Innovative educational tools in kindergarten

or how to apply computational thinking and the creative use of modern technologies in early childhood education, ensuring the needs of the child's natural development and the importance of experiential learning

Innovative teaching tools in kindergarten process NPJR-2024/10074
methodology based on best practices

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Introduction

Innovation and technological development in modern society have become inseparable from everyday life and educational processes. Innovative digital tools are increasingly being integrated into early childhood education with the aim of enriching children's learning experiences, fostering their digital literacy, and ensuring their preparedness for a world shaped by rapid technological progress.

However, a growing body of research highlights another side of this process: intensive screen use in early childhood may be associated with language, cognitive, and emotional-behavioural difficulties, as well as structural changes in the brain (Madigan et al., 2019; Hutton et al., 2019; Wu et al., 2021). For these reasons, parents and psychologists are increasingly concerned about how the premature introduction of digital devices may affect brain development, and they are seeking ways to ensure a healthy balance between technology use and the natural developmental needs of children.

Our project aimed to address the needs of contemporary society and the challenges posed by technological advancement. The figure presents information about the evolution of technologies and innovation and their impact on education (see Fig. 1).

Project-Based Learning (PBL)		**1938**
John Dewey	**“Experience and Education”**	
Dewey’s experiential education emphasizes learning through doing. PBL involves real-world projects that foster critical thinking and problem-solving skills. Ideal for AI and innovation education.		
Design Thinking		**2009**
Tim Brown	**“Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”**	
Design thinking focuses on a human-centered approach to problem-solving. It involves empathizing, defining, ideating, prototyping, and testing, making it valuable for applying AI technologies.		
Blended Learning		**2014**
Michael B. Horn and Heather Staker	**“Blended: Using Disruptive Innovation to Improve Schools”**	
Blended learning combines face-to-face instruction with online learning, providing a flexible, personalized learning experience. It leverages technology to teach complex topics like AI.		
Smart technologies for teaching and learning		**2020**
Miscellaneous / Technological developments	**Machine learning and generative artificial intelligence in education**	
Since 2010, machine learning and neuro-linguistics and programming have transformed education into personalised learning and tailored assessment. Since 2022, generative artificial intelligence, such as ChatGPT, enables the creation of human-like text and interactive learning support.		

Figure 1. Technology and innovation developments and impact on education

Cognition and technology in early childhood

Together with project participants from three countries—early childhood education specialists from preschools in Norway, Lithuania, and Estonia—we discussed how digital tools could be used purposefully and meaningfully to foster children's creativity, problem-solving skills, and critical thinking. Taking into account the characteristics of early childhood development, we seek to ensure children's emotional and cognitive well-being during the dynamic period of brain growth in early childhood.

Jean Piaget wrote extensively about early childhood development. In his 1923 work, he examined the development of children's language and thinking. Piaget studied how children use language to express their thoughts, communicate with their environment, and solve problems. He identified key patterns of cognitive development and defined the stages of children's cognitive processes. In early childhood, he emphasized the transition from egocentric speech to dialogue and communication with others. This perspective helps us understand the specifics of early childhood development and supports educators in planning the development of cognitive and computational thinking skills in young children.

By understanding how children's problem-solving abilities emerge, how the foundations of logic are formed, and how causal thinking develops, educators can design digital learning activities, use interactive applications or educational robots, and encourage children to experiment, plan actions, and observe outcomes. In this way, children gradually develop algorithmic and modeling skills, an understanding of sequences, and decision-making abilities.

It is important that digital tools serve not only as playful instruments aimed at developing children as technology users, but also as elements that enrich and support a structured learning environment. As parents increasingly express the desire—and psychologists recommend—that children spend less time in front of screens, the development of computational thinking should also be extended into environments that are not tied to technology and are more naturally aligned with the child's developmental needs.
By fostering computational thinking, educators cultivate children's systemic and critical thinking while supporting their innate creativity and curiosity-driven discoveries.

Adapting the curriculum for the development of children's computational thinking

In the project, we raised a key question: how can we enrich the educational process by providing children with opportunities to develop computational thinking and by integrating elements of technological education in ways that ensure safe, developmentally appropriate conditions? We sought answers on how to achieve a balance between the opportunities offered by technology and the need to preserve natural child development, ensuring that technologies and digital tools do not become the primary aim of education, but rather a well-balanced and thoughtfully applied support instrument.

Therefore, our guiding principle was the integration of traditional and innovative educational tools, aiming to create a dynamic, multisensory learning environment that aligns with children's developmental needs and fosters the development of computational thinking.

