes' Learning Stages)**

1. Free play: The child explores the tool and gains experience.
2. Structured play: Purposeful and rule-governed use of the tool.
3. Analysis and searching for common features: The child compares and organizes.
4. Representation: Graphic depiction of experiences.
5. Symbolisation: Graphic elements transform into mathematical symbols.
6. Formalisation: The learner applies and uses abstract concepts.

### **Play as a Learning Tool**

Dienes not only formulated his principles theoretically, but also developed concrete tools and games. These are not only entertaining but also demand intensive intellectual work from children, simultaneously developing logical thinking and problem-solving skills. Experiences gained through play lead to deeper understanding because learners:

- Learn through their own senses and movement
- Are not afraid of making mistakes
- Are active participants in the learning process
- Find joy in learning

Dienes paid special attention to incorporating musical, movement-based, and storytelling elements, recognizing that these activities carry hidden mathematical structures (Debrenti, 2019).

### **Opportunities for Classroom Application**

Traditional curriculum mathematics education is often overcrowded and abstract, seldom building on children's experiences and intrinsic motivation. In contrast, the Dienes approach is experience-centred and child-friendly, considering individual differences and supporting interdisciplinary and holistic personality development. The teacher's task is to seek varied, realistic tasks connected to children's everyday experiences, adapt them as needed to be tangible, and support children in discovering connections through their own explorations.

Cooperative learning methods, open-ended tasks, and group problem-solving are tools that promote active student participation and success. Zoltán Dienes' pedagogical legacy remains timely and indispensable today. He advocated as a fundamental principle that learning must be experiential, activity-based, and rooted in the child's inner world and motivation. His methodology not only facilitates mathematical knowledge acquisition but also supports the development of the child's whole personality, contributing to raising an open-minded, critically thinking, and independently learning generation.

## 7. The Poly-Universe Game Family

Invented by János Szász Saxon, a visual artist, the Poly-Universe game family aims to connect art with mathematics through its simplicity. This game family not only targets students with outstanding logical thinking skills in mathematics, but also seeks to engage those who excel in artistic styles through its formal design and simple colour scheme. By linking art with formal structures, the learner uses both hemispheres of the brain, fostering thinking and forming systems of relations.



Figure 13: The three basic shapes of the Poly-Universe

The Poly-Universe game family is built upon three basic shapes: circle, triangle, and square. Each set based on these shapes consists of 24 game pieces. The colours of the game family are red, green, yellow, and blue. Every game piece contains all four colours, which makes the game very eye-catching. The base colour is the colour of the central area of the specific game piece. Each game piece can be divided into four size-based parts: the base element part (A), the large part (N), the medium part (K), the small part (P), and in the case of the square, there is also a whole part (L) (Andić et al., 2022).

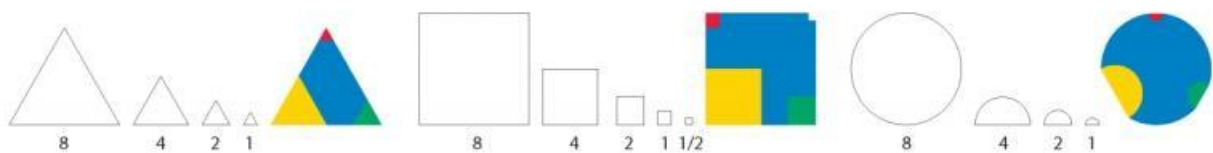


Figure 14: All four colours are present on the Poly-Universe game pieces

How can we play with this game family? They can be connected at the vertices, along the edges, or—in the case of circles—along the diameter, based on colour or shape. The variations are countless. The connections can be shifted or slid depending on what shape we want to create or what we want to demonstrate to the learners. Closed shapes can also be built: from all the triangles, one large triangle; from all the squares, one large square; or from all the circles, one large circle. Open shapes can be formed as well, connecting pieces according to certain rules, by shape or colour.

We can even recreate the shapes of objects around us using the Poly-Universe game family, utilizing either identical or different game pieces.

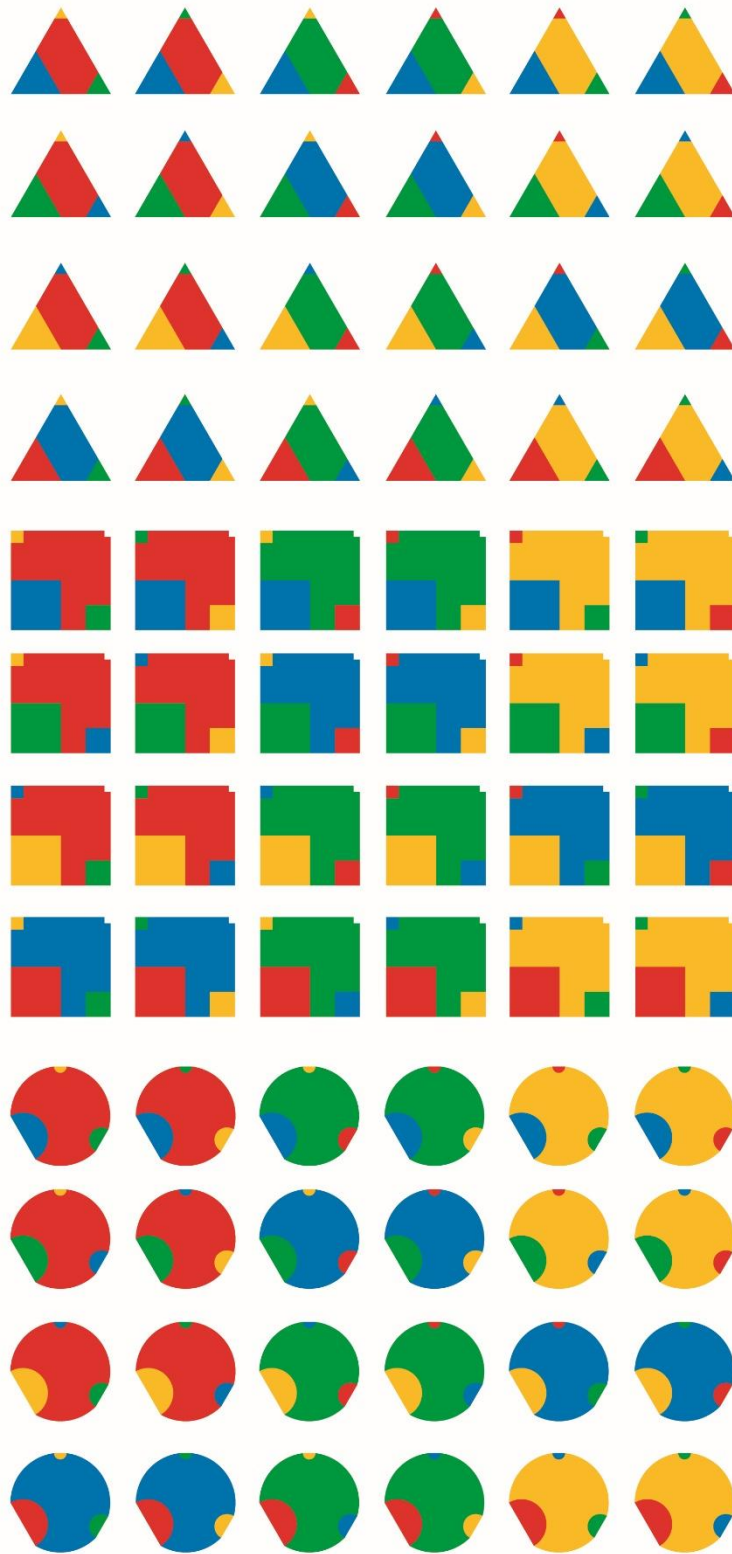


Figure 15: The complete Poly-Universe set



Figure 16: Joining Poly-Univers elements at the edges



Figure 17: Joining Poly-Univers elements at the vertices



Figure 18: Sliding assembly of Poly-Univers elements

Over the past ten years, this game has been tested by thousands of teachers and students of various age groups (6–18 years) in hundreds of institutions and events (school workshops, conferences, “art and mathematics” festivals, and museums) across Europe.

In their study, Debrenti and Bella (2025) introduced the Poly-Univers game family to students in grades I–VI and mathematically gifted high schoolers. Their findings revealed improved attitudes toward mathematics and demonstrated the toolkit’s versatility across various subjects—including personal development, language, mathematics, and art. The hands-on approach also fostered creativity, engagement, and confidence among students.

## 8. The Poly-Univers Set: An Engaging Educational Tool

The Poly-Univers set consists of simple geometric shapes that follow a clear proportional system. Its vibrant colours and variety immediately captivate users, inspiring them to create and explore. This process of discovery is engaging and enjoyable, where participants naturally produce outcomes, solve problems, and create new forms. Completing a shape encourages further exploration, modification, and reconfiguration, deepening the learning experience.

The Poly-Univers set serves as a powerful tool in experiential education. According to the principles of experiential learning, key goals include motivating learners through active participation and enjoyable activities that encourage them to engage further and improve their skills. The set’s colour

combinations and forms make it highly adaptable for integration into various elementary school subjects as a didactic game. Through gameplay, students collaborate, analyze, and evaluate while solving problems — all within an enjoyable learning experience that prepares them for real-life challenges.

Successful use of the set requires careful planning. Game rules must be precise and clear to all players, and trial sessions should precede actual gameplay. It is important to ensure that the experience remains enjoyable for the children and that every student in the class can participate. The Poly-Universe set is safe and suitable for all age groups.

High-quality games provide significant benefits for learners by offering opportunities for choice, adaptability, and active engagement. Carefully designed to align with cognitive and mathematical structures, these games support the integration of diverse forms of knowledge and promote meaningful learning connections (Debrenti, 2024a). The Poly-Universe game family is one such high-quality game.

### **The Use of the Game Across Different Subjects**

The Poly-Universe game set can be utilized as a didactic tool in various subjects. It can be integrated into weekly or daily thematic lessons, adapting to the opportunities these topics provide. The first subject where we tested the set was mathematics. Within this subject, the pieces were used as tools to assist first graders in learning addition and subtraction.

The second subject in which we tried the game was art, also with first graders. The students traced around the shapes to create pictures and then painted them with watercolours, choosing their favorite colours.

The next two subjects where the game set was used were native language and personality development, again, with first graders. Debrenti (2024b) found that learners are receptive to new learning experiences and demonstrate a willingness to collaborate with the teacher when exploring new, unfamiliar tools, even in case of other classes.

### **Detailed Description of the Didactic Game Used in the Native Language Class**

Objective: To recognise phonological phenomena and consciously apply phoneme awareness: blending phonemes represented by letters.

Teacher: Bella Hajnal Annamária

Name of the exercise/game: “Let’s play with sounds/letters!”

Preparation: Associate small printed letters with the colours red, yellow, green, and blue, and display these colours on the board. Underneath each colour, hang the corresponding small printed letter. In my case, the letter *p* is associated with red, *á* with yellow, *c* with green, and *k* with blue. For this exercise, we also need coloured dice, which can be made out of cardboard. The dice has four sides coloured with the four colours, and the remaining two sides have question marks. When someone rolls a question mark, they can choose from the available options described below.

Next, take out the triangle-shaped Poly-Universe set and discuss the meanings related to the sizes of its elements:

- The colour of the base element corresponds to the letter on the board.
- If a student rolls the same colour on the dice as the base colour of the element, they have to say a word (not a name) starting with the sound associated with that colour.
- If the large size colour appears on the dice, the student must say a name starting with the base colour's sound.
- If the medium size colour appears, the student says a word where the base colour's sound is the last phoneme.
- If the small size colour appears, the student must say a word containing the base colour's sound anywhere in the word.
- The game itself:

After explaining the rules and colours, place the triangle-shaped Poly-Universe pieces into a small bag. Ask a student to draw one piece from the bag and show it to the others. The student names or pronounces the letter corresponding to the base colour of the piece, then rolls the colour dice. They look at the colour on the dice and then check their own piece to see what to do according to the colour:

- Base colour: say a word starting with that sound
- Large size colour: say a name starting with that sound
- Medium size colour: say a word ending with that sound
- Small size colour: say a word containing that sound anywhere
- Question mark: the student chooses from the above options.

At first, the exercise proceeds slowly, as all students need to understand the rules. Once every student has tried and understands the game, a 10-second time limit can be introduced for thinking. After the time runs out, those who answer correctly may receive extra points. Stickers can be awarded to the students with the most points (Bella, 2023).

### **Advanced Version of the Exercise/Game:**

Once all students are familiar and comfortable with the basic exercise, the difficulty can be increased. Students are then required to say words that they can also write down (since during the early stages of learning letters, not all letters may yet be known). The new task is to write the spoken word with handwritten letters.

Summary: Finally, ask the students to draw a Poly-Universe element and write down a word for each possible category:

- A word starting with the base colour sound
- A name starting with the base colour sound
- A word ending with the base colour sound
- A word containing the base colour sound anywhere in the word
- Purpose/Benefits of this Exercise:
- Students expand and develop their vocabulary.
- Their attention remains focused throughout the activity.
- They must pay attention not only to their own task but also to the tasks of others.
- While playing, they think and learn without even realizing it.

Applicable Level: Primarily for primary school students, but the exercise can also be adapted for secondary school learners.

### **Didactic Game Used in Personality Development Class (Bella, 2023)**

Goal of the exercise/game: To express basic emotions using nonverbal elements and to convey simple verbal and nonverbal messages.

Name of the exercise/game: How do I feel?

Steps of the exercise/game:

Preparation: Assign emotions to the colours red, yellow, green, and blue, and display these colours on the board. Represent the emotions with figures as well.

In my case:

- Red = anger
- Yellow = happiness
- Green = joy in the outdoors
- Blue = sleepiness

Discuss the meaning of the colours with the students. Then take out the triangle-shaped Poly-Universe set and explain the meaning of the element sizes:

- The base colour shows the primary emotion dominating me now.
- The large size shows what most influences this feeling.
- The medium size shows what is less characteristic of my feelings.
- The small size expresses the least characteristic feeling.

### **The exercise/game itself:**

After discussing the rules and colours, ask the students to choose elements to express their emotions. After everyone has chosen, they take turns explaining why they selected the figure of that particular colour.

### **Advancement of the exercise/game:**

Once everyone has shared their opinions, bring out the square and circle-shaped sets as well, and ask them to choose elements with colours matching their emotions and create/build something that best represents them.

Summary: Finally, ask the students to draw their weekend or a day, colouring the people with the colours red, yellow, green, and blue depending on how they felt.

Why is this exercise beneficial?

1. Students express their emotions more easily and confidently using a game or element.
2. Students with a limited vocabulary are not disadvantaged in expressing their emotions.

Applicable level: Primarily for primary school students but can also be used with secondary school students.

School subjects: Personality development, moral education, but can be partially applied to setting the mood in any subject.

## NOTES

1. Emotions can be assigned to any colour depending on the goal of the exercise. The exercise does not have to be done fully; parts of it can be applied separately.
2. Based on students' enthusiasm, I considered not only designing a didactic game with the Poly-Universe sets but also holding a full class based on the game elements. This was in the personality development subject.



Figure 19: Possible combined applications of Poly-Universe elements

## 9. Maths Relay Race with the Poly-Universe Game Family

One of the students' favorites in math lessons is the *Math Relay Race* (Bella, 2023). The rules are more complex, so I usually play this game with fourth graders. I use this game mostly during review and systematizing lessons. With the Poly-Universe game set, I can make the game more complex and creative.

I divide the students into teams of 3-4 players (usually I appoint team captains to ensure fairness, and then the captains choose their teammates one by one). Each team receives a worksheet with tasks. They can all get the same worksheet (in which case students work at their desks and run to fetch something like Poly-Universe pieces), or if we want them to calculate at the board, the worksheets are similar but not identical. The task sets vary in difficulty, gradually getting harder, and there is always one more task than the number of players per team. The last task is the most difficult and complex.

After receiving the tasks, the teams distribute the tasks among themselves. The last task goes to the team captain, who can choose a partner from their team to help solve it. Players go to the board in turn according to the task numbers, solve the problem, then run back to their seats. The next player can only start once the previous player has sat down.

For example, if they need to collect Poly-Universe game pieces from a basket after solving a problem, the player runs to the basket, takes a piece, returns to their seat, and only then can the next player begin solving.

There is a time limit of 2 minutes per task, except for the last one (which lasts until one team finishes first), and the time is measured with a timer. If a player gets stuck and cannot finish within 2 minutes, they can call a teammate for help, and the time limit is lifted. They keep working until they find the correct solution.

The teacher/game leader checks the correctness of the solutions. The winning team is the one that finishes first.

In larger classes, to prevent the non-active team members from getting bored, I give them a colouring task related to math. In this case, the winning team is the one that finishes the tasks first, has at least one correctly completed colouring sheet, and can assemble the predetermined Poly-Universe shape from the collected pieces.

The game is a bit complicated at first, and the rules might be challenging to follow, but by the second or third attempt, students get the hang of it. They enjoy it and hardly notice they have spent the whole lesson solving problems, reviewing, and creating while playing.

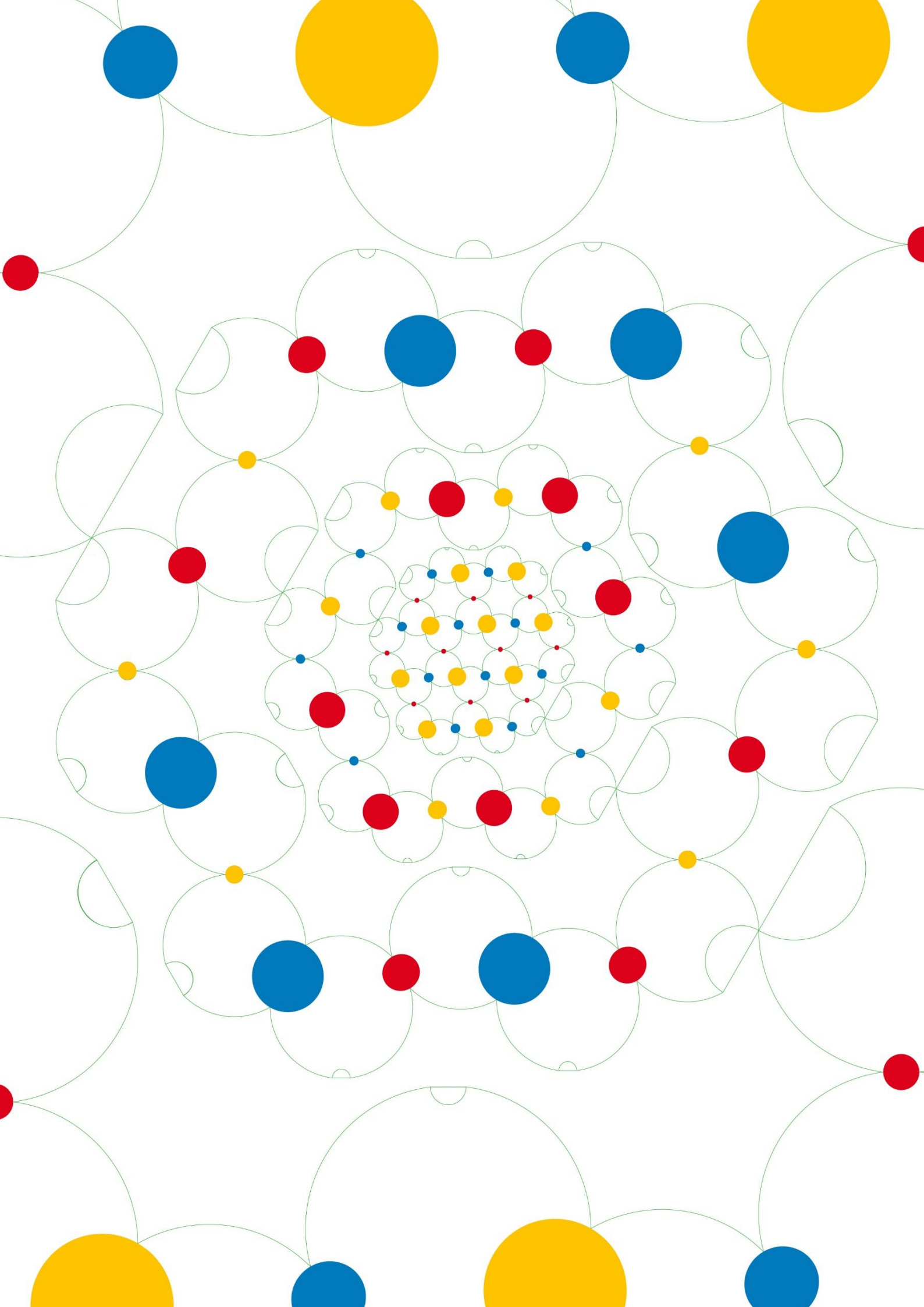
In this way, the Poly-Universe game becomes an integral part of the sequence of rules, but the tasks cannot be fully completed without it. These lessons are influenced by constructivist principles, as the student is active and engaged. The teacher's role is mainly supervisory, ensuring the rules are followed, checking solutions, and helping teams if they get stuck.

The goal is solving problems and helping each other, with motivation coming from within. The whole process is discussed afterward, including reasons for failure. Students learn from their mistakes and strive not to repeat them next time (Bella, 2023).

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## NON-FORMAL EDUCATION SETTINGS

### Espace de l'Art Concret (EAC)



Figure 1: Château de Mouans © crédit photo eac.

#### 1. The Espace de l'Art Concret and Education

Founded in 1990, the Espace de l'Art Concret is a contemporary art centre of national interest that houses a unique collection of abstract art in France: the Albers-Honegger Donation.

The Espace de l'Art Concret (eac.) develops its artistic, cultural, and educational initiatives around three complementary missions:

1. the conservation and promotion of the Albers-Honegger Collection;
2. a research mission, centred around temporary exhibitions and artist residencies that foster connections between the works in the collection and contemporary creation;
3. an educational mission, through exhibition mediation and practical art workshops.

The primary objective of the Espace de l'Art Concret is to raise awareness of contemporary art among the widest possible audience. With artistic education at the heart of its mission, it has always placed a strong emphasis on pedagogy, establishing from the outset a dedicated structure to welcome young visitors from schools and leisure time settings.

Thanks to its unique position, the centre has received recognition and support from the French Ministry of Culture, the Regional Directorate of Cultural Affairs for Provence-Alpes-Côte d'Azur, the South Provence-Alpes-Côte d'Azur Region, the Alpes-Maritimes Department, and the Town of Mouans-Sartoux.

In 2008, the eac. was awarded the “European Cultural Project Prize” by the European Cultural Foundation “Pro Europa”, in recognition of its European engagement and its commitment to arts education.

In 2020, the eac. was granted the designation “Contemporary Art Centre of National Interest” by the Ministry of Culture.

Also in 2020, the eac. was awarded the “Qualité Tourisme™” label by the Ministry of the Economy and Finance.



Figure 2: Donation Albers-Honegger, architectes Gigon & Guyer © crédit photo Bruno Gros



Figure 3: Ateliers pédagogiques, architecte Marc Barani © crédit photo Jean Brasille

From its inception, the eac. has placed artistic and cultural education at the core of its mission. It has developed a rigorous approach to mediation, aiming to raise public awareness—especially among young people—of abstract art. This commitment was embodied in the opening of the Ateliers pédagogiques (Educational Workshops) in 1998, a space dedicated to welcoming young audiences.

The Public Engagement Department and the Educational Workshops at the eac. offer a wide range of artistic and cultural education activities, such as guided tours, hands-on artistic workshops, and various cultural experiences designed for all audiences—from the very young to the elderly. The eac. works with nurseries, kindergartens, childminders, and also with senior residents in care homes (EHPAD), as well as schoolchildren, children during leisure time, those with disabilities, and individuals from socially disadvantaged backgrounds.

Training sessions related to exhibitions are also organised for a wide range of audiences. The eac. supports professionals, students, and individuals who wish to deepen their knowledge and skills in cultural education and art mediation.

These training programmes are aimed at: teachers (from nursery to higher education) and other professionals from the national education system; educators, specialised educators, early childhood educators, youth protection educators; early years professionals such as childminders, parental assistants, nursery assistants; social, educational or medical intermediaries; socio-educational or cultural facilitators; students in cultural mediation and education; and members of the general public.

The eac. regards artistic education as a fundamental tool for children’s development. Art stimulates curiosity, creativity, and critical thinking. It offers young people a space for personal expression and encourages open-mindedness. By introducing children to art from an early age, the eac. contributes to the development of a shared culture, as well as to fostering tolerance and respect for diversity.



Figure 4: Parc du château de Mouans, paysagiste Gilles Clément © crédit photo Pascal Béjean – eac

Through its various initiatives, the Espace de l'Art Concret demonstrates that art is far more than an aesthetic discipline: it is a powerful lever for education, inclusion, and social cohesion.

It is therefore only natural that the Espace de l'Art Concret has become involved in the 100% Artistic and Cultural Education (EAC) programme of the Communauté d'Agglomération du Pays de Grasse.

The "100% EAC" is a public policy initiative launched in 2017 by the French Ministries of Culture and National Education. Its goal is to ensure universal access to artistic and cultural education for all young people aged 0 to 18, across all regions, throughout their schooling.

The primary objective is to enable 100% of young people in a given area (in this case, the 23 municipalities of the agglomeration) to benefit from a high-quality artistic and cultural education pathway—without exception.

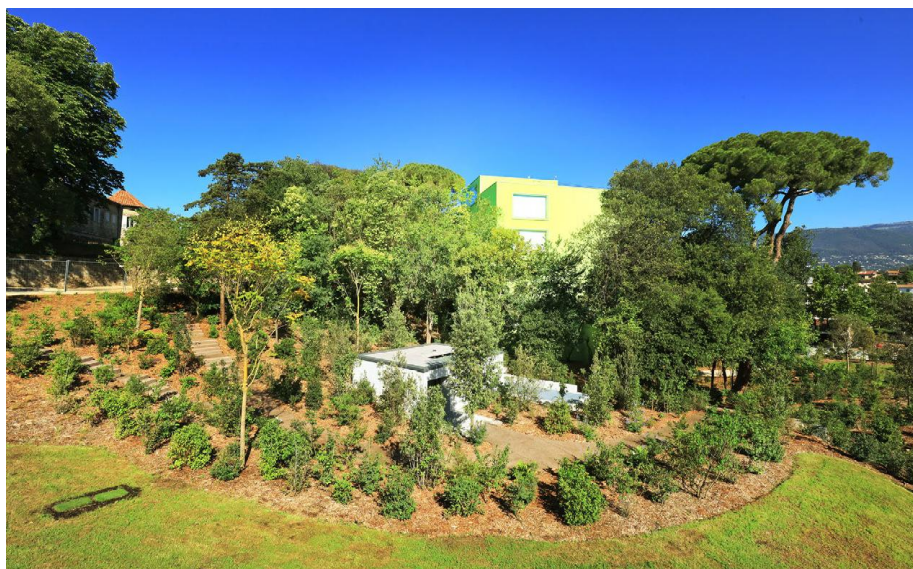


Figure 5: Extension du Parc du château de Mouans, paysagiste Gilles Clément © crédit photo Bruno Gros

## 2. EAC – Espace de l'Art Concret

The key principles of 100% Artistic and Cultural Education (100% EAC):

1. Encounter with artists and artworks: Provides a direct experience of art—through visits to exhibitions, shows, concerts, performances, meetings with artists, etc. It encourages cultural awareness and the discovery of artistic diversity.
2. Artistic practice: Involves the child or young person in a creative process—through theatre, visual arts, writing, music workshops, etc. It develops creativity, self-confidence, and personal expression.
3. Acquisition of knowledge: Integrates knowledge about artworks, artists, artistic movements, cultural institutions, and more. It fosters understanding of the cultural and historical context of art.
4. Universal accessibility: Available throughout the territory, including in rural, disadvantaged, or sensitive areas...

5. Partnership: Involving schools, local authorities, cultural institutions, artists, associations, and others.
6. Progressiveness: A structured, evolving pathway from nursery to upper secondary school.
7. Artistic diversity: Encompassing all disciplines—visual arts, music, theatre, dance, cinema, heritage, and more.
8. Equal opportunities: Aiming to reduce inequalities in access to culture



Figure 6: Visite de l'exposition Gottfried Honegger – Du singulier au pluriel © crédit photo eac.



Figure 7: Atelier maternelle « L'art par la forme et les couleurs » © crédit photo eac.

100% EAC embodies the ambition to make art and culture a fundamental right for all children and young people, by ensuring a complete, coherent, and shared artistic education rooted in local communities.



Figure 8: Atelier rencontre avec l'artiste Vincent MALASSIS © crédit photo eac.



Figure 9: Atelier rencontre avec l'artiste Céline SICARD © crédit photo eac.

### 3. Below are some of the key benefits of mediation in front of artworks

Mediation in front of artworks—whether artistic, cultural, or historical—plays a fundamental role in public engagement and understanding. It serves as a bridge between the artwork and the viewer, facilitating access to interpretations, evoking emotions, and enriching the overall experience.



Figure 10: Visite scolaire dans le cadre du festival Art Plastique des Ecoles © crédit photo eac.

#### ENHANCING UNDERSTANDING

Mediation provides historical, cultural, or technical context for the artwork. Without this framework, some works may appear opaque or inaccessible. By explaining the context of creation, the artist's intentions, the techniques used, or the influences involved, the mediator helps the viewer gain a deeper understanding of the work and appreciate its richness.

#### FOSTERING EMOTION AND ENGAGEMENT

Well-designed mediation aims to provoke emotions. A mediator can guide the viewer through an emotional exploration of the artwork by asking open-ended questions or drawing attention to specific details. This makes the experience more immersive and engaging. The goal is to move beyond a purely intellectual framework and enable an emotional connection with the art...

#### STIMULATING PERSONAL REFLECTION

Effective mediation does more than simply provide information. It invites reflection by offering avenues for interpretation without imposing a single truth. This encourages viewers to form their own opinions, challenge ideas, and nurture their creativity. It may also prompt them to question society, art, or their own beliefs.

## MAKING ART ACCESSIBLE TO ALL

One of the great strengths of mediation is its ability to democratise access to art. Artworks can be intimidating for some, especially if they originate from unfamiliar times or cultures. Mediation helps make art more approachable and understandable, even for those who are not experts or regular museum-goers.



Figure 11: Atelier Baby Visite dans l'exposition Des designers du JAD dialoguent avec la collection Albers-Honegger, © crédit photo eac.

## ENCOURAGING INTERACTION AND DIALOGUE

Guided tours, workshops, and discussions around artworks create spaces for exchange. Mediation is not a monologue but a dialogue that invites the public to participate—asking questions, sharing impressions, and discussing artworks. This results in a rich and diverse collective experience.

