# Teaching Magnetism to Preschoolers through ICT: An Early Childhood Science Approach

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## Abstract

This publication aims to explore the introduction of scientific concepts during preschool age, focusing specifically on the natural sciences and the concept of magnetism. The properties and types of magnets were chosen as the central theme based on the children's interests. The educational process began with a series of structured activities designed by the educator, followed by the integration of Information and Communication Technologies (ICT), including educational software and interactive tools used by the children. A key element of the approach was the creation of an improvised story-a fairy tale scenario-that served as a springboard for the implementation of the activities. Through the use of ICT, children were encouraged to explore and verify the concepts of magnetism and magnet properties. The use of these digital tools played a crucial role not only in reinforcing previously acquired knowledge but also in introducing new technological challenges that further enhanced the educational process. In conclusion, the integration of storytelling, hands-on activities, and ICT in teaching magnetism at the preschool level demonstrates the effectiveness of technology in enhancing engagement, understanding, and knowledge retention in early childhood science education. The evidence indicates that the integration of structured educational activities with Information and Communication Technologies (ICT) proved to be an effective approach for enhancing preschool children's conceptual understanding of magnetism. Increased engagement and active participation were observed, as storytelling and play-based methods facilitated the comprehension of core scientific concepts, such as the properties and types of magnets. ICT tools supported experiential learning by enabling children to explore, experiment, and verify acquired knowledge. Improvements were noted in observation skills, the formulation of simple hypotheses, and the ability to draw basic conclusions. Overall, the pedagogical design-enriched through the use of digital technologies, yielded positive learning outcomes and contributed significantly to the development of early scientific thinking within a preschool education context.

**Keywords:** Preschool, magnets, magnetism, science

## Introduction

### Magnetism in early childhood

The main goal of this teaching intervention is to help children explore magnets and the concept of magnetism. More specifically, the implementation of this educational approach focuses on understanding the properties of magnets in relation to other magnets, as well as their interaction with various materials, the identification by children of the magnetic field, through activities that are meaningful to them, and that challenge them, and at the same time invite them to participate in them. At this point, an important factor is the use of ICT in childhood education. Through modern science, children better understand the phenomenon of technology, information, and communication, and the possibilities that can be applied in preschool, hoping to promote a more advanced development of children (Zhao J. et al.,2022).

The use of ICT in preschool education attempts to address different aspects related to the subject matter, recognizing the opportunities for learning and the potential risks involved, while also exploring new trends for further development (Kremer M et al., 2013). Some key characteristics of children at this stage include physiological limitations, difficulty with abstract thinking, limited attention span, and a tendency toward animism and anthropomorphism (Barra C.L. et al., 2023).

The younger the child is, the more obvious the above-mentioned characteristics become. As educators, in order to organize science activities that are meaningful to children (Fig.1) and to choose appropriate software in which children can experiment, these specific characteristics must be respected. This ensures that children can respond appropriately to the aforementioned factors and that the previously set goals are both realistic and achievable (Holm A et al., 2023), (Chan DK, 2024). The topic of magnets and magnetism, while scientific in nature, was introduced through a fairy tale format to facilitate experimentation (Aboud KS et al, 2019), (Pulimeno M. et al., 2020), (Wallace R. et al., 2019), (Goodwin SC, 1997). The fairy tale "The

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Adventures of Takis Magnetakis" was written with these developmental traits in mind. Special care was taken to incorporate the unique characteristics of young children, aiming to translate scientific knowledge into an age-appropriate form and to adapt the intended cognitive goals to the needs of the learners (Raptis & Rapti, 2007).

Based on the subject presented in the fairy tale, related activities and experiments were designed and appropriate educational software was selected. Technology was used to introduce the concept of magnetism and magnets, helping students gain a basic understanding of these concepts.

**Research methodology**

This study adopts a qualitative research approach, emphasizing a teaching intervention aimed at fostering early scientific thinking. The research design involves the development of educational materials, the implementation of an experimental teaching framework, and the integration of epistemic knowledge through narrative practices, hands-on experimentation, and the use of digital tools to support learning in early childhood settings.

