Journal of Research in Environmental and Science Education
ISSN 3062-8660 (online) & 3062-8431 (print)
January 2025, Vol. 2, No. 1, pp. 1–17

Scientia Publica Media

Research Article

The Use of STEM as a Tool for Teaching the Concept of Magnetism in Kindergarten

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Abstract
This study explores the integration of STEM education as a tool for teaching the concept of magnetism to kindergarten children. The research highlights the importance of engaging young learners through hands-on activities and creative storytelling, which allows them to express their understanding of magnetism based on their everyday experiences. The findings indicate that children initially possess misconceptions about magnets, such as believing that they attract all metals and that larger magnets are inherently stronger than smaller ones. Children are guided to correct these misconceptions and better understand magnetic properties through structured activities, such as drawing objects attracted and repelled by magnets. Artificial intelligence tools, such as ChatGPT and ideogram.ai, facilitate collaborative storytelling, enabling children to create illustrated narratives about magnets and enhancing their engagement and creativity. The study also emphasizes the role of technology in supporting children's learning processes, allowing them to visualize and present their findings innovatively, such as through videos and presentations. Moreover, the research identifies the need for further exploration of children's interactions with magnets and the effectiveness of AI in teaching complex scientific concepts to preschoolers. The results suggest that active participation in STEM activities significantly boosts children's confidence and interest in science, laying a foundation for future engagement in STEM fields. Overall, this paper contributes valuable insights into the pedagogical strategies that can enhance the teaching of magnetism in early childhood education, advocating for the continued integration of technology and creative methods in the learning process.

Keywords: Hands-on Activities, Kindergarten, Magnetism, STEM Education

Received
April 11, 2024
Accepted
August 18, 2024
Published
January 2, 2025

Citation: Samara, V., & Kotsis, K.T. (2025). The use of STEM as a tool for teaching the concept of magnetism in kindergarten. *Journal of Research in Environmental and Science Education, 2*(1), 1–17.

DOI: 10.70232/jrese.v2i1.1

1. INTRODUCTION

In recent years, there has been an effort to highlight teachers' perceptions and attitudes regarding robotics (Samara & Kotsis, 2023b; Gavrilas & Kotsis, 2024). Additionally, there has been a literature evaluation of various STEM activities (Fanchamps et al., 2024; Samara & Kotsis, 2023c). However, insufficient research highlights STEM practices in which the planning, implementation, and evaluation of STEM activities are presented in detail. This would significantly assist teachers, particularly those who have not implemented STEM in their classrooms for various reasons, in encouraging them to take the initiative. Ideas were taken from these practices. In addition, the educators with the most expertise in the implementation of STEM could be motivated by the practices of their colleagues, the methodological tools they use, and the applications of STEM to either invent new activities linked to STEM or expand and enrich those that have already been implemented. According to Van Hook and Huziak-Clark (2007), a comprehensive grasp of magnetism is one of the most valuable aspects of scientific education. Over the past twenty years, many studies have been carried out to investigate students' level of comprehension regarding magnets. This research has included students of many ages, ranging from elementary school children to university students.

1.1. Literature Review

1.1.1. STEM in Kindergarten

STEM education starts throughout the kindergarten years. Preschool-aged children possess an inherent inclination towards inquiry, characterized by their inclination to experiment and use diverse tools, problem-solving, and puzzle-solving, comparison of phenomena and objects (Sharapan, 2012), and exploration of facts, patterns, and laws.

Furthermore, the incorporation of STEM education in early childhood can positively impact the development of children in their later years (Kermani & Aldemir, 2015). This, in turn, reduces the likelihood of subpar performance in their subsequent education, thereby improving their chances of gaining admission to higher education and achieving success in their future professional endeavors (Chesloff, 2013).

Moreover, studies have shown that incorporating STEM subjects into elementary education enhances student motivation and accelerates the pace of learning (Scaradozzi et al., 2015).

STEM serves as a foundation for developing individuals who possess critical thinking skills in preparation for the future of digital technology. Early childhood is ideal for this process (McClure et al., 2017).

To summarize, preschool children are prepared and capable of participating in STEM activities. Hence, exposing them to STEM methodologies is crucial, starting at an early age. Children construct and assimilate scientific and mathematical principles in preschool settings with STEM activities through experimentation and exploring diverse materials. STEM education offers significant learning opportunities and has the potential to result in favorable educational experiences in the future (Moomav & Davis, 2010).