When formulating educational objectives and activities for preschool-age children, the project participants followed the list of educational areas defined in the preschool education curriculum (see Table 1), which reflects the developmental characteristics of this age group, while also taking into account the context of the Project.

Table 1. List of Educational Areas in the Preschool Education Curriculum

• Daily life skills • Physical activity • Understanding and expression of emotions • Self-regulation and self-control • Self-awareness and self-esteem • Relationships with adults and peers • Understanding of the environment • Mathematical thinking • Digital thinking	• Language comprehension • Linguistic expression • Aesthetic perception • Artistic expression • Creativity • Exploration • Problem-solving • Ability to play • Ability to learn

For example, children at the Salininkai (LT) kindergarten discussed what robots might look like. They expressed their ideas by constructing two-dimensional robot prototypes and talking about possible ways they could be used. They also became familiar with the basic operating principles of the educational robot *Photon*. The children tried out and learned to understand movement directions: forward, backward, left, and right, both with music and without it. They shared examples of robots present in their environment. At the same time, the children practiced sharing their belongings, listening to others, and waiting for their turn.

The classification of possibilities for using technological tools in the educational process helps to better understand how various tools can be applied for presenting information, collecting, processing, and creating data, acquiring basic programming skills, and exploration. These tools may be categorized according to their purpose or place of use (outdoors, in the group/classroom, in the reading corner, in the play laboratory), or according to other criteria depending on the goals and context of the learning process (see Table 2).

Table 2. Classification of technological tools by educational purpose

Purpose	Resources	Customization
Information presentation (visualisation)	• Projector • Interactive whiteboard • Document camera	Video demonstrations in the group, library, play lab.
Data collection (audio/video capture)	• Dictaphone • Camera • Mobile phone	Recording audio or interviews. Recording observations of nature. Quick search (e.g. in the field).
Data processing and creation	• Computer • Printer • Binding machine	Information preparation, analysis. Editing text, video. Printing and booklet production.
Programming and exploration	• Educational robot • Microscope • QR codes	Exploring through a magnifying glass and microscope. Getting started programming your robot. Scanning QR codes.

Reflection on best practices: applying technologies

Summarizing the participants' experiences in applying technology in the Project, it is evident that direct application of technologies was the most prevalent (see Table 3).

Table 3. Classification of activities regarding the innovation integration way and competences

Title of the Activity		Type	Innovation (direct/indirect)	Competencies
NORWAY	Innovative teaching Hide and seek Plastic sorting Robot types	Individual/group Individual Individual/group Individual	Direct (video) Direct (phone) Direct (video) Indirect	Problem solving, creativity, daily actions, digital tools, language, experiences
ESTONIA	Sami's people Microscope Family pictures Count to 9	Group Individual Individual/group Individual	Direct (video) Direct (lupa) Direct (computer) Direct (robot)	Language, experiences, logic, math, teamwork, problem solving
LITHUANIA	Water physics Device Beebot	Individual Individual Individual	Indirect Direct Direct (robot)	Language, experiment, logic, technology

Although video and audio formats are no longer considered the most advanced innovations, they are suitable for children when they help develop understanding and have educational value. On one hand, this indicates that the ways children are introduced to technology can be expanded; on the other hand, storytelling can be learned not only from a video—which is one of the most effective tools for visualizing content—but also through oral narration, which also provides an opportunity to cultivate children's imagination and creativity.

It is important to pay attention to **how we present technologies.** Whether through sound, images, or screens, all of these shape a child's perception and interaction with the world. Therefore, when selecting activities that incorporate technology, we are, in one way or another, influencing the child's development.

Innovative educational tools in kindergarten

Examples of activities and games, a stimulating learning environment, and engagement strategies are the key elements of innovative teaching tools aimed at developing computational thinking in preschool-age children. We will next discuss the trials conducted in our Project.

Multimodal Learning – Combining Movement, Sound, and Visuals

Multimodal learning stimulates children's senses through visual, auditory, and movement (kinesthetic) inputs. Kinesthetic learning is carried out through bodily sensations, motor skill development, and experiential activities focused on physical experience, among others. This approach helps children perceive and retain information while adapting information reception to their age. For example, developing children's coordination skills through movement-based activities with the Photon robot (see Figure 2).

Figure 2. Illustration of the sense of movement for the development of algorithmic thinking What type of robots there can be and what are they for? (Vilnius Salininkai Nursery – Kindergarten, Lithuania)

Interactivity and active participation

Children become active participants rather than passive observers. Interactive activities, games, and modeling are included to encourage children to explore, experiment, and solve problems. Movement (running, jumping, climbing) is an essential means of cognitive and emotional expression. Children learn through experience by actively moving, touching, and manipulating objects. For example, they might search for natural elements—such as plants or leaves—and classify and identify the types of leaves collected during their exploration of a nearby forest (see Figure 3).