## STRENGTHENING EDUCATIONAL IMPACT

Mediation is often used in educational settings to introduce young audiences or the general public to art and culture. It allows artworks to be integrated into broader programmes, linked to themes such as history, sociology, politics, or philosophy. It is a way of conveying knowledge while fostering critical thinking.

## PROMOTING INCLUSION AND DIVERSITY

Mediation can also be used to promote an inclusive approach by taking into account diverse audiences—school groups, people with disabilities, international visitors, and more. For example, some mediations are adapted to be more accessible to the visually impaired or deaf, using tools such as audio descriptions or sign language interpreters.

## RENEWING THE ART EXPERIENCE

A mediator can offer innovative approaches that renew the experience of an artwork. Instead of merely viewing the piece, visitors may be invited to interact with it or engage in sensory exploration—by closing their eyes, listening to associated sounds, recreating scenes, or viewing the artwork through a contemporary or personal lens.

### **4. Promoting inclusion and diversity**

In summary, mediation goes far beyond technical explanation. It demystifies, opens up dialogue, and most importantly, makes art accessible, engaging, and stimulating for all. It transforms a visit to a museum or an art centre into a truly enriching and interactive experience.

Educational tools are primarily designed to facilitate understanding, engagement, and appropriation of artworks or exhibitions by various audiences, particularly:

#### TRANSMITTING KNOWLEDGE

Explaining the historical, cultural, artistic, or scientific context of an artwork or exhibition. Providing reference points to understand artistic processes, movements, materials, and more.

#### PROMOTING ACCESSIBILITY

Adapting content for different audiences (children, school groups, people with disabilities, non-specialist visitors, etc.). Offering various levels of interpretation: playful, simplified, in-depth.

#### STIMULATING CURIOSITY AND INTERACTION

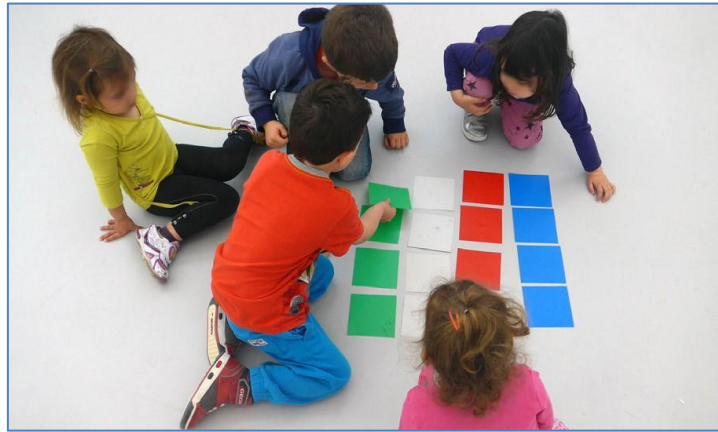
Encouraging an active attitude: observation, questioning, dialogue. Including games, hands-on activities, workshops, or interactive devices to capture attention.

#### SUPPORTING CULTURAL MEDIATORS

Providing resources for guided tours, educational workshops, and school visits.

## 5. Educational Games at the Espace de l'Art Concret

### LE JEU DU VISEUR



Created in 1993, Le Viseur is an educational tool imagined by Gottfried Honegger to introduce children to concrete art and raise their awareness of visual perception. The game consists of simple geometric shapes (squares, circles, rectangles, triangles) and primary colours (red, blue, yellow, green), allowing for countless visual combinations and explorations.

In 2004, a portable version of the game was released, making it easier to use in various educational and cultural settings. More recently, a tactile version has been developed for visually impaired users.

Le Viseur is presented in a 33 × 33 cm case, containing:

- 16 thick plastic boards (32 × 32 cm) that serve as coloured backgrounds, some of which are cut or perforated to allow for layering;
- 20 large bands in various widths and colours to place on the coloured boards;
- 50 coloured shapes (10 triangles, 10 squares, 10 circles, 10 thin mini bands, 10 wide mini bands).

Le Viseur aims to develop in children an active and creative perception of the visual world around them. According to Gottfried Honegger, “seeing is not the same as looking”: the game encourages children to actively look —to observe, analyse, and create— rather than passively perceive. It stimulates their imagination, aesthetic sensitivity, and ability to visually organise space.

The game stands out for its lack of strict rules, offering total freedom for players to invent their own rules and compositions. This approach encourages personal expression and experimentation.

Le Viseur is widely used in the eac.'s educational workshops, where it serves as an introductory tool for concrete art for children starting from nursery age. It is also employed in various educational contexts—such as schools, leisure centres, media libraries, and specialised institutions—to foster creativity by encouraging children to create original visual compositions.

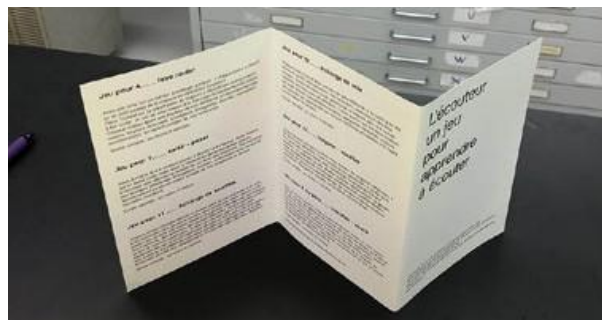
Thematic educational sheets are also available, addressing artistic concepts such as primary shapes, curves and straight lines, form and linearity, cadence and rhythm, chaos and order, materiality, and randomness.

In summary, Le Viseur is an innovative educational tool that combines art, play, and learning, offering children a playful and creative introduction to concrete art and visual perception.

#### GENERAL EDUCATIONAL OBJECTIVES WITH LE VISEUR

1. Develop visual and spatial perception
  - a. Identify shapes, sizes, colours.
  - b. Recognise alignment, symmetry, and regular patterns.
2. Stimulate creativity and imagination
  - a. Freely compose using abstract shapes.
  - b. Invent stories or representations from compositions.
3. Encourage language and verbal expression
  - a. Describe a composition: shapes used, placement, relationships.
  - b. Justify aesthetic or logical choices.
4. Promote cooperation
  - a. Create a collective composition.
  - b. Compare creations and discuss them together.

#### L'ÉCOUTEUR



In 1995, Yves Rousguisto and Gottfried Honegger met at the Picasso Museum in Antibes, where Yves Rousguisto was presenting an installation using large reeds. Honegger then invited him to design a musical game for the eac.

The aim was to create an “open” tool, in the same spirit as Le Viseur, but more easily transportable and lendable (as the original version of Le Viseur was too large), with a practical and child-friendly approach that allowed children to actively experience the situation.

The game was published in 1997 and consists of a plastic case divided into two parts (a transparent lid and a yellow base). It contains:

- 1 AIWA V-Sensor TP-VS520 cassette recorder, along with user manuals
- 1 KONICA 60-minute audio cassette
- 28 reeds (4 sets of 7 different lengths). These are “cor anglais”-style reed tubes ordered from Le Roseau du Var (Antibes), with a diameter of 12/15 mm. There are 7 different lengths: 20 cm / 18.5 cm / 17 cm / 15.5 cm / 14.5 cm / 13 cm / 12.5 cm. The tubes are knot-free.
- 1 explanatory booklet titled L’Écouteur: a game for learning to listen, including: A text by Gottfried Honegger A text by Yves Rousguisto

Several game suggestions: Game for 4: rolling, Game for 7: grasp and place, Game for 11: exchanging breaths, Game for 12: exchanging voices, Game for 14: inhale–exhale, Game for 8 or more: blocking and unblocking.

Each proposed game is designed to last between 1 and 4 minutes.

## LE CARRÉ



A game created by Swiss artist Rita Ernst in 2001.

“Le Carré is a game without instructions. Le Carré is a game to explore, to make combinations, and to learn”.

- It consists of 36 cards.
- It is made up of 6 primary colours: yellow, red, blue, green, black, and white.
- It includes 6 shapes (derived from the square).
- Each shape appears once in each primary colour.

## EDUCATIONAL OBJECTIVES RELATED TO MATHEMATICS AND GEOMETRY

### Cycle 1 (Nursery School)

- Recognise and name basic geometric shapes: square, circle, triangle, and rectangle.
- Work on spatial awareness: above/below, next to, in the centre, around, etc.
- Compare sizes and classify by colour or shape.
- Identify regularities (early patterns and sequences).

### Cycle 2 (Year 1 — Year 3)

- Identify flat shapes and basic properties (right angles, equal sides...).
- Use geometric vocabulary: alignment, symmetry, axes, solid or hollow shapes.
- Reproduce or mirror a pattern.
- Introduce the notion of perimeter or surface by comparing shapes.

### Cycle 3 (Year 4 – Year 6)

- Explore geometric transformations: translation, rotation, axial symmetry.
- Break down complex shapes into simple ones.
- Use concepts of proportion, repetition, and rhythm.
- Work on coding a shape (vocabulary, position, proportions).
- Approach maths without fear, relying on intuition and play.
- Anchor abstract concepts (shapes, axes, proportions) in a concrete experience.
- Develop spatial intelligence—often overlooked but essential in geometry.

## TACTILE GEOMETRY CASE



Educational Tool for the Visually Impaired

Adaptation of *Le Viseur* by Gottfried Honegger Development: Claude Garrandes – Arrimage Association.

The Tactile Geometry Case is an educational tool designed to allow visually impaired or blind individuals to explore, manipulate, and understand the works in the Albers-Honegger collection through geometric shapes and a sensory, inclusive approach...

Inspired by the original game *Le Viseur* by Gottfried Honegger —a game designed to teach observation and spatial composition— this adapted version places a strong emphasis on touch, spatial perception, and artistic creation.

The aim of the tactile case is to use the tactile experience of different shapes (triangles, squares, rectangles, circles, bands, etc.) to: facilitate understanding of fundamental mathematical concepts such as plane, volume, and spatial relationships; stimulate creativity through composition and arrangement activities; develop spatial orientation skills and hand-mind coordination; encourage autonomy through a design entirely suited to users with visual impairments.

Contents of the Case:

170 magnetic geometric pieces:

- 85 white pieces, magnetic on both sides
- 85 black pieces, also magnetic on both sides, with distinctive tactile relief on one side
- Available shapes: squares, rectangles, triangles, circles, and bands
- Various sizes: from 2 cm to 32 cm

1 foldable magnetic board (64 × 90 cm):

- Can be used flat or vertically for spatial activities

1 rigid transport case:

- Practical for mobile use (in the classroom, workshop, at home, etc.)

Enhanced accessibility:

- Labels in braille and large print
- High contrast (black/white) for users with low vision

More recently, mediation tools related to exhibitions have been designed by the eac.'s public outreach department.

This department publishes its own tools specifically intended for children and teenagers. These materials are created not only to explain concepts found in the exhibitions, but also to introduce the core ideas of concrete art. They offer keys to understanding the different concepts presented.

The eac. is committed to making its exhibitions and content as accessible as possible to all types of audiences. These tools are therefore designed for children, but also for parents and families, who are encouraged to use them for shared moments of explanation and enjoyment.

The items created serve both as educational supports related to the exhibition and as distraction tools for children who may sometimes find visits long or may not feel represented in a contemporary art centre—a space that can seem, at first glance, exclusively for adults.

Through the design of these tools, the eac. seeks to challenge and overturn that assumption.

## DISCOVERY BAG



Exhibition ma poésie est le monde – herman de vries

The “Little Discovery Bag” is an educational tool designed for the exhibition My poetry is the world by artist herman de vries. This resource offered young visitors a sensory approach through three activities:

- A herbarium for plant-matching and identification
- A soil rubbing game to explore patterns and textures
- A scent recognition game

These activities aimed to make the artist’s work accessible and engaging for children, with a focus on direct experience and contemplation of nature.

## THE LITTLE CONCRETE ARTIST’S CASE



Collection Albers-Honegger

This special case allows children to discover explanations on how to use the items it contains, interactive games, and a laminated booklet that introduces them to the current exhibition’s themes.

The booklet, primarily designed for children, also includes content for adults and early readers. Its visual design helps visitors easily distinguish between content for adults and for children, thanks to the use of icons featuring the eac's mascot, specially created for activities aimed at the youngest audiences.

#### LUCIOLES BOOKLET



Dans la collection du Cnap

As part of the exhibition Lucioles – Read and Play with Les Trois Ourses in the Cnap Collection, an accompanying booklet was created for both children and adults, addressing the key concepts of the exhibition: the artists and their ways of bringing knowledge and play into children's lives.

By handling different textures, exploring forms, and engaging their senses, young visitors were invited to immerse themselves in the world of the book—in all its many forms.

## THE POLY-UNIVERSE EDUCATIONAL GAME Espace de l'Art Concret (EAC)



Figure 1: Poly-Universe – An Educational Game by János Szász SAXON

Poly-Universe is an educational game developed by Hungarian visual artist János Szász Saxon. It is a skill-building system based on simple geometric shapes (circle, triangle, square) and combinations of primary colours (red, blue, green, and yellow). Each game piece contains geometric elements at different scales, allowing for a wide variety of visual configurations.

What sets this game apart is its concept of scale-shifting symmetry, which provides a unique framework for exploring geometry, combinatorics, and logic. This approach helps users to develop visual thinking, creativity, and problem-solving skills.

### 1. Poly-Universe is at the heart of the Erasmus+ projects

Educational Applications – ERASMUS+ PUSE Project:

«Poly-Universe in School Education» (PUSE), which aims to develop a new visual methodology for teaching mathematics. The project adopts an interdisciplinary approach, combining art, mathematics, and computational thinking to promote more intuitive and engaging learning.

The PUSE methodological handbook offers teaching resources for educators, including task examples and formative assessment tools. It is designed for use with pupils of all ages —from preschool to secondary school— and is also suitable for students with special educational needs.

## Research-Based Benefits of Poly-Universe

Studies have shown that using Poly-Universe supports the development of key competencies, including:

- Algorithmic thinking and problem-solving
- Spatial awareness and creativity
- Collaboration and peer communication
- Student engagement and motivation.

These skills are increasingly essential in today's educational context, which prioritises the development of critical thinking and the ability to address complex problems.



Figure 2

## 2. Using the Poly-Universe game

Using the Poly-Universe game with toddlers outside of school or educational settings (ages 1–3)

Using the Poly-Universe game with very young children outside formal schooling or education (ages 1–3) can be a fun and stimulating way to introduce basic geometric concepts while supporting children's cognitive and motor development. Here is an example of an activity that could be adapted for this age group:

### EXPLORING SHAPES AND COLOURS

#### Educational Objectives

- Develop recognition of simple geometric shapes (circle, triangle, square).
- Encourage recognition of primary colours (red, blue, yellow, green).
- Promote fine motor skills through handling the shapes.
- Encourage sensory exploration (shape, colour, texture).
- Develop basic spatial concepts such as «big/small», «front/back», and «next to/above».



Figure 3

## ACTIVITY OUTLINE

### 1. Introducing Shapes and Colours

- Show the children the pieces of different shapes and colours, gently naming each one: “Here is a red circle, a blue triangle, and a yellow square.”
- Demonstrate by handling the shapes and placing them on a play mat.

### 2. Tactile Exploration

- Allow the children to handle the shapes themselves. Encourage them to touch and explore by asking simple questions: “Can you find a round shape?” or “Which one is the biggest?”
- Encourage stacking or lining up the shapes on the mat to foster hands-on experimentation.

### 3. Sorting and Tidying Up

- Ask the children to sort the shapes by colour or by type (all circles together, all triangles together).
- This helps develop their ability to categorise and organise objects, reinforcing visual memory.

### 4. Free Play with Shapes

- Invite children to create their own structures or patterns with the pieces, for example: “Build a tower with the shapes” or “Make a path with the triangles.”
- Encourage creativity while allowing them to discover solutions independently.

### 5. Movement Exploration

- Place shapes on the floor and organise simple movement games such as: “Jump to the red shape!” or “Tap the yellow square!”

## ADAPTATIONS

- For younger toddlers, simplify the activity by introducing only two or three shapes and colours at a time.
- Use larger shapes that are easier to grasp (e.g., cushions shaped like circles, triangles, squares).
- Incorporate songs or rhymes about shapes and colours to make the activity more interactive and enjoyable.

## DEVELOPMENTAL BENEFITS

- Fine Motor Skills: Handling and placing shapes helps develop hand-eye coordination and fine motor control.
- Cognitive Development: Exploring shapes and colours helps children learn to identify and differentiate objects, laying the foundation for future mathematical skills.
- Sensory stimulation: Playing with colourful and tactile objects stimulates the senses of touch and sight.
- Social interaction: When playing in groups, children can learn to share and collaborate.

This example activity with Poly-Universe allows toddlers to engage with geometric concepts in a simple and accessible way, while supporting their motor, cognitive, and sensory development. It is an excellent way to prepare children for an early understanding of mathematics, while offering them a joyful and engaging learning environment.

## WHY ACT FROM EARLY CHILDHOOD?



Figure 4

The first years of life are crucial for cognitive development and the construction of gender identity. Studies have shown that girls and boys display similar mathematical skills from birth. However, a performance gap begins to appear around ages 5–6, especially in mathematics, due to sociocultural factors such as gender stereotypes.

UNESCO highlights that early learning activities, such as counting, building games, and manipulating geometric shapes, strengthen girls' confidence in their science and mathematics abilities. Unfortunately, parents often offer these activities less frequently to girls, influenced by unconscious stereotypes.

### 3. Poly-Universe from a Young Age

By offering varied activities

Mathematical awakening activities must be diversified and adapted to children's ages. For example, from age 1, sorting, classifying, and handling simple geometric shapes can be introduced. These activities develop logic, fine motor skills, and understanding of basic mathematical concepts.

By encouraging girls' participation

It is essential to encourage girls to take an active part in these activities. Educators and parents should ensure equal opportunities for girls and boys, avoiding stereotyped games. For example, offering girls building or spatial orientation games can stimulate their interest in mathematics.

By raising awareness among parents and educators

Awareness campaigns can help parents and educators recognise and overcome their own gender stereotypes. Messages can be disseminated through educational materials, training sessions, or meetings with education professionals.

These activities with Poly-Universe provide a fun and inclusive way to promote mathematics learning from a very young age. They enable girls to develop essential skills in geometry and logical reasoning while offering equal opportunities to explore and create, free from gender stereotypes. By emphasising inclusivity and encouraging all children, regardless of gender, to participate actively, you create a learning environment where girls can thrive.

#### EDUCATIONAL SUMMARY OF USING POLY-UNIVERSE FOR CHILDREN AGED 3 TO 5



Figure 5

## ACTIVITY OBJECTIVE

Allow children to discover, handle, and understand basic mathematical concepts (shapes, colours, sizes) through free and intuitive play, while being thoughtfully supported to stimulate their logical thinking and vocabulary.

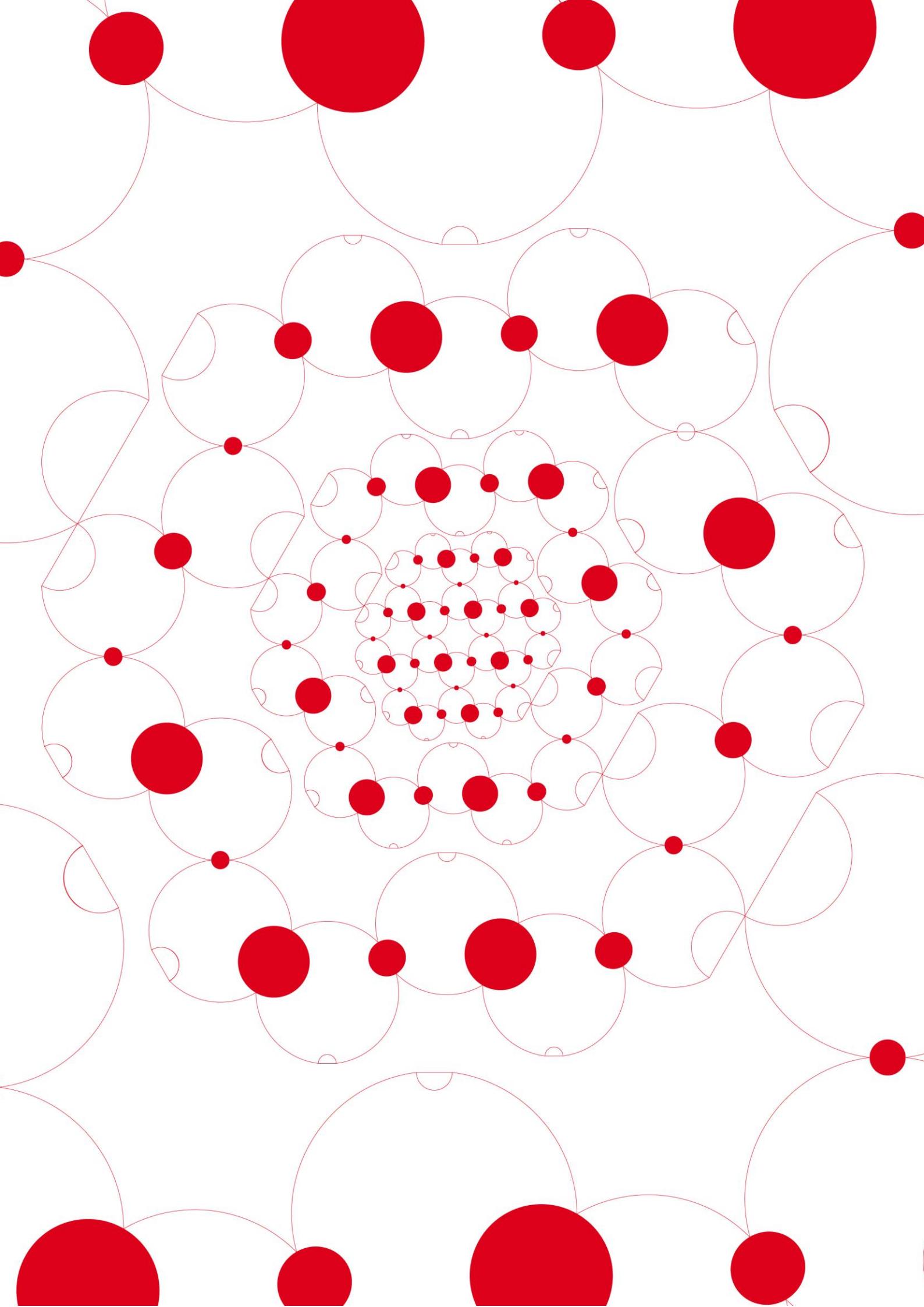
### Activity steps:

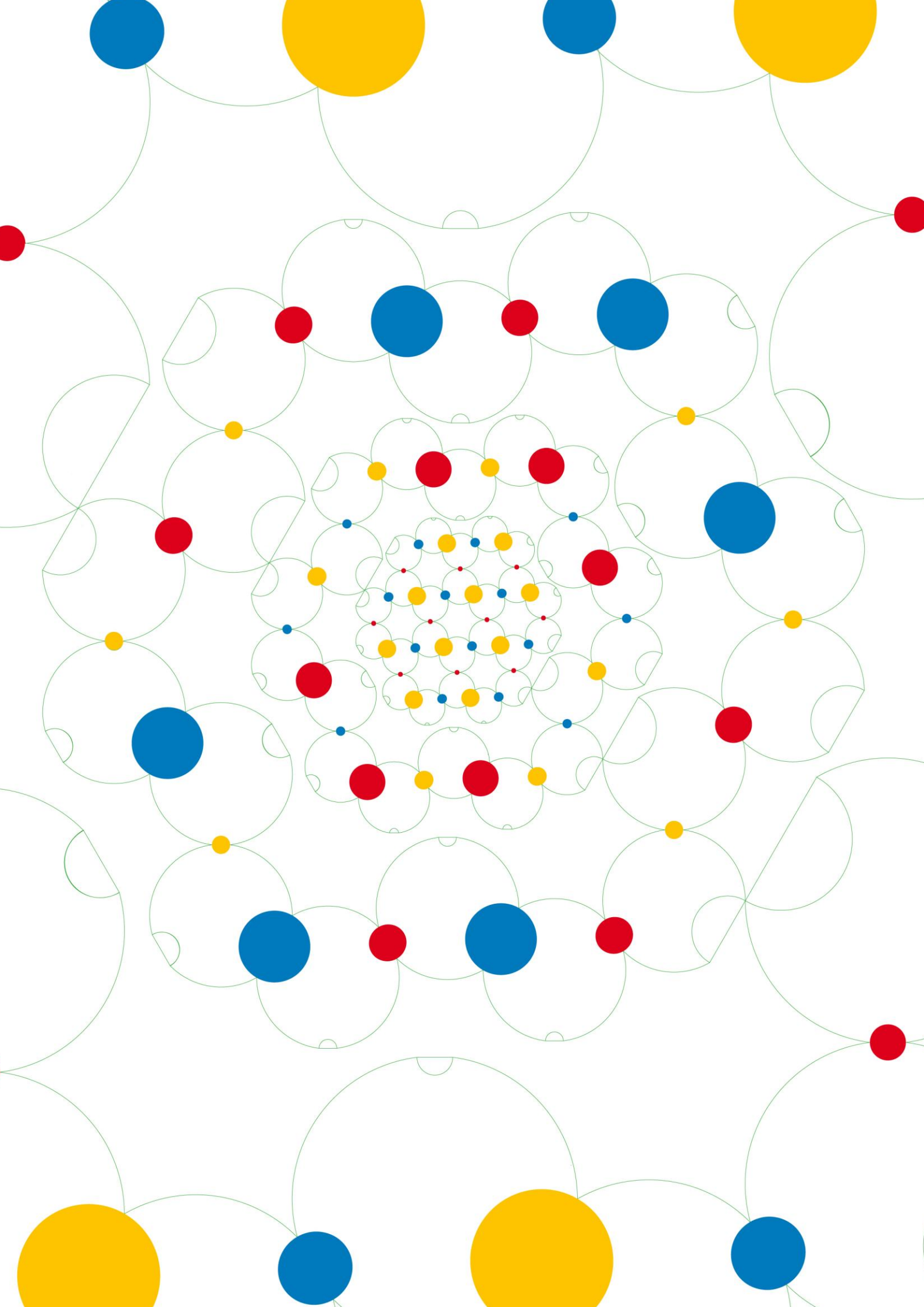
1. Let the children explore the game freely
  - Give them the Poly-Universe pieces without initial instructions. The goal is for them to handle the shapes and discover the different textures, colours, and sizes on their own.
2. Observe their actions
  - While they play, observe how children use their senses to explore the objects. Do they manipulate the pieces? Do they compare them? How do they react to the different shapes and colours?
3. Support the child according to their discoveries:
  - Name and comment on what they do (e.g. “You are holding a red circle”). This helps them associate vocabulary with shapes and colours.
  - Compare shapes and colours: Encourage them to compare the pieces, for example by saying, «This circle is bigger than this square.» This develops their logic.
  - Observe and understand association rules: The child spontaneously associates pieces.
  - The role of the facilitator is to detect this logic (for example: a colour or size association) and help the child become aware of it by asking questions.
4. Play with the child to reinforce learning.
  - Suggest games to recognise colours, compare sizes, assemble or stack shapes. For example: «Can you stack the shapes from smallest to biggest?»

### WHY IS THIS BENEFICIAL?

- Stimulates logic and thinking: By handling and comparing shapes, the child develops logical skills (classification, comparison, noticing differences and similarities).
- Encourages expression and vocabulary: Verbal support helps enrich the children’s vocabulary by introducing mathematical terms (shape, size, colour).
- Develops a playful approach to art and mathematics: Through play, children become familiar with the basics of mathematics while being immersed in an artistic approach that stimulates their creativity.

This activity allows children to explore mathematical concepts actively, while developing their artistic sensitivity and ability to reflect on their actions. When thoughtfully supported, they learn to associate objects and become aware of their choices logically, all while having fun.





## POLY-UNIVERSE IN EARLY CHILDHOOD EDUCATION Shaping Competence through Play in Finland

Poly-Universe is an innovative educational toolkit that bridges art and science. It consists of simple geometric game pieces (circles, triangles, and squares) in four sizes and four colours. Each Poly-Universe piece contains all four primary colours (red, green, yellow, blue) and can be combined by matching colours along edges or vertices, yielding countless playful configurations. Notably, a recent study introducing Poly-Universe in elementary and secondary classrooms found improved attitudes toward mathematics and versatility across subjects – including personal development, language, mathematics, and art – as students’ creativity, engagement, and confidence flourished (Debrenti & Bella, 2025).

EarlyPoly methodology refers to the pedagogical approach of applying the Poly-Universe toolkit in early childhood education and care (ECEC). It adapts Poly-Universe’s rich *play-and-learn* potential to young children’s developmental needs. In practice, EarlyPoly emphasises hands-on discovery, open-ended play, and guided exploration using Poly-Universe pieces. The aim is to support holistic competence development in children aged 3–6 through playful, inclusive, and pedagogically grounded activities.

EarlyPoly builds on the idea that even very young children can engage with basic shapes and colours in meaningful ways. For example, toddlers (ages 1–3) can handle the colourful pieces to explore simple geometric concepts, like distinguishing circles vs. squares and recognizing primary colour. Such activities encourage sensory exploration and fine motor skills (by touching, picking, and placing pieces) while laying foundations for spatial understanding (e.g. learning “big” vs. “small” or positional words like *next to* and *above* in a tangible context). As children mature into the preschool years, EarlyPoly methodology introduces more complex play scenarios – building patterns, creating composite shapes, and solving simple puzzles – always through *play*. This playful approach aligns with core early education principles by engaging children as active, joyful learners.



Figure 1: EarlyPoly STEAM Education meeting with ECEC teachers in Finland.

## 1. Alignment of Poly-Universe and EarlyPoly with Playful Learning

Poly-Universe and the EarlyPoly methodology align naturally with Finland's Playful Learning framework in early childhood education (Karvonen et al., 2022). In Finland, play is not just recreation but is considered *the key mode of learning* for young children. The National Core Curriculum for Early Childhood Education and Care (ECEC) highlights play as a fundamental activity through which children experience the world holistically. Children are seen as active agents in play, which brings them joy and meaning while supporting their social, physical, and cognitive development. Research and practice in Finnish ECEC emphasise that playful learning enables children to explore, observe, create meaning, and learn social rules in an integrated way. Crucially, adults are expected to *join in* and support play, because when teachers genuinely play alongside children, they can better understand children's thinking and scaffold new learning. This ethos of playful, child-centred pedagogy underpins Finland's ECEC system, where formal instruction is delayed until age 7 and early learning happens largely through guided play. By prioritizing learning through play, Finland has nurtured children's curiosity and confidence, contributing to later academic success and well-being.