1.1.2. Theories of Learning

STEM education is founded upon a set of learning theories, one of which is Piaget's Constructivism. This theory posits that students engage in the process of constructing current information by building upon their previous knowledge. The instructor's primary responsibility is to provide guidance and facilitate the student's information acquisition by providing suitable stimuli (Mödritscher, 2006).

In the context of Papert's constructivism. Piaget's Constructivism serves as the foundation for this approach. However, the primary focus is on "knowledge construction," when students actively develop current information by drawing upon their existing knowledge. According to Chatzidimitriou (2015), knowledge is a product of construction rather than transmission.

According to Bruner's theory of discovery learning, grounded in constructivism, students independently acquire knowledge through internal motivations. These motivations primarily include curiosity, the desire to collaborate with peers to attain shared objectives, and the pursuit of recognition (Raptis & Rapti, 2004).

1.1.3. STEM Application Methods

The STEM application strategies include:

The Project approach is widely used in the implementation of STEM education. According to Frey (1991), the Project method is a collaborative learning approach in which the whole group engages in active, regulating, and decisive participation. According to Koutsikouri et al. (2008), projects may be defined as collaborative and multidisciplinary work plans that include many intelligences. Students use the Project method to execute intricate work plans autonomously, fostering the development of their critical thinking and collaborative abilities via engagement with their peers, instructor, and social milieu (Koutsikouri et al., 2008). According to Katz and Chard (2004), the method's approach consists of four distinct stages. These phases include a temporal gradient perspective and the characterization of the first, middle, and final phases in the life of a Project. The following are the four phases:

1. Problematization
2. Designing the instructional exercises

3. Execution of tasks
4. Assessment. Although not obligatory, separation is essential to show the action in a more structured manner.

The evidence suggests that the problem-solving technique positively impacts students' engagement in STEM education (La Force et al., 2017). Furthermore, pupils can cultivate their creativity, critical thinking, and problem-solving abilities while acquiring the capacity to interact effectively and enhance their communication proficiencies. Furthermore, students' self-assurance concerning STEM domains is bolstered, hence augmenting the probability of their future involvement in such disciplines.

According to Zakariah et al. (2016), using the exploratory technique has enhanced children's inclination toward science. The exploratory approach is suitable for STEM education (Crippen & Archambault, 2012) since students systematically collect evidence to get the necessary solutions to a topic that captivates their attention in their daily lives. Moreover, the examination of these components and the exposition of the findings of their investigation using diverse visual depictions, such as tables, diagrams, and so on. Subsequently, they assess their exertion and meticulously report their conclusions.

The Engineering Design Process involves using children's Mathematics and Engineering knowledge to construct a final product. This process primarily involves involving children in the search for workable solutions rather than focusing on successful product manufacturing (Mann et al., 2011).

1.1.4. Planning Teaching Intervention

According to the existing body of research literature, it becomes evident that studies on children's perceptions of magnetism are scarce. This is although children possess a considerable level of familiarity with related phenomena, which are often included in the physical activity curriculum in kindergarten settings. Previous studies investigating children's comprehension of the concept of gravity have revealed a tendency among children to establish a connection between magnetism and gravity. This association arises from their tendency to elucidate the existence of gravity by attributing it to a magnetic force that exerts a pulling effect on objects toward the Earth (Driver et al., 1998).

Preschool children are known to develop hypotheses about items or circumstances based on their intuition, as shown by many researchers (Gopnik, 2012; Bonawitz et al., 2019). Young toddlers often engage in impromptu actions that they have not previously categorized or structured cognitively (Ravanis, 1994).

Bagno and Eylon (1997) assert that several studies have agreed that pupils need assistance in comprehending the concept of magnetism. Driver et al. (1994) have observed the persistence and resistance to modification of children's scientific misunderstandings.

Several research investigations have shown that youngsters attribute the phenomenon of magnet attraction to an "invisible force" (Selman et al., 1982) and use the term "sticking" (Piaget & Chollet, 1973).

Barrow (2000) posits that infants primarily perceive magnets' appealing characteristics and believe that the attractive force exerted by magnets would amplify as their size increases. According to Kalogiannakis et al. (2018), the observation that children attribute "miraculous" qualities to the magnet and use inaccurate conceptual expressions highlights the need to accurately explain imperceptible phenomena to facilitate preschool children's comprehension of scientific concepts.