Figure 3. Sensory-motor activities for the development of algorithmic thinking (Brennastubben Familibarnehage, Oslo, Norway)

Visual and experiential learning

Preschool children have a short attention span. Deodhar and Bertenthal (2023) explain that attention is a distinct set of processes that develop during the preschool years. Children find it particularly difficult to maintain sustained attention due to not yet fully developed cognitive control mechanisms. To keep their attention, activities need to be active, brief, and frequently varied. For example, children are given opportunities to observe phenomena—such as natural physical or biological processes—that are difficult to access or observe directly in real life. **Visual models and simulations encourage children to understand abstractions through concrete experiences** (see Figure 4).

Figure 4. Sensory-motor activities for the development of algorithmic thinking : „A bear or Rudolf 3D, "You do not bring wild animals into the group room" (Kopli kindergarten, Tallinn, Estonia & Brennastubben Familiebarnehage, Oslo, Norway)

Research shows that brain activation for abstract words becomes similar to that for concrete words when they are processed together with a visual context related to their meaning. According to Kewenig, Vigliocco, and Skipper (2024), the **perception of abstract concepts depends on visual context.** This means that the processing of abstract concepts can be grounded in concrete objects and contextual imagery. The formation of abstract concepts is a complex process, which in early childhood is limited due to insufficient brain maturity and limited sensory experience. Children's ability to understand and use **abstract concepts develops gradually** as they accumulate enough experience to associate linguistic symbols with various sensory and social contexts.

Linguistic abstraction is not an innate trait. It emerges through the dynamic interaction of cognition, environment, and sensory experience. Young children do not yet have fully developed complex abstraction skills. Their thinking is based on experiential images, which is why in educational practice it is especially important to **make concepts concrete.** For example, by using real objects or pictures of objects from their immediate environment. This helps children understand and connect direct experience with ideas at a level appropriate for their cognitive development, supports them in grasping abstract objects and transformation processes through concrete representations (see Figure 5).

Figure 5. Exploring real objects for computational thinking development (Kopli kindergarten, Tallinn, Estonia)

Development of fine and gross motor skills and informational thinking

The use of images to help children grasp abstract concepts is based on the understanding that language development occurs in two distinct brain areas, each of which may develop at different times in early childhood. The Wernicke area is responsible for language comprehension, while the Broca area is responsible for language production, grammar, and articulation. This explains the differences between language comprehension and language production (for more information, see *Psychology* by Myers and DeWall, 2023). **For educators, this means that using visual supports can bridge the gap between comprehension and expression, helping children understand abstract ideas even before they can fully articulate them.**

Development of Fine and Gross Motor Skills and Computational Thinking

Fine and gross motor skills develop intensively in early childhood; therefore, activities that promote coordination, balance, and movement control are especially valuable for motor development. When aligned with the goals of developing computational thinking, activities involving **object manipulation and movement** (e.g., catching or throwing a ball) are particularly suitable. Goal-oriented and cooperative games that require children to **plan their actions, follow rules, and adapt to changing conditions are also highly effective.**

This approach integrates physically active, developmentally appropriate experiences with elements of computational thinking. For example, children may find a way to complete an activity or plan the steps needed to achieve a goal. For early logical reasoning, it is useful to engage children in solving "if–then" situations. Imagination creates different solutions and alternatives to logical thinking" (see Figure 6). It is especially beneficial to encourage them to search for and discover not just one, but multiple solutions.

Figure 6. Useful for introducing logical thinking in "if-then" situations
What type of robots there can be and what are they for? (Vilnius Salininkai Nursery – Kindergarten, Lithuania)

Flexibility and the ability to adapt, as well as collaborative strategies involving the sharing of roles and decisions during group activities, help develop algorithmic thinking. Especially when discussions are supported with diagrams, drawings, or **pictures that illustrate sequences of actions, logic, numbering, or directions represented with arrows.** For example, children may choose tasks from a set of activities related to local customs (such as those they explored during group work on St. Martin's Day traditions (see Figure 7).