Poly-Universe aligns with this playful learning approach on multiple levels. First, Poly-Universe is inherently playful: it presents mathematical and artistic concepts as a hands-on game rather than formal lessons. Children manipulate brightly coloured shapes, invent patterns, and make creative decisions, often without realizing they are learning important concepts. This resonates with the Finnish idea that in early childhood, the *process* of play is more significant than any tangible product or "right answer". Poly-Universe play sessions are open-ended and driven by children's curiosity – for instance, a child might joyfully experiment with fitting pieces together by colour, essentially learning about matching and symmetry through self-motivated play. Such intrinsically motivating play "brings pleasure and joy" to children while also nurturing cognitive skills.

Second, Poly-Universe supports a holistic, imaginative learning experience. Finnish playful learning emphasises that children use imagination and narrative in play to make sense of the world. With Poly-Universe pieces, children can invent their own designs or even stories (e.g., treating shapes as characters or objects) – blending artistic creativity with logical patterning. The toolkit's simplicity and abstract forms encourage imaginative use. A child might create a "boat" from triangles or a mosaic "garden" from circles, engaging aesthetic expression alongside emergent math reasoning. This reflects how Finnish pedagogy values combining play, art, and exploration to develop the *whole child*. Indeed, Poly-Universe was conceived to bridge art and mathematics; as such, it invites an interdisciplinary form of play where drawing, building, storytelling, and problem-solving coexist. This synergy mirrors the Finnish integrative approach in ECEC, where learning areas (such as math, arts, and literacy) are not siloed but often intertwined within play themes and projects (Karvonen et al., 2022).

The Finnish Experience Workshop has played a central role in introducing Poly-Universe across all levels of education, from early childhood to secondary schools and teacher training. In the ECEC context, its programmes have emphasised how the toolkit can be adapted to merge multidisciplinary and phenomenon-based learning with play, positioning Poly-Universe as both a playful manipulative and a STEAM education resource. Through workshops (Figure 1) and co-teaching activities, teachers and children explored ways in which geometry, art, storytelling, and problem-solving naturally intertwine when using the toolkit. This has demonstrated how Poly-

Universe can enrich Finland's established playful learning pedagogy while simultaneously supporting the broader integration of STEAM practices in early education.

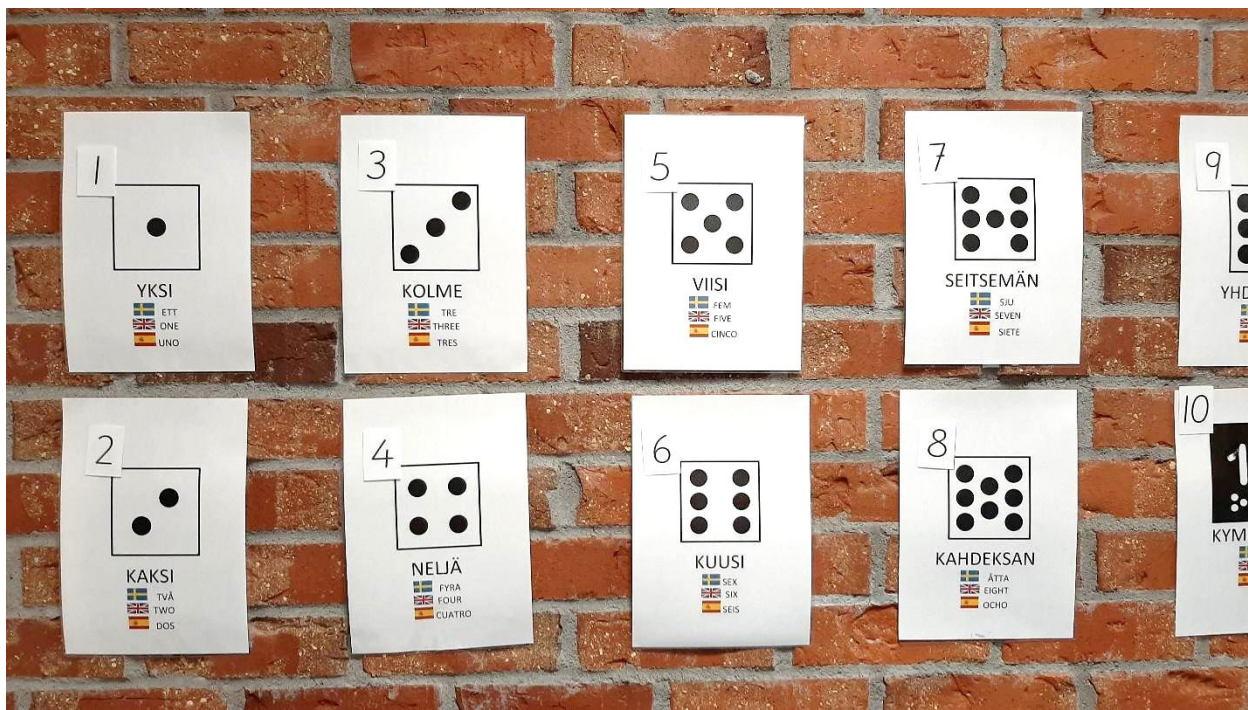


Figure 2: Numbers in multiple languages and representations in a Finnish early childhood education centre.

Third, Poly-Universe play is child-centred and inclusive, matching the participatory, inclusive nature of Finnish playful pedagogy. In Finland's ECEC culture, children are encouraged to influence activities and follow their interests, with educators adapting to each child's ideas and needs.

EarlyPoly activities are flexible and can be guided by children's choices – for example, children may choose which shape or colour to start with, or invent new rules for a game. The teacher's role is primarily to facilitate conditions for play (providing materials, space, and gentle guidance) and to *co-play* as needed, rather than direct instruction. This aligns with participatory pedagogy where a child's voice is valued and their agency in play is respected (Karvonen et al., 2022). Poly-Universe also naturally embodies an *inclusive approach* because it is open-ended and non-verbal; every child in a group can engage with the shapes at their own level. When playing in a group setting, children using Poly-Universe have opportunities to try out ideas together, collaborate, and share in the "inclusive approach which facilitates successful experiences and motivates everyone" (National Core Curriculum, 2018). In short, Poly-Universe play creates a dialogic, interactive environment much like the Finnish model where play is a dynamic process supporting creativity, social skills, and enjoyment for all.

Finally, the Poly-Universe toolkit aligns with Finland's learning through play outcomes by quietly building foundational skills under the guise of play. The Finnish Playful Learning framework is credited with helping children develop confidence, collaborative skills, and a positive attitude toward learning. Poly-Universe contributes to similar outcomes. Its *game-based* learning format encourages children to not fear mistakes – they can always rearrange pieces and try new configurations, which cultivates a mindset of experimentation and resilience. By working together

on Poly-Universe puzzles or artwork, children practice communication and teamwork in a playful context. Indeed, studies have found that using Poly-Universe tends to increase student engagement and motivation across various age groups, an effect very much in line with playful learning's goal of making learning fun and meaningful through child-centred play, joy in learning, holistic skill development, and guided discovery all come together when young children learn with this toolkit.

## 2. Core Didactic Principles of EarlyPoly in a Competence-Based Playful Learning Context

A central aim of the EarlyPoly methodology is to support competence development in early childhood through play. In Finnish Early Childhood Education and Care (ECEC), children's learning is framed in terms of developing broad, *transversal competences* – a blend of knowledge, skills, values, attitudes, and will that they will carry forward in life. The National Core Curriculum for ECEC defines several key competence areas: (1) *Thinking and learning*; (2) *Cultural competence, interaction, and self-expression*; (3) *Taking care of oneself and managing everyday life*; (4) *Multiliteracy and ICT competence*; and (5) *Participation and empowerment* (Figure 1). EarlyPoly's didactic principles are closely aligned with nurturing these competencies through playful, hands-on experiences.

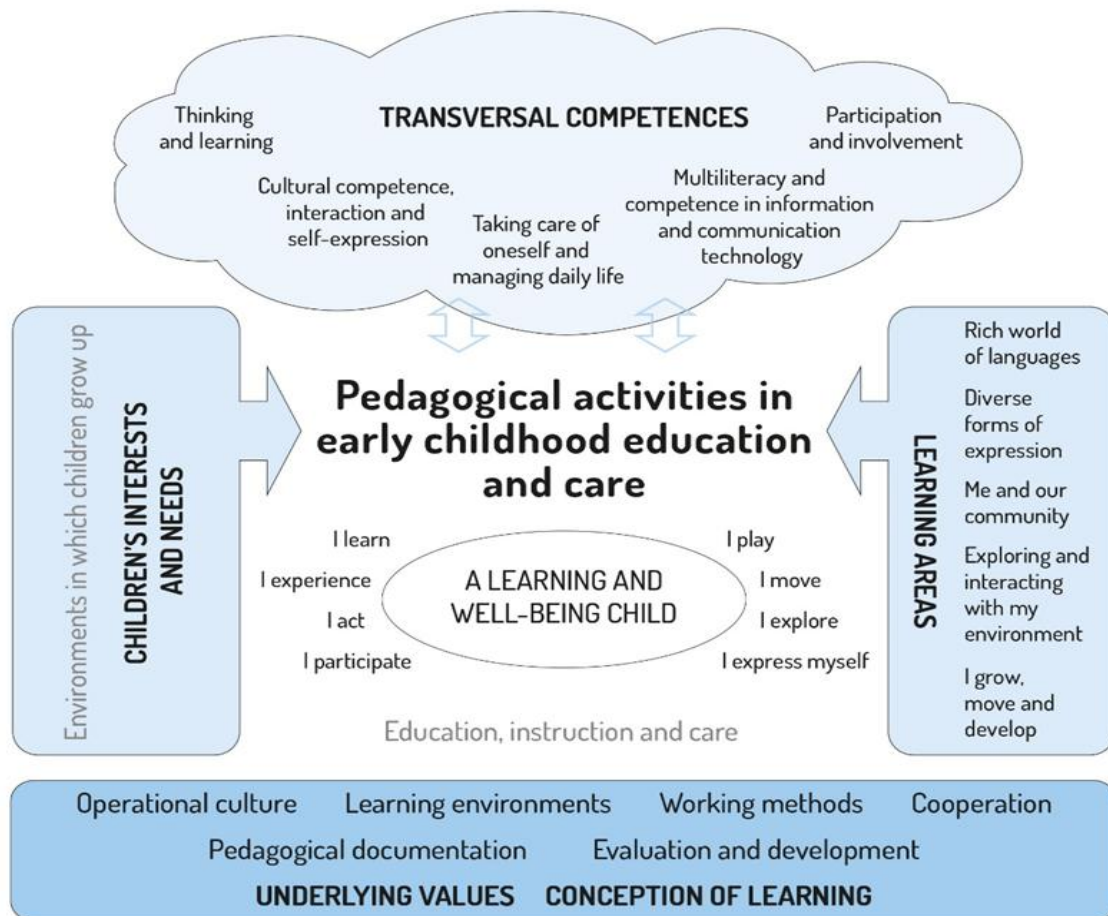


Figure 3: Key learning areas in the Finnish Core Curriculum for Early Childhood Education and Care.  
Source: Finnish National Agency for Education, 2018

**Learning through concrete play** is the first didactic principle. Young children learn best by doing – manipulating objects and experiencing concepts firsthand – rather than via abstract instruction. EarlyPoly embraces this by using tangible shapes that children can hold, move, rotate, and connect. This concreteness helps children internalize mathematical and logical ideas in an age-appropriate way. As educational theorist Jean Piaget observed,

5–6-year-olds benefit from *manipulatives* and physical play to develop cognitive operations. A playful, object-based approach allows children to gradually bridge from concrete understanding to abstract thinking. For example, by physically joining two triangle pieces to make a square, a child may grasp the concept of geometric composition or fractions (two halves make a whole) through *action*. This principle reflects a constructivist stance: children construct knowledge actively, and the Poly-Universe toolkit provides an ideal medium for such active learning. The hands-on play with shapes aligns with Piaget’s view that the child’s active, hands-on play is particularly significant in mathematical education and with Maria Montessori’s idea that the child discovers the world through their own senses using didactic materials.

In EarlyPoly sessions, the teacher often just introduces materials and opens a challenge (“Can you find all the ways to match these pieces?”) and then steps back to let children explore. Through this playful trial-and-error, children deepen their *thinking and learning* competence, gaining problem-solving strategies and confidence in their own ability to figure things out.

**Integrative and multi-sensory learning** is another key principle. EarlyPoly activities are designed to integrate multiple domains (math, art, language, motor skills) rather than teaching skills in isolation. This interdisciplinary play nurtures the competence of *interaction and expression* as well as *multiliteracy*. For instance, when children create patterns or pictures with Poly-Universe shapes, they are not only learning geometry but also engaging in artistic expression and storytelling. A teacher might encourage children to describe their creations (“Tell us about your design – what does it look like? How did you decide to put these pieces together?”), prompting use of new vocabulary (shape names, colour names, positional words) and thereby supporting language competence.



Figure 4: Playing with Poly-Universe in a Finnish pre-school programme.

One school task using Poly-Universe had first-graders associate shapes with letter sounds and then play a game of finding words that start or end with those sounds, based on the colour patterns of a drawn piece. During this playful phonological game, children practiced early literacy skills (phoneme awareness) while moving pieces and rolling a colour dice – an excellent example of integrative learning. The tactile, visual, and even auditory (if children sing or chant patterns) involvement caters to different learning styles and strengths, making learning accessible and engaging. By linking mathematical concepts with art and language in a single playful activity, EarlyPoly fosters *multiliteracy*: children learn to interpret and create meaning across symbol systems (numerical, visual, verbal). This holistic, multi-sensory approach is deeply rooted in playful learning pedagogy, which holds that young children learn in *whole-bodied* ways – using senses, movement, and imagination together.

**Active participation and collaboration** form a third didactic principle of EarlyPoly. Poly-Universe games encourage children to work together, share pieces, and solve challenges as a team. For example, a group of preschoolers might collectively try to assemble a large shape using all the pieces, which requires communication and turn-taking. In one Finnish ECE implementation, children in a “middle group” (4–5-year-olds) played with Poly-Universe collaboratively (Karvonen et al., 2022). Such activities build social and emotional skills: children practice listening to each other’s ideas and regulating their behaviour to achieve a common goal. This directly contributes to the competence of *participation and empowerment*, as children realize their contributions matter in a group project and they experience the empowerment of succeeding together. Moreover, collaborative play with inclusive tools like Poly-Universe can diminish hierarchies among children.

There are no predefined “winners” or “losers” in a Poly-Universe puzzle – often the play is about the process. This allows each child, regardless of background or ability, to participate meaningfully, echoing Finland’s commitment to equity and every child’s right to be involved. The EarlyPoly methodology often incorporates peer learning, where children help each other find solutions or invent new games with the pieces. According to Lev Vygotsky’s socio-cultural theory, learning is amplified in interactive contexts where peers scaffold each other. By designing activities where children must engage with one another – for example, trading pieces to complete each other’s patterns or playing a shape “relay race” in teams – EarlyPoly not only makes learning fun but also builds *interaction competence* (communication, cooperation) and a sense of community.

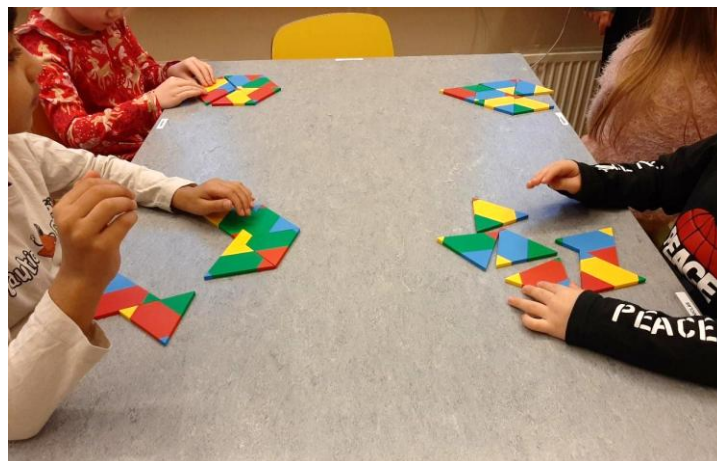


Figure 5: Playing with Poly-Universe in a Finnish pre-school programme.

**Guidance and reflection by the educator** is the final crucial principle ensuring EarlyPoly remains pedagogically grounded. While play is child-led, the teacher's intentional planning and facilitation turn play into learning opportunities. In EarlyPoly, educators carefully prepare the environment and introduce playful challenges that align with educational goals. They observe children's play closely to know when to intervene with a probing question or a new twist to extend learning. For instance, if children have freely explored making shapes, a teacher might gently introduce a rule: "What if all pieces touching must share the same colour? Can you make a pattern like that?" Such guided constraints can deepen mathematical reasoning within the play. This practice follows the Finnish idea that guided play can spark self-initiated play and that teachers can take on roles like co-player or "inspirer" to enrich the play experience.

Another aspect of guidance is ensuring the activity is appropriately challenging but not frustrating. The teacher may conduct *trial runs* of a new game in small steps and clarify rules so that children feel confident and enjoy the game. Maintaining the fun is paramount: teachers are advised to keep the experience enjoyable and stress-free for all children. When well guided, Poly-Universe play serves as a form of experiential learning where children actively reflect (with teacher support) on what they are doing and learning. EarlyPoly encourages teachers to ask reflective questions during or after play, like "How did you decide to place that piece there?" or "What did you notice when the big triangle was completed?". These prompts help children verbalize their thinking and connect it to underlying concepts, reinforcing their *thinking and learning competence*. According to experiential learning principles, such reflection turns a fun activity into a deeper learning experience. In summary, EarlyPoly's didactic approach combines free play with thoughtful adult guidance, aiming to cultivate a broad set of competences in a playful yet purposeful manner.

### 3. Implementing Poly-Universe for Competence Development in ECE

Implementing Poly-Universe in an early childhood setting involves integrating it into everyday pedagogical activities in a variety of playful ways. There are a few teachers in Finland who have incorporated Poly-Universe into different learning areas to develop children's competences, from mathematical thinking to language and socio-emotional skills. A hallmark of Poly-Universe is its versatility – the same set of pieces can be used in multiple contexts and for multiple objectives, simply by changing the rules or framing of the activity. Below are some core strategies and examples for effective implementation:

**Free Exploration and Guided Discovery:** When first introducing Poly-Universe, teachers often allow children a period of open free play with the pieces. Children might sort them by shape or colour, stack them, or make simple mosaics. This exploration stage is important for competence development as it lets children familiarize themselves with properties (shape, size, colour) and exercise agency. Even very young children (3–4 years) can discover basic attributes through play, e.g. "*All these pieces have a little circle inside!*" Such discoveries build early *thinking skills* and curiosity. After free exploration, educators can guide discovery by posing a playful problem: "*Can you find a way to connect all the red parts together?*" or "*How many different pictures can we make using exactly four pieces?*". This kind of challenge gently introduces mathematical concepts like grouping, counting, or symmetry, while children remain in a playful mindset. It also fosters *problem-solving competence* as children figure out solutions through trial and error, often collaboratively.

**Cross-Curricular Play Activities:** Poly-Universe can be woven into various learning areas of ECE, creating rich cross-curricular experiences. In mathematics, a common use is to practice spatial reasoning and geometry. For example, children can play a game of forming larger shapes: using all the small triangles to assemble one big triangle, or tiling circle pieces to form a ring. Through such play, children implicitly learn about part-whole relationships, shape decomposition, and symmetry. A teacher reported using Poly-Universe pieces with first-grade children to practice basic arithmetic: the class pretended each shape had a numerical value and they combined pieces to perform additions and subtractions. In art activities, Poly-Universe supports *creative competence*. One class used the pieces as stencils: children traced around Poly-Universe shapes on paper and then painted their drawings, blending mathematical precision with artistic creativity. This activity not only taught shape recognition but also let children express personal creativity (choosing colours, making a picture), addressing both *cultural expression* and fine motor development.

For language development, teachers have devised Poly-Universe games that integrate early literacy. In a playful phonics exercise, different colours were associated with different letter sounds; children drew a Poly-Universe piece from a bag and then had to come up with a word starting with the sound of the piece's base colour. Rolling a coloured dice added randomness and excitement to the task. Children were enthusiastically expanding their vocabulary and phonological awareness, all within a game format. Such an activity targets *multiliteracy competence* by linking symbols (letters) to playful context. For socio-emotional learning, Poly-Universe has even been applied in *personality development* lessons – for instance, children might pick a shape and use its colours or sizes to express an emotion (“The big red circle means I feel happy!”), providing a concrete way to talk about feelings. This kind of implementation shows how Poly-Universe can support *self-expression and emotional skills* in an inclusive, game-like manner.

**Routine Inclusion and Learning Centres:** To fully harness Poly-Universe for competence development, there are already some Finnish ECEC centres, which integrated it as a regular part of the learning environment (Figure 4, 5, 6). For example, a Poly-Universe station may be set up in the classroom where children can choose it during free-play time. Teachers rotate small group activities using Poly-Universe, ensuring each child gets frequent hands-on experience. A possible weekly plan could involve a “Poly-Universe morning” where children engage in a guided game targeting a specific skill (e.g., pattern sequencing on Monday, collaborative shape-building on Wednesday). By embedding it in routine, children have repeated exposure, which deepens learning. The *learning environment* is arranged to invite independent exploration – perhaps a low table with pieces readily available, and pictures of sample patterns to inspire the children. Finland's ECEC guidelines note that rich learning environments with accessible materials encourage children “to play, explore, create and express themselves”. Poly-Universe certainly contributes to such an environment: its colourful, hands-on nature entices children to engage without prompting. During these activities, the educator's task is to *observe and facilitate*, stepping in to nudge higher-order thinking or collaboration as needed.

**Adapting to Developmental Levels:** Implementing Poly-Universe effectively means tailoring activities to different ages and abilities. EarlyPoly methodology provides a continuum of complexity. For toddlers (ages 2–3), implementation might simply involve sensory play: touching and naming shapes and colours, or grouping identical pieces. The educational focus here is on language (learning shape/colour words) and basic cognitive skills like sorting – aligned with competence in *thinking* and

*communication*. For preschoolers (ages 4–5), activities become more rule-based and goal-oriented. Children can handle simple pattern rules (e.g., alternate colours in a sequence) or games like memory (finding matching halves). One playful learning activity could be a “shape treasure hunt” where pieces are hidden around the room for children to find and then assemble into a large design collectively – combining physical movement, teamwork, and problem-solving.

At this stage, implementation targets a broader set of competences: *thinking*, *interaction*, and *participation* (as children plan and execute together). For the oldest kindergarteners (~6 years) or in pre-primary, Poly-Universe can be used in quite sophisticated ways resembling early mathematics or art lessons, but always with a playful twist. They might explore symmetry explicitly: a teacher can introduce terms like “rotate” or “reflect” by showing how a pattern changes when a Poly-Universe piece is flipped, thus connecting their play to formal concepts. This level can also incorporate *documentation* – children might draw their final pattern or dictate a story about it, blending play with early literacy and reflection.

**Using Poly-Universe Resources and Community:** Teachers implementing EarlyPoly are not alone – the approach is supported by resources developed in projects like PUSE (Poly-Universe in School Education). The Erasmus+ PUSE project produced a methodological handbook with task examples and formative assessment tools, intended for educators working from preschool up to secondary school. These resources provide practical guidance on integrating Poly-Universe into lesson plans and adapting it for learners with special needs.

For instance, the PUSE handbook includes game templates and suggestions on how to observe children’s problem-solving during the game (formative assessment). By leveraging such resources, teachers can refine their implementation strategies and ensure they are hitting desired learning outcomes through play. Additionally, a community of practice has formed around Poly-Universe: Finnish ECEC teachers, in collaboration with researchers (e.g. at the University of Jyväskylä), continuously exchange ideas and feedback on using the toolkit. This collaborative development means EarlyPoly implementation is informed by evidence and experience, enhancing its effectiveness in building children’s competencies.



Figure 6: Playing with Poly-Universe in a Finnish pre-school programme.

In summary, implementing Poly-Universe in early education involves creative, flexible use of the toolkit in daily pedagogical play. By offering diverse activities that map to various competence areas – from spatial reasoning to language and cooperation – teachers can use Poly-Universe as a powerful vehicle for competence-based learning. The key is maintaining a playful, child-centred atmosphere: children should feel like they are playing a game, even as the educator knows the game is nurturing critical developmental skills.

#### **4. STEAM in ECEC and Poly-Universe’s Contribution**

Across early childhood education, STEAM (Science, Technology, Engineering, Arts, and Mathematics) is increasingly understood not as five silos but as integrated ways of knowing and doing that children explore through play, inquiry, and making. In competence-based curricula such as Finland’s ECEC framework, this integration supports transversal competences—thinking and learning; cultural competence, interaction and self-expression; multiliteracy and ICT; participation and empowerment—by inviting children to connect observation, representation, and problem-solving in meaningful contexts. In practice, STEAM in ECEC privileges hands-on, multimodal, and collaborative activity where artistic expression and mathematical/ scientific reasoning develop together rather than sequentially (cf. Karvonen et al., 2022; EDUFI, 2018).

Poly-Universe offers a developmentally appropriate gateway to STEAM because its design couples mathematical structure (shape, size, symmetry, part–whole relations, pattern) with aesthetic decision-making (composition, colour, rhythm). Children manipulate tangible elements to test ideas (engineering), notice regularities (science/mathematics), and communicate meanings (arts/language), while teachers can frame the same materials as open-ended explorations or guided challenges. This dual affordance makes Poly-Universe suitable for phenomenon-based projects (e.g., building mandalas to study symmetry; designing “cities” to discuss shapes in the built environment; creating “data pictures” to count, classify, and compare), naturally weaving together measurement, representation, and storytelling. Such activity also nurtures 21st-century dispositions—curiosity, creativity, perseverance, collaboration—central to early STEAM aims.

Importantly, Poly-Universe scales across developmental levels and modalities. For toddlers, it supports sensory exploration and early language (naming shapes/colours); for preschoolers, it enables rule-based games (matching, sequencing) and design thinking (plan–test–revise). Teachers can document learning through photographs and children’s talk, linking playful artefacts to competence growth in multiliteracy and interaction. Prior classroom studies report that Poly-Universe increases engagement and positive attitudes to mathematics while transferring to other subjects, reinforcing its value as a STEAM catalyst that is inclusive, low-threshold, and adaptable to diverse ECEC contexts (Debrenti & Bella, 2025; Karvonen et al., 2022).

#### **5. Formative and Playful Assessment and Documentation of Learning through Poly-Universe**

Assessment in Finnish early childhood settings is distinctly formative and play-oriented, and the use of Poly-Universe aligns with this ethos. In ECEC, assessment is not about standardized tests or grades; instead, it centres on observing each child’s development and providing feedback to guide further learning. The National Core Curriculum for ECEC emphasises that teachers should *observe and assess children’s skills at the beginning of each term* to understand each child’s starting point

and needs. Importantly, the *most natural way to assess* young children is *within the context of everyday pedagogical and play activities*, rather than pulling children out for artificial “testing”. In practice, this means educators watch children during play (like a Poly-Universe session) to gauge their competence development – for example, noting how a child approaches a puzzle (Do they persist? Do they strategize? Do they collaborate?), which reveals cognitive and social skills.

Poly-Universe play offers rich opportunities for such observation-based assessment because it elicits behaviours across multiple domains: problem-solving strategies, interaction with peers, fine-motor manipulation, creativity in design, and even language use if children verbalize their thinking. A teacher might jot down anecdotal notes: *“Child A found two different solutions to the pattern – showing flexible thinking”* or *“Child B named all the shapes confidently – demonstrating shape recognition”*. These observations, made in the flow of play, serve as formative assessment data that can inform the teacher’s future planning (e.g., introducing a slightly harder pattern next time for Child A, or spending more time on shape names with Child B). This approach keeps assessment *playful and stress-free* for children; they often are not even aware they are being “assessed” in any formal sense.

To systematically capture learning progress, Finnish ECEC practitioners use pedagogical documentation. Pedagogical documentation is an ongoing process of recording and reflecting on children’s activities and achievements, typically through photos, notes, or learning stories, which is then used to plan further pedagogical steps. In the text of Poly-Universe, a teacher might take photos of a child’s pattern constructions over time or keep a portfolio of “designs” the child has made with the pieces. They might also write a brief narrative: *“In September, Maria was mostly exploring random placements with Poly-Universe. By November, she independently created a symmetrical butterfly shape, indicating growth in spatial awareness.”* Sharing these documented moments with parents or the children themselves turns assessment into a *celebration of learning*. Finnish guidelines note that documentation, when shared among staff, children, and parents, increases everyone’s understanding of the child’s learning process. In an EarlyPoly setting, teachers can invite children to talk about their Poly-Universe creations as part of documentation – effectively involving children in assessing their own work in an age-appropriate way (e.g., a child might say, “I made a flower. Next time I want to make it bigger!” which gives insight into their self-assessment and goals). This reflects a *participatory assessment* approach aligned with playful learning: children’s voices are included and their play artifacts are valued as evidence of learning.

**Playful assessment** strategies specific to Poly-Universe have also been developed. The PUSE project, for instance, provided formative assessment tools integrated with Poly-Universe tasks. One example is using simple checklists or rubrics during a Poly-Universe game – not to “grade” children, but to focus the teacher’s observation on key competencies. For a pattern-making game, a rubric might list items like “Uses trial and error to solve problems,” “Cooperates with peers to combine pieces,” or “Explains their pattern out loud.” The teacher can note which behaviours each child exhibited and which might need encouragement.

These tools transform assessment into a natural part of the play activity. In fact, some Poly-Universe games themselves can double as assessments. For instance, a teacher might play a *Shape Sort Challenge* where children race to sort pieces by shape; while children just think it’s a fun game, the teacher is able to see who confidently recognises shapes and who might still confuse some. Similarly, a *storytelling game* using Poly-Universe pieces (where each child picks a piece and adds a sentence

to an ongoing story) can inform the teacher about children's language and narrative skills in a playful context. The immediate feedback loop is another hallmark of formative assessment in play: if a child struggles with a task, the teacher can modify the game on the spot or provide a hint, thus using the assessment insight to support the child right then and there. This is in line with the idea that assessment should *support each child's development*, not simply evaluate it.

Crucially, Finnish ECEC educators maintain that any assessment at this stage should *never be an end in itself*, but a tool to help each child progress at their own pace. Poly-Universe play lends itself to this philosophy because it is open-ended – there is no single metric of success like a test score. Instead of asking “Did the child get the right answer?”, teachers consider *qualitative questions*: “How does the child approach the game? Have they improved in collaboration or persistence since last time? What new skill are they showing?” In a way, the Poly-Universe pieces become assessment props: a child's evolving ability to manipulate and create with these pieces is a visible marker of their cognitive and motor development. For example, a teacher might notice that a child who initially only made random arrangements can, after some weeks, create a deliberate repeating pattern – indicating growth in logical thinking and attention to detail. By documenting such milestones, the teacher can communicate to parents in concrete terms (“Now he can make ABAB patterns with colours, which is a big step in early math!”) and adjust the curriculum to introduce new challenges.