The investigation by Bailey et al. (1987) aimed to examine the extent to which primary school pupils use their conceptions of magnetism to predict the interactions between magnets. The study was implemented in a sample of 119 pupils from an elementary school. The students reached the following conclusions: a) that the impact of a medium is directly proportional to its recency, and b) that the impact of a medium is directly proportional to its size. A common misconception among students was that the magnetic strength of a magnet decreases as it ages, contradicting the scientific evidence. According to Bailey et al. (1987), most researchers also considered that a magnet half the length of the magnetic strip will have a lesser magnetic effect than a magnet twice the size.

Smolleck and Hershberger (2011) found that children between 3 and 8 believed that magnets can attract anything, including metals. Furthermore, the youngsters provided accounts of magnets exhibiting variations in colors, forms, and sizes. They also claimed the presence of a north pole and a south pole, as well as distinct forces acting against them. Most youngsters also said that the magnets would adhere to them. Confident youngsters had the belief that magnets possess specific characteristics, such as being magic, 'hard', 'sticking to all metals', 'sticking to silver', the size of the magnet influencing its magnetic field, the unequal attraction between the poles, and the inability of the magnet to attract items that are 'heavier' than itself. Magnets lack attraction towards items with greater hardness, thickness, strength, or size than the magnet.

Research has shown that children under the age of seven struggle to differentiate between things or materials drawn to magnets and those that are not. In other words, they cannot articulate the concept of magnetic attraction (Finley, 1986; Ravanis, 1994).

The existing body of literature also highlights the need for students to enhance their accuracy in comprehending the impact of magnetic force generated by magnets. A prevalent misunderstanding exists among students across many grade levels that larger magnets possess more strength than smaller magnets (Lemmer et al., 2018; Smolleck & Hershberger, 2011). A study conducted by Bar et al. (1997) revealed that students between 9 and 18 believed that a magnet must contact a substance to attract it. Previous research has also shown misunderstandings about how much magnets may attract items among children across various grade levels (Bar et al., 1997; Bar & Zinn, 1998; Hickey & Schibeci, 1999).

By including deliberate exercises and using diverse instructional methods, it is possible to assist younger children in overcoming misconceptions about magnetism. A study by Christidou et al. (2009) examined the efficacy of three distinct instructional methods for teaching magnetic attraction to preschool-aged children. The first method prioritized the examination of the children's various interpretations of magnets and magnetic forces, as well as the observed interactions among the children inside the classroom setting. The second method prioritized the examination of children's views, including using instructional resources such as storytelling, experimentation, and dramatization via specifically created activities. The third methodology focused exclusively on the instructor and concerned magnetic attraction. The study found that children who engaged in the first two methods showed a more comprehensive comprehension of magnetic attraction. However, the third method did not alter their original erroneous alternative beliefs (Christidou et al., 2009).

In a study investigating the instruction of magnetism in kindergarten using an alternative method of reading picture tales, it was observed that the children exhibited little understanding of magnets and their characteristics before the teaching intervention. Additionally, they need to be elucidated on magnets' definition, practicality, composition, and provenance. Furthermore, they were unaware of the magnet's ability to repel but rather its capacity to attract. The children hypothesized that the magnets could attract due to adhesive on the magnets, a substance often used by children of their age. They were still required to determine the specific components responsible for the magnetic attraction, while they comprehended that magnets could attract substances other than magnets. Following the implementation of the instructional intervention, the students successfully formulated a comprehensive concept of magnets. Furthermore, they were able to distinguish the substance from magnets accurately. The individuals comprehended that a magnet had the characteristic of both attraction and repulsion, attributing these attributes to an imperceptible force. In addition, most youngsters comprehended the magnet's ability to attract iron objects exclusively, although they need clarification about its source and purpose before or after the instructional intervention (Kalogiannakis et al., 2018).

Dimitriou (2015) conducted a study to examine the progression of object sorting skills through their interaction with magnets and the acquisition of magnet sequencing skills based on their strength. The study aimed to investigate these skills before and after implementing suitable activities designed using a didactic learning sequence. During the instruction, it was noted that the youngsters could categorize the items based on their magnetism and rate them based on their strengths. The categorization of things according to their magnetism property contradicts previous research, such as the study by Temertzidou and her colleagues (2014). In their research, children could correctly classify objects into magnetic and non-magnetic materials after the evaluation. Before receiving education, youngsters could not identify any magnetic item or make a single remark. Out of the 32 youngsters, only two could correctly identify two or three things attracted by the magnet. However, they also made inaccurate identifications simultaneously, such as "nail, paper clip, coin, and glass ornament" or "Coin, paper clip, and plastic cup". Before the instruction, 18 of the 32 youngsters in the study successfully arranged the magnets in a particular sequence, acknowledging that the most oversized magnet is the most powerful, followed by the medium and tiny magnets (Dimitriou, 2015).