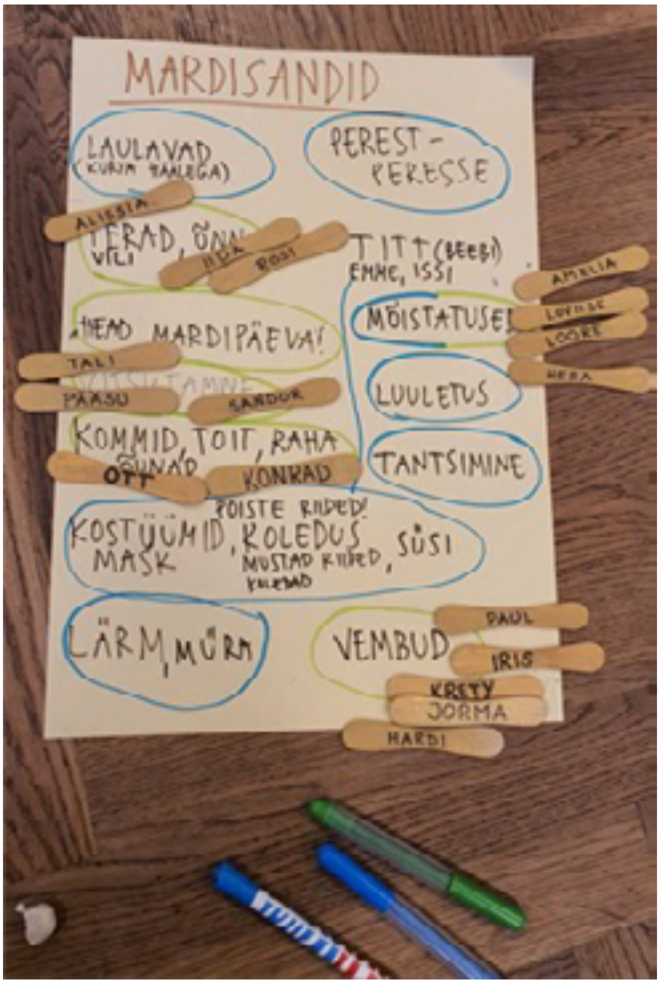

Figure 7. Diagrams, drawings or pictures used for discussion Estonian's "Mardisandid" (Kopli kindergarten, Tallinn, Estonia)

Technology provides opportunities to foster creativity, stimulate imagination, imitate real or imaginary situations (e.g., fairy tales), combine visual or auditory elements, look at things "from a different angle," and experiment. For example, children can explore how a flower grows, how planets move, or how waves form—phenomena that are difficult to observe directly in real life or are impossible to perceive with the naked eye. They can also investigate invisible processes, such as cell division, the structure of an insect's wings, the texture of a plant leaf, microorganisms in a drop of water, or fibers in a piece of fabric, which can be seen using a simple optical microscope (see Figure 8).

Figure 8. A look through a microscope, "Anatomy of a Flower" (Vilnius Salininkai Nursery – Kindergarten, Lithuania)

Teachers’ Ability to Apply Differentiation Strategies

We understand that there is no universal method that fits every child’s abilities and developmental needs. However, teachers can individualize activities by differentiating according to the level of difficulty, the child’s cognitive pace, and the amount of time allocated for each task. Such personalized activities help ensure that every child can experience success, which is crucial for fostering a positive attitude toward future learning, as well as developing independence and organizational skills.

Teachers can offer children alternative ways of completing activities, and they can flexibly adjust the flow of activities by considering children’s fatigue, concentration levels, daily rhythm, mood, and other contextual factors. Purposeful and sensitive organization of the learning process strengthens children’s self-confidence, self-regulation, and the core cognitive readiness skills that form the foundation for future learning.

The Balance of Children's Natural Development in technological Environment

The balance between technology use and children's natural development is achieved when technology is used purposefully and in moderation, when activities are short and clearly defined, and when children are not left alone with screens. In this way, virtual and real experiences are combined, ensuring that technology does not replace live interaction, play, and exploration of the environment. Situations are created that encourage cooperation, recognizing emotions, and creating rules. For example, children learn to name emotions or identify the educational environments in which those emotions appear (see Figure 9).

Figure 9. "Bird and Vehicle Hide or Seek" using QR codes – "Our mother uses this in her work, combining virtual and real experiences to help children understand emotions" (Brennastubben Familibarnehage, Oslo, Norway)

It is important to observe each child's progress and needs so that activities are challenging yet achievable, promoting motivation and active participation. Flexible adaptation of activities allows children to engage in play according to their existing skills, while gradually increasing complexity or introducing new elements. This ensures consistent skill development.

Not only does it serve as a barometer of children's moods, but a game that simulates elements of computational thinking also functions as a quick and effective feedback tool, enabling the teacher to assess children's emotional state, engagement, experience, and logical thinking (see Figure 10).

Figure 10. Mood barometer "What types of robots can be". Understanding the different ways children imagine a robot's mobility" (Brennastubben Familibarnehage, Oslo, Norway)

By understanding how children perceive a robot's mobility differently, we can simultaneously observe each child's current level of impulse control and the suitability of the activity, allowing us to adjust the flow, complexity, or pace of the activity to maintain optimal motivation and the quality of cognitive engagement.