Finally, the role of reflection and discussion is part of playful assessment. Finnish educators often conclude play activities with a group reflection: children are encouraged to share what they made or learned, in their own words. In an EarlyPoly session, a teacher might gather the children around to admire each group's creations and ask questions like, “Which shape was hardest to use and why?” or “How did you decide to work together on that big design?” These conversations help children become aware of their own learning (metacognition) in a simple way and allow peers to appreciate each other's ideas – reinforcing the learning in a social context. It turns assessment into a form of *learning dialogue* rather than a one-sided evaluation. Moreover, listening to children's explanations can yield additional assessment insights (for instance, a child might reveal they sorted pieces by size even if the teacher didn't notice it, showing an analytical approach).

In summary, assessment and documentation in EarlyPoly are woven into the fabric of play. Through careful observation during Poly-Universe play, use of formative tools and playful “challenges,” and ongoing documentation, teachers gain a rich picture of each child's developing competences. This process stays true to the spirit of *playful learning*: it's low-pressure, reflective, and focused on supporting growth rather than judging performance. As Harcourt and Jones (2004) note, documentation in early education is a critical practice, and the Finnish curriculum underscores its importance for evaluating and developing pedagogy. Poly-Universe provides an excellent context for such pedagogical documentation, as the tangible outcomes of play (patterns, structures, stories) can be recorded and revisited. In essence, EarlyPoly transforms assessment into another opportunity for playful interaction and understanding, thereby closing the loop between teaching, learning, and reflecting in the early childhood classroom.

## 6. Inclusion, Equity, and Gender-Sensitive Practices in EarlyPoly

Inclusion and equity are foundational values in Finnish education, and EarlyPoly methodology strives to embody these values in practice. An inclusive, gender-sensitive approach ensures that *all* children – regardless of gender, background, or ability – can participate fully and benefit from Poly-Universe play. There are several aspects to how EarlyPoly promotes inclusion and equity:

**Universal Design for Learning:** The Poly-Universe toolkit’s design is inherently inclusive. Its use of basic shapes and colours is culturally neutral and free of language barriers, making it accessible to diverse learners including multilingual children and those with communication difficulties. The game pieces are tangible and visual, which is beneficial for children with various learning needs (e.g. children who are stronger visual or kinesthetic learners). Additionally, Poly-Universe is *open-ended* – there is no single correct way to play – which allows children of different skill levels to engage at their own pace and level of complexity. One child might simply enjoy matching colours, while another composes intricate patterns, and both can play side by side. This flexibility aligns with equity-focused pedagogy, which calls for materials that can be adapted to each child’s zone of development.

Notably, the PUSE project documentation highlights that Poly-Universe is suitable for children with disabilities (including autistic children, and those with hearing or vision impairments) as a tool for developing abilities through multisensory, hands-on play. In an EarlyPoly session, a teacher might use additional support for children with special needs – for example, using a simplified set of pieces for a child who gets easily overwhelmed, or allowing a child with motor difficulties to place pieces on a nonslip mat. Such adaptations preserve the core play experience while ensuring *everyone* can participate meaningfully. Research indicates that high-quality games with these characteristics can actually help level the playing field: they “provide significant benefits for learners by offering opportunities for choice, adaptability, and active engagement,” which supports diverse learners and promotes equality in learning outcomes (Debreñti, 2024a). Poly-Universe is cited as one such high-quality educational game.

**Encouraging Collaboration over Competition:** EarlyPoly activities are typically structured to encourage cooperative play rather than competitive play. This is a deliberate equity strategy – cooperation allows each child to contribute and learn from others, whereas competitive games might consistently favor certain children (older, faster, or more advanced) and leave others behind. For instance, instead of asking “Who can solve this puzzle fastest?” an EarlyPoly activity might be, “Let’s *all together* try to use every single piece in one big mosaic.” In this way, success is shared and every child’s effort matters. If a child completes their part early, they can help a peer, fostering empathy and peer support. Finnish ECEC places strong emphasis on communal learning experiences where children see each other as partners rather than rivals. Poly-Universe sessions naturally create moments of peer teaching – e.g., a child might show another how to flip a piece to make it fit, or two children might jointly figure out a symmetric arrangement. These peer interactions break down gender or ability stereotypes, as children learn to appreciate each other’s strengths. It’s often observed that in a mixed-gender group, one child might excel in artistic design and another in spatial logic; Poly-Universe requires both, so children can recognise different forms of competence. In a playful learning environment with Poly-Universe, *everyone becomes a teacher and a learner*, which is a powerful inclusive practice.

**Gender Neutral Play:** The Poly-Universe toolkit is free from stereotypical gender coding – there are no princesses or cars, just shapes and colours, which appeals broadly to all genders. Early childhood classrooms in Finland make conscious efforts to avoid reinforcing gender stereotypes, providing all children equal access to all types of play (National Core Curriculum for ECEC, 2018). EarlyPoly supports this by inviting both boys and girls to engage in spatial and artistic play simultaneously. Traditionally, spatial construction play (blocks, puzzles) might be encouraged more in boys, whereas art and colour play might be seen as more “*for girls*.” Poly-Universe deliberately blurs these lines: it’s a puzzle (math-oriented) but also an art set (creative-oriented). Teachers report that both boys and girls show high interest in Poly-Universe activities, often playing together in mixed groups. This helps reduce any gender gap in developing spatial skills or creativity. Research suggests that providing equal opportunities in playful activities can mitigate gender differences in skill development (e.g., in spatial awareness or willingness to engage in math-related tasks). By ensuring that Poly-Universe is introduced as a game for *everyone* and by possibly highlighting diverse role models (e.g., mentioning the game was created by an artist, János Saxon, and developed by a team including women mathematicians and educators), teachers can further reinforce that *math-art play is gender inclusive*.

**Equity in Participation:** A practical equity consideration is making sure every child gets a turn and a role during Poly-Universe play. Teachers are mindful of not letting more assertive children dominate the pieces or decision-making. Strategies include using *turn-taking rules* (each child adds one piece in sequence to a group pattern), assigning cooperative roles (one child finds pieces of a certain colour while another assembles, then they swap), and designing tasks that require input from all (like a puzzle that has different “sections” each child is responsible for). Finnish pedagogy values creating a safe and respectful atmosphere with common rules that ensure everyone is included and heard. In an EarlyPoly context, an example rule could be: “We can’t complete our big picture unless everyone contributes a piece.” Such approaches instill in children the understanding that *inclusive play* is the norm. Also, by mixing groups frequently, teachers allow children to experience different peer dynamics and appreciate diversity. One day children might play Poly-Universe in pairs, another day in a large group or with a child they don’t usually play with, which can enhance social inclusion and cross-gender or cross-cultural friendships.

**Cultural and Linguistic Inclusion:** Poly-Universe’s abstract nature also makes it a culturally inclusive tool. It does not rely on specific cultural knowledge or language, so children from various cultural backgrounds can engage with it on equal footing. In Finland’s increasingly multicultural ECEC classrooms, this is a valuable feature. Teachers can even use Poly-Universe as a *language bridge*: for multilingual children, shapes and colours are often some of the first concepts learned in a new language. Playing with Poly-Universe provides a concrete context to practice Finnish (or another common language) in a low-pressure way: children naturally start naming colours or counting pieces together. It also offers opportunities for children to teach each other words in their home languages (for instance, they could share what each colour is called in Finnish, Swedish, Arabic, etc. as they play). This not only validates each child’s linguistic identity but also fosters *cultural competence* by exposing peers to different languages within play. Moreover, teachers can incorporate cultural themes using Poly-Universe – e.g., creating patterns inspired by motifs from different cultures – to celebrate diversity in a playful medium.

**Role of the Educator in Inclusion:** The teacher’s awareness and intentional actions are critical to making EarlyPoly truly inclusive and gender-sensitive. Educators are trained in Finland to observe group dynamics and intervene if certain children are marginalized or if gender biases surface. In Poly-Universe play, a teacher might notice, for example, that boys initially grab more pieces, leaving girls to watch. They can address this by gently structuring the activity (ensuring materials are shared evenly) or by encouraging girls to take leadership in a task (e.g., “Leena, would you like to decide which shape we build next?”). Because Poly-Universe is a novel tool for most children, it doesn’t come with pre-assigned gender roles (unlike, say, play kitchen vs. construction blocks which unfortunately can have gendered perceptions). Teachers can leverage that novelty to set expectations from the start that *everyone is an explorer* in this activity. The Finnish framework also stresses *equity in learning environments*, meaning that when planning play environments, educators consider equality and gender equality so that all children feel represented and included. EarlyPoly in practice has embraced this; for instance, teachers ensure that examples and imagery associated with Poly-Universe include diverse participants.

In conclusion, EarlyPoly methodology is deeply committed to inclusive education. By design, Poly-Universe supports diverse learners through its adaptable, multisensory play. In facilitation, teachers emphasise cooperation, equal participation, and respect for differences during Poly-Universe activities. And in the broader learning environment, Poly-Universe becomes a tool to promote gender equality and cultural inclusion by engaging all children in shared playful experiences. This approach not only aligns with Finnish ECEC values but also helps foster a classroom culture where *every child belongs* and can succeed. The positive social atmosphere generated in inclusive play further enhances learning – as children feel safe and valued, they are more likely to take risks, be creative, and help one another, leading to richer learning outcomes for all.

## 7. Poly-Universe Playful Learning Games in Early Childhood

Below is a collection some of developmentally appropriate games using Poly-Universe shapes, each inspired by activities in the Finnish *Playful Learning* book (Karvonen et. al, 2024). The games target various learning goals (mathematical thinking, creativity, social-emotional skills, pattern recognition, fine motor development) and are explicitly linked to Finnish ECEC competence areas. All descriptions include the intended age group, required materials, learning objectives, rules of play, and ideas for formative assessment.

### Game 1: Shape Matching Magic / COL\_117\_EN

Age Group: 5–6 years

Competence Area(s): Mathematics (geometry, problem-solving), Arts (visual expression)

Materials: Poly-Universe set – multiple circles, triangles, and squares in red, blue, yellow, green (ensuring a variety of the 72 puzzle-like pieces); a flat surface or tabletop for assembling shapes.

Learning Goals: Familiarize children with basic geometric shapes and colours; develop visual discrimination and mathematical thinking through matching and classifying; practice fine motor and spatial reasoning skills. Game Description & Rules: This game is adapted from the Poly-Universe shape-matching activity. First, allow children some free play time to explore and combine the shape

pieces creatively (to discover how smaller coloured shapes form larger patterns). Then introduce a “matching rule” game:

Step 1: The teacher chooses a simple rule for matching pieces (e.g. *“Connect pieces so that touching sides share the same colour”*). Demonstrate a couple of examples so children see how a red edge meets another red edge, etc.

Step 2: Children work individually or in pairs to join as many pieces as possible following the rule, creating a patchwork of shapes. They might form a multicolour mosaic or a symmetrical design as they match sides. Encourage them to talk about what they’re making (naming shapes or colours).

Step 3: After a round, introduce a new rule – for example, *“Now match pieces by shape instead of colour”* (triangle to triangle, square to square, etc.), or *“Create a large shape using only circles,”* and let them reconfigure the pieces accordingly.

Step 4: Invite children to come up with their own matching rules (*“Let’s put pieces in a red-yellow-blue-green repeating pattern!”*) and play again following a child’s rule. This empowers them and adds creativity to the challenge.

The game can be replayed many times with new rules or goals (like making a specific picture). It strengthens shape recognition and problem-solving in a playful way.

*Formative Assessment: Observe how children approach the puzzle – do they recognise and name shapes and colours correctly? Can they find matches quickly or create intended patterns? Take note of collaboration if in pairs (are they negotiating which piece goes next?). Prompt with questions like “How did you know these fit together?” to assess their reasoning. Document each child’s strategy or any difficulties (e.g. struggling to rotate a shape to match) to inform future support. A quick check at the end: have each child proudly “present” their shape creation and describe one thing they learned or enjoyed.*

## Game 2: Colour & Shape Shopping / LOG\_509\_EN

Age Group: 5–7 years

Competence Area(s): Mathematics (counting and classifying), Multiliteracy (following symbolic “shopping list”), Arts (creative expression)

Materials: Assorted Poly-Universe pieces sorted into colour groups (e.g. a tray for red pieces, one for blue, etc. – since each Poly-Universe piece has multiple colours, decide a dominant colour or a specific segment to classify them by); picture shopping lists for each child (simple cards showing coloured shapes and a number, e.g. 2 × red circle, 1 × bl encourage planning and independent work... (collecting items from a list); foster creativity by using collected shapes to make an art piece. Fine motor skills are exercised as children pick up and handle small pieces.

Game Description & Rules: Inspired by *“The Colour Shop”* activity, this game turns the classroom into a mini shape market: – Preparation: Set up shopping stations around the room – small areas or tables where Poly-Universe pieces are laid out by colour (all pieces with a lot of red at one station, blue at another, etc.). Give each child a shopping list card with pictures indicating how many pieces

of certain colours or shapes to collect (for example, a card might show a red circle and the number 2, a green triangle and the number 1, etc.). Start with just 2–3 items per list for younger children.

Step 1: Explain that each child is going on a shopping trip to collect the “items” on their list. Show an example card and model reading it: *“This says I need two red circles. That means I go to the red station and find two circle pieces with red.”* Emphasise taking the correct quantity and colour of each shape (this links numeral symbols to actual counted objects).

Step 2: Let children move freely between stations with their basket, “buying” the pieces on their list. An adult can play the shopkeeper if desired, pretending to sell pieces to each child – which adds a social interaction element. Children practice politely “asking” for a piece and maybe using simple exchange (for fun, play money can be used once they grasp the basic idea, similar to the letter merchant game).

Step 3: Once a child has gathered all items on the list, they bring their basket to the teacher to check out. The teacher and child count together to verify the right number of each colour/shape was collected – *“Let’s count... you have 1, 2 red circles – correct!”* This reinforces counting skills and gives immediate feedback.

Step 4: Creative extension: After shopping, children use their pieces to create a small artwork or pattern. For example, with their shapes they might arrange a simple picture (a house, a flower, or any design). This step encourages creativity and integrates art – much like in the original Colour Shop game where children made an art piece from their “purchases”. Take a photo of each creation and have children name it, linking back to multiliteracy by labeling their work (the name could be written and placed next to the piece).

*Formative Assessment: Review each child’s shopping list versus their collected pieces to assess counting accuracy and understanding of quantities. Note if they recognised the numerals and colours correctly or if they needed help (e.g. mistook 3 for 5, or grabbed a wrong colour). The creative output can be observed for patterns or arrangements – ask the child to describe what they made and why they chose those shapes, to probe their reasoning and language use. This activity also offers insight into attention and self-regulation: did the child follow the task independently? If a child wanders off-task or seems confused by the symbolic list, that’s an opportunity to scaffold by simplifying the list or pairing them with a peer. Positive reinforcement can be given by showcasing the “art gallery” of shape creations to the whole class, celebrating both the math (counting) and art outcomes.*

### **Game 3: Emotion Explorers (Colour My Feelings) / EMO\_408\_EN**

Age Group: 5–6 years

Competence Area(s): Arts/Expression (identifying & expressing emotions), Interaction (social-emotional skills), Multiliteracy (interpreting colours as symbols for feelings)

Materials: Poly-Universe pieces in various colours (ensure each child has access to a few pieces that prominently feature each of the basic colours – red, blue, green, yellow); also prepare emotion cards or emoji faces representing basic feelings (happy, sad, angry, calm, etc.) and matching coloured paper or mats for those emotions (e.g. blue circle for sad, yellow for happy, etc.), as decided by the group discussion. Optional: a mirror for children to practice facial expressions.

**Learning Goals:** Help children recognise and name different emotions and associate them with colours or abstract representations; build empathy by understanding that others may feel differently (social awareness); encourage creativity and self-expression by using shapes and colours to represent feelings. The fine motor aspect comes in arranging the pieces to depict an emotion.

**Game Description & Rules:** This game is inspired by the *“Colours and Emotions”* morning circle activity. It adds a hands-on twist with shapes:

**Step 1: Discussion** – Gather children in a circle. Begin by talking about feelings and colours: *“What colour do you feel like when you’re happy? Maybe yellow like the sun? What about angry – is it red like fire?”* As a group, decide on some colour-emotion matches (there are no wrong answers). For example, children might agree green feels “calm,” blue “sad,” red “angry,” yellow “happy”. Place the coloured emotion cards or mats in the centre as a reference.

**Step 2: Shape Selection** – Hand out a mix of Poly-Universe pieces to each child. Now introduce the idea: *“Use your shapes to show how you feel today.”* Each child picks a shape piece in the colour that represents their current mood or an assigned emotion. They will use it to share that feeling with the group. For instance, a child who feels joyful might choose a bright yellow circle piece.

**Step 3: Express & Share** – One by one, children take turns showing the shape they chose and acting out or describing the emotion. For example: *“I picked a blue triangle. Blue is my favorite colour but it’s also a little sad. My triangle has a small yellow corner – that’s my happy part peeking out. I feel a little sad because my friend is absent, but also happy because I like triangle shapes.”* Encourage them to make a matching facial expression or pose (tie-in with drama/physical expression). The group can then guess or name the emotion and hold up a matching emotion card if available (this fosters empathy – they observe how each child shows feelings).

**Step 4: Group Emotion Mosaic** – As a culminating activity, children work together to create an “emotion mosaic.” Using a large sheet of paper, they place their chosen shape onto it one by one, forming a collective artwork. Perhaps arrange the pieces into a giant heart or a smiley face outline. This represents the class’s range of feelings at that moment. It visually reinforces that we all have feelings and they all fit together in the classroom community.

*Formative Assessment:* During sharing, listen for correct emotion vocabulary and observe if children can connect colour to feeling coherently (this shows emotional awareness). Note each child’s comfort level: who eagerly expresses and who is shy? These observations help in supporting social-emotional development. After the activity, you might ask questions: *“How did it feel to share your emotion? What did you notice about others’ emotions?”* This reflection gauges empathy growth. Additionally, keep the finished emotion mosaic on display. Over time, you could revisit it and ask if anyone’s feelings have changed, using the shapes to talk about managing emotions. This ongoing dialogue aligns with supporting children’s self-regulation and social competence as emphasised in the Finnish ECEC approach.

## Game 4: Storytime with Shapes / TAL\_707\_EN

Age Group: 5–6 years

Competence Area(s): Multiliteracy (narrative skills, interpreting symbols), Language/Interaction (oral storytelling, listening), Creativity (imaginative play)

Materials: A set of Poly-Universe shapes for each child or pair (ensure a mix of shapes and colours). Optionally, a large felt board or flannel board where shapes with velcro can be placed as story visuals, or simply a table space for each child to lay out a story scene. Also prepare a few example story prompts (short scenarios or themes like “A Trip to the Moon” or “Under the Sea”) to inspire them if needed.

Learning Goals: Encourage children to construct and articulate their own stories, enhancing vocabulary and narrative structure skills; use shapes as visual prompts (pictorial literacy) to support storytelling – aligning with multiliteracy by interpreting and creating messages with symbols; build social and emotional skills by having children listen to others and ask questions about each other’s stories. Fine motor skills are practiced in manipulating the shapes to set up scenes.

Game Description & Rules: This activity is an adaptation of the “*Stories by Puppets*” idea – but instead of puppets, children will use Poly-Universe pieces to create characters and settings for a story:

Step 1: Introduction – Explain that shapes can tell stories! Show an example: place a green triangle and a blue circle on the board. Make up a simple tale like, “*Once upon a time, Triangle (point to it) was a little mountain, and Circle was the sun in the sky. Every morning, Sun would wake Mountain up with its warm rays...*” This whimsical demonstration helps children see how a triangle or circle can represent things in a story (mountain, sun, characters, etc.).

Step 2: Create a Scene – Give children time to select some shapes and arrange them into any scene or “picture” they imagine. They can work solo or in pairs for collaborative storytelling. Encourage creative interpretations: a circle could be a face or a ball; a square might be a house or a robot. There’s no wrong way – the aim is to ignite imagination. (For example, one child might group a blue circle and a green triangle and decide it’s “a turtle with a shell,” while another stacks shapes to make a rocket ship.) Teachers can walk around and ask guiding questions about what they see forming: “*I notice you put a small red circle on a big yellow circle – what could that be?*” to spark ideas.

Step 3: Tell the Story – Now each child (or pair) gets a turn to present their shape story to the group. They describe what they created and weave a short narrative around it. For instance: “*This is a castle (square) on a hill (triangle). The circle is a dragon who lives there...*” Allow them to move the pieces as they talk (making the circle “dragon” fly, etc.). The other children practice being a respectful audience – listening and then asking one or two questions of the storyteller: “*What is the dragon’s name? Why is he on the hill?*” etc. This Q&A builds interactive communication, much like the puppet story activity where peers ask the puppets questions.

Step 4: (Optional) Group Story – If time permits, do a collective storytelling: Start with a blank board and one shape. Each child in circle adds one shape to the board and adds one sentence to continue a *joint story*. For example, the first child places a shape and says, “*There was once*

*a lonely red circle who wanted a friend.” The next child adds another shape, “Along came a green triangle...” and so on around the circle. By the end, the whole class has built a story together using many shapes. This extension fosters group imagination and listening, as they must build on each other’s ideas.*

*Formative Assessment: Pay attention to each child’s storytelling abilities: Do they sequence events logically? Are they using descriptive language? Note if the child assigns creative roles to shapes (this shows symbolic thinking – a key pre-literacy skill). Also observe audience skills: who listens patiently, who is eager to ask questions or who struggles to wait their turn. These observations relate to interaction competence. You can tape-record or jot down key phrases from their stories to later evaluate language development (vocabulary, sentence length) and narrative structure. After the session, reflect with the class: “How else could we use shapes to tell stories?” The goal is for children to realize that their ideas can be represented in many forms – an important aspect of multiliteracy. The shapes serve as an engaging medium for expression, much like picture books or puppets, and the children’s enthusiasm during this game can indicate growing confidence in communication.*

### **Game 5: Shape Friends (Find Your Pair) / MOT\_614\_EN**

Age Group: 3–4 years

Competence Area(s): Interaction (social skills, cooperation), Mathematics (shape and colour recognition)

Materials: Poly-Universe shape pieces or cards showing individual shapes (for durability, you could enlarge and laminate images of the Poly-Universe circle, triangle, square in various colours). You will need pairs of identical shapes – enough that each child in the class gets one shape and there is exactly one matching piece held by someone else. For example, in a group of 10 children, prepare 5 different shapes in duplicate (two of each shape). If using actual Poly-Universe pieces, ensure you have pairs that are the same shape and colour arrangement. Optionally, tape or pin the shape card onto each child’s back (or use a necklace badge) to add a mystery element.

Learning Goals: Promote social interaction by having children seek out a partner, practising communication and observation skills; reinforce knowledge of basic shapes and colours as they compare pieces; support turn-taking and peer cooperation (they succeed only by helping each other). Gross motor movement is also incorporated as children move around the space, and fine motor if handling small pieces.

Game Description & Rules: This game is directly inspired by “*Who Is My Pair?*”, which in the book had children find partners by matching a number on their backs. Here we use shapes instead:

Step 1: Setup – Secretly attach a shape card or give a shape piece to each child. If using the “on back” method, children will not see their *own* shape, only others’. If that’s too challenging for 3-year-olds, you can instead give it in hand and have them keep it secret from others (or simply let them see it and still do the matching openly). Decide based on the group’s level. The key is each shape appears on two children.

Step 2: Instructions – Explain that everyone has a special shape friend, and their job is to find the person who has the exact same shape. Model what “same” means by showing two sample

cards that match (same shape and colour) versus two that don't. Use simple language: *"If you have a blue circle, you need to find another blue circle. That person will be your shape friend!"*

Step 3: Find Your Pair – Let the children walk around and ask each other questions or observe each other's cards to figure out who matches. Young children might just wordlessly compare cards side by side – that's okay. Encourage them to use words if they can: *"I have a triangle – do you have one too?"* or *"What colour is yours?"* An alternative approach is to make it a guessing game: if cards are on their backs, they must ask others yes/no questions about their own shape (*"Is mine a round shape? What colour do you see?"*) and others can answer, guiding them to figure out their shape, then find the other one. This variation adds a problem-solving element for older preschoolers.

Step 4: Pair Up and Discuss – Once everyone thinks they found their matching partner, have pairs stand together and check with the teacher. Celebrate correct matches: *"Hooray! You both have the green square – you found your shape buddy!"* If some pairs are incorrect, gently shuffle them to find the right partner (you can give hints like shape names or colours). After pairing, give a minute for each pair to converse or do a quick task: for example, each pair can high-five and then together name their shape and count its sides out loud (e.g. *"Triangle, 3 sides"*). This reinforces shape properties cooperatively.

Step 5: Group Reflection – Bring all children back together and ask: *"How did you find your shape friend? What did you say or do?"* This brief talk helps them articulate the strategies they used (like noticing colour or asking a friend) and reinforces the social skill of approaching and communicating with a peer. You can also highlight how it felt to work together.

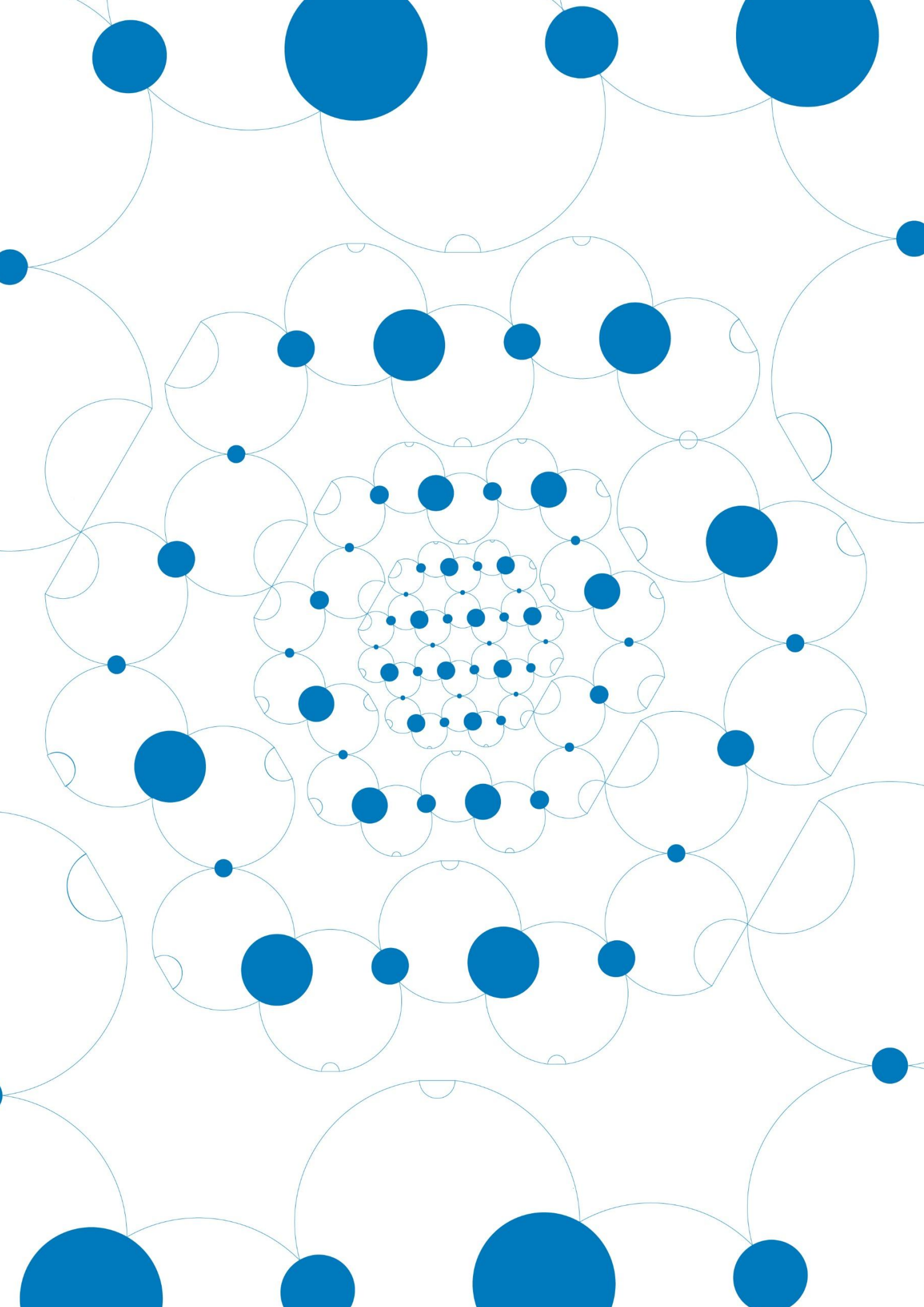
*Formative Assessment: This playful activity gives insight into social and cognitive development. Observe which children confidently roam and find their partner and which hang back or seem unsure. Did they recognise their shape easily? Did they need help naming the shape or colour? Note if any child did not find their match and why – was it lack of shape knowledge or social hesitation? Document any language used ("I have circle!" is a big win for a shy child speaking up). Since the goal is both cognitive (shape/colour ID) and social, you might make anecdotal notes: Child A recognised shapes but did not engage with peers; Child B asked for help naming her shape; Child C cheerfully helped others find matches. These observations can guide future grouping (perhaps pairing a more outgoing child with a quieter one in other tasks). The game can be repeated over time with new shape pairs or even extended to shape families (e.g. find all three people who have triangles, each a different colour) as children grow more confident.*

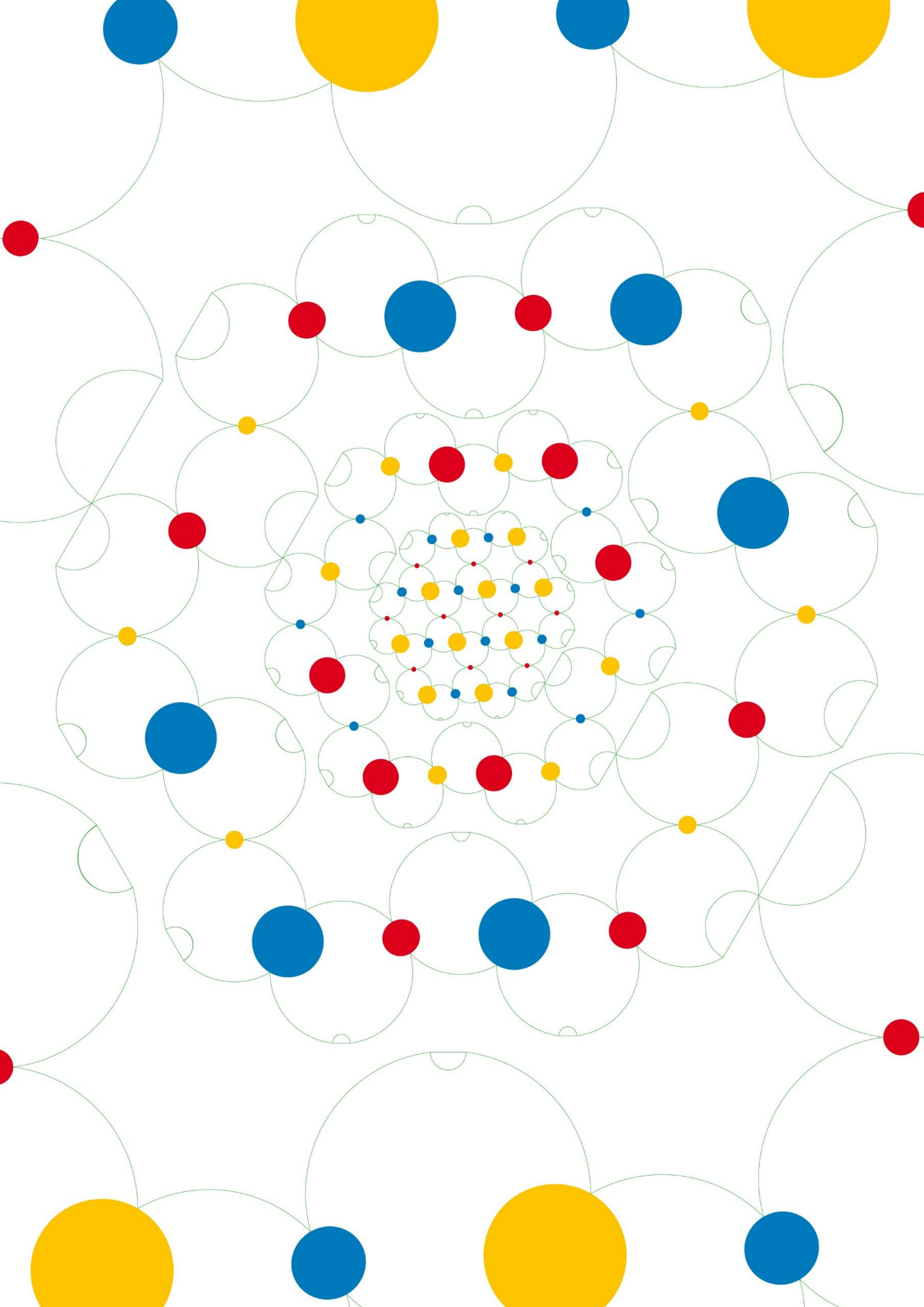
## NOTE

As recommended in *Playful Learning*, teachers should demonstrate game steps concretely (especially for younger children) and encourage children to modify rules or take on leadership roles in play. This flexible, child-centred approach keeps activities *fun* and engaging while supporting the development of key skills.