According to Ravanis (1994), preschool-aged children need to play with and manipulate magnets to explore the concept of reciprocal forces of interaction.

Furthermore, a study by Rendom et al. (2022) showed that using an alternative instructional approach, which incorporates active and experiential participation of children throughout the educational process, might facilitate their comprehension of the idea of magnetism.

It is essential to use a systematic design to provide a framework for analyzing communication practices and their impact on the development of kindergarten activities related to magnets and magnetic attraction (Poimenidou & Christidou, 2010).

According to Constantinou (2013), the performance of two groups of children aged 4-6 years in defining two operational definitions of a magnet was influenced by their chronological age rather than their cognitive maturation in the context of a structured teaching intervention (Constantinou et al., 2013).

The findings from the prior studies indicate that it would be beneficial to provide preschool-aged children with the chance to sort various objects that exhibit attraction or non-attraction towards magnets. These objects may include cardboard, plastic, metal objects, iron or steel, and materials such as aluminum. Through this method, children will learn that many substances do not exhibit magnetic attraction: the materials drawn to magnets are only metals, while not all metals are drawn to magnets.

2. METHODOLOGY

2.1. Research Questions

Do children know (Samara & Kotsis, 2023a):

1. Magnets must exhibit push and pull behaviors due to their positive and negative poles.
2. that magnets attract and repel certain materials.
3. that magnets have different shapes and sizes, and
4. How effective is the use of STEM technology and tools in the related activities regarding teaching the magnet concept to preschool children?

2.2. Research Cases

Children (Samara & Kotsis, 2023a):

1. will explain the concept of magnetism based on their experiences from everyday life (Barrow, 2000).
2. will only know the property of the magnet to attract and not repel (Kalogiannakis et al., 2018)
3. will think magnets attract all metals (Smolleck & Hershberger, 2011).
4. will realize that magnets have different shapes, sizes, and colors (Smolleck & Hershberger, 2011).
5. will consider that more oversized magnets are stronger than smaller ones (Lemmer et al., 2018).
6. With the use of new technologies and STEM in teaching magnetism, they will be able to express themselves more easily regarding the characteristics of magnets (Cambell & Speldewinde, 2022).

2.3. Design and Description of Activities: Method, Applications, Objectives, Means-Materials, Pedagogical Management

2.3.1. Method

The Project approach is advised since it allows youngsters to recall their prior thoughts, picture their observations, and strategize, execute, and showcase their activities. The instructional methodology will be interdisciplinary, and many learning domains will be integrated into each activity. This approach aligns with the recently implemented Greek Kindergarten Curriculum (Early Childhood Curriculum, 2023) and caters to preschool-aged participants' specific requirements and capabilities.

2.3.2. Applications

1. Story jumper
   https://www.storyjumper.com/book/read/16476072/StoryJumper
   Story Jumper is a web 2.0 tool for creating illustrated e-books.
2. Kidspiration
   Kidspiration is a concept mapping software specifically for young children https://learningworksforkids.com/apps/kidspiration/
3. BeeBot
   Beebot is a programmable floor robot specially made for younger children https://grobotronics.com/bee-bot.html.

2.3.3. Description of Activities

A and B Phase of the Project: Problematization and Planning of the Activities

Activity 1
Learning Areas: New Technologies – Language
- Goals from the Greek Early Childhood Curriculum (2023):
  The children should develop their oral language, build new knowledge about magnetism on top of the old, i.e., what they know, and formulate their opinions and hypotheses.
- Materials - media: Kidspiration software

Activity description:
Create histograms to highlight children's previous ideas through the Kidspiration application.

C Phase of the Project: Implementation
Activity 2.1
Learning Areas: Natural Sciences - Mathematics
- Goals from the Greek Early Childhood Curriculum (2023):
  Children express their ideas about the natural phenomenon of magnetism and negotiate with others, adopt or formulate relevant questions to investigate, formulate answers to the questions they investigate, and use the results of their investigations in new situations.
- Materials - media: various materials, such as plastic, metal, magnets of diverse sizes, A3 paper, A4 paper, and markers.
- Pedagogical management: Children work in small groups.

Activity description:
Children experiment with varied materials and magnets and form their perceptions of which magnets attract materials.

Activity 2.2
The children divide the A3 paper into two parts and draw the objects attracted by the magnets on one side and the objects repelled by the magnets on the other.