Examples of Descriptions of Tried Activities

Project participants shared best practices and prepared descriptions of activities (games) according to the provided scheme:

- Rationale for selecting the activity
  (reasons why this activity/game is significant for education)
- Objective
- Activity (game) title
- Learning outcomes (children's achievements)
- Topics
- Duration of the activity
- Materials required
- Number of participants
- Participants' age
- Suitability (location of the activity: indoors or outdoors)
- Description of the activity (game)
- Notes
- General insights (how it went)

After sharing their best practices, participants tried out activities proposed by colleagues in their own preschools.

Example A. Comparison of Activities Tried in Different Contexts

A detailed description of an educational activity presenting the experiences of two kindergartens. This allows us to compare **differences in activity planning and detailed implementation.**

Activity title: *The Bear or Rudolf, the Red-Nosed Reindeer*

Motives (reasons):
During the wildlife project, the child had a question: how big is a bear really? Will it fit in our room? I used Google search which gives a 3D image. Through it, it is possible to listen to the bear's voice and see how it moves and observe it from all sides (including from under the paw). You don't bring a wild animal into the group room.

Objective: The child gets an idea of how big a real bear is. The child gets to know the measurement activity and the tape measure. The child knows the terms "length" (body length, tail length), "height" (height of the withers, how tall the bear is when standing).

Contextualised objective:** We changed the observation object from a bear to Rudolph the Red-Nosed Reindeer and other deer. This way, we could connect the observation object with our annual plan and Christmas.

DESCRIPTION OF THE ACTIVITY (GAME)	ACTIVITY (GAME) TESTING
Learning outcomes: Since we put the measurement results on the wall, the child could decide for himself whether he could fit in the bear's belly, whether the bear's butt is higher than the child, etc.	**Learning outcomes:** Similar to the original best practice, the children could decide for themselves if they were inside Rudolph's belly and visualize the correct size of Rudolph. The children learned to measure on a larger surface, such as a wall. They also learned the different words associated with the various body parts of reindeer. The children were fascinated for many days and talked to their parents about Rudolph visiting the kindergarten, and they wanted to take pictures with the deer. They were also fascinated to learn that Rudolph can swim, which was highly relevant since the children had just started swimming lessons organized by the kindergarten. How was it possible that Rudolph could swim, and they couldn't yet? This practice led to further discussions about herd animals. "What is a herd animal?" the children asked. We also learned to connect a smartphone directly to a projector so that all the children could see the visit of the deer in real-time. This makes it easier in the future to use a smartphone for other practices and themes.
Topics: Topics that are part of the Best Practice Description of the activity must be marked with an **X**. 1. Daily life skills **X** 2. Physical activity **X** 3. Perception and expression of emotions **X** 4. Self-regulation and self-control **X** 5. Self-awareness and self-esteem 6. Relationships with adults and peers **X** 7. Environmental awareness **X** 8. Mathematical thinking **X** 9. Digital thinking 10. Language comprehension **X** 11. Linguistic expression **X** 12. Aesthetic perception 13. Artistic expression 14. Creativity 15. Exploration **X** 16. Problem solving 17. Ability to play **X** 18. Ability to learn	**Topics:** The topics which are covered by this activity need to be indicated by an **X**. 1. Daily life skills 2. Physical activity **X** 3. Perception and expression of emotions 4. Self-regulation and self-control **X** 5. Self-awareness and self-esteem 6. Relationships with adults and peers 7. Environmental awareness **X** 8. Mathematical thinking 9. Digital thinking 10. Language comprehension 11. Linguistic expression 12. Aesthetic perception 13. Artistic expression 14. Creativity **X** 15. Exploration 16. Problem solving 17. Ability to play X 18. Ability to learn

Duration of the activity:
20-25min.

Materials needed for the activity:
smartphone with internet connection, tape, measuring tape, computer with internet connection (Google search).

Number of Participants:
15 since the interest came out during the group-meeting. It is better to carry out similar activities in a group of 5-6 children

Age of participants:
3-4 years

Suitability (indoor/outdoor):
Indoor

Activity (game) description:
At the beginning of the activity, we were in the morning circle with the children, and the questions arose: "how big is the bear really?" "Will it fit in our room?" The teacher proposed that everyone are a bear explorers today!!!. We had previously studied the bear from books (what it eats, whether it sleeps and how). This time we used the internet to find out the bear's measurements.