A purposive sampling strategy was employed to select participants most appropriate for the research aims. The sample consisted of preschool children aged between 3 and 3.5 years, drawn from a single early childhood education setting. This specific age range was chosen to investigate the emergence of early scientific reasoning through structured and play-based learning experiences. Selection criteria included accessibility, parental consent, and the willingness of educators and caregivers to support the research process. Ethical considerations were strictly followed, including informed consent and the anonymization of participant data.

The study was conducted in strict accordance with ethical standards governing research involving minor participants. The study design included structured educational activities integrated within the regular kindergarten curriculum, posing no physical or psychological risk to the participants. No personal or identifiable data were collected from the children, ensuring full anonymization and protection of their privacy. Prior to implementation, informed consent was obtained from the legal guardians of the children, and the kindergarten educators were fully informed and provided explicit approval for the study. The research protocol was reviewed and granted exemption based on its educational and non-invasive nature.

The educational intervention was organized into sequential phases, structured to ensure a balance between guided learning and child-led exploration. In more specific terms, the implementation process involved the following stages: design of activities, narrative and technology integration, experimental and experiential learning, discussion, and reflection. All stages were systematically documented through observational field notes,

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photographs, and samples of children's work, allowing for rich data collection across multiple modes of expression.

A thematic content analysis was employed, consistent with the qualitative nature of the study. The analytical process focused on the following data sources:

1) Observational data: Field notes were coded for key themes such as engagement level, expressed curiosity, scientific behaviors, and language use related to scientific content.
2) Children's artifacts: Drawing and constructions were analyzed for conceptual understanding, symbolic representation, and relevance to the learning objectives.
3) Verbal interactions and feedback: Transcripts and recordings of discussions were examined to identify moments of meaning-making, conceptual shifts, and personal interpretations by the children.

Data analysis occurred iteratively and reflexively, both during and after the intervention, enabling continuous refinement of the educational design and the emergence of interpretive categories grounded in the children's authentic responses.


**Figure 1.** Teaching preschool children

***Presentation of activities: Title of the activity 'Do you want to be friends?'***
***Objectives/Scientific Ideas***

- To arouse students' curiosity and satisfy their need for action and experimentation.

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- To get children to approach some characteristic properties of magnets, in particular, the attraction of magnetizable materials (distinguishing magnetizable materials from non-magnetizable materials).

**Description**

The children are divided into groups. To explore the topic, the teacher starts reading the first part of the story 'The Adventures of Takis Magnetakis' to the children and stops at the point where the magnet is stuck to the fridge. At this point, the teacher traces the children's ideas about magnets. Then, the groups of children, having been provided with the materials that the hero of the fairy tale encounters, are invited to experiment with them and come up with whether they become friends or not. After separating the materials based on their behavior when they approach the magnet, they classify the materials into a log table (objects that are magnetized and objects that are not magnetized).

**First part of a fairy tale**

Takis, the round little yellowish-marble magnet from Magnesia, lived in the house of Mr. Epistimonakis. He carried, with his south pole, a small notepad of notes. On it, the people of the house wrote things they had to remember. When the pad was finished, Takis would step out of the fridge for a while to stretch his legs and then return to his seat to hold a new pad of notes. Up there, in the fridge where he lived, he could see everything. He had the whole world at his feet. And... not only that! He had also acquired a very good friend, the fridge, and even though they were separated by the notepad that never spoke to them, as it didn't fit in their company, the two of them, day and night, and their conversations dragged on for hours. Just as they were drawn to each other. Takis was happy with his life.

**So, he thought...**

One day, Mr. Epistimonakis pulled out a sheet of paper with force. Takis did his best to hold the block in place, but he couldn't. He fell down hard. It jerked away, spun on the tiles for a moment, and stopped. He stopped in the corner by the kitchen door, the north pole facing the ceiling. In an instant, his life was turned upside down.

**Or so he thought...**

Mr. Epistimonakis looked for him, couldn't find him, and put in a - what did he call it...Ah! Blue tack until he bought a tape recorder. On leaving, he passed him, and so as he tried to get the keys out of the door- chop! He dropped them! Straight away, Takis just felt the keys close by, felt a pull and stuck on them, without Mr. Epistimonakis being aware of it.

Whew! Okay Takis sighed, " I've made myself comfortable again and something tells me we're going to make great company!"