Activity 2.3
Children write about objects attracted to and repelled by magnets using phonological awareness.

Activity 3
Learning Area: Mathematics
- Goals from the Greek Early Childhood Curriculum (2023)
  Children should think about and investigate various situations, rely on previous knowledge and experiences, make simple assumptions, come to relevant conclusions, and "interpret" general elements of the world around them through processes of observation and description, comparison, classification, mapping, serialization, and symbolic representation.
- Materials – media: magnets of diverse sizes, various materials: plastic, metal
- Pedagogical management: Work in small groups

Activity description:
The children put the magnets in order, from the smallest to the largest magnet, and vice versa.

Activity 4
Learning Areas: New Technologies – Language
- Goals from the Greek Early Childhood Curriculum (2023):
  Children should work together in groups to produce a project, respect the opinions and work of others, and develop their oral language.
- Materials – media: story jumper application, photos of the children's activities
- Pedagogical management: Work in small groups

Activity description:
Children create an electronic book with photos and drawings of their actions with the Story Jumper application.

Activity 5
Learning Areas: Robotics – Art
- Bee-Bot
- Goals from the Greek Early Childhood Curriculum (2023):
  Children to become familiar with the correct use of simple robots.
- Materials – media: Beebot robot, tape measure, markers, and other painting materials
- Pedagogical management: Work in small groups

Activity description:
Children create a track for Beebot using simple materials. They must move it so that it passes through areas where there are only magnetic objects.

D Phase of the Project: Evaluation
Activity 6
Learning Areas: New Technologies – Robotics
- Goals from the Greek Early Childhood Curriculum (2023):
  Children compare their initial alternative perceptions and their perceptions after implementing the activities using appropriate applications of New Technologies to develop their oral language and argue.
- Materials – media: Kidspiration app
- Pedagogical management: Work alone

Activity description:
The kindergarten teacher will help the children construct a histogram of their ideas using the Kidspiration software, "What did you learn about magnets?"

3. RESULTS

In Activity 1, where the histogram (Figure 1) was constructed with the Kidspiration software, to the question "What do you know about magnets?" the children gave the following answers: "Magnets do not stick to shoes, mobile phones, hair, on the blouse, on the pants", "they stick to the fridge", "they stick to the metal", "they do not stick to plasticine, to the glass, to the table, to the face" magnets are something that sticks", "Because the scissors are iron, it will stick to the nose", "it sticks to the metal sharpener", "You can play a game: put one below and one above, move one and where one goes, the other goes too".

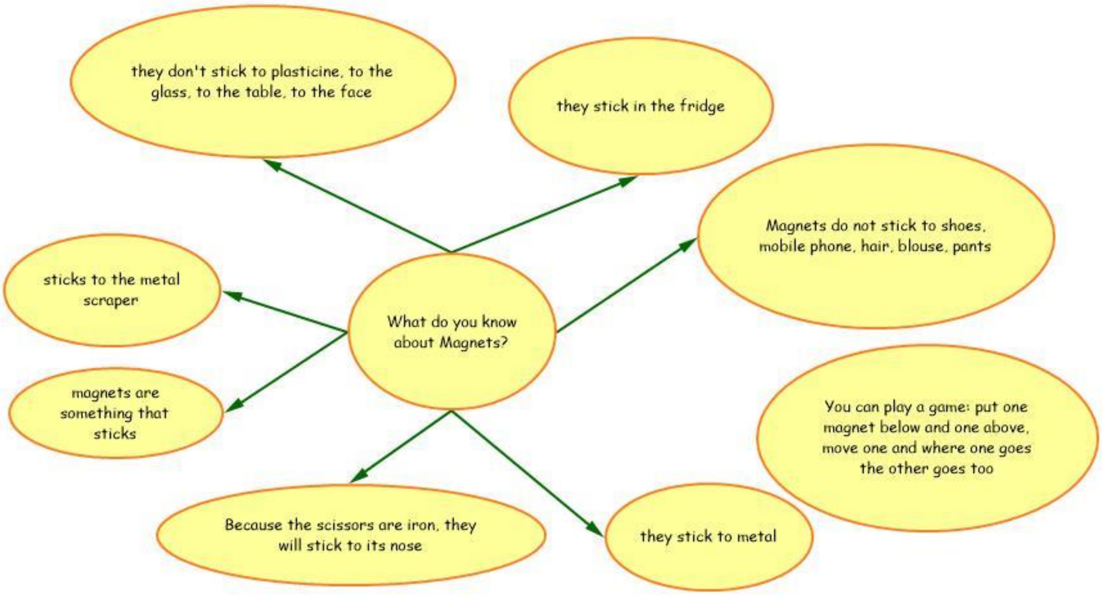

Figure 1. Kidspiration Application: What Do You Know About Magnets?