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## NATURE AND CREATIVITY

*“The important things depend much more on the teachers. It's up to them to do the very least (and the most) that a school can do: to inspire a love of learning, a love of life.” (Bodóczy 2003.)*

### 1. The power of communication and expression through nature motifs in the transition between nursery and school

Arts education offers an excellent opportunity to develop personality, to make the transfer of knowledge experiential and to maintain motivation to learn. Consequently, the role of art education is to contribute to the fulfilment of educational tasks through the experience of creation and reception. This is both art education and education through art. In summary, it uses the arts to foster motivation, creativity, skill development, and the development of children's personalities (Asztalos Kata et al., 2018). This is compatible with the elements of the ÓNOAP, highlighting the following:

- Learning through play
- Emotional motivation
- Experience-oriented learning
- Flow experiences

The above elements also fit in with the everyday life of a kindergarten, where similar activities are also carried out, but here it is the complexity that allows us to create something new and bring a new approach to kindergarten education. This complex activity can be very important in pre-school preparation, especially for large groups, with the aim of compensating for disadvantages.

The freedom of artistic activities can provide a continuity between kindergarten and school, since the focus is on creation, one of the main sites of which can be nature itself, its forms, materials and the freedom (flow) experienced there. The experiences lived there and then, the observation of changes in nature, the recreation with collected materials, in addition to learning, also help to creatively explore the use of tools (picture 1). Through the creative process, we can support cognition, while the experience of creation and communication also provides a communal experience that offers knowledge through experience, thus contributing to the development of a wide range of skills and thus to the development of a harmonious personality (Kárpáti, 2021).

In our experience, in addition to freehand drawing, it is important to link different forms of visual perception and reception, and in reaching school readiness, to use creative practices of media to capture movement, and the relationship between structure and space (picture 2). The varied and diverse use of the knowledge of creative methods provides positive reinforcement in both aesthetic and fine motor terms but also offers the opportunity to experiment with technical mixing, which can be used to play with materials and tools to support creative problem-solving (Fejes et al., 2023).

Working with materials, whether it is clay, sand, mud or even building bridges by tying branches, making shelters, weaving leaves together, weaving, all help to discover inter-ecological properties. Experiencing these processes provides children with a joyful exploration of the many properties of the tools, with the potential for diverse adaptivity, thus shifting the focus to creative problem

solving. The authenticity of all these practices is achieved through deepening collaborative work, drawing on reflective experiences, learning from and mastering each other is the most authentic and effective learning support tool. The complexity of the experiential knowledge transfer is a priority through the promotion of creativity, aesthetics and the experience of co-experience in the process of creating in the external space (Kárpáti, 2021).

As creators and educators in the visual and artistic fields, it is important to stress that our profession has long been about more than just teaching to represent but about articulating issues and solving visual problems through creation, from both a didactic and pedagogical perspective (Sándor, 2009). Visual art as a form of activity is also an important aspect of education in the school setting, a typical mode of workshop activity that presupposes not only the maintenance of a creative attitude, but also an experiential way of making common connections, which in this form and framework is the most authentic source of learning, on which we need to build emphatically in the organisation of learning (Lenkey, 2015).

And in the kindergarten environment, by creating a place and space for creation, reminiscent of the atmosphere of the workshops, it motivates and attracts attention, stimulating curiosity to explore, which raises the question of what the child is going to do today. In the process of creating in nature, it is also essential to design the place together, to provide a space for the processes to take place there, as creativity can only be realised in a safe space and medium, creating a space for the experience of learning to be explored, which also provides children with additional motivation by looking out from the interior space by the journey they have taken.

## **2. Workshops in nature**

In early childhood, visual activity is an informal, non-prescriptive, free-flowing action that supports intellectual and aesthetic development, helping to develop skills. It is the practice of exploring different forms of activity, offering a positive experience through exploration (Gyöngy, 2015). It is here and at this time that the experiential knowledge of "seeing and feeling, touching and grasping" begins to be transferred (Lenkey-Tóth, 2015). The pleasure of creating with the educator, with peers, leads to the development of social emotions (Bimbó, 2015). The emotions that are displayed during the activity play a role in shaping taste, together with the internal spatial arrangement that surrounds them and the visual content that is appropriate to the season (Gyöngy, 2022).

Moving from the inside out (e.g. the drying of a form drawn with water on concrete on a spring day) or entering from the outside in (e.g. putting snow in a container after it has melted, dripping dew into it and dipping it on a sheet, carrying further task content, tearing, gluing), the world around him becomes sensitive towards the discovery of environmental phenomena (Fejes et al., 2023). Through creative, creative technical adaptability in our everyday life, the small details that we do not notice in a hurry can become the focus of task solutions, through observation and mapping from the early preschool age.

How can the small surfaces of our environment be able to direct our attention? If technical involvement is the frottage here in relation to communication and expression, then the focus is certainly on the details that can create surfaces that are exciting to trace (picture 1). In observing surfaces, we focus on tactile properties, surface qualities of materials, the appearance of material structure, and in translating them, we pause for a moment in the practice of these content exercises.

The information we acquire about materials is not only through vision, but also through tactile perception, which can provide us with a variety of insights. By touch we can get an idea of the softness and roughness of a material. From the resulting image, we can tell what we have retouched, what we see on the page and what was the basis for the surface we have mapped on the page. We can apply this knowledge to school-age children, and even in the transition from nursery to school, in other tasks with different content, in order to talk about children's arrival in the morning, afternoon or evening, for example, and their habits, by inviting them to play a game of imaging, focusing on the surface impression of the journey they have made.

We can then indicate our intention in the title of the task, which could be a route or a route and space, which could also carry the space/image result, and we can even invite them to play their own title game. With the simplest of tools, reduced to almost nothing, how mapping can support communication, guide attention, help memory and visual memory through call images, help recall experiences. How much detail can the memory of a journey reveal, how much information can it carry, if we also help to discover the details by setting tasks to help orientation (picture 1). Here and then we can use the images to shed light on the following questions: – what is it that we have not noticed before, – what is it that we have just passed by without really discovering the beauty of the detail?

In this way, a walk on an everyday journey can be seen in a new light. The execution of the tasks, their realisation in an educational environment, helps the creation of one's own feelings and thoughts, the formulation of one's own feelings and thoughts, the acceptance of one's own feelings and thoughts. The concept of self-awareness, self-acceptance, exploration, analysis and problem-solving supports creative and planning abilities in the various fields of education.

In terms of objectives and competences to be acquired, the development of memory, visual memory and sense of composition is achieved by highlighting the observation of small details. The recognition of the positive emotions associated with creative work, through aesthetic experiences. Visual memory and creative imagination are developed. The acquisition and development of a visual language of communication is shaped together with the exchange of information and self-expression. Task creation can also be a focus that can be turned into: let's take a trip together, where the surfaces we collect help us discuss the journey we have made. The surfaces are placed in the common space as a map when we arrive at the end of the journey, to recall what we have seen and review the surfaces that were exciting to collect here and then, taking advantage of the action-oriented attitude of the preschool children. And then we can build shapes and systems of shapes, create visual montages to illustrate and add further modules from the smallest observation, almost from our most minimal tools. Here, the building on each other of the tasks offers the possibility to create a dialogue, to present the visual content in a variety of forms and contents, focusing on the relationship between the outside world and the environment (picture 2).

The succession of mapping builds their inner visual world, thus shaping their taste, and all these processes presuppose a creative attitude on the part of the task-maker, thus promoting creative renewal and not being bogged down in the repetitive method of making a simple image print. The brevity of the task's diverse potential and its practical rhythm can be well adapted to the complementary and introductory themes of further exercises.

During a walk in nature, the fruits found there can not only be used to make a print, but also to create pictorial content and compositional elements from the fruits, avoiding direct intervention in

nature and only modifying the position of the fruits found. The thematic collection created here carries a new content meaning message, it can be recorded in the form of a still image in kindergarten, while in the school setting the possibility of creating content through moving images can be called in and offered. In the case of school offerings, the images will be recorded one by one, frame by frame, using a phone and stitched together using stop motion software. Here and then, the work should contain a minimum of 1 second / 9 still images (ideally twelve image units) and the work should be stitched together to show a minimum of 30 seconds of footage. The content of the captioning option is an opportunity to nuance the expression of the pictorial communication and to give scope for creative practical execution.

MOVIES: <https://drive.google.com/drive/folders/1FISrkq0KybcorNjVI6D113XIG10Y27Mo>



Video 1: autumn leaf/colour



Video 2: Wreath Stop motion video

Practical realisations are a creative process of exercises in nature to learn about children's emotional methods, and it is also important to consider the balance of the pupils when forming a group. When developing skills and abilities, positive self-feedback is essential. Assessment should be developmental, based on a helpful exchange of views. In the definition of the task, it is important to explain what is taken into account in the evaluation. It is essential here that the individual or group work produced in the course of the project is viewed and listened to in equal measure, even if this takes time outside the scope of the school. Only by working within the framework indicated above, and by keeping to it, will the goal of making the process of joint creation, learning and experience an experience be achieved.

We also set out to create tasks to facilitate the experience of creating through thinking together, learning and experiencing. Supporting socialisation, it should be a communal experience that provides knowledge through experience with a focus on developing creativity. All this is done with the help of a methodological procedure that treats children as whole human beings, taking into account their emotional, intellectual and motor skills, thus giving them the opportunity to engage in purposeful activity and creative work based on curiosity. It helps them, by training them, to grasp the complexity of real problems that arise in the dialogues of the sub-tasks.

In the process of visual mapping in nature with natural materials, in live contact with practical places, we have observed that fear of destruction of the creation is an inhibiting factor in the experience of the free creative process. To overcome this, the extensive use of inter-media tools has proved to be the most appropriate way of engaging, because by connecting digital imagery with the visual element, a lasting visual element can be created (Gyöngy, 2021).

The image thus captured generates new compositional possibilities, perspectives and pictorial meanings (Kepes, 2008). Converting shapes in 3 dimensions into 2 dimensions, spatial orientation in the plane and spatial orientation in space also helps to understand the linking of information through visual experience. Knowledge crosses subject boundaries and skills acquired can be integrated in several areas, in particular nature, environment, technology and literature (Sándor, 2009). It is in the light of this content that an attitude of educators and teachers becomes a practice, which, instead of “by what means”, gives room for development, building on the possibility of conscious recycling, and also on the “how and what way of looking”, to the challenge and creativity of visual education teaching. By doing visual exercises together in this way, students can experience themselves as competent, and the combination of peer attachment helps to foster intrinsic, intrinsic motivation (i.e. the sense that the activity is not being done because it is compulsory or because of the reward, but because doing the activity itself becomes rewarding for the person) in relation to the visual tasks (Ryan & Deci, 2017).



Figure 1: A playful exploration of nature using the frottage technique during a kindergarten group walk in nature.



Figure 2: Light-shadow and projection, Camera Obscura, – What if our shadow had eyes and a mouth?  
– exercises at the beginning of school

<https://archivum.uni-eszterhazy.hu/hu/gyetem/kultura/camera-obscura>

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## NATURE – ABSTRACTION – ART

*“Nature, and in it the sun and the wind and the rain, the summer and the winter, the indescribable innocence and generosity – what health, what good spirits they give, while the world is a world! Do we not understand each other with the earth? Am I not myself partly leaf and green mold?” (Henry David Thoreau: Life in the Woods)*

### 1. Abstract sensitization: Nature – Environment – Similarity

If we observe how a child reacts to a butterfly, a beetle or a dangerous wasp, we find that little ones are still very interested in the movement of insects, and they want to touch, hold, and examine them. They do this because they do not yet feel any fear of them. By the time they enter kindergarten, this attitude is often reversed, these visible, tangible wonders of nature are more likely to be closed off to them by fright, fear and disgust. Because out of fear or limitation, we raise children to fear nature rather than love it, and in doing so we deny them the innate need to be part of it. Consequently, when we lose our holistic perspective, we completely forget that we are children of nature, and we also forget that what we do to nature, we do to ourselves. The threads of affection that can create a lifelong bond between human existence and nature begin to weaken. Yet, in addition to family and community togetherness, this universal manifestation of love can ensure healthy development, a balanced life, and later effective learning and work for society.

The urban way of life built for the 20th century partially or completely blocks the natural environment from them. By the 21st century, more than half of children grow up in small urban apartments, in artificially created environments (asphalt, glass, concrete), which further deepens their alienation from nature. Their contact with animals is limited to the pitiful sight of individuals found in the world of zoos, or to petting pets such as dogs and cats. Of course, responsible parents try to visit the nearest smaller or larger parks and natural environments on their days off, at least for an excursion.

One way or another, it is best to spend a lot of time outdoors with children, and not only direct their attention to them, but also let them study the movement of animals, the structure of insects and arthropods for days. This is an abstraction of nature that can be seen with the naked eye and experienced, and in an artistic sense we can safely say that it is a cubist, geometric and kinetic world. Then, the sparkling crystals and metallic flows on the stones found in quarries and the pebbles collected from the riverbanks further open up the boundaries of their observation. They can perhaps learn the most from the green environment, because while examining the infinitely fine veins of the leaves of trees, they suddenly see the tree in the leaf, the structure of the tree, the sea in the drop...

The love and observation of nature can take on cosmic perspectives, if, for example, we direct their attention to the clear sky. If we are in the countryside, or occasionally in the yard of our grandparents' house, the structure and space of the observed stars and galaxies make them feel the eerie concept of infinity. In their minds, as if they were steps, their childish imagination can glide along them, farther and farther away – until the infinite space opens up vast horizons and sucks them in.

School should be a place for learning, a place for acquiring knowledge, where they constantly find answers to mysteries. This is where they can have their first encounter with atomic models, through which they can imagine solar systems and galaxies. They may begin to see analogies between atomic and cosmic structures. It is certainly a great discovery, another “aha” feeling for every child when they realize that there is always a smaller one, and there will always be a larger one, and that the smallest can also be the largest...

All these discoveries are naturally connected in the hearts, souls, and minds of children, and thus the openness, sensitivity, and holistic worldview they are born with can continue to live on in them. We hope that this way we can help them make a smoother transition to elementary school and then navigate the abstract world of higher education. In later chapters, we will connect the micro-macro forces of nature with the resulting Poly-Universe game, which operates on the same principles.



## 2. Artistic sensitisation: Shapes – Colours – Dimensions – Connection

*“The world is actually different from what we see, hear, and experience – and we only perceive as much of it as we are able to perceive with our own and extended auxiliary artificial senses. There is therefore a reality beyond perception, which not only the scientist-inventor, but also the artist is called to explore.” (Saxon’s ars poetica)*

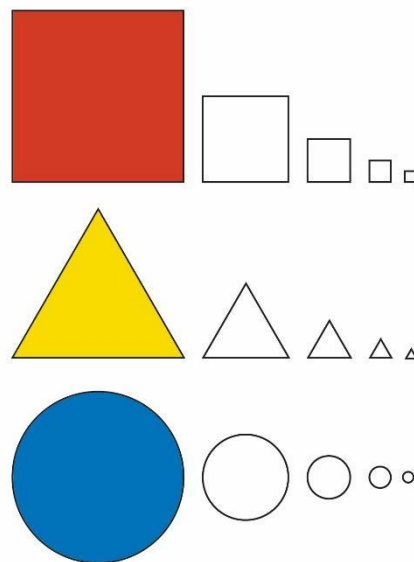
In the 20th century, scientific progress determined the development of modern trends in the arts. New and worldview-transforming scientific discoveries came to the fore, such as atomic theory, quantum physics, genetics, microbiology, thermodynamics – In mathematics, developments such as non-Euclidean geometry, formalist approaches, and later fractal geometry also contributed to new ways of conceiving form and space. Thanks to all this, artists' attention shifted from the visible world to the sensory essence behind perceptible phenomena.

One of the most important precursors of this process was Kasimir Malevich's painting Black Square, which shows only a black square on a white background. These processes initially caused a public scandal from an artistic point of view, not only the general public, but also artists, critics and intellectuals who believed in tradition considered abstract art to be a bourgeois farce or a manifestation of diletantism. However, with the emergence of abstract art, the mandatory nature of representation that had prevailed for millennia and was in line with social expectations ceased.

Because of all these and similar ideas, abstract art is still often the subject of negative public and professional criticism. While the artificial environment of urban life, the infrastructure, and our designed tools all serve our needs thanks to this approach, it is still a common opinion that non-figurative art is made by those who are not talented enough to practice figurative art; and that such

pictures – especially abstract expressionism – can be easily made by children and even chimpanzees. However, art that does not depict nature has been present since the beginning of humanity, for example in ornamentation, in decorative forms that develop from the gradual simplification of natural forms, but also occurs outside of art, for example in ancient times in non-ideographic writings systems, whose letters were initially small pictures depicting shapes.

According to the internal professional critical tone, it is also true that someone does not become an abstract-geometric artist simply by building on the basic elements of geometry. What matters more is that they have a sensitivity to abstraction. The goal of the creative method based on the observation of nature is not imitation; it creates new artistic forms by understanding the laws arising from the visual. Forms, colours, materials are merely tools for making an idea visible. We strive for this from the perspective of children as well, so it is simpler to reverse the relationship between abstract art and nature, that is, if we start from the basic geometric forms, for example, and look for relationships found in nature, e.g. what the triangle, circle, square shape resembles. Similarly, what is red, blue, yellow, green, etc...?



Through the relationships listed in this way, we can encourage children to use the coloured tiles of the Poly-Universe to lay out and model the equivalents found in nature (we cannot exclude the built environment either). During free play, those social and cultural background mechanisms that result from the aversion to and incomprehensibility of abstract geometric forms always come to the fore. Therefore, they prefer to depict and display, for example: people, animals, dogs, flowers, cars, ships, houses, Christmas trees, etc. At the same time, these are the first steps when children encounter the abstract world of geometric forms and during the work (seeing, touching, moving, connecting) they can get to know the basic elements. Of course, natural/cosmic laws have their own internal system of rules. This regularity can be read from the tool system itself through the procedure, along with finding the sizes and relationships of the forms. In the Poly-Universe, there is no need to learn the rules beforehand; everyone can study with it at their own interest, age and knowledge level.

In the meantime, the children learn about the deeper structural connections resulting from the differences in sizes, in addition to basic shapes and basic colours. During the methodology. The diff-

erences in scale within the game elements can lead children towards an understanding of micro–macro relationships that are not directly visible to the naked eye. For example, we can ask the question, which object or animal is the smallest in the world. What is still visible and what is no longer, either because it is too small or because it is too big, etc. We can collect and examine pebbles of different sizes, which allows us to reach the almost invisible grains of sand and beyond. Or let's go out into the yard, into the forest and examine the veins of the leaf until they see the tree in it. Look for the connection with our own body structure, and if they have found it, the children can hold hands and create trees, that are bent this way and that by the wind and everyone together can be a big round forest etc... These are very important first steps, thanks to which the children's holistic worldview can further expand.

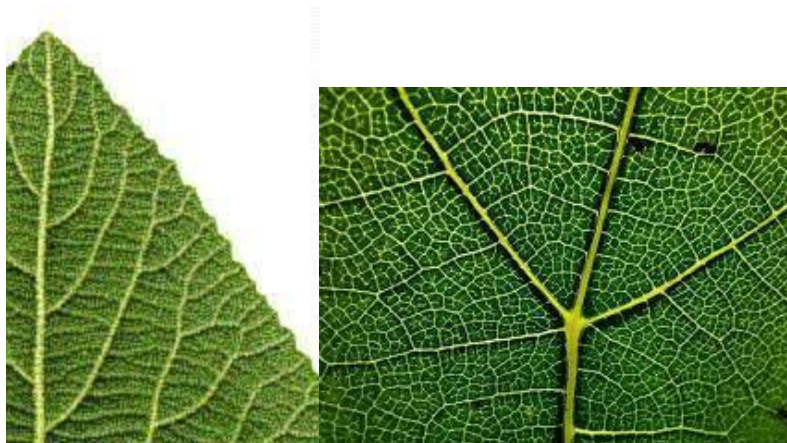
### 3. EXAMPLES: The relationship between Poly-Universe Game Elements and Nature

#### 1/ Micro- and Macrostructures in Nature and the Poly-Universe / NAT\_304\_EN

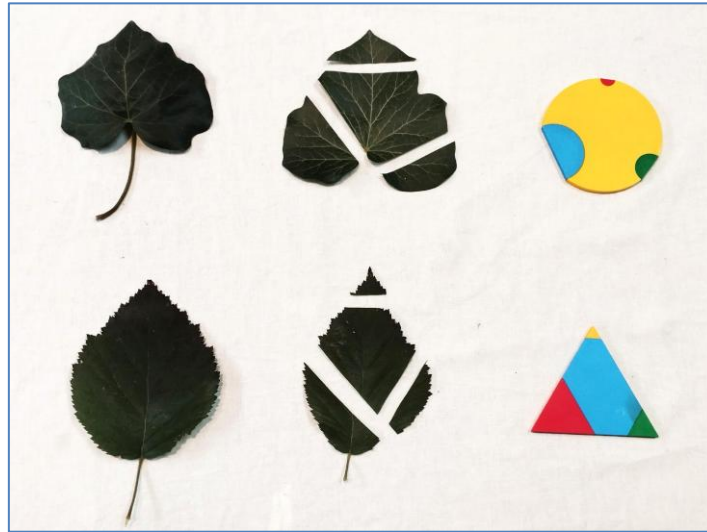
Can be used in smaller groups or more informal educational settings.

Most relevant age group: 6–8 / 8–10

Description of the task: Leaf Puzzle



1. Collect 2–3 different types of leaves in the park. They should be larger if possible, and there should be two of each type.
2. Cut one of them into four differently sized parts according to the proportions/shape arrangement of the Poly-Universe game element.
3. Mix the leaf parts and then place them in front of the children so that they can put the cut parts back together. We can help the younger ones by showing them the whole leaf.
4. The children – like in a puzzle game – first sort out the elements of the different types of leaves, then find the matching parts and fit them together.
5. During the matching, the children discover the veins of the leaf, discover the connections between large-small-tiny, and see the tree in the leaf.
6. After the matching, we place the Poly-Universe game element next to the leaf and together with the children we discover the similarity between the leaf and the Poly-Universe units.



*Why this exercise is useful: During the matching, the children discover the veins of the leaf, discover the connections between big-small-tiny, and see the tree in the leaf, and then all this knowledge is transferred to the visual world of abstract geometry with the help of the Poly-Universe elements.*

## 2/ The relationship between Poly-Universe game elements and infinity / NAT\_301\_EN

Can be used in informal educational settings.

Most relevant age group: 3–5 / 6–8

Description of the task: From the tiniest grain of sand to the infinite ocean.

Location: Spain on the beach. A father draws signs in the sand on the beach, teaching his daughter the basic shapes. This scene gave the idea for the following Poly-Universe exercise:



Starting from a Poly-Universe square, we draw ever-growing, double-sized squares in the sand on the beach, the sizes increasing towards the sea, giving a huge perspective.

From the grain of sand to the infinite sea, we follow the orders of magnitude between the infinitely small and the infinitely large in such a way that we continuously jump further in the squares, and at one point, we open up in thought towards infinity.



*Why is this exercise useful?: We talk to children aged 3–8 about differentiating the sizes of successive squares: tiny-small-big-giant-infinite. Together we discover that the Poly-Universe square at the very beginning of the row consists of tiny-small-big-even bigger elements and we think about what to do next. We can connect what we experience on the beach with fairy tales. Children can create free illustrations for the fairy tales with changes in size until they reach the Poly-Universe, discover the different scales on the game, find the connection points, and match the elements of the same size to each other. We can use the words we learned from fairy tales for the different sizes: tiny-tiny; small; big; giant; infinite... and they can draw all this freely in the sand.*

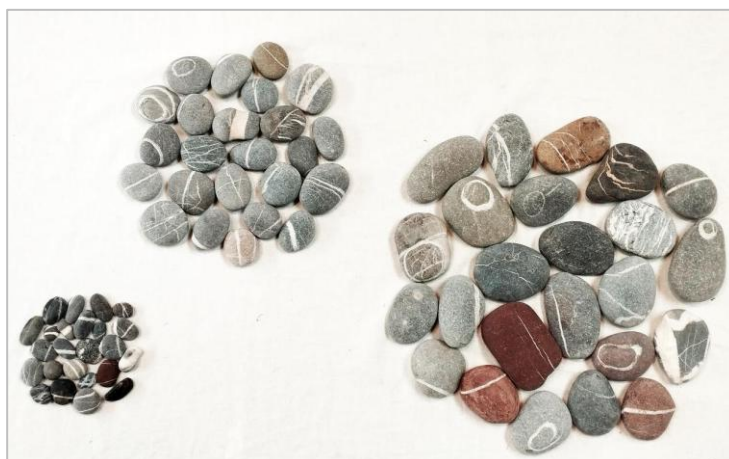
### 3/ Anthropomorphization of the natural forms/objects and PU game elements / NAT\_305\_EN

Can be used in formal teamwork educational settings.

Poly-Universe most relevant age group: 3–5 / 6–8

Description of the task: Stone mans

1. It can be purchased in advance, but it is best to collect pebbles of different sizes with the children during targeted joint excursions (e.g. beach, riverbank, etc.).



1. On the kindergarten/school table/bench, we sort the collection together with the children and group them into 3 different piles according to their size. In borderline cases, we decide together to which pile the given piece belongs.
2. Then everyone can build a stone man for themselves -similar to a snowman- along the above logic.
3. After that, lay out all the elements of the Poly-Universe circle and group the stone men!



Let's look for the connection between the large-small-tiny shapes and elements!

*Why this exercise is useful: The experience of collective work is already present in the collection phase, the joint selection of the harvest is real teamwork, continuous communication and control! The joint construction, the fact that everyone can create their own stone men, which eventually line up next to each other, represents a small social grouping, which can also personify the given class or kindergarten group itself. Following these experiences, when the children encounter the abstract world of the Poly-Universe element family, they discover familiar connections in the unity of nature, man and the abstract world, and their worldview expands imperceptibly, individual interests are transformed into a holistic community experience.*

#### **4/ Part-Whole: Continuity of nature's parts in the Poly-Universe / NAT\_306\_EN**

Can be used in formal and informal educational settings.

Most relevant age group: 3–5 / 6–8

Description of the task: Poly-Flow

1. We collect elements that can be obtained in advance, but it is best to collect pebbles, shells, berries, etc. of different sizes together with the children during targeted joint excursions (e.g. seaside, riverbank, etc.).
2. In kindergarten/school, we put the jointly collected harvest in a large pile on the table and then scatter the Poly-Universe game elements next to it, so that everyone gets one or two basic shapes (any one).



3. Based on the photos above, we ask the children to place a pebble, shell, berry, etc. of the appropriate size next to the big-small-small corner shapes.
4. If one has been placed on each corner, we can continue the process with further connections, i.e. e.g. we can connect 2–2 smaller shells to the larger shell according to the Poly-Universe elements, while the set lasts.