**He thought so...**

The plastic key chain that supported the keys ostentatiously disdained Takis, and only the keys attracted him, and they became inseparable. And what Takis did not experience on the keys of Mr. Epistimonakis! When he entered his portfolio, he beheld all sorts of things! A yellow chalk for the blackboard of the University, you know, but which wanted to be left alone, like a lemon! "He's probably got the color!" he thought. But also, a big paperclip that, on seeing him, ran quickly over to greet him and never left him again. And he saw a glass marble, of a cold blue color, which did not even react to the sight of Takis. And a wooden pencil that stood there unmoving, upright, ready to "mark" another page. But also, a handkerchief that was prolonged further along, seemed inaccessible, unapproachable, unapproachable. But it had to be taken out again and put into other bags!

In the supermarket bag, for example, he got a close look at the smelling fruits and vegetables, but...they didn't click. Instead, a fine 9V battery caught his eye, and they became friends at once. In the sea bag, there you see! He met a rock and a pumice stone for the first time. But even the pumice stone seemed heavy and weightless. And what can I tell you about the mirror! Wouldn't Takis ask, "Mirror, mirror, mirror, is there a more beautiful magnet in the world?" The mirror- nothing. On the other hand, the peg that fastens the towel came briskly up to him and told him he could trust his iron arms.

*"I've seen it all," thought Takis.*
*So, he thought.*
Returning from the sea, the lady of the house took the keys and –
"Oh, what have we here? A magnet has pulled a bunch of iron objects!" She grabbed Takis by the north pole, pulled him hard, and threw him onto the entrance landing.

*"That's it, it's the end of me..." Takis whimpered.*
*So, he thought.*

The next day, while Mr. Epistimonakis bent down to pick up his morning paper, what did he see? 'Our old magnet...what on earth is he doing here?' he muttered. He picked it up and tossed it into the toolbox.
Taki found himself between a screw and a nail.

'There he is,' the fine-tipped screw said to him. "What news from outside?" The tiny nail asked him from his corner.
"Ah here's good company!" Takis thought.
So, he thought.

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***Activity title: 'I'm attracted - I'm not attracted'***
***Objectives/Scientific Ideas***

- To approximate some characteristic properties of magnets- Magnets have two poles.
- To discover the attractive property between (heteronymous) magnetic poles.
- To discover the repulsive properties between like (homonymous) magnetic poles.
- To introduce the concept of magnetic field.

**Description**

The teacher begins by reading the second part of the fairy tale 'The Adventures of Takis Magnetakis'. The children are divided into groups, and each group receives two magnetic rings to use in their experiments. The educator encourages the children to manipulate the magnetic rings and, through hands-on exploration, discover the attraction between opposite poles and the repulsion between like poles. At the end of the activity, the children discuss the results of their experiments.

**Second part of a fairy Tale**

Takis, the little Magnetakis, had many adventures as a child. One day- like all the others- he ended up inside a cardboard box. And there, he saw something he had never imagined before! He saw a beautiful, round, purple-and-yellow little magnet.

> "Oh, you look like a fairy," whispered the poor little magnet, as if enchanted.
> "Beauty of the world, wait! Will you tell me your name?"
> "My name is simply Catherine the Magnet. What's your name, and why am I getting closer and closer to you?"
> "My name is Takis Magnetakis, and as for the irresistible attraction, I have no idea what's going on."
> "My dear Takis Magnetakis, I knew it was you the moment I saw you behind that screw." "Lovely Catherine, I feel dizzy and shaky. And it's so nice inside the box. Would you like, to join me?"

She brought her south pole close his north pole, because -as we all know- "North and north and south and south, don't go together." As the saying goes: 'Opposites attract!'

> "But let me tell you, my sweet and handsome Takis Magnetakis. Are we going to be stuck together all the time? I can't deal with routine. I need my peace and quiet at least once a month!"

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"Oh," thought Takis... "There's always a way to keep her from getting bored of me! "
"We've got that sorted too! So, when you feel like going for a walk on your own, just turn your back on me and I'll be gone in a flash!"