In Activity 2.1., where the children were asked to experiment with different materials and magnets (Figure 2, Figure 3), the children's prior knowledge about magnets is summarized in the phrase "Magnets stick". The materials given to the children's groups were as follows: materials from the kindergarten dollhouse: forks, plates, fruit, paper cups, milk cartons, maraca, bells, stapler, pins, pins, mittens, plastic and wooden blocks, tin jar of markers, keys, plasticine box.

Figure 2. The First Group of Children Experiments with Magnets and Various Objects

Figure 3. The Second Group of Children Experiments with Magnets and Various Objects

Children's conclusions from their experiments with the magnets and with the various objects were the following: "Magnets stick together", "the magnet sticks with other objects, large, medium, and small", "the magnet lifts light objects, but it does not lift heavy things", "you put a magnet inside the roll of kitchen paper and a magnet on the outside, and you move the one on the outside, and the other one moves too". The children's groups consisted of children aged 4 and 5 years old. It was observed that the groups of children, which consisted of more children aged 5 years old, were more successful in the answers they gave.

In Activity 2.2., the children drew the objects attracted and repelled by the magnets (Figure 4).

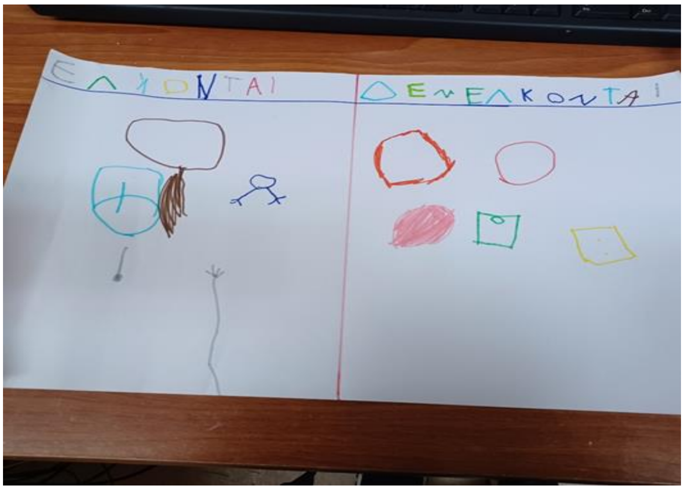

Figure 4. The Children Drew the Objects Attracted and the Objects Repelled by Magnets

In Activity 2.3., where the children divided the A3 and A4 paper into two parts, writing on one part the objects attracted by the magnets and the objects repelled by them (Figure 5), they wrote that they are attracted: the pins, the key, the fork, the lock, the teapot, the piggy bank, the paper clip, the coffee can, the magnets and the scissors. They wrote that magnets repel them: the milk carton, the bowling pin, the saucer, the paper orange, the paper ball, the plastic saw, the plastic pencil case, and the rattle.

After experimenting with the different objects and magnets, the children seemed to have established which objects were attracted to and repelled by the magnets in the previous activity. Perhaps this was because this activity was implemented very close in time compared to the previous experimentation, precisely the next day.

Figure 5. The Children Wrote Which Objects are Attracted and Which are Repelled by the Magnets

In Activity 3, the children, working in groups, easily sequenced the magnets from smallest to most significant and vice versa (Figure 6, Figure 7, Figure 8).

Figure 6. Children Put the Objects in Order from Smallest to Largest

Figure 7. Children Put the Objects in Order from Largest to Smallest

Figure 8. Another Group of Children Ranks Objects from Largest to Most Minor

In Activity 4, the children created their own story with the story jumper software (Figure 9, https://www.storyjumper.com/book/read/170390491/65ef590c4d02b) with photos of their actions from the present educational intervention. This activity also forms part of the evaluation of the entire activity since the children expressed their experiences and knowledge from it. Kindergarten teachers could also use the present material in their classrooms as a starting point for implementing similar activities or as a trigger for the implementation. The children were seen to be actively involved in the whole activity. They used age-appropriate arguments to support and present it, developing their psychosocial world, creativity, language expression, and adaptability. Skills are essential for tomorrow's citizens and are related to the theoretical framework of applying STEM to children from early childhood.