The children themselves suggested that a measuring tape is needed for measuring. Together we looked for a measuring tape in the drawer and the teacher suggested that the size of the bear can be marked on the wall. We searched the internet for the dimensions of the bear, which we placed on the wall with tape. Have the child take the tape and place it on the wall. Each child got a specific body hazard that they placed on the wall (ears, feet, tail, etc.). When the image of the bear was on the wall, the children wanted to know how many children could fit inside the bear (it turned out that 9 children). The children were also interested in whether the bear's butt is higher than the child's butt. The child, who was interested, could go and measure and found out that the bear's butt is higher.

Duration of the activity:
3 days (1st day 40 min, 2nd day 60 min, 3rd day 30 min)

Materials needed for the activity:
Smartphone with internet connection, tape, measuring tape, computer , projector, cable to connect smartphone to projector /UCB to HDMI adapter, paper, Youtube videos

Number of Participants:
6 children

Age of participants:
3-6 years

Suitability (indoor/outdoor):
Indoor

Activity (game) description:
Since Christmas was near and to tie into our educational program, we decided to change the testing object from "bear" to "Rudolph the red-nosed reindeer," the other deer, and Santa Claus but keep the same procedures as the original case.

Day 1
We introduced Santa Claus and Rudolph by painting on the windows as part of the Christmas decorations. At the same time, we started working with the children by singing "Rudolph the Red-Nosed Reindeer" and listening to the song.

Day 2
We informed the children that Rudolph would visit the kindergarten, creating excitement and anticipation. Can a reindeer or deer truly visit the kindergarten? The children started telling their parents about the reindeer visiting with Santa Claus, or maybe even before? We asked the children where reindeer are found and where they live? What do they eat? Who actually uses reindeer? The children replied, "Santa Claus and Elsa," but who else? What are reindeer used for? Are they only used to pull Santa's sleigh?

The teacher proposed to invite the bear to the group room. The teacher used a smartphone, Google search, which gives results in a 3D image. The teacher pronounced the word BEAR with the children and entered it into the search-field, chose 3D. Then the group room and a bear appeared on the screen. The children gathered closer to the teacher and were surprised! The bear made a sound! It was so fun that the image of the bear could be moved on the screen and we could look under the bear's belly, under the paw, on top of the bear, from the front and behind... And we saw how the bear moves.

The teacher proposed to take a picture with the bear. The children went and stood where they had seen the bear standing on the screen. In fact, there was no bear there... the children waited. The teacher took a picture with the same phone, invited them to look, and the children were in the picture with the bear!

Together with the children, we decided to watch and listen to a YouTube video titled "Reindeer sound effects – reindeer sounds" (2:12 min). The children learned there are different names for male and female reindeer, and various names for certain body parts. We then asked the children if they knew how big Rudolph really is, and if they wanted to draw Rudolph on the wall to find out his actual size. The educational leader had prepared and laminated a small picture of a reindeer, along with physical dimensions for body parts like nose, hooves, eyes, and antlers.

With the help of tape, we began drawing the reindeer's physical dimensions on the wall based on measurements found by the educational leader on the internet. We talked to the children about dimensions and the meaning of height and width. We discussed that reindeer are mammals. The children wondered what a "mammal" is, leading us to talk about other mammals we know. The children also questioned if reindeer are herd animals, prompting a discussion on herd animals and which other animals live in herds. Are humans herd animals too? The children also wondered why Santa uses only one reindeer, leading us to discuss how many reindeer would be optimal for Santa. The children's suggestions were 3 or 6. We also watched a short video of reindeer swimming across a river. The children were fascinated to see how reindeer could swim in a line, which they connected to their recent swimming lessons.

Day 3

The next day, after we had outlined the reindeer on the wall, it was time to compare our own sizes with the reindeer's physical size. After connecting the smartphone to the projector, the children compared themselves to the reindeer on the wall. They were excited about the promised visit, and by searching "White-tailed deer 3D" on Google, they could hear the deer's sounds before seeing it. They were excited. Then we saw images of the deer both on the mobile and the wall, projected by the projector, and we could rotate the deer in 360 degrees for close observation. Using Augmented Reality (AR), we could place the deer within the kindergarten room, and the children could see the deer both on the mobile and the projector simultaneously. Everyone wanted to touch the deer and take pictures with it. A wonderful combination of play and learning! Some days later, we received a visit from Santa Claus.

Additional comments:
As a teacher, I was surprised that the children were fascinated by such knowledge. One child was initially afraid of the bear when he saw it as a 3D image - you have to be prepared for this in the future and explain it to the child. The suggestion, to be close to teacher, worked well. It would be better to use a tablet because it has a bigger screen and children can see better. The activity could also be done in smaller groups, the child could enter the search word himself, move the image. It is so good, that you can search for different animals and birds (e.g. eagle, panda...)