***Activity title: 'Love goes through the stomach...'***
***Objectives/Scientific Ideas***

- To stimulate children's curiosity and satisfy their need for action and experimentation.
- To help children explore some characteristic properties of magnets, particularly the attraction of magnetizable materials and the distinction between magnetizable and non-magnetizable materials.

**Description**

The teacher begins reading the third and final part of the story 'The Adventures of Takis Magnetakis'. Then, the children, seated in a circle, experiment with laminated cards placed on the floor by the teacher. These cards depict sweets. Attached to the end of these cards with a string. The children, in turn, appear with a ribbon on the end of each card is a small iron ring, fastened with string. In turn, each child approaches with a ribbon that has a magnetic ring attached to its end. Through this process of experimentation, the children are able to 'fish' for sweets, thereby discovering which materials are attracted to magnets and which are not.

**Third part of a fairy tale**

...And so, it happened! And since they say that love goes through the stomach, they went to the amusement park and ate sweets...What a funny and innocent game they played, what a ballerina ride they went on… Takis did everything he could to keep Catherine from getting bored with routine. He even caused a bit of a scene!

And the amusement park was just the beginning. What romantic excursions they took - to lakes and rivers for fishing, and to weightlifting competitions that Catherine enjoyed... And it seems they had a great time - and we had an even better one!

***Activity title: 'Conflict- Resale'***
***Objectives/Scientific Ideas***

- To approximate some characteristic properties of magnets.
- Discovery of the attractive magnetic property and distinguishing between magnetizable and non-magnetizable materials.
- Discovery of repulsive properties between like poles of magnets.

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- To enable children to approximate the intensity of the magnetic field.

**Description**

The children are divided into groups, and each group is seated on a table, as the activity takes place on a smooth and flat surface. The teacher provides each group with magnetic rings and two toy cars with special holders for the magnets. Depending on how the magnets are placed, the cars either move closer together or are pushed apart. The children are encouraged by the teacher to manipulate the cars and magnets for a while in order to make them either repel or stick (collide). In addition, they are instructed to experiment and observe the effect of the number of magnets on the strength of the magnetic field. The more magnets are placed on the cars, the more forcefully the cars collide when attracted, and the greater the distance between them when repelled.

***Activity title: 'Ballerina'***
***Objectives/Scientific Ideas***

- To introduce children to the concept of a magnetic field.
- To explore some characteristic properties of magnets:
  - Magnets have two poles.
  - Attraction occurs between opposite poles (either by contact or at a distance).
  - Repulsion occurs between like poles.

**Description**

The children are divided into groups, and each group is provided with a story foam mat, which is attached to the table with paper tape. Attached to the story foam is a pendulum with a magnet at its end. The children are invited to experiment, play, cooperate, and this hands-on process, discover the attraction that occurs between two magnets with opposite poles and the repulsion between similar poles. The repulsion between magnets - where one is at the end of a pendulum - becomes a playful experience, as no matter how hard the children try, they cannot make the magnets ‘stick' together. This makes the existence of a magnetic field around the magnets clearly observable in a fun and engaging way.

***Activity title: 'Time for cleanliness'***
***Objectives/Scientific Ideas***

- The visualization of the concept of the magnetic field.

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**Description**

The educator continues reading the third part of the fairy tale 'The Adventures of Takis Magnetakis' to the children, where Takis and Catherin's companionship begins with...cleaning. The children are divided into groups, and each group is provided with a transparent box of iron filings and a magnetic ring. An experiment begins about the 'behavior' of the dust when the magnet is approached - when it moves right, left, up, and down. Ideally, in the first contact, there would be iron dust on an A4 sheet, which would be 'picked up' by the magnet. In the second phase, the dust is in a box to emphasize the strength of the magnetic field and the fact that it can attract objects even when there are obstacles. Because the overriding aim of the activity is to visualize the magnetic field, and not the strength of the magnet to attract objects through barriers, particular emphasis is placed on the material of the box contents, rather than on the box obstacle between them and the magnet.

***Activity title: 'Weightlifting Competitions'***
***Objectives/Scientific Ideas***

- To arouse students' curiosity and satisfy their need for action and experimentation.
- To measure the 'strength' of different magnets or the strength of the magnetic field of magnets.