Figure 9. Creating A Story With The Story Jumper Software
https://www.storyjumper.com/book/read/170390491/65ef590c4d02b

In Activity 5, with Beebot (Figure 10), the children of a morning class where the researcher taught were divided into 3 groups of 7 children each. It was observed that many toddlers had difficulty identifying the objects attracted to the magnet. Then, the other group members helped them and confirmed their answers, experimenting with the objects and the magnets. However, they handled the Beebot well and chose different paths to reach the objects they pulled. Each child chose a path to reach their chosen object (attracted by magnets) and followed that path to the end.

Figure 10. Beebot is Directed to Objects Attracted by the Magnets

This activity consolidates the previously acquired experiential knowledge and evaluates the children's degree of understanding of magnetism. This evaluation revealed that magnetism is extremely difficult for preschool children.

In Activity 6, the kindergarten teacher recorded the children's answers to "What did you learn about magnets?" in the Kidspiration software (Figure 11). The children compared the answers they had given before the educational action to the question "What do you know about magnets?" with the answers they gave after the action was implemented, i.e. how their knowledge about magnets evolved during the activity educational intervention.

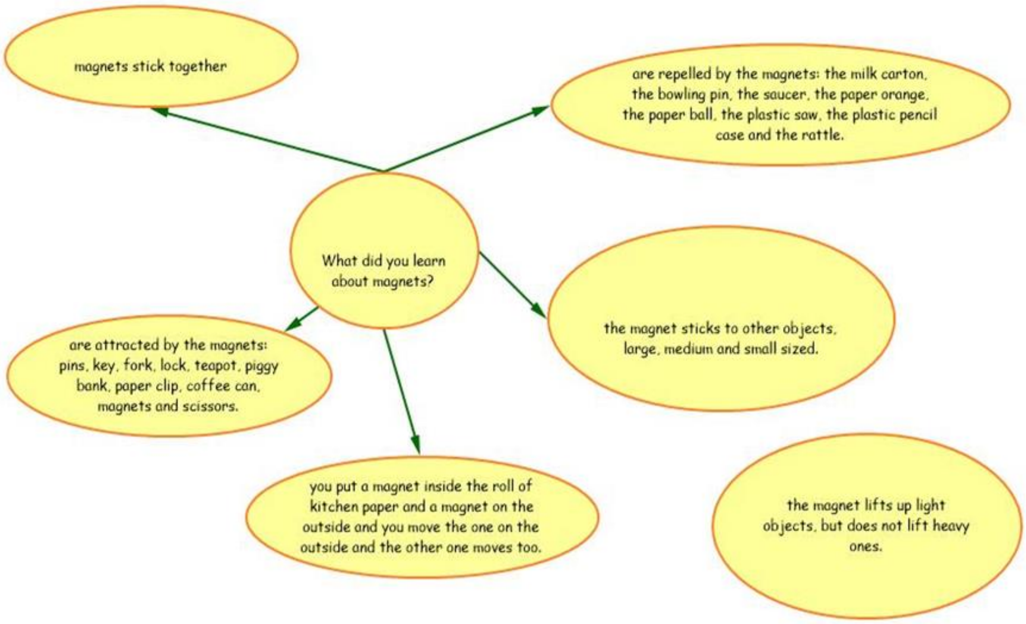

Figure 11. Evaluation of the Educational Action using the Kidspiration Software

4. RESEARCH LIMITATIONS AND FUTURE RESEARCH

There are some limitations to this research. The results of children's action cannot be generalized because the sample of participants was small. Also, the activities implemented with the use of the robot, presuppose children's familiarity with it, through their previous engagement with other activities, in which it was used as a means. Also, the results cannot be generalized, because to implement a similar activity in another kindergarten, the development of the children's phonological awareness and their participation in creative writing activities should have been preceded. In addition, the objectives, materials, means and methods of implementing the activities differ according to each country's relevant preschool education program. However, it would be a great challenge for each country to develop similar activities, which would be a source of inspiration for colleagues from other countries, who would adapt the actions to the level of their students, according to their class's given cultural and educational context.

The children proposed that, as a continuation of their occupation, they would later discover and implement new activities related to discovering the properties of magnetism. Then, the kindergarten teacher talked about artificial intelligence and its use through ChatGPT (https://openai.com) to search for specific actions to be selected and implemented by the children based on their interests and needs.