*Why this exercise is useful: The connection of natural shapes known and loved by children with geometric shapes helps them acquire abstract vision. Connecting natural shapes and the different-sized windows of the Poly-Universe reveals the deeper connections of nature. For example, the song “You can also be a Tiger and it’s so wonderful” known from the children’s fairy tale, in this exercise, the fact that small can be big, big can be small and small can be giant, etc., gives a similar experience!*

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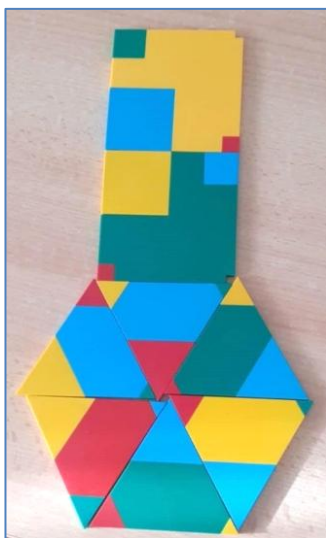
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## POSSIBILITIES FOR INTEGRATING THE POLY-UNIVERSE GAME INTO KINDERGARTEN EDUCATIONAL ACTIVITIES

### 1. Play-Integrated Learning in Kindergarten

The basic form of activity for preschool children is play, through which they discover the world around them. *“The young child expresses impressions from the outside world and their inner world in play.”* (ONOAP). This makes play one of the most important factors in personality development.

Play shapes children’s abilities and skills in a complex way, which later become indispensable for school readiness. Through play, their knowledge and cognitive abilities expand, they can discover relationships, develop manual dexterity, and become familiar with the properties of materials and tools (colour, shape, size, texture, etc.) and their relations to one another. Their speech and communication skills develop, they acquire basic concepts, and not least, their social skills also evolve. Reaching the level of development necessary for school readiness comes as a result of age-specific characteristics and maturation processes, during which children’s play activities also progress. From spontaneous and voluntary (practice) play, they reach a higher level, where construction, following and applying rules demand a much higher intellectual capacity. In free play, guided by their imagination, everything can be anything.



Crystal vase (child, 4.5 years)  
(Image source: Královitsné H. Alíz)



Free creation of a 3-year-old child  
(Image source: own)

The forms of kindergarten life activities are characterized by playfulness and play-integrated learning.

**Active exploration of the outside world** and its mathematical content permeates almost the entire educational process. Children get to know and discover their immediate and wider environment through movement and activity. They gain experiences of the *“formal, quantitative, and spatial relations of the narrower and broader natural–human–material environment.”* (ONOAP). Through

active exploration of the living and non-living environment, children develop positive emotional attitudes toward nature, human creations, and the preservation of values (ONOAP).

In the process of discovery, they recognise quantitative, formal, dimensional, and spatial relations, their judgment develops, and their perception of plane, space, and quantity improves (ONOAP).

Visual activities (drawing, painting, modeling, handicrafts) bring out children's inner imagery. Various visual techniques form an organic part of kindergarten life, displaying children's creativity, self-expression, imagination, and imagery in diverse ways. Mastering, practising, and applying these techniques develop children's abilities and skills in a complex manner, indispensable for school readiness. Artistic and aesthetic education, becoming familiar with artworks, and exposure to Hungarian and foreign visual art represent values whose knowledge may contribute to personality development. The aesthetic experience of colours, shapes, and figures can be inspirational for children.

## **2. STEAM Education with Poly-Universe Game**

The holistic approach deals with the development and education of the whole child's personality – the pedagogy of the “heart, the hand, and the head.” This pedagogy treats the physical, mental and spiritual development of the child in a harmonious unity.

1. Heart: arts as a shaper of emotions.
2. Hand: increases and strengthens the child's will through the development of the limbs.
3. Head: aims to develop the ability to observe accurately, think and draw independent conclusions.

*Rudolf Steiner*, an outstanding figure of reform pedagogy of Austrian origin, the creator of Waldorf pedagogy, built his educational method on this.

*Maria Montessori* – who was also an Italian representative of reform pedagogy – developed a pedagogical method that is related to the aforementioned holistic approach: the formation and development of sensory awareness. The goal of her method is intellectual development, thinking based on experiences, which is based on direct observation.

According to Montessori:

1. The child learns from what he experiences and experiences – he acquires knowledge and develops his abilities through his own activities.
2. We direct the child's attention to physical reality with the help of his emotions.
3. The child learns by doing.
4. Direct experience is the most effective way of learning.

The Poly-Universe game also reflects this holistic approach, aiming to develop the child's personality as a whole through experiential learning.

This complex educational tool is both art and game, a visual experience-based mathematical skill development, and its usability ranges across a wide spectrum.

## SUMMARY

The Poly-Universe game family is excellent for the versatile development of preschool children. The game provides countless opportunities to broaden and enrich preschool play activities. It can be used taking into account the individual development of children, taking into account their age characteristics. It encourages discovery and is accompanied by a sense of success. It is a complex development tool that can be used in almost all areas of preschool activities. It builds on children's imagination, creativity, free thinking, association skills, etc. It requires a new approach from kindergarten teachers, which can result in the broadening of methodological culture. The number of possibilities is endless, only imagination can set limits. We can also build on children's ideas, let them soar and create freely.

### 3. Holidays and Traditions in Kindergarten

Holidays play an important role in community building, value formation, and aesthetic experience. They are embedded in social life through customs and traditions that differ from everyday routines and vary across cultures and nations. Our country abounds in holidays, each of which enriches the sense of national identity with a different tradition and system of customs. Our ancestors linked the significant days and traditions of the church and economic year to the eternal cycle of nature and the change of seasons. The significant days and the traditions associated with them differed in some way from everyday life. The significant days of Hungarian folk life were connected to a specific holiday cycle (autumn, winter, spring, summer). Different symbols, emblems, customs and rituals were connected to each tradition and holiday. In our modern life, these holidays seem to be fading away, which is why we consider it important to incorporate them into kindergarten education, to preserve our traditions and to keep them alive.

Kindergarten life and everyday activities are interspersed with significant days related to the seasons. Incorporating folk traditions into kindergarten activities multifacetedly develops kindergarten children, promotes the development of a sense of national identity, patriotism, and establishes a connection to cultural values, homeland, and family. In addition to traditional significant days, kindergarten everyday life is also coloured by green significant days. Green holidays are also becoming increasingly common in our Hungarian kindergartens, which are days that focus on a particular problem of nature and the environment. We pay attention to global problems locally, taking into account local conditions. During kindergarten education, great emphasis must be placed on the environmental education of children, applying the pedagogy of education for sustainability. Getting to know our natural environment and exploring it with as many senses as possible is of paramount importance for the preschool age group. The world of animals and plants can be brought closer to children within the organisational framework of the kindergarten, they can get to know the living world in their habitat during walks and excursions. The experiences are processed in the kindergarten, integrated into their play activities, individual and group activities, and visual activities.

Traditional and green days and holidays are not limited to just one single day, but can be prepared for even weeks. The more versatile the range of activities in connection with a particular topic or holiday, the better it is integrated into the children's personality, their emotional attachment deepens, they become more receptive to receiving values, and their outlook is shaped.

#### 4. Game activities (ideas) related to traditional and green holidays by year

##### AUTUMN HOLIDAYS

The first holiday period of the kindergarten year, covering the months of September, October, and November. The period of autumn fruit ripening and harvest.

##### APPLES

Tasks:

1. Painting an apple tree on large wrapping paper. We play with the circular elements, these will be the apples. We make 4 baskets under the tree, mark them according to the primary colours, and harvest the apples in them. We play with all four colours.
  - Pick a red (primary colour) apple from the tree and put it in the appropriate basket! etc.
  - Find the apple on the tree that is yellow, the large field is red, the small field is green, the tiny field is blue! etc.
  - Pick all the green (primary colour) apples and put them in the appropriate basket! etc. How many apples did you put in the basket?
  - Multi-aspect selection according to a given colour key/size.
  - Which basket has more, fewer, the same number of apples?
2. We draw an apple tree in A4 size and laminate the sheet. We place the smaller coloured, printed circle elements on it. We play in the same way as the previous game.

The age and individual development level of the children determine the course and rules of the game.

##### GRAPES

1. Make a bunch of grapes from the circular elements. Free creativity.
2. Place the circular elements on a pre-drawn base using any colour. We can also make a coloured version (several types) and the circles of the appropriate colour must be placed on the base plate accordingly.
3. We make a plasticine sheet with a grape cluster shape. Based on a pattern or freely using plasticine, make the cluster with the appropriate colours.

##### AUTUMN FOREST

The autumn forest beckons everyone to go on a trip. Its magical colours and shapes always provide wonderful experiences for children and adults. We can also create this colourful, autumn forest experience with the Poly-Universe game.

1. We can create a 3D forest by setting up the circle and triangle elements, or we can use them in a paper cylinder. This way we can create lower and higher, green, yellow, red leafed trees, and we can imitate pine trees using the triangle elements. We can group the finished trees according to colours and shapes. We can determine which tree is the lowest/tallest, whether there are any that are the same height, and what colours they are. We can also practice spatial orientations.



2. The autumn forest can also be created as a visual, artistic activity.

Let's paint an autumn forest using the circle elements. After selecting the circle elements of the game, choose one element for yourself and paint the circle shape on the sheet you received accordingly, and make a trunk for it. After drying, we cut out the shapes, glue them and we can also make a joint/individual creation from it. We can talk about the picture: How many trees are yellow? How many trees are there in your forest? This green tree here, what colour tree grew on the right? etc. This activity also includes practising stem and ordinal numbers, counting, recording spatial directions and many other development opportunities. The conversation can be guided by targeted questions, or just simply tell about the picture.

3. We can also create series from the colourful trees – either from the children's creations or from the elements of the game (we can also combine them). We can make playing cards that can be continued: Which element would you continue with? (colours and shapes can also be changed)

Lay out the series according to the given criteria (e.g. circle shape, red as the base colour, the large field is yellow, the small field is green, the tiny field is blue, the next one is triangular, etc.), continue the series. The trunk of the tree can be made of paper or felt. It can also be made based on the picture.



(Continue the sequence)

## WORLD ANIMAL DAY

In connection with the autumn forest, we can commemorate World Animal Day, which is celebrated every year on October 4, the name day of Saint Francis of Assisi. On this green day (week), children can learn about forest animals in a playful way and we can also connect some ideas with the Poly-Universe game.

1. The animals are hiding in the Poly-forest. Let's find them! We can play with the set shapes or the paper cylinder version.

Where is the deer? – Behind the pine tree.

Where is the bear hiding? – Next to the yellow-leafed tree to the right. etc.

Conversation with guided questions or free play activity, during which the child speaks.



2. Let's build a maze (labyrinth) using the elements. Lead the bunny out of the forest!  
Where should he go to get to the clearing?

It develops, among other things, spatial orientation, problem-solving thinking, and practising right-left directions.

Animals in a different way:

1. Free creation – add any shape to the basic shape to make it an animal. They can use different techniques – colouring, cutting, gluing – they can also add photocopied elements of different sizes.

Free creation: Fox



Extension



Free creation

2. Camel caravan – make camels using game elements. You can also make them by copying from a picture.

Everyone can make a camel out of paper elements and stick them on a large piece of wrapping paper to create a camel caravan. You can even turn the background into a desert by spraying sand.



## 5. Activities, games, ideas with the Poly-Universe game

### WINTER HOLIDAY CIRCLE

The winter holiday circle includes the months of December, January, and February. December is the period of Advent waiting, preparation for the holy holiday of Christmas. Many folk significant days are associated with this month. The busy preparation also includes playful activities and creation.

### CHRISTMAS HOLIDAY CIRCLE – ADVENT / FEA\_801\_EN

Based on the children's prior experiences and observations, we make a wreath shape from green basic circle elements. "Let's make an Advent wreath from this game!" Which shape would you make

it from? We placed 4 LED candles on it, so the wreath symbolizing the wait becomes visual in this form as well.

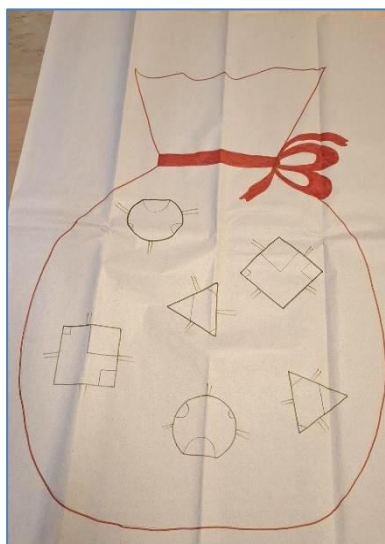
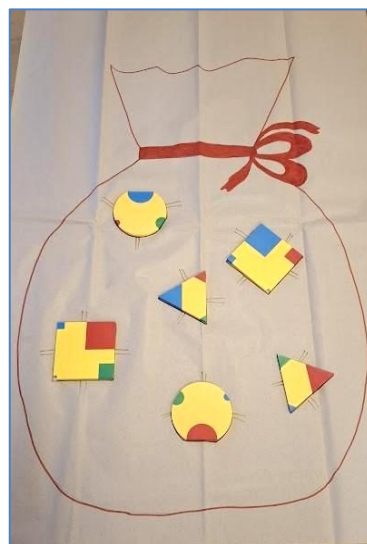


#### ADVENT PERIOD – SANTA CLAUS / FEA\_805\_EN

1. Santa's sack is punctured! Let's patch it up! (Santa Claus's sack drawn on a piece of wrapping paper)

We can play in several versions, and we can vary the colours (all elements should be the same basic colour, each element should be a different colour, etc.). They can place them freely or according to instructions. Pay attention to the directions and fields.

Variation: Place the shapes corresponding to the "spots" in a textile bag. Pull one out by touch (you can even name the shape before pulling it out) and place it on the correct "spot", paying attention to the directions and spaces.



Children can get to know the elements of the set in a playful way. The shape of the “spots” must be recognised and selected from the set. It can be placed as desired, so even younger children can join in the game. It develops tactile sense, colour and shape constancy. It develops spatial orientation, thinking (problem solving).

2. What is hidden in Santa's bag?

We put all kinds of elements from the set in a textile Santa's bag. The children pull them out one by one. Tell them what kind of element they are holding in their hands, what colours it has and how big it is.

- At the end of the game, they can build freely from the elements they have pulled out.
- They put the drawn element on a sheet and complete it with a drawing showing what kind of gift they have drawn (e.g. candy, gift box, etc.)
- We put a few elements of different basic colours and shapes in the bag. The player draws from it and says what shape they drew, what colour it is, paying attention to the name (base colour, large, small and tiny field). Play with a double set. Find the same one among the many elements. You can also play in pairs.

They can get acquainted with plane geometric shapes in a playful way. They can learn about the properties of shapes. Their speaking skills develop. They recognise colours, name them. Their tactile sense also develops through the game. In the drawing version, their imagination and creativity, and graphomotor skills also develop.

#### CHRISTMAS HOLIDAY CIRCLE – CHRISTMAS TREE / FEA\_803\_EN

Let's make a Christmas tree. Which elements would you use for it?

We use a double triangle package to make the Christmas tree. Let's make a large one from the small triangles. The trunk can be made of square elements. A top ornament can also be placed on the top. Free creation, joint play activity.



The joy of playing together and creating permeates the activity. The ability to cooperate, the ability to cooperate, and the group cohesion are strengthened. Creativity, construction skills, shape and colour constancy are developed. Fine motor movements, eye-hand coordination, speech skills, mathematical skills, and thinking functions can be developed. Attention and concentration skills are also strengthened.

## CARNIVAL

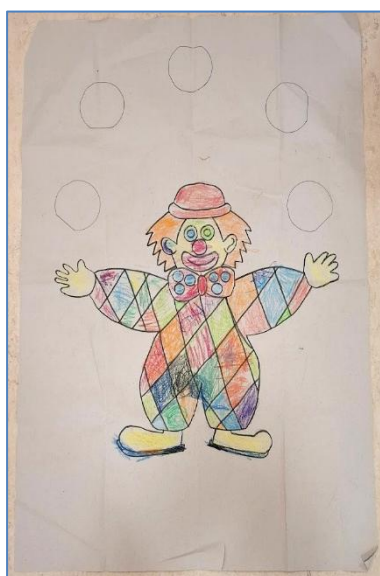
Another defining and significant day of the winter holiday season is the Carnival period. Many traditions are associated with this sometimes short or longer period. Fooling around, good humor, and fun are at the centre. At the end of Carnival, we drive away winter and wait for the good weather of spring.

Let's make a clown!

Complex activity:

### 1. The clown's balls

- Together we make and colour the clown drawn on the wrapping paper.
- Everyone draws a circle element and gets a colourable shape. Colour it in the colours corresponding to the drawn element, then cut it out with scissors.
- The circle elements will be the clown's balls. Put the elements in the correct place, paying attention to the direction of the large field. Put their own cut balls in the correct place by matching them.
- We can also play by laying out the original balls, paying attention to the order, then taking them off and having them lay them out from memory in the correct order, paying attention to the direction of the fields.



Another variation could be to lay out the clown's balls in the order of the playing cards. This can also be done from memory – visual memory and seriality can be developed.

### 2. The clown's hat and tie

- The children colour a clown's head. Choose one of the triangular elements for the clown's hat and two for his tie. Colour the photocopied elements in the same colour as the chosen elements. After colouring, cut them out and glue them to the clown's head. It can be an excellent decoration for the room or hallway.



### 3. Clown's costume

Photocopied sheets show clown costumes in the shapes of triangles, squares and circles. Choose the appropriate shape from the play set and colour it in the same colours. After cutting, glue the shape in the correct place.



## SPRING HOLIDAYS

The spring holiday season includes the months of March, April and May. In addition to the important days of folk tradition in kindergarten, several important green days also fall in these months.

### WORLD WATER DAY (March 22)

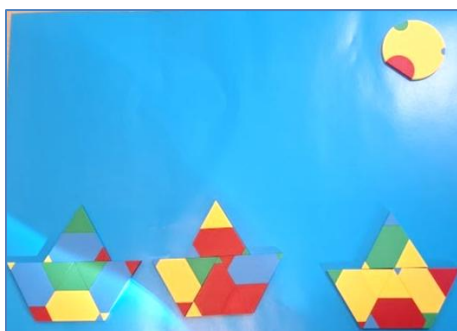
1. Life in the Sea – joint creation from the elements of the Poly-Universe and the objects found in the room. During the joint game, cooperation skills are developed, and they can experience the joy of creation. We can talk about the creation or while creating it – What kind of fish could it be?, How many fish do you see in the water?, What colour are they?, Do they swim to the right or left?, etc...

It contains many possibilities.



1. This marine life can also be painted together or even individually on a smaller scale. We can use materials with different textures and work with various techniques. Children can express their inner visual world while developing their imagination, creativity, and aesthetic sensitivity.
2. Water transport – Ships

It can also be a joint creation or an individual one. We can display several types of ships.



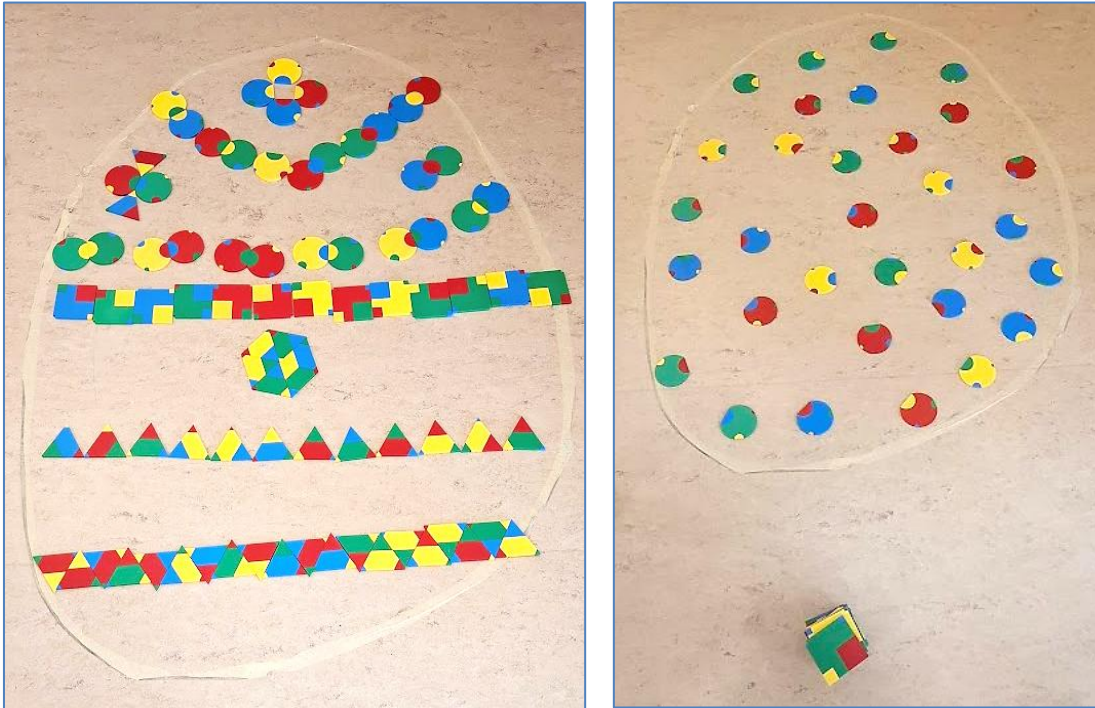
## EASTER

One of the most prominent holidays of the spring holiday cycle, the celebration of spring renewal, the death and resurrection of Jesus Christ. In folk traditions, we can encounter numerous rituals, images and symbols, which we can also introduce into kindergarten life. One such symbol is the egg, which is a symbol of the origin of life, the birth of a new life. The rich world of colours and shapes of Easter embroidered eggs and decorative art is part of our folk culture, which is our national value and therefore provides rich opportunities for observation and experience for the preschool age group.

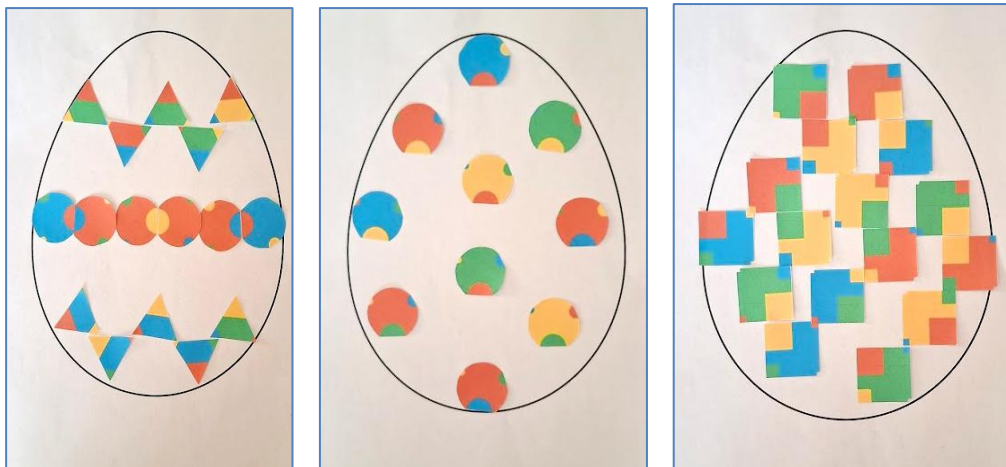
The geometric shapes and colours of the Poly-Universe game also provide a variety of opportunities for decorating eggs.

1. Decorating a giant egg with game elements – we make an egg shape on the floor (with the help of the children) with adhesive tape and can freely decorate it with circle, triangle and

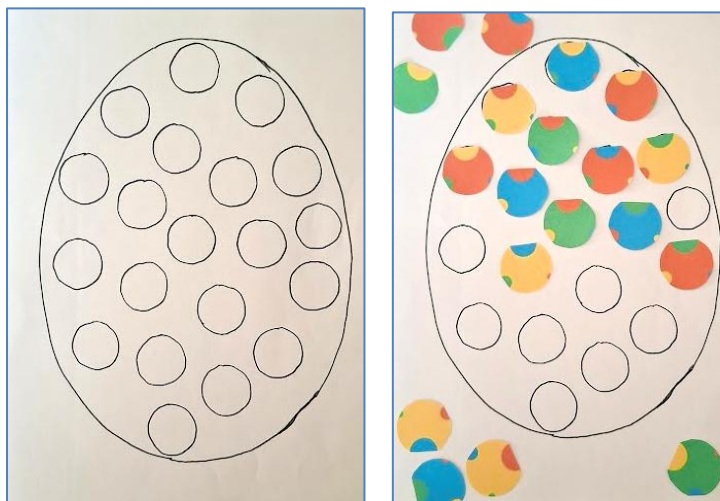
square elements. The decorative elements can also be made according to a given criterion, e.g. use only circular elements, or put triangular elements in the first row, etc.



2. You can also play as a board game with pre-made egg shapes. You can create rules based on your individual abilities or decorate them freely.



3. Board game: 2 – 4 children can play. Everyone gets a base card, the circle elements are laid out on the table. They roll a dice and place the corresponding number of circle shapes on the base card. The winner is the one who decorates the egg shape first.  
A variation can be if we also use coloured dice, in this case we have to pay attention to the basic colours and place the corresponding circle elements on the base card.



## EARTH DAY (April 22)

Earth Day highlights global problems that affect all people. The Earth is the only planet we can live on, which is why we must take care of it so that it remains livable for both wildlife and people. That is why it is important to highlight these serious problems for preschoolers. Following the principles of sustainability – “think globally, act locally” – we do not only deal with these things on this day or during the theme week, but these activities permeate our entire preschool life. Space, the mysterious world of planets and stars is always an interesting and attractive topic for children. With the help of the Poly-Universe game, we can even fly into space. We can build on the children's experiences, knowledge, and existing knowledge on this topic.

## SPACE, PLANETS

1. We can make our own Universe using game elements. We can build a space rocket and place the planets in outer space. We can even capture the Galaxy on larger wrapping paper. We can list the planets one after the other. We can also make constellations out of stars, and use books to count how many stars each constellation consists of. We can also capture our adventure in our own pictures.



## BIRDS AND TREES DAY (May 10)

The celebration of Birds and Trees Day and its inclusion in education is attributed to Ottó Herman. At the end of the 19th century, in parallel with the development of industrialization, the Hungarian forests and natural waters were damaged to such an extent that regulations had to be introduced at the national level for this problem. Many living beings – birds and other animal species – were on the verge of extinction. The tree population of the forests also decreased. This day sheds light on this problem, which can also be observed in our lives today. Human activity – construction sites, road networks, etc. – are increasingly displacing living beings from their natural habitats. From the point of view of environmental education of kindergarteners, it is important for children to get to know the natural habitats in their immediate vicinity and their wildlife. Birds can be easily observed by children, and they can learn how to take care of them during winter bird feeding. They can even watch birds chirping on trees in the kindergarten yard. In addition to birds, we can also draw children's attention to the importance of trees.

*"Without trees, the landscape is not worth a penny.*

*And if there are no birds, the tree is remaining empty.*

*I think the sun would not rise ever,*

*If no trees and birds there were."*

*/Imre Horváth/*

## BIRDS

1. The circular Poly-Universe elements can be used to create birds. We can build on the experiences of looking at picture books, conversations, and direct observations before creating. You can choose a bird and depict its colours, but they can also create fantasy birds. Children can experience the joy of free creation.



2. Birds and Trees Day displayed in a common picture

We use triangle and circle shapes to make trees, and circle elements for birds. Individual and joint creation with colouring, cutting, gluing, and additions.