Overall insights (how the testing turned out):
Most of the testing was like the Best Practice. The difference was that we watched some videos in advance about reindeer and connected the mobile device to the projector, which projected the Augmented Reality (AR) of the deer on the wall. This way, all the children could see the deer at the same time. By connecting our smartphone to the projector, we discovered that we could use AR for other practices as well.
The children were excited and eager to help the pedagogical staff get the dimensions right.

A detailed description of activities is valuable because it provides clarity and structure, helping to understand the flow of the activity, its objectives, materials, and expected outcomes. That makes it easier to share experiences with colleagues or other educational institutions, which can replicate or adapt the activity in their own context. Such a description also supports reflection and process improvement, as it allows for evaluating what worked, the challenges encountered, and what can be improved in the future. Additionally, it records children's achievements, reactions, emotions, and acquired skills, making it easier to monitor educational progress. Finally, detailed documentation of activities ensures quality and demonstrates that the educational process is **planned systematically, thoughtfully, and in alignment with curriculum objectives.**

It is evident that while such detailed activity descriptions are thorough, they take up a lot of space and require more time to prepare and read. Therefore, when sharing with colleagues or a broader audience, it is useful to have condensed versions. For example, this could be a **short activity description (Example B), a description of the activity development process (Example C),** or another chosen format that allows **for a quick understanding of the essence,** while retaining the option to return to the detailed version, ask questions, and discuss it if needed.

In the Project, we discussed ways to share experiences and present information concisely. The prepared **Example B** – a short activity description – is designed to **introduce the activity's objectives, flow, and key outcomes.**

Example B. Short Activity Description for Sharing Experiences

Theme: What can robots be like and what can they be used for?

This activity is designed to introduce preschool-aged children to robots. First, children discuss what robots are and the benefits they can provide. They then create their own robot prototypes using construction sets and express their functions through drawings. Later, they become familiar with the educational robot “Photon,” learning to control it via an app and experimenting with its movements. The activity promotes children’s creativity, social skills, logical thinking, and interest in technology.

Example C.
Description of the Activity Development Process

Example C is designed to describe the development process of an educational activity on the same theme, covering the stages of idea selection/motivation, goal formulation, activity planning, activity implementation, and reflection and evaluation.

Theme: What can robots be like and what can they be used for?

1. Idea Selection / Motivation

1.1 Importance: children are introduced to robots and artificial intelligence, fostering creativity, imagination, and collaboration.

1.2 Reason for selection: The topic is relevant and aligns with children's curiosity and experiences.

2. Goals

2.1 Overall goal: Introduce children to the educational robot "Photon."

2.2 Context-specific goal: Foster creativity, social skills, and logical thinking.

3. Activity Planning

3.1 Duration: Up to 1 hour.

3.2 Materials: Construction sets, paper, drawing tools, educational robot, tablet, pictures of robots.

3.3 Space: Indoors with a flat surface to allow the robot to move.

4. Activity Implementation

4.1 Introduction: Discuss robots, their purpose, and movements.

4.2 Creative activity: Build robot prototypes, draw them, and discuss their functions.

4.3 Practice: Explore controlling the "Photon" robot and experiment with its movements.

4.4 Discussion: Children share ideas and experiences.

5. Reflection and Evaluation

5.1 Children discuss what they liked, what was difficult, and what they learned.

5.2 Assess outcomes: Foster creativity, strengthen logical thinking, and develop communication skills.

Monitoring and Assessment of Children's Progress

Idiographic assessment in early education is an individualized approach **focused** on a child's **personal progress, abilities, and developmental characteristics,** rather than comparing them to standards or other children. In idiographic assessment, a child's development is continuously observed within their own context, comparing current achievements with previous ones and taking into account individual needs, interests, and developmental pace. This type of assessment helps educators plan personalized learning activities, strengthening the child's self-confidence and motivation to learn.

Assessment is also important for **communication with parents,** to explain how the child explores the world, interacts and collaborates with other children in the group, which educational approaches are most effective, and how to provide conditions for further growth and learning.

In the Project, we discussed what is important when encouraging **children's self-assessment** and how to discuss a child's achievements with parents. We formulated seven questions for educators: what should be observed and assessed during activities?

1. **Does the child actively engage in activities involving different sensory stimuli (visual, auditory, movement)?** Observe how the child responds to various sensory inputs and whether they can focus and maintain attention during different activities.
2. **How does the child perceive and perform activities that require coordinating movements (jumping, throwing, catching)?** Assess fine and gross motor control, balance, the ability to plan actions, and adapt to changing conditions.
3. **Can the child understand the sequence of actions and navigate space using visual aids (schemas, pictures, models)?** Observe whether the child can follow instructions and connect visual information with practical actions (e.g., directions, numbering, arrows).
4. **How does the child respond to experiential activities that involve observing hardly visible phenomena or using a microscope?** Assess the child's ability to connect observations made through a microscope or other technology with their own experiences and apply this understanding in the learning process.