With the artificial intelligence application https://ideogram.ai/t/explore, children will create an illustrated story about magnets together with the artificial intelligence assistant (https://chat.openai.com/software), which will help them have a further flow to their story when they struggle to keep it going. The story will be created using the creative writing technique, where each child will continue the story from where the previous child has left it. At the same time, the kindergarten teacher will record the children's words in the application of artificial intelligence, and at the end, the children will see their story come to life after the choices they have made from the available means of the artificial intelligence tool.

Another action with the help of artificial intelligence will be the creation of a presentation of the children's actions automatically with the above applications, aswell as the creation of an image or video with background music that the children themselves will create with the application https://www.beatoven.ai/

5. DISCUSSION

The study highlights several important implications for early childhood education, particularly in integrating STEM into kindergarten curricula. One significant implication is the recognition of STEM as a vital educational tool that aligns with young children's natural curiosity and technological familiarity. The study suggests that incorporating STEM activities, such as those related to magnetism, can enhance children's engagement and joy in learning as they explore concepts through hands-on experiences and collaboration with peers. Moreover, the research indicates that children's prior misconceptions about magnetism can serve as a foundation for building new scientific knowledge. This suggests that educators should not shy away from addressing incorrect understandings; instead, they can leverage these misconceptions to facilitate deeper learning. Educators can foster a more robust understanding of scientific concepts by allowing children to experiment and confirm their answers. This approach encourages critical thinking and problem-solving skills essential for future STEM engagement.

The findings also point to adapting educational activities to different countries' cultural and educational contexts. The paper emphasizes that while the results are promising, they cannot be generalized due to the small sample size and varying preschool education programs. This highlights the need for further research and adaptation of STEM activities to suit diverse educational settings, which could inspire educators globally to implement similar initiatives tailored to their students' needs.

Additionally, the study suggests that familiarity with technology, such as robots, is crucial for successfully implementing STEM activities. This implies that educators should ensure that children have prior exposure to such tools to maximize their learning potential. Integrating artificial intelligence tools, like ChatGPT, into the learning process also opens new avenues for personalized learning experiences, allowing children to explore topics of interest more engagingly.

In summary, this research's implications advocate for a more integrated and context-sensitive approach to STEM education in early childhood, emphasizing the importance of hands-on learning, addressing misconceptions, and leveraging technology to enhance educational outcomes.

5. CONCLUSION

STEM in kindergarten is a need of our time, but it is also a tool not far from the actions already implemented in kindergartens. Since software, robots, etc., are used, the context of these actions only changes to make positive use of today's children's familiarity with New Technologies. The results of the action are very encouraging. The children seemed to feel that STEM involvement in the educational process led them effortlessly and joyfully to discover knowledge using all their senses. They also gained more familiarity with the Beebot robot when asked to choose different routes to reach their goal. The findings of this study underscore the significant role that STEM education can play in early childhood learning, particularly in teaching complex concepts such as magnetism. Implementing STEM activities in kindergarten aligns with contemporary educational needs and enhances children's engagement and understanding of scientific principles. The results indicate that children actively participated in the learning process, utilizing their senses and creativity to explore the concept of magnetism through hands-on experiences and technology, such as the Beebot robot.

In addition, the present action was a start for further involvement of children in new paths of discovery and expansion of their knowledge about magnets using artificial intelligence tools. The results of the planning and implementation of this action will be presented in a subsequent work. Moreover, the study highlights the importance of collaborative learning, where children support each other in overcoming challenges related to their understanding of magnetism. This peer interaction facilitated knowledge acquisition and fostered essential social skills, creativity, and adaptability among the children. The positive outcomes suggest that integrating technology and STEM into early education can lead to a more enriched learning experience, allowing children to express their understanding and develop critical thinking skills.

The research also points to the necessity of addressing children's pre-existing misconceptions about scientific concepts. By building on these misconceptions, educators can create a more effective learning environment that encourages exploration and discovery. Tools like the Kidspiration app for evaluating children's understanding further emphasize the potential of technology in enhancing educational practices.

In conclusion, the study advocates for the continued integration of STEM education in kindergarten settings, emphasizing the need for further research to explore the long-term impacts of such educational interventions. The encouraging results pave the way for future initiatives to expand children's knowledge and interest in science, ultimately preparing them for a more technologically advanced world. The findings are a foundation for educators to develop innovative teaching strategies that leverage technology and collaborative learning to foster a deeper understanding of scientific concepts among young learners.

Data Availability Statement. The results are based on activities conducted in a particular kindergarten setting. The corresponding author can provide all the data.

Conflicts of Interest. The authors declared no conflicts of interest concerning this article's research, authorship, and publication.

Funding. The authors received no financial support for this article's research, authorship, and publication.

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