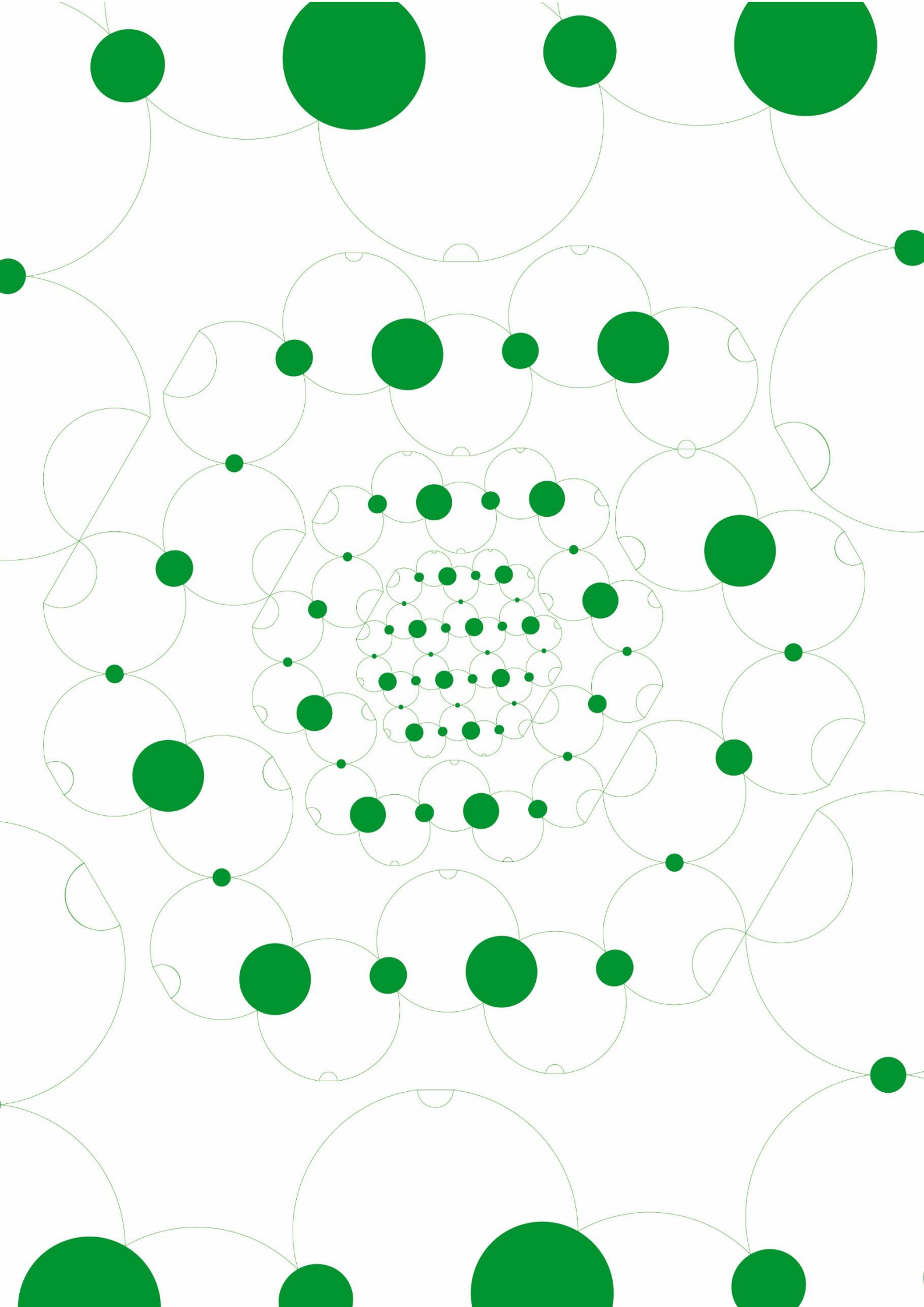
## SUMMARY

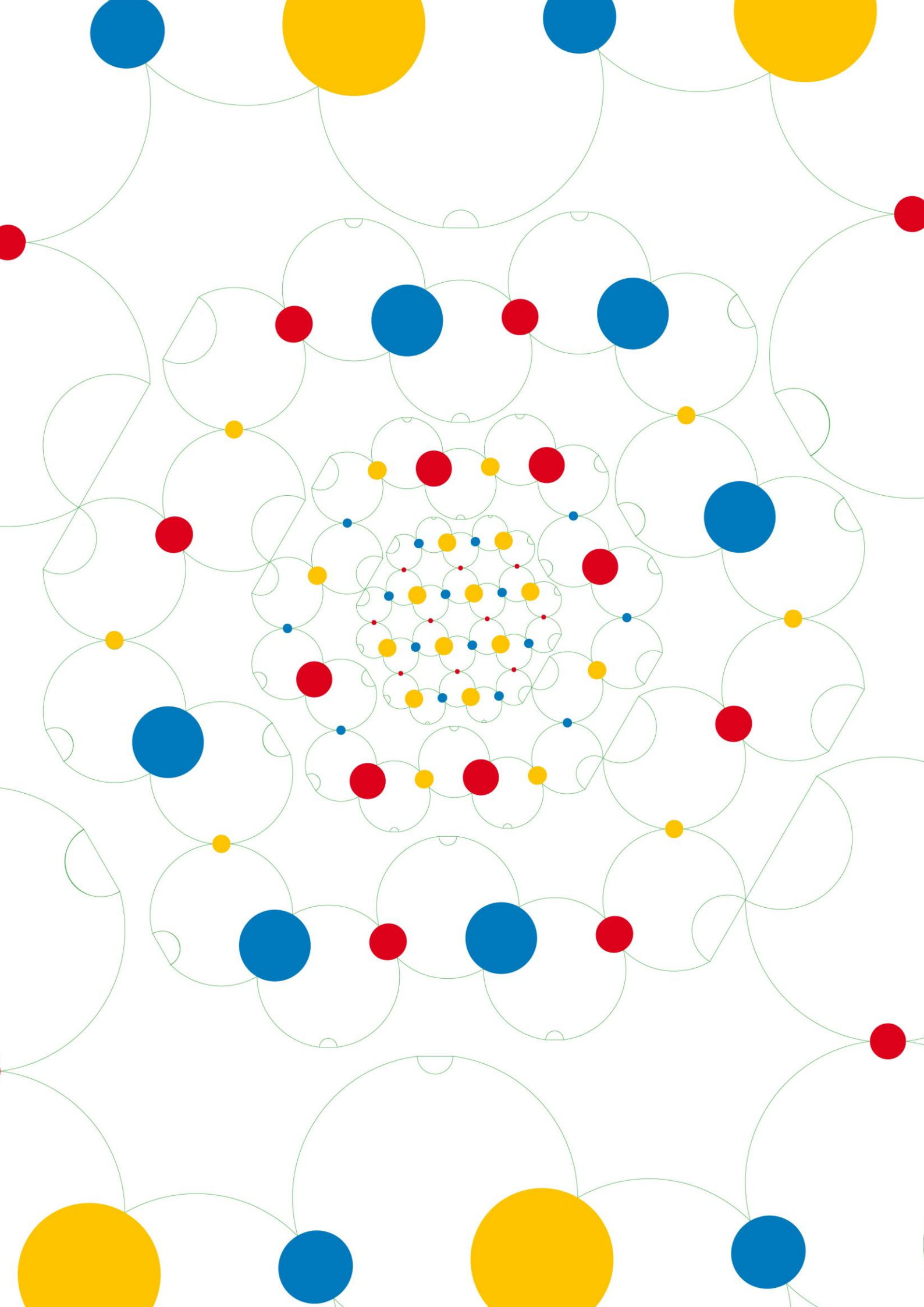
The listed ideas, games, and tasks serve as inspiration, most of them have already been tried out. All game activities can be adapted to the individuality of the group, the children, and the kindergarten teachers, and can be varied and supplemented as desired.

It also becomes clear from the above that the Poly-Universe game can be used very versatilely in almost all areas of kindergarten life. It can be used in a complex way, not only does it develop skills and provide aesthetic experience, but it also expands the storehouse of scientific knowledge, mathematical thinking, and planning. A game that contains new experiences for all ages.

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## THE PEDAGOGICAL USE OF THE POLY-UNIVERSE GAME

Introducing the Poly-Universe game into kindergarten and school environments through well-designed practices is important. These guidelines help ensure that the game is not seen merely as an entertaining pastime, but as an educationally meaningful tool that supports children's holistic development.

The systematization of best practices related to the Poly-Universe game has been developed around eight key thematic areas, supplemented with specific task ideas collected from educators.

**1. Colour and Shape:** This category focuses on developing visual perception, creativity, and fine motor skills. Children learn, match, create, and tell stories using colours and shapes.

- **Colour Matching:** Children look for and pair elements of the same colour and shape, improving their observation skills and colour recognition.
- **Shape Creation:** They build familiar objects—such as houses, cars, or animals—enhancing their creativity and spatial thinking.
- **Colour Stories:** Children invent short stories based on specific colours and illustrate them using matching elements, strengthening their visual expression.

**2. Observation and Memory:** These playful activities develop concentration, visual memory, and attention to detail. Children recreate patterns from memory or identify missing elements, thereby enhancing both observation and recall.

- **Remember It!** Show a Poly-Universe structure for a few seconds, then hide it. Children must rebuild it from memory.
- **What's Missing?** Remove one element from a structure secretly and ask the children to identify which piece is missing.

**3. Nature and Harmony:** These activities focus on observing natural patterns, fostering environmental awareness, and developing a sense of balance and harmony.

- **Inspired by Nature:** Children use Poly-Universe elements to build natural forms—such as trees, flowers, or insects.
- **Balance Games:** They create constructions where maintaining balance, proportion, and symmetry is key.

**4. Emotion and Therapy:** The Poly-Universe game can also be used as a therapeutic tool for expressing emotions, relieving tension, and strengthening social relationships. The following examples are based on best practices collected from educators.

- **Emotion Structures:** Children express different emotions (e.g., joy, sadness, fear) through their constructions, helping them to recognise and articulate their feelings.
- **Collaborative Building:** Working together in groups promotes cooperation, communication, and mutual attention.

**5. Logic and Maths:** These activities aim to develop logical reasoning, problem-solving, and basic mathematical skills.

- **Pattern Building:** Continue a given pattern (e.g., red–blue–red–blue) using Poly-Universe elements.
- **Counting and Measuring:** Count elements, compare heights, or apply simple measurement concepts (e.g., how many pieces make up a building).

**6. Motion and Rhythm:** Movement-based activities develop gross motor coordination, spatial awareness, and a sense of rhythm.

- **Track Building:** Create obstacle courses where children crawl under, step over, or jump across constructions.
- **Rhythm Games:** Combine building activities with music or rhythmic movements.

**7. Tale and Role-play:** Role-playing activities nurture narrative thinking, imagination, and social skills.

- **Fairy-Tale Landscapes:** Recreate scenes and characters from favorite stories using Poly-Universe elements.
- **Character Figures:** Build figures from the elements and use them to act out short stories.

**8. Feast and Tradition:** Exploring traditions and celebrating holidays together takes place through themed play activities.

- **Folk Decorations:** Use Poly-Universe elements to create Christmas ornaments, Easter eggs, or other festive decorations.
- **Reinterpreting Traditions:** Represent traditional customs (e.g., St. Lucy's Day, nativity plays) using Poly-Universe figures and constructions.

## SUMMARY

The collection of best practices is not a rigid set of rules, but rather a source of inspiration for educators. Its aim is to help teachers adapt the Poly-Universe game to children's individual needs, developmental stages, and curriculum goals.

In this way, the game promotes not only creativity but also thinking skills, emotional intelligence, and social cooperation, all through joyful, experiential learning.

## TASK IDEAS FROM THE SUBMITTED EXERCISES

### 1. Colour and Form

#### Task No. 1 / COL\_102\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–5 years

Description of the idea / problem / exercise: How many houses can you see?



Let's build a house out of squares and triangles with the same colour base so that squares and triangles of the same colour and size meet. Point out to the child that not only the shapes but also the matching colours form a house.

Task: How should the elements be placed so that a third coloured house becomes visible?

*Why this exercise is useful: Develops observation skills, shape-background differentiation, logical thinking, and combinatorial thinking.*

#### Task No. 2 / COL\_104\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–4 years

Description of the idea / problem / exercise: Getting to know the game, colours, shapes

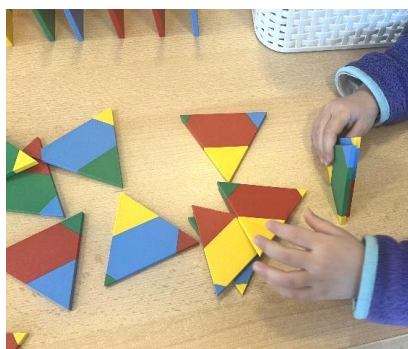
First, we examined the triangle: why is it called that? = 3 angles, what colours do we see on it?

What is the “main” colour and what colour is each vertex, which is smaller and which is larger.

Within a few minutes, we came to the realization:

Can all colours be found on every triangle? Yes!

(Yellow like the sun, blue like the sky, green like the grass, red like an apple. )



*Why this exercise is useful: Colour recognition, shape recognition, comparison, smaller-larger, differentiation.*

### **Task No. 3 / COL\_106\_EN**

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–4 years

Description of the idea / problem / exercise: Matching

Circular game set: find pairs and match semicircles of the same colour and size

Recognition: two semicircles form a whole circle



*Why this exercise is useful: Observation skills, matching, part-whole relationships*

### **Task No. 4 / COL\_114\_EN**

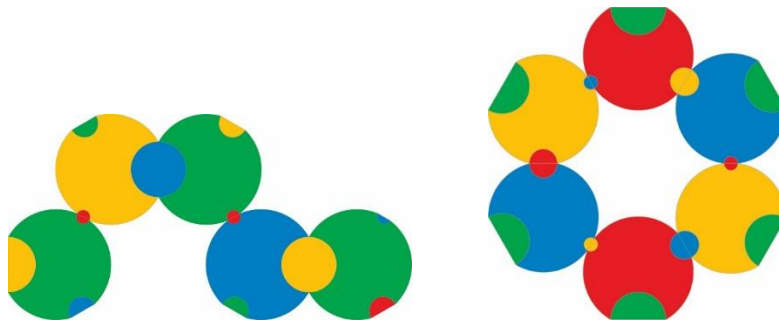
Formal and/or non-formal educational setting: Both

Most relevant age group: 3–5, 6–8 years

Description of the idea / problem / exercise: Matching colours

After we show the children how they can also match the colours, they almost always play this way with the tool. There is great joy when they manage to create a longer or larger shape, or to close a circle.

We can make it more challenging by having them, as in the game of dominoes, draw one piece after another and try to fit it in. If they cannot, they set it aside, and in the next round they first try the set-aside pieces; if they still do not fit, they draw again. In this case, we define the shape — the simplest is in a straight or crooked line, placing them next to each other, for example, from one edge of the table to the other.



*Why this exercise is useful: Development of attention, visual perception (part–whole), shape-background differentiation.*

## 2. Observation and Memory

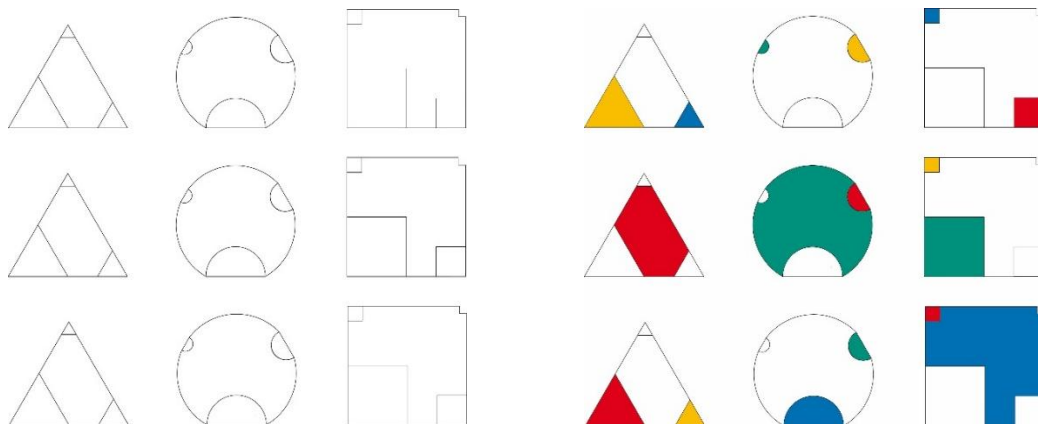
### Task No. 1 / OBS\_204\_EN

Formal and/or non-formal educational setting: Formal

Most relevant age group: 5–7 years

Description of the idea / problem / exercise: Poly-Uni colouring

We draw the Poly-Universe elements on a card, leaving certain parts “blank”. The children’s task is to colour in the missing parts according to the elements.



*Why this exercise is useful: It develops observational skills and fine motor skills.*

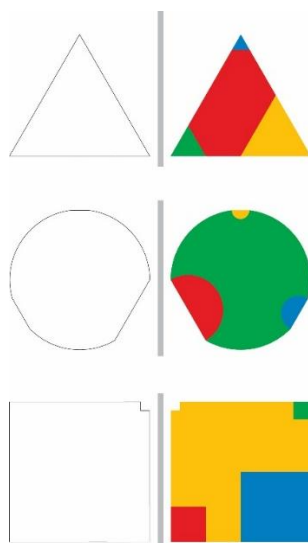
### Task No. 2 / OBS\_215\_EN

Formal and/or non-formal educational setting: Formal

Most relevant age group: 5–7 years

Description of the idea / problem / exercise: Mirroring

Each element and an identical “blank” version are drawn on a card. The children’s task is to colour the “blank” image so that it becomes the mirror image of the original element.



*Why this exercise is useful: It is very good for practising mirror images; the elements are simple, and even the little ones can easily colour the mirror image.*

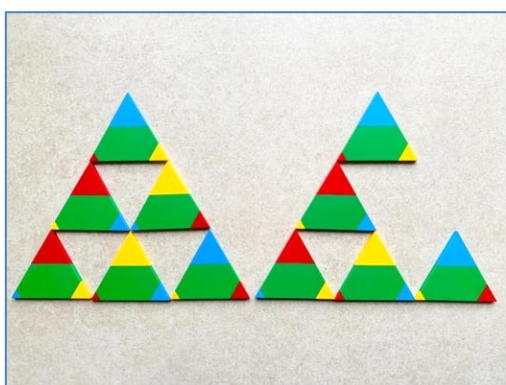
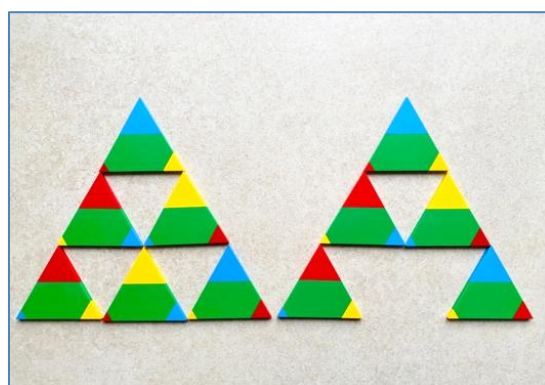
### Task No. 3 / OBS\_205\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–8 years

Description of the idea / problem / exercise: Find the missing piece!

The child should find which element is missing in the shape on the right by observing and comparing the two arranged shapes. They should identify the missing element and then complete the shape on the right to match the one on the left.



*Why this exercise is useful: It develops observational skills, attention to small details, and memory. In addition, children enjoy themselves during the game and learn actively. After completing the two shapes, they will be identical. The game can continue by highlighting a different piece, and in the same way, finding the missing part.*

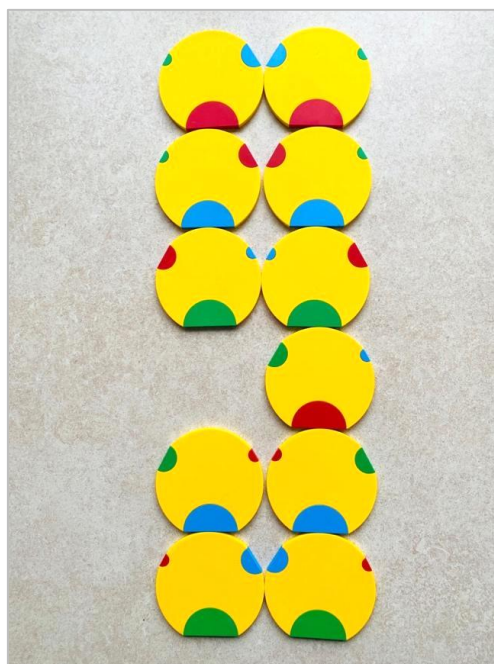
#### Task No. 4 / OBS\_213\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 6–8 years

Description of the idea / problem / exercise: Find the missing element!

Complete the left column with the missing element so that after adding it, the two columns are mirror images of each other.



*Why this exercise is useful: It develops observational skills, attention to small details, and memory. In addition, children enjoy themselves during the game and learn actively.*

#### Task No. 5 / OBS\_218\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 6–8 years

Description of the idea / problem / exercise: Identification – Description – Comparison – Memorization – Association

In one part of the game, by searching for given properties, we prepare for the next step of associating concepts of shape, colour, and size.

We list all identifiable elements in a table and write these words on strips of paper. These words are then grouped into families. For example, we can find 4 families:

- 1/ Colours: yellow, red, blue, and green
- 2/ Shapes: square, triangle, full circle, incomplete circle, regular shape, irregular shape, background (large central part that remains)
- 3/ Sizes: small, medium, large
- 4/ Positions: centre, edge (or outer side), two consecutive colours, two opposite colours, etc.

Distribution of elements: Each child has enough pieces for the game (minimum 4).

The children sit on the floor in a circle (or semicircle). The game pieces, corresponding to the announced concepts, are placed in the centre.

### GAME RULES

Level 1: The teacher asks a child to draw a word from one family.  
Every child whose word matches a game piece places it in the centre of the circle.  
The group checks and self-corrects if necessary; the teacher checks and explains if needed.  
Each child takes back one of the pieces placed in the centre (their own or another).  
Then a word is drawn from another family, and the process continues for all 4 families.

Level 2: A word is drawn from 2 families, and each piece placed in the centre must meet 2 conditions (must contain both concepts).

Levels 3 and 4: A word is drawn from 3, then 4 families, and each piece placed in the centre must meet 3, then 4 conditions, respectively.

*Why this exercise is useful: This exercise allows for the naming of basic concepts that are found in both art and geometry. It enables the child to observe the game pieces and gradually focus on one concept, which they must identify in the pieces, and then focus on two concepts at once. The exercise then gradually becomes more complex, asking whether there are game pieces that contain all four concepts simultaneously. This game incorporates both individual and collective dimensions. It is a constructive approach where each child can be an active participant in their own game and can also help others.*

## 3. Nature and Harmony

### Task No. 1 / NAT\_303\_EN

Formal and/or non-formal educational setting: Can be used in smaller groups or more informal educational settings.

Most relevant age group: 4–8

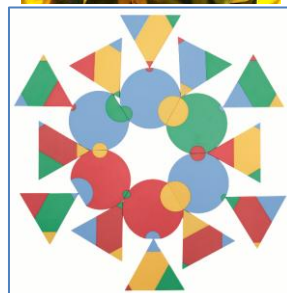
Description of the task: Modeling Plants with Poly-Universe

Modelling flower petals:

Children gain basic knowledge about the shape of flowers of different plant families. The task can be implemented in the following steps:

1. Children collect fresh plant petals and analyze the shape of different flowers: colours-shapes, simple-complex, small-large, etc...
2. Using the Poly-Universe kits, children make models of flower petals
3. Children present their models, discuss their solutions and give each other feedback.

Two examples of possible solutions that students can create as models of different plant families.



*Why this exercise is useful: This activity promotes children's creativity, recognition of the relationship between part and whole, abstraction of nature and the ability to create models, interdisciplinary learning and communication between children.*

## Task No. 2 / NAT\_302\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–8 years

Description of the idea / problem / exercise: Find the missing flower petal!

The child should find which element is missing from the shape on the right by observing and comparing the two shapes, finding the missing element, and then completing the shape on the right.



*Why this exercise is useful: It develops the ability to abstract and observe, pay attention to small details, and memory. In addition, children have fun while playing and actively learn. After completing the two shapes, they will be similar, with the same basic colour within a flower. The game can be continued by highlighting another element, this time on the left, and similarly finding the missing element.*

## 4. Emotion and Therapy

### Task No. 1 / EMO\_407\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 4–8 years

Description of the idea / problem / exercise: POLY-Ice Cream

Poly-Universe equipment needed: triangle, circle elements

Every child loves ice cream.

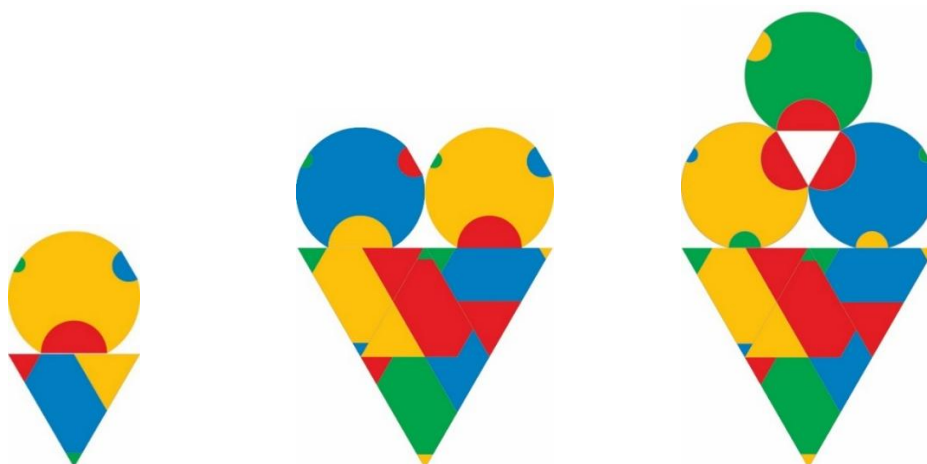
We ask the children which ice cream is their favorite and what colour it is.

For example:

- raspberry, strawberry, sour cherry, cherry, currant, punch... = red, bright
- vanilla, lemon, mango, banana, peach, melon, tutti-frutti... = yellow, light colour
- chocolate, smurfette, blue bubblegum, plum, blackberry, blueberry... = blue, dark colour
- pistachio, mint, apple, kiwi... = green, natural

We lay out the Poly-Universe triangle, circle and square elements and ask them to make their own ice cream. But the children will figure out for themselves that the triangle will be the cone, and the circle elements will be the scoops, and according to the colours, everyone can make ice cream that matches their favorite fruit.

It can be one-ball, two-ball, or three-ball. Of course, if you want more balls, you need to increase the size of the funnel. The elements are distributed either randomly or by conscious choice.



Then everyone looks at their own Poly-Universe element to see if they got the most of the colour corresponding to their favorite fruit.

Then they look at each other and think together how they can get the colours/balls they like the most, and then they exchange the elements between themselves until everyone has the most of the colour corresponding to their favorite fruit.

If they have served themselves satisfactorily, they can form pairs and give each other gifts according to each other's wishes. With ice creams with multiple scoops, it is possible to sneak decorative elements into the gift.

*Why this exercise is useful: It improves children's sense of colour, logical skills, and visual observation skills. It prepares them for metaphorical thinking, they have to associate colours with delicious snacks, and it develops a sense of quantity and proportion. It also improves communication, strengthens teamwork, and the feeling of joy for others.*

## Task No. 2 / EMO\_402\_EN

Formal and/or non-formal educational setting: Non-formal setting

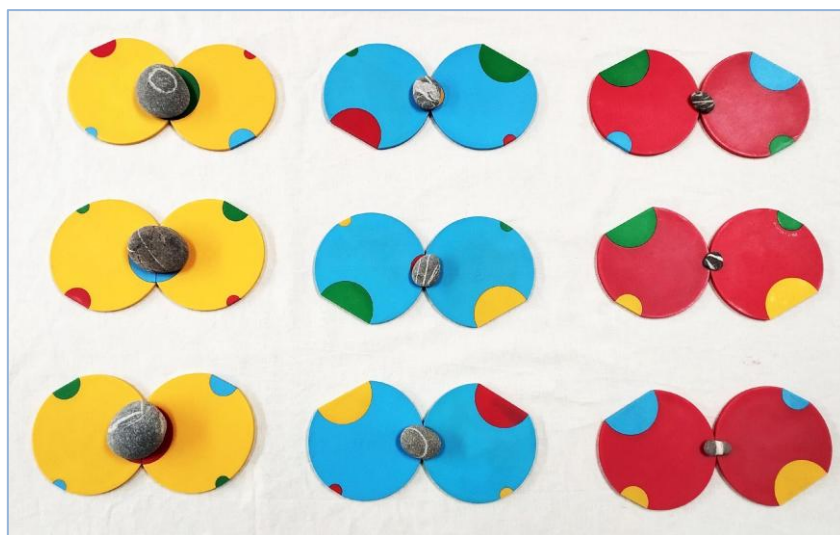
Most relevant age group: 3–5 years

Description of the idea / problem / exercise: Poly–High-Five

Connecting Poly-Universal Circle shapes: Big High-Five, Small High-Five, and Tiny High-Five

Big High-Five = I love it very much, Small = I love it, Tiny = I love it a little

1. We place circular shapes from the Poly-Universal on the table in front of the children. The children begin to connect semicircles of the same size in pairs. They do not always succeed in matching them by colour, but even 2-3-year-olds can try to find colours and sizes that match.
2. Through formal association, the basic shapes become personified and a kind of physical love relationship is created between them, which the children interpret as a High-Five, since this language of love means security, harmony, and wholeness to them.
3. Once all the High-Fives have been given, we can seal the symbolic loving relationship with a pebble of the same size. Furthermore, we can express differences in size by clapping the palms together with different strengths.



*Why this exercise is useful: Through its formal association, the Poly-Universal is suitable for expressing certain emotional states/love, experiencing them in a figurative sense, and experiencing certain degrees of love even in very young children. By connecting the two semicircles, the world becomes round again!*

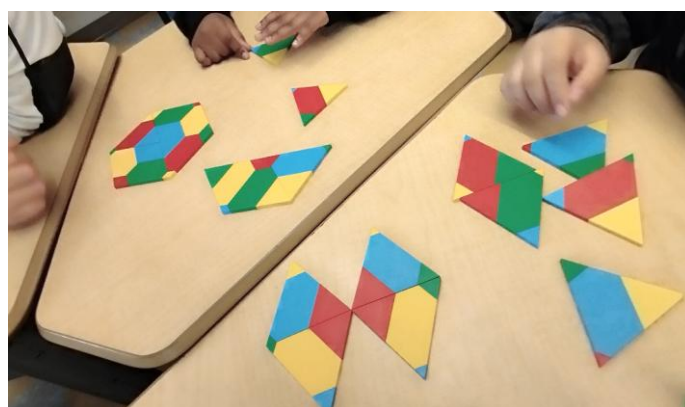
### Task No. 3 / EMO\_404\_EN

Formal and/or non-formal educational setting: Formal

Most relevant age group: 3–6 years

Description of the idea / problem / exercise: The therapeutic use of the game

The game can also be used for therapeutic purposes. In my group, where I tested the tool, there are two children with speech related autism, and they were very successful at putting together coherent shapes. They spent a long time working on it, intently fitting the pieces together.



*Why this exercise is useful: The autistic children with speech impairments were completely absorbed in the game and had a great time playing it.*

### Task No. 4 / EMO\_403\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 8–10 years

Description of the idea / problem / exercise: Spa

Set: Triangles

Description: Make four hexagons with large triangles of the same colour facing the inside of the hexagons. Arrange a beach!



Where the blue triangles meet, there is a cold water pool; where the green triangles meet, there is a playground; where the red triangles meet, there is a thermal pool; where the yellow triangles meet, there is a children's pool, etc.

*Why this exercise is useful: With the help of the Poly-Universe tool, children can come up with solutions that can be assembled using basic geometric shapes linked to specific experiences.*

### Task No. 5 / EMO\_406\_EN

Can be used in formal and/or non-formal educational settings: Non-formal

Most relevant age group: 6–10 years

Description of the idea / practice / task: Self-representation good practice

Tools:

1. Predefined intuitive symbol system
2. Poly-Universe Game packages
3. Post-it
4. Pen

Aspects: play in a group, connect with each other, but discuss individually.

SYMBOL SYSTEM: the appearance of the 4 scales is the intensity of the given qualities in the person (small scale – least characteristic, large scale – most characteristic).



1. CIRCLE: sensitivity, positivity, harmony, unity, community, belonging  
SQUARE: stability, order, balance, professionalism, security, thoroughness, solidity, rigidity and limitation, loyalty, diligence, perseverance  
TRIANGLE: reality, knowledge, responsibility, control, stability
2. YELLOW: life, happiness, creativity  
BLUE: calm, peace, loyalty, trust, wisdom  
GREEN: growth, development, balance  
RED: passion, energy, action, courage, love

## EXAMPLES:

- a) Yellow circle: active, lively, harmonious, happiness, creativity  
Blue circle: peaceful, calm, harmonious, sensitive, trust  
Green circle: developmental desire and balance, sensitivity  
Red circle: passionate and energetic, emotional intensity
- b) Yellow square: creativity, stability, security and order  
Blue square: reliability and loyalty, structure, wisdom, balance.  
Green square: balance of development and stability, closeness to nature, orderliness.  
Red square: passion, organisation, perseverance, energy and determination
- c) Yellow triangle: creativity, responsibility, innovative thinking, desire for knowledge  
Blue triangle: wisdom, control, responsibility, stability  
Green triangle: balance, stability, development, desire for knowledge, closeness to nature  
Red triangle: passion, courage, leadership, energy, control and responsibility



Task, Part 1: we do not show the symbol system here yet

- a) they choose a shape and colour that they think best characterizes them at the moment
- b) they tell why they chose that shape and colour – what does the colour and shape mean to them, how does it make them feel
- c) we write their name on it with a post-it and they try to connect their qualities to each other

Task, Part 2: they do not see the symbol system here yet

- a) what quality do they want to acquire? What colour and shape do they think this chosen property could appear in? They choose an element
- b) label it with a post-it
- c) connect it to the existing property – why did they connect it like that?