5. **Can the child solve "if–then" type tasks and explore multiple solutions?** Observe the child's emerging logical thinking, problem-solving strategies, and creativity in various situations, which can be represented using "if -> then" arrows.
6. **How does the child participate in team activities and share roles?** Assess collaboration skills, communication, the ability to follow rules, and work according to a shared activity plan.
7. **How does the child's emotional state and engagement change during activities?** Observe whether the child responds to the difficulty level of the activity, maintains motivational balance, and can express their emotional state (e.g., using a mood barometer). For observation and assessment, questions and indicators are used to help educators record the child's progress in computational thinking and appropriately adapt educational activities to the child's individual abilities and needs (see Table 4).

Table 3. Classification of activities regarding the innovation integration way and competences

	Sufficient level	**Average level**	**High level**
To what extent is the child actively involved in the activity, asking questions, making comments, exploring technologies?	The child participates in activities, asks some questions and shows interest, but is not very active yet.	The child actively participates, initiates activities, asks questions and explores.	The child actively participates in the activity, asking questions, commenting, searching and finding solutions.
How brave is the child in trying new solutions, not being afraid to make mistakes, seeking technical solutions?	The child is trying but still lacks confidence and may avoid mistakes.	The child makes mistakes and experiments.	A child is brave enough to try, experiment, learn from mistakes and draw conclusions.
To what extent does the child understand and can explain the sequence of actions in the "if-then" algorithm?	The child can explain the sequence of actions with the help of an adult.	The child learns to interpret the sequence and predict the consequences.	The child explains the sequence in a comprehensible way and predicts the consequences.
How much does the child interact with other children in the technological environment?	he child participates in group activities and cooperation is not yet consistent.	The child cooperates and leads others.	The child cooperates in the group, shares.
How much does the child pay attention to technological details?	The child notices details with the help of an adult	The child notices details without adult help	The child notices many details without the help of an adult, asks questions and explores.

During observation, it is important to pay attention both to the repetition of a child's more common actions, as a typical indicator of thinking and behavior, and to manifestations of unusual, creative behavior. Such a carefully balanced analysis allows educators to formulate personalized educational goals, assess the child's progress, and, if necessary, identify individual learning needs and prerequisites for further development of computational thinking and other cognitive skills.

It is important to observe elements of computational thinking in both the child's and the teacher's activities—how problems are broken down into smaller parts, how patterns are recognized, how questions are formulated, how explanations and justifications are provided (relying on facts and opinions), how solutions are explained, and how collaboration is organized and engaged in.

Features of an Environment Enriched with Technology and Innovations

Based on the results of observing the environments in the project's kindergartens, this methodology is supplemented with practical insights from participants regarding the planning and design of educational environments, specifically the features of environments enriched with technology and innovations.

Participants recognized the importance of breaking down large and complex activity examples into smaller, clearly defined parts, which can be flexibly adapted to the educational contexts of different kindergartens. The following are practical insights considered important for educators.

How do children respond to and learn from technology and innovations?

- By expressing their senses and emotions
- By focusing and exploring consequences
- By showing curiosity and fascination
- By experimenting and participating

What types of thinking are activated during an activity or game?

- Digital, visual, and creative thinking; logical and inquisitive thinking
- Critical, creative, strategic, logical, and analytical thinking
- Problem-solving, computational, and digital thinking
- Efforts to “think intelligently”

What technologies or innovations are visible in the learning environment?

- QR codes, augmented reality, projector, audio and video tools
- Television, smart screen, computer, tablet, smartphone
- Robots (e.g., Photon, Cubic, Snail), computer mouse
- Microscope, talking book, audiobook
- Cameras and photo review (e.g., children photographing themselves in the forest)

Which innovative activities did children enjoy?

- When children operate digital tools themselves (QR codes, apps, educational robots)
- Watching short films and trying similar activities
- Photography and exploring augmented reality (e.g., AR dinosaurs)

During discussions in the project, participants emphasized the priority of developing thinking, focusing on elements of computational thinking that are observable in the course of activities and in the organization of children’s information processing and logical reasoning.

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Contributed to the methodology:

Vilnius Salininkai kindergarten (LT)

BRENNASTUBBEN FAMILIEBARNEHAGE AS (NO)

Kopli kindergarten (EE)

Public Institution Inovaciju Tinklas (LT)