**Description**

Children are divided into groups and asked to predict whether all the magnets available to them (bar magnet, horseshoe magnet, magnetic ring) have the same strength to 'lift' the same number or a different number of fasteners. They are then asked to find a way to check whether the magnets taking part in the weightlifting game are equally strong or whether one is superior to the others. Conclusions about which magnet is 'stronger' are drawn from measurements of the number of fasteners that each magnet lifts.

***Activity title: 'Fishing with obstacles'***
***Objectives/Scientific Ideas***

- To arouse the curiosity of young learners and their need for action and experimentation.
- To encourage children to explore certain characteristic properties of magnets, particularly the attraction of magnetizable materials (distinguishing materials from non-magnetizable ones).
- To test whether magnets attract objects when obstacles of different material and thicknesses are inserted.

**Description**

Children are divided into four groups. Each group is provided with a fishing rod (pole, rope, magnetic ring), magnetizable materials (e.g. safety pin, iron rod, coin, pin, small iron tools), and non-magnetic materials (e.g. craft stick, shell, glass, chalk, plastic toy, tulle, cloth, plastic piece). Each group also receives a glue stick, a piece of cardboard, a piece of cloth, and a book of approximately the same size and thickness. The children experiment to see whether the magnet can attract magnetic and non-magnetic materials, even when an obstacle is placed between the magnet and the object. The main aim is for the children to understand that the thicker the obstacle, the less effectively the magnetic force can penetrate it.

***Presentation of educational software and games -Use of educational software Little Artists in Action***

***Objectives/Scientific Ideas***

- To familiarize children with the use of the computer, mouse and keyboard.
- To experiment with searching for information and images on topics that interest them.
- To identify, among many pieces of information, those that are useful for understanding the topic.

**Description**

Children begin experimenting with the computer while engaging in a discussion about the usefulness of the device, how it works, and what kind of information we can extract about magnets and magnetism. Then begins a learning journey, where, through a basic search engine, we are led to the educational software 'Little Artists in Action'. One of the applications used is 'Let's draw together', where children, using various tools, create random drawings and then draw the characters from the story 'The Adventures of Takis Magnetakis', giving form to the magnets. Next the 'Learn to Draw' application is used, where children practice mainly the using the mouse and keyboard. This is followed by the ‘Draw with ribbons' application, where, with a magic brush, children created ‘magic magnets’ in different colors, trying to match magnets that can connect with each other. Finally, the 'Print what you want on paper' application allows children to print pictures related to magnets and magnetism.

***Use of YouTube website***

***Objectives/Scientific Ideas***

- To familiarize children with using and searching on the computer, using the screen, keyboard, and mouse.

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- To discover that YouTube website is an easy way to search for and find information through digital videos.
- To enable children to connect the visuals and fast-paced changes in the image with the knowledge they are acquiring.

**Description**

Children are introduced to the computer, and through the guided intervention by the teacher, we use a central search engine to access the You Tube website. By typing the words 'magnets and 'magnetism' videos into the search field, related videos immediately appear. The videos shown to the children were carefully selected by the teacher. They were short and contained the basic information about magnets and magnetism. After viewing the videos, a discussion follows to help consolidate the newly acquired knowledge. This develops into a role-play activity, where children act as magnets, sometimes attracting and sometimes repelling one another.

***Use of an Interactive Whiteboard***
***Objectives/Scientific Ideas***

- To encourage children to experiment with the interactive whiteboard.
- To enable children to participate collectively and equally in educational activities.
- To engage children's interest in the learning process.

**Description**

The interactive whiteboard was used to display a folder containing all the information acquired so far, including the characters and adventures from the fairy tale. Then, after watching the visual material, the children continued experimenting with the interactive whiteboard, focusing specifically on the drawing tool. Each child took turns illustrating elements from the story through their drawings. This hands-on interaction gave the children the opportunity to practice the theme while having fun at the same time.

***Use of TYX PAINT digital drawing program***
***Objectives/Scientific Ideas***

- To allow children to express their interests and demonstrate their understanding through the digital drawing program.
- To promote collaboration to achieve the desired result.

