International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(REVIEW ARTICLE)

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A playful approach to the concept of air using archaeological exhibits within the framework of Natural sciences

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International Journal of Science and Research Archive, 2025, 15(02), 1290-1297

Publication history: Received on 16April 2025; revised on 22May 2025; accepted on 25May 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.15.2.1555

Abstract

In the present study, the author aimed to develop a museum education program that not only fosters students' aesthetic cultivation but also connects the exhibits of non-scientific museums with key concepts from the natural sciences, thereby emphasizing their educational potential.

Through the analysis of museum exhibits, the program seeks to highlight explicit and implicit correlations with themes from the natural sciences curriculum addressed to preschool and early primary education. In this context, recent international studies, as well as findings from the authors' previous research, are presented—focusing on both the identification of such connections and their application in the design of appropriate educational interventions.

More specifically, the museum education program developed centers on the concept of air and is implemented at the Archaeological Museum of Nikopolis, located in the Prefecture of Preveza, Greece, where selected exhibits act as "bridges" to scientific knowledge related to this concept. During their visit to the museum, students engage with the exhibits in a playful manner and, through a series of interactive and collaborative activities, are led to understand the concept of air and its properties, in alignment with the principles of the national curriculum for preschool and primary education.

The program is therefore addressed to students of all grades, in both kindergarten and primary school, with minor adjustments to the level of difficulty depending on the age group

Keywords: Archaeological Museum of Nikopolis; Natural sciences; Educational value of scientific concepts; Program

1. Introduction

In contemporary times, museums no longer confine themselves to their traditional museological function, which primarily aimed at fostering aesthetic cultivation—namely the experience of beauty, aesthetic pleasure, and enjoyment—or at offering lessons of moral and historical value (Filippoupoliti, 2023: E1). Instead, they are emerging as dynamic educational institutions, actively contributing to shaping a positive public attitude toward the institution of the museum.

By largely adopting communication strategies that promote the free interpretation and meaning-making of exhibits—rather than the one-dimensional transmission of knowledge—museums enhance the participatory experience of visitors.

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Within this framework, there has been a noticeable increase in interdisciplinary collaborations among different types of museums, both internationally and in Greece. This development reflects a broader trend toward integrating science into wider cultural and social contexts. In recent years, efforts to connect scientific knowledge with other domains through interdisciplinary approaches have gained particular significance, fostering new forms of learning and communication within the museum environment (Kornelaki, 2023: 133).

It is particularly important to highlight the findings of Georgopoulou (2022), who conducted an in-depth study on the emerging trend of classical museums becoming actively involved in the teaching of natural sciences, both in Greece and internationally. Her research findings underscore not only the usefulness but also the pressing necessity of integrating elements of the natural sciences into the exhibition practices and educational programs of archaeological museums. Such integration substantially contributes to enriching these institutions' activities and achieving their broader educational and social mission, as shaped by the demands of the contemporary era (Black, 2012, as cited in Georgopoulou, 2022, p. 146).

This approach aligns with international trends within the museum sector—regardless of thematic orientation, whether art museums or science museums—that promote a multifaceted, intercultural, and sensorially enriched understanding (Achiam, 2014, as cited in Georgopoulou, 2022, p. 146), while simultaneously advancing the discourse around diversity and the acceptance of multiplicity in human experience (Shelton, 2015, as cited in Georgopoulou, 2022, p. 146).

2. The Program, " By Solving the riddle….I fly"

2.1. Program Objectives

The ultimate goal of the program is for students to gain learning experiences related to the concept of air, through experiments and hands-on activities, and to experience some of its properties by engaging with mythological elements and characters, as well as with the exhibits and the stories they convey.

More specifically, the program aims to:

- Apply scientific methods to achieve learning goals.
- Develop imagination and creativity.
- Explore the concept of air and some of its properties.
- Become familiar with the exhibits and their historical context.
- Use a variety of tools and materials to carry out the activities.
- Collaborate as a team and interact with each other and with the facilitator.

    - **Target Group:** Children aged 5–12 years
    - **Estimated Duration:** 2 teaching hours (90 minutes)
    - **Required Educational Material:** Magnifying glasses, exhibit cards, markers or colored pencils, A4 papers, glue, a lion puppet, clothes and wings, cardboard, scissors, post-it notes, Canson paper.