Task, Part 3: introduce the symbol system

- a) based on this, what colour and shape do they think is characteristic of them now?
- b) label it with a post-it and connect it to the previous ones
- c) discuss what they chose first, how much it differs from the property described by the symbol system

d) why did they connect it to the previous ones in this way?

Task, Part 4: with a symbol system

- based on the symbol system, what property would they like to acquire?
- label it with a post-it and connect it to the previous ones
- discuss what they chose first, how much it differs from the property described by the symbol system
- why did they connect it to the previous ones in this way?

EXPERIENCE: Based on the children's free choices, dialogues were started in which they could talk about their own feelings, relationships, and desires through the language of colours, shapes, and sizes. For example, those who chose a large, red triangle often turned out to be passionate, determined, and impulsive; while those who chose a small, blue circle were more reserved, sensitive, and deep-thinking.

During this process, not only did the children's emotional self-awareness develop, but the teachers also saw their students in a new light. In this interpretation, the Poly-Universe was not just a visual development tool, but also a psychological mirror in which the children could boldly show themselves.

The atmosphere of the session was liberated, playful, and yet deeply emotional. The colours and shapes made the children open up, and conversations were born in which they expressed their feelings in simple words, but honestly and originally.



*Why this practice is useful: During the session, we developed the children's emotional self-awareness and self-expression – through the aesthetic language of play. The associations made with colours and shapes created an opportunity for them to express and show their inner world while moving in a safe, creative space. During the conversations, inhibitions were dissolved, and "little miracles" were born in which the children expressed their feelings, relationships, fears or joys in a simple, yet deeply honest way.*

## 5. Logic and Maths

### Task No. 1 / LOG\_501\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–5 years

Description of the idea / problem / exercise: Getting acquainted with the colours, elements, and connections of the Poly-Universe game

- 1) Give the children the Poly-Universe game without any instructions.
- 2) Observe and analyze what feelings children use in their relationship with the object.
- 3) Based on the results of the observation, choose the appropriate support from the following suggestions:

Let's name and comment on what the child touches or does.

The idea is to help children acquire the vocabulary.

Let's play comparison games (if the child finds a colour or shape, compare it with another one). Through perception, the child unconsciously/consciously connects the pieces of the game according to their own rules.

The role of the mediator: Analyze the rule and make the child aware that the connection was not made randomly (comment on what happened).

- 4) Play with the child so that they recognise colours, compare quantities, assemble, stack, pour, etc.



*Why this exercise is useful: Through games, we give children the opportunity to think about their actions. They will develop their logical thinking as they observe objects, first pairing them and then identifying their characteristics: shape, size, colour. We experiment from the earliest age to create a connection between the worlds of art and mathematics.*

## Task No. 2 / LOG\_503\_EN

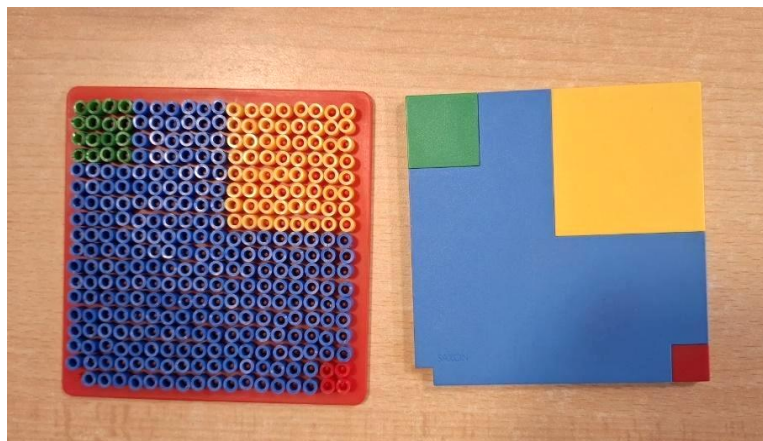
Formal and/or non-formal educational setting: Individual play

Most relevant age group: 5–7 years

Description of the idea / problem / exercise: A square made of beads

The square element from the Poly-Universe game can be laid out on a square base using ironing (perler) thermobeads.

With the help of the beads, children can experience how many units are needed to make up the large, small, and tiny fields. Each field is twice the size of the other. The beads make this easy to visualise and count, and children can take measurements (how many do I need to place?). This lays the foundation for mathematical operations such as multiplication and area calculation. The shape must be placed on the base according to the colours of the selected elements. With the help of an adult, several elements (6) can be glued together to form a three-dimensional shape (cube).



*Why this exercise is useful: We can lay the foundations for mathematical skills and develop their perception of colours and shapes. They can practice the concepts of rows and columns. Their hand-eye coordination, fine motor skills, patience, and perseverance will improve. They can practice directions (under, above, next to, etc.).*

## Task No. 3 / LOG\_504\_EN

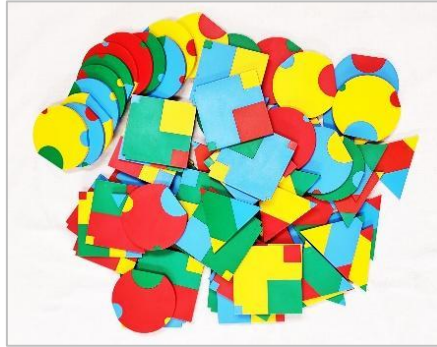
Formal and/or non-formal educational setting: Formal

Most relevant age group: 3–5 / 6–8 years

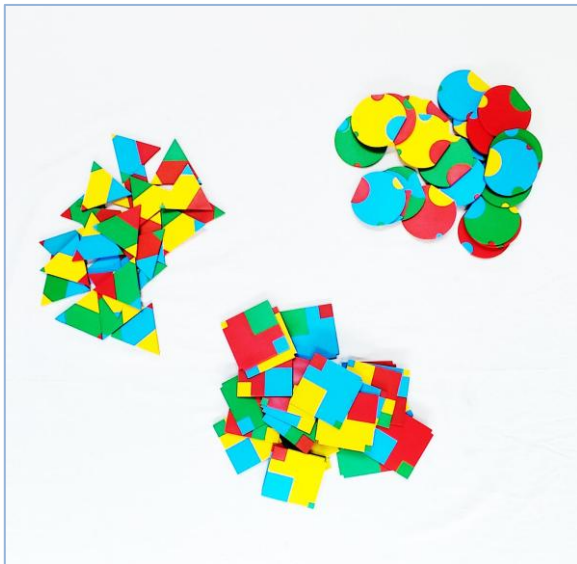
Description of the idea / problem / exercise: What do they have in common?

Which one has more or less? Which one is smaller, which one is bigger?

At the age of 3, children are already capable of solving important logical thinking tasks, such as sorting things based on certain characteristics: size, colour, sets of different sizes...



1. We put all the shapes from the Poly-Universe into one pile:  
What shapes does the Poly-Universe consist of: triangle, circle, and square?  
Task: sort the different shapes and put them in a pile.



2. Within the different Poly-Universe piles, collect the triangle, circle, and square elements into separate piles according to their colour (colour recognition). How many colours did you find?
3. How many single-colour shapes are there in the triangle, circle, and square shapes? (small calculation)
4. I select a game format and show it to the children:  
For example: Are the smaller shapes in the large circle all the same size? Which is the largest, the large and the small, show me! ...and the very largest?

*Why this exercise is useful: This skill will be needed in school when children have to form different sets, for example, from numbers (even-odd), letters (vowels-consonants), or even living beings (pets-forest animals). Regular play and spending time together has many positive effects: one of them is that during the meaningful time spent together, a deep and secure emotional bond develops between the teacher and the child... Children can get to know the elements of the set in a playful way.*

*By observing the differences in shape and size of the various shapes and flat figures, they learn to generalize and concretize, i.e., to recognise the properties of things and then extract a specific characteristic from them, analysis-synthesis: breaking down the whole into parts, then combining the parts, understanding relationships: naming the relationship between two things (e.g., smaller-larger). Young children progress from active thinking to visual thinking and then to conceptual thinking. At school age, after storing up experiences of active thinking, they will be able to solve individual problems in their minds, and conceptual thinking will develop.*

#### Task No. 4 / LOG\_506\_EN

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–4 years

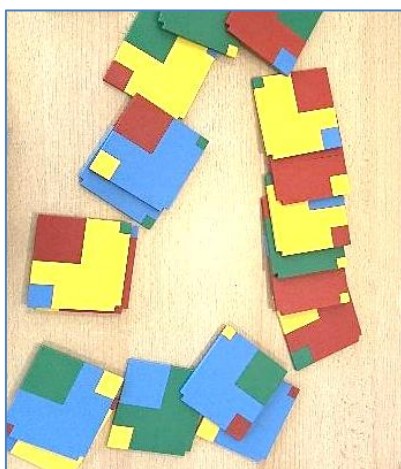
Description of the idea / problem / exercise: Square shape: what does it look like?

Square shape: what does it look like? Why is it a square? (Not a cube! Why?!)

Its four corners are different colours (four colours!).

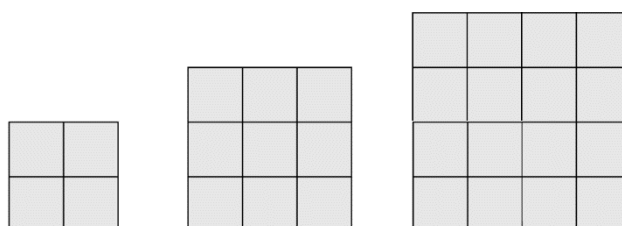
Let's put them next to each other and find the corners that are the same colour/single colour.

What shape will it be if we put two together? What if we put four together? Are all four sides the same length?



*Why this exercise is useful: Shape recognition, comparison, smaller-larger, part-whole relationship, preparation for multiplication.*

*Development: I asked the older children (aged 5–6 years) to do more difficult tasks, e.g. make squares of different sizes ( $2 \times 2$ ,  $3 \times 3$ ,  $4 \times 4$ ) and explain the difference between a rectangle and a square.*



## 6. Motion and Rhythm

### Task No. 1 / MOT\_601\_EN

Formal and/or non-formal educational setting: Individual

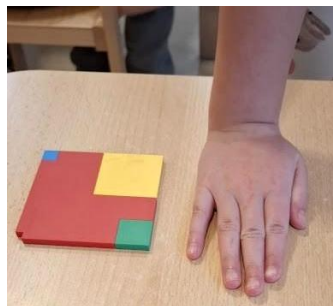
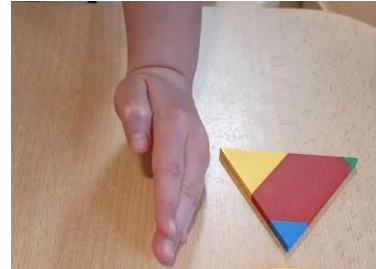
Most relevant age group: 5–7 years

Description of the idea / problem / exercise: Body image, crossing the midline, rhythm

We place circles, squares, and triangles on the table. Each shape is paired with a different movement.

- a) Circle: clenched fist
- b) Square: palm
- c) Triangle: edge of hand

Place the elements parallel to each other so that the children's hands can fit between them. First, practice with two different elements. Then you can add another element. You can even place the elements on the two sides according to the rhythm of a song or rhyme (ta: separate elements, ti-ti: placed closer together).



You can practice going there and back.



*Why this exercise is useful: The game helps strengthen the body's midline crossing. This is a dividing line that splits the body into two symmetrical parts (right and left) in a longitudinal direction. Crossing the midline requires both the right and left hemispheres of the brain. This game also helps to coordinate these two hemispheres. It focuses attention and encourages concentration. It develops a sense of rhythm and hand-eye coordination.*

### **Task No. 2 / MOT\_603\_EN**

Formal and/or non-formal educational setting: Both

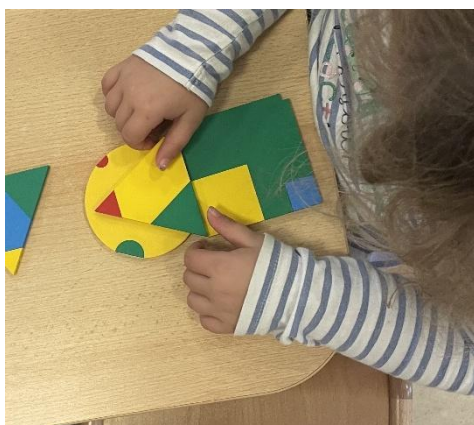
Most relevant age group: 3–4 years

Description of the idea / problem / exercise: Put it under, next to, on top of, on...

Everyone chooses a piece.

Let's start playfully.

We show it on our own body parts: Put it above your head/under your foot/next to your ear/in front of your nose!



*Why this exercise is useful: Orientation in plane and space. Development: 5–6 year olds say, for example, I put the triangle under the circle, I put two squares next to the circle. Or they have to say where each shape is located in relation to the others.*

### **Task No. 3 / MOT\_605\_EN**

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–4 years

Description of the idea / problem / exercise: Reaction/speed development game

All three games mixed together on the carpet

Everyone picks a circle!

Or on cue:

- a) One clap = find a circle!
- b) Two claps = a square!
- c) Three claps = a triangle!



*Why this exercise is useful:* Speed, observation skills, shape recognition. For 5–6 year olds, gradually increase the difficulty, e.g., by adding colour identification.

#### **Task No. 4 / MOT\_611\_EN**

Formal and/or non-formal educational setting: Both

Most relevant age group: 3–5 / 6–8 years

Description of the idea / problem / exercise: Fire-water-airplanes

Children love the movement game “Fire-Water-Airplanes.” Each of the three words requires a different series of movements: for example, for fire, you have to squat down; for water, you have to lie down; and for airplane, you have to climb up the wall bars.

In this case, by showing the three shapes, you can get them to do different movements, e.g., for triangle, they have to stand sideways, for circle, they have to curl up and rock on their backs, and for square, they have to lie on their stomachs.

*Why this exercise is useful:* Attention development, body schema, spatial orientation, visual perception, shape-background differentiation, cross-lateral development.

#### **Task No. 5 / MOT\_613\_EN**

Can be used in formal and/or informal educational settings: Both

Most relevant age group: 5–11 years

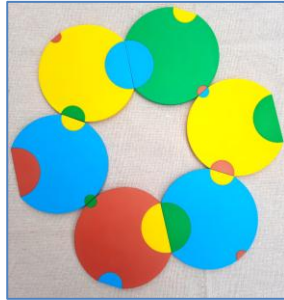
Description of the idea / exercise / task: Brain exercise — Hand exercise — Pairing

The child should independently lay out a shape similar to the one on the left, if he/she cannot, the leader should help him/her. Then, lay out the right-side pattern as well. (The right-side pattern can be laid out in any way, just make sure that it contains the same elements.)

The child should use his/her left hand/finger for the left-side pattern, and his/her right hand/finger for the right-side pattern. First, he/she should place his/her index finger on the base colour part of the left figure, starting from the top and moving to the left, and then with his/her right finger on

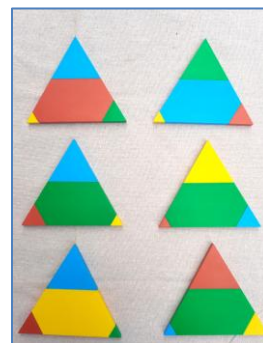
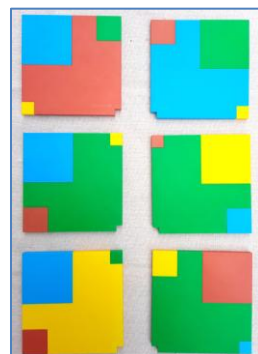
the right-side pattern, he/she should find the colour shown on the left in the base colour part of an element. The child moves around the shape nicely with your left finger and looks for the colours in the right figure with your right finger.

Once you have covered the basic colours, you can continue with the colours of the large, medium, and small parts. Meanwhile, with the right finger, they look for the colours in the appropriate parts of the element in the same way.



The colours of the left pattern base element in this case are: green, yellow, blue, red, blue, yellow. Once the game has been practiced well, we can complicate it by associating the parts of the game element with other parts. For example: the colour of the base part on the left side – the colour of the large part on the right side should match, etc.

Another examples of solving the triangle and square shapes:



*Why this exercise is useful: This exercise supports bilateral coordination, attention, problem-solving, and creativity.*

### **Task No. 6 / MOT\_615\_EN**

Can be used in formal and/or non-formal educational settings: Both

Most relevant age group: 5–11 years

Description of the idea / exercise / task: Step by step

To complete the exercise, you will need at least 8 pairs (1 pair = 1 right and 1 left footprint) of footprints. The colours of the footprints should be as follows: 2 pairs of red, 2 pairs of green, 2 pairs of yellow and 2 pairs of blue. Place the footprints on the ground so that they can be walked on. The distance between the footprints is adjusted to the children's steps (closer for the smaller ones, farther for the larger ones).

The colours of the footprints are placed on the ground in a variety of ways, meaning that no two identical colours should follow each other, and left footprints should be placed on the left side and right footprints on the right side. Any basic element of the Poly-Universe set can be used to perform the exercise.

The child draws an element from a small bag and must walk along the footprints according to the colours found on the element, according to the colours of the ascending order of the parts (T, S, L, B) or according to the colours of the descending order of the parts (B, L, S, T). The order used in the exercise must be determined in advance.

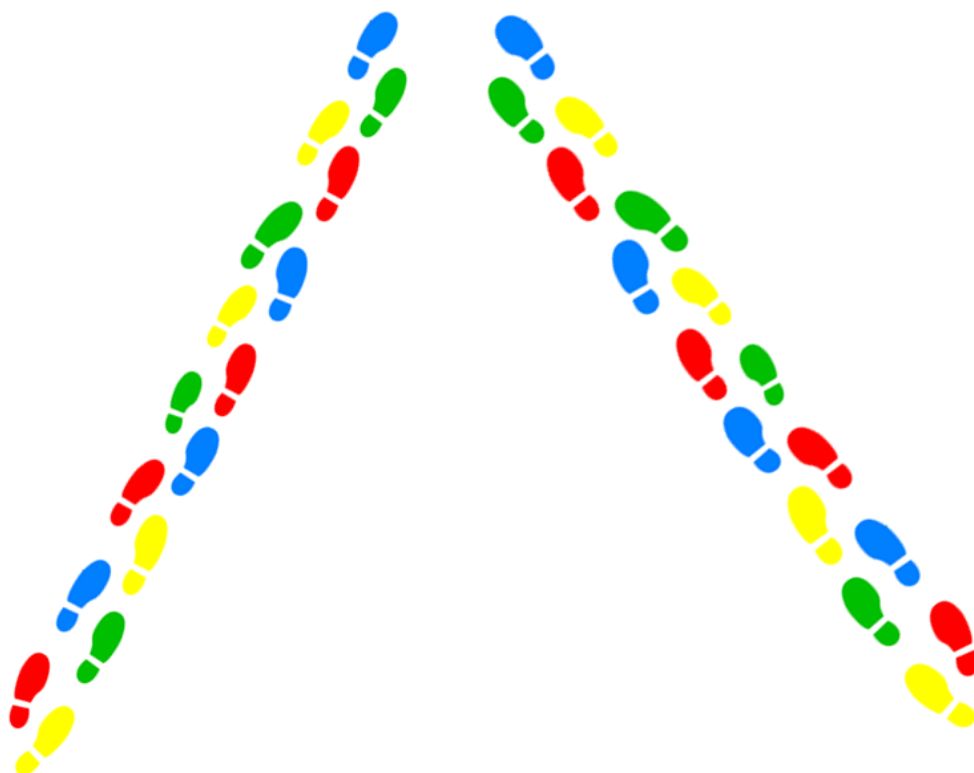
The game starts with the right foot, and a step with the right foot is always followed by a step with the left foot. If one part of the element is too far to move forward, then stepping back is also allowed. The child draws elements from the bag and steps until he has walked along the footprints.

When using the exercise as a game, two identical tracks with footprints are created, in an inverted V shape. Two children start at the same time, and the winner is the one who reaches the finish line first, i.e. the top of the inverted V shape first. If a student takes too big a step instead of stepping back and possibly falls, he is out of the game.

Example of laying out the footprints for the exercise:



Example of laying out footprints for the pair game:



*Why this exercise is useful: Experiencing randomness, practising ascending-descending order, practising right-left directions, developing attention, practising following rules, and decision-making.*

## 7. Tale and Role-play

### Task No. 1 / TAL\_703\_EN

Formal and/or non-formal educational setting: Non-formal setting

Most relevant age group: 6–8 / 8–10 years

Description of the idea / problem / exercise: The Square Around Forest

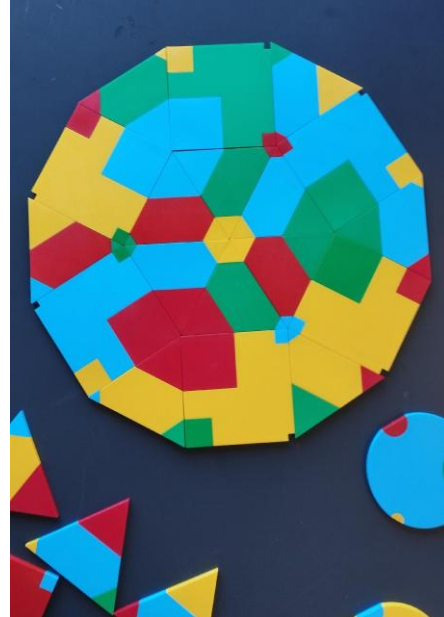
The task was inspired by our visit to the Espace de l'Art Concret, where teachers learned about the Poly-Universe and created their own unique solutions.

Régine Roubaud, one of the EarlyPoly team members, created the circular polygon shown below.

Fairy tale pairing: Ervin Lázár / The Square Around Forest.

The Square Around Forest is a collection of independent fairy tales, unified by the characters, just like a circle formed from different Poly-Universe elements.

After building their own, children tell the others: what is inside, according to colours and shapes, consciously or randomly arranged, how many trees are inside, where the fox and hedgehog are hiding, whether mushrooms grow inside, where the hunter is, etc.



*Why this exercise is useful: The playful development of creativity, thinking, and imagination; the enrichment of poeticism, literary influence, and the emotional world. The activity creates a bridge between the world of fairy tales and the abstract world.*

## Task No. 2 / TAL\_706\_EN

Formal / non-formal setting: Daycare

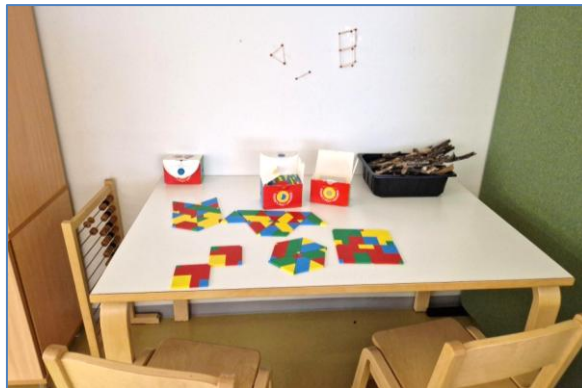
Most relevant age group: 3–5 years

Description of the idea / problem / practice: Role play – Pantry

The children used the shapes from the Poly-Universe as food and play, creating new shapes and structures.

At first, the children started using the pieces from the Poly-Universe game for role play. The shapes were their food.

After a while, they pretended that the Poly-Universe tool-set was their pantry and started creating new shapes/foods.



*Why this activity is useful: It engages children's creativity. The open-ended nature of the activity allows children to explore and experiment with shapes in their own way. Promotes collaboration and communication. Discussion and group work encouraged children to share ideas and collaborate.*

### **Task No. 3 / TAL\_705\_EN**

Formal and/or non-formal educational setting: Both

Most relevant age group: 5–7 years

Description of the idea / problem / exercise: How many rooms are there in the Palace on Duck's Leg?

We form four groups. Each group receives pieces from the triangle and square sets with the same base. After they have built their palaces on duck legs, we help them discover that the colours of the houses indicate the living rooms in the palace. We ask the children to try to create as many rooms as possible in their own creations. Beforehand, we can ask them how many rooms they think can be created.

1. Let's count the small, medium, and large rooms separately. Let's count the rooms by colour.
2. Let's try to create as many small and large rooms as possible.
3. Let's try to create as many medium and large rooms as possible.
4. Let's think together about why it is not possible to create many small and medium-sized rooms at the same time.
5. Let's look at the finished works together. Let's talk to the children about who lives in the palace, what they do, which room belongs to whom, etc.



*Why this exercise is useful: Develops imagination, construction skills, cooperation, shape-background differentiation, counting and communication skills, combinatorial thinking, and reasoning.*

## 8. Feast and Tradition

### Task No. 1 / FEA\_802\_EN

Formal and/or non-formal educational setting: Individual or small group

Most relevant age group: 6–7 years

Description of the idea / problem / exercise: Christmas festivities – Advent candles

1. Make candles from as many square elements as there are corners (places of pointy edges) on the square. Make as many candles as there are on the Advent wreath (4) and make sure that none of them are the same (they can be one basic colour or mixed colours). Add flames made from yellow/red basic colour circles/each flame should be a different basic colour/each flame should be the same colour as the candle.



2. There are several ways to play: The four candles should have different coloured flames. Make as many candles as there are angles in the triangle. How many more candles are needed to match the number of candles on the wreath?



3. We light one candle every Sunday during Advent. We light the longest candle in the first week and the shortest in the fourth week. Let's make candles: the longest candle should have as many elements as I clap (4), the candle lit in the second week should have as many elements as the triangle has angles, and the candle in the third week should have one element less. How many elements will the fourth candle have? We can determine the colour of the candles, but they can also be created freely. (In the picture, the child chose the colours and the corresponding flame colours.)



*Why this exercise is useful: It develops children's mathematical abilities, shape and colour constancy, and strengthens their understanding of numbers. They can practice the names of flat shapes, learn about geometric shapes through touch, recognise and name colours, and develop their seriality skills. It develops their construction skills and thinking (analytical, synthetic, problem-solving, logical), and we can also lay the foundations for combinatorics with colour combinations. They can practice cardinal and ordinal numbers.*

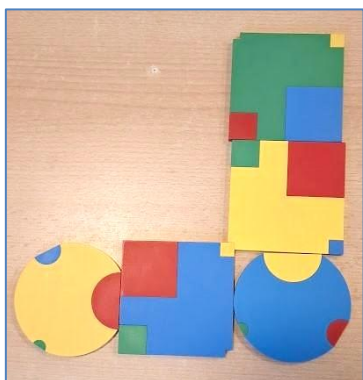
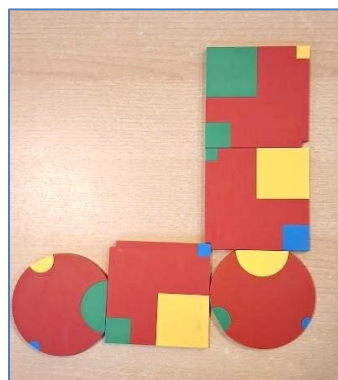
## Task No. 2 / FEA\_807\_EN

Formal and/or non-formal educational setting: Individual or small group

Most relevant age group: 4–7 years

Description of the idea / problem / exercise: Advent season – Santa socks

Use three squares and two circles to make socks for Santa to put presents in. Try to use as many different colours as possible—don't make them the same!



*Why this exercise is useful: Their creativity and construction skills develop. They recognise and name shapes and colours. Colour variations can be used to lay the foundations for combinatorics. Their thinking and mathematical skills develop. We can reinforce their understanding of prepositions such as under, above, and next to, as well as their ability to orient themselves in a plane.*

### Task No. 3 / FEA\_804\_EN

Formal and/or non-formal educational setting: Individual or small group

Most relevant age group: 4–7 years

Description of the idea / problem / exercise: Christmas tree decorations

We work on a pre-prepared (drawn) base.

We use circular elements for the game. Five decorations can be placed on the base. Several variations are possible.

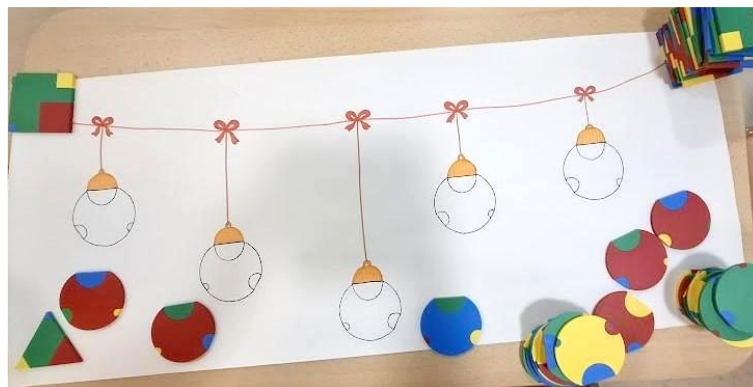
In the basic game, the pieces are fitted into the large fields. You have to pay attention to which direction the small and tiny fields are facing. The "decorations" must be placed and fitted precisely according to this. You can also check whether you have done the task correctly. We discuss which is the longest/shortest/equally long string, and you can show it.

#### Version 1

- Select the appropriate elements based on the instructions provided, e.g., place a red-based ornament on the longest string, with a small green field, a tiny blue field, etc.
- Place a blue-based ornament on the longest string, with a small yellow field and a tiny green field. Place identical ornaments on the two strings of equal length.
- With the exception of the longest one, all ornaments should have the same base colour.

#### Version 2

- Arrange the decorations as you like, but pay attention to the direction of the fields. Tell me what colours make up the decoration hanging on the shortest string, etc.



(The motherboard: this can be made in several ways)

### Version 3

- We make cards using the circle elements. Select the elements of the appropriate colour for the card and place them on the base in the correct order.



### Version 4

- We make another type of base plate (the small fields are coloured at the joints), where the decorations must match the colour of the small fields at the joints. Pay attention to the direction of the large and small fields.

### Version 5

- The game can also be played in this way (we draw a base board where all three fields are alternately represented), where when hanging, we have to pay attention to the large, small and tiny fields and place the "decorations" accordingly, paying attention to the directions as well.

### Version 6

- We can play the same games with rhombus (drop) shapes joined together along the long sides of two triangles. We can pay attention to matching colours, or we can join them together randomly. We can also make cards for this game, where the elements on the cards must be used.



*Why this exercise is useful: A complex activity that develops their sense of form and colour, their serial abilities, and their mathematical experience with plane geometric shapes and differences in size. It develops their thinking (analytical, synthetic, problem-solving, and logical), their speech and text comprehension skills, and their understanding of tasks. A game can be played in many ways, with a wide range of variations (this can be achieved most effectively through tasks, questions, and discussion). In addition to giving specific tasks, stacking can also be an enjoyable experience for younger children, so it can be used with groups of children of younger age. It is also suitable for differentiated task assignment, taking individual abilities into account, and can be used in the area of talent development.*



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