**Description**

The TYX PAINT digital drawing program offers children a variety of colors and tools, allowing them to create drawings using tools different from

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those they usually use. While listening to the fairy tale 'The Adventures of Takis Magnetakis', the children created figures, faces, scenes, and objects from the story. In this way, they began designing various magic magnets, using colors that were sometimes placed close together and other times spaced apart.

***Use of HOT POTATOES software***
***Objectives/Scientific Ideas***

- To have the children experiment with the use of the computer.
- To introduce children to mathematical concepts, such as the concept of matching and filling in blanks.
- To approach some characteristics of magnets and the magnetic field.

**Description**

The children were introduced to a series of online exercises, the preparation of which was based on their age and abilities. Therefore, the matching and gap-filling exercises were mainly formulated with images related to the types of magnets, magnetizable and nonmagnetizable materials, and the properties of the magnetic field. In both types of exercises, pictures were chosen to replace the words in order to enable children to understand the understand of the exercises.

***Use the STORY JUMPER tool***
***Objectives/Scientific Ideas***

- The children will be able to combine the pictures with the corresponding texts in order to compose a story.
- To experiment in capturing their respective stories in pictures, leading to the creation of a picture book.

**Description**

After reading the story 'The Adventures of Takis Magnetakis', the teacher encourages the children to create their own drawings, which will relate to the different scenes from the above story. So while the teacher is reading the story, the children stop her at the points where they want to capture the moment from the story in their drawing. As the children complete the drawings, the educator then asks the children to place them in a time sequence. The educator's concern is then to use the Story Jumper tool to create a picture book that includes both the children's drawings and the words of the story. Finally, the illustrated book can be distributed to the children and their families. Also, a presentation can be made on the school premises, in which the children, teachers, and their classmates will participate.

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## Research results

The findings of the present study highlight the success of the teaching intervention through the active participation of the children, their increased engagement during the activities, and their overall responsiveness to the educational environment that combines storytelling and technology. The use of the improvised story script proved particularly effective in capturing the children's interest and maintaining their attention throughout the lesson. Furthermore, the integration of ICT enhanced the learning experience by offering interactive stimuli that facilitated the understanding of concepts such as magnetism. The participating educators expressed a positive attitude towards the use of technological tools and stated that this methodology boosted their confidence in teaching science in kindergarten. Despite the absence of quantitative data, observations and feedback from both the children and the educators provide clear indications of the approach's effectiveness, paving the way for its further development and application across broader populations and different scientific domains.

## Conclusions

This paper aims to introduce science to preschoolers through the creation of an improvised story and a set of organized activities, and then through the use of communication and information technologies. The use of the story scenario was an important factor in engaging the children during the process of carrying out the teaching intervention. Subsequently, the proper use of ICT involves positive results for all involved, both for teachers and young learners. Active participation, continuous training, and experience make the respective teachers active in equipping the school units with a variety of technological means, which will be used in the realization of the educational process, especially when it comes to preschool children. Finally, young learners are placed in a new technological reality, which aims to enhance their learning development.

This research paves the way for future studies that can improve the teaching of science in pre-school education, such as quantitative evaluation of the method, including comparing the effectiveness of the method in different groups of children, and developing measurable indicators of understanding of magnetism before and after the teaching intervention. Also, possible research directions may include the investigation of the effect of storytelling on learning, in the way the use of stories enhances understanding and retention of knowledge, as well as the possibility of extending the method to other scientific fields. Completing the development of innovative educational tools, such as augmented reality and virtual reality, to be integrated in the teaching of science.

Some limitations of the research are the lack of quantitative data, as the evaluation is mainly based on observation and participation of children, without rigorous quantitative data. Also, the sample may be considered small and the results may not be generalizable to all preschool children. Still, the limitations in the use of technology may be difficult due to limited resources for the corresponding equipment, due to a lack of training of teachers in the use of technological tools. Maintaining children's attention is also an important factor, as young children have a limited attention span. In conclusion, despite the challenges, the use of storytelling and technology can make the magnetism process more accessible and interesting for children. However, careful planning, adequate training of educators, and adaptation to the needs of each child are needed for best implementation.

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**Declaration for Human Participants:** No formal ethical approval was required for this educational study involving non-invasive classroom observation. However, the principles of the Helsinki Declaration were respected. Parental informed consent was obtained for all participants.

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