2.2. Identifying the Bridges between Museum Exhibits and Natural Science Topics from the National Curriculum

There are various "bridges" between the exhibits of the Archaeological Museum of Nikopoli's and concepts from the Natural Sciences. Particularly engaging are exhibits related to the concept of air—such as an oil lamp depicting Zeus as an eagle abducting Ganymede, a gold coin featuring Pegasus (associated with the ferryman Charon), and an oil lamp representing the Sphinx—and the use of air by various beings, mythical and otherwise, to achieve flight.

Furthermore, the program could include elements of nature—fire (oil lamp), air (winged creatures), and water (Pegasus as a symbol of sea spray).

We also identified coins portraying the goddess Athena holding a trident and another showing Zeus transformed into a bull abducting Europe. These exhibits reference the distinctive characteristics of both mythical and real creatures and relate to their classification or evolution over time, reflecting their adaptation to the natural environment.

3. The Design Phase

3.1. Selection of the Museum Exhibits to βe Utilized in the Educational Program

Table 1 Nikopolis' Museum exhibits, used for the program

A/A	Description	Exhibits
1	Full-relief lion statue, late 4th – early 3rd century BC	
2	Gold danake with Pegasus, 2nd century AD	
3	Oil lamp depicting the abduction of Ganymede, second half of the 2nd – early 3rd century AD;	
4	Oil lamp with a depiction of a Sphinx, second half of the 2nd century AD.	

3.2. Methodology

Particular emphasis should be placed on the way children at these ages learn—namely through experiential, experimental, and discovery-based methods. Therefore, the program seeks to activate these modes of learning. The educational program focuses on two main themes, depending on the students' age and the science concepts addressed in the national curriculum:

Air

- **The existence of air,**
- **The property of warm and cold air** in relation to the flying ability of living beings, especially birds or other mythological creatures.

Furthermore, additional activities can be developed to teach about:

- **Animal classification** based on their characteristics (birds, mammals, vertebrates or invertebrates, etc.)
- **Biodiversity – evolution of species**

3.2.1. Scientific content

It is particularly important to emphasize that humans do not understand the world directly, but rather through the formation of ideas and perceptions, mental representations, and models. Children, in their attempt to interpret the

world, develop ideas formed through their experiences, by observing phenomena and events, as well as from the influence of adult perceptions, the media, peer interactions, school textbooks, and instruction. However, when a child attempts to explain a scientific issue, they will do so using vocabulary from their everyday language, which often results in incorrect interpretations. Some of the ideas (alternative conceptions) that students form relate to outdated theories. Furthermore, several common features of these student-formed ideas include:

- **Anthropocentric views**, e.g., "oxygen exists so that humans can breathe."
- **Animistic views**, e.g., "clouds sweat."
- **The belief that invisible things do not exist**, as in our case, "air does not exist inside a room because we cannot see or feel it."
- **Lack of conceptual differentiation**, etc.

Therefore, in the teaching of concepts related to natural sciences, it is crucial for educators to take these alternative conceptions into account. Otherwise, the following outcomes may occur:

- Pre-existing ideas remain unchanged.
- Teaching reinforces misunderstandings.
- Pre-existing ideas and scientific concepts coexist.
- Scientific perspectives remain confused and unclear (Kotsis, 2005).

With regard to the concept of air, kindergarten students are introduced to it and some of its properties through daily routines such as the weather report during the morning circle, as well as through their everyday experiences inside and outside of school. As previously mentioned, young children often believe that there is no air in the classroom since they cannot see or feel it.

In the early primary grades (1st and 2nd), students are also expected to recognize weather changes and become familiar with some properties of air through simple experimental activities.

In the 6th-grade physics textbook, there is a reference to animal species from antiquity to the present day in order to emphasize the diversity of species, which share common features but also possess unique abilities that help them survive.

In the 5th-grade physics curriculum, heating of solids, liquids, and gases is studied experimentally, including how their composition changes. Specifically, regarding the heating of air, there is the experiment known as "the spirit of the bottle."

3.2.2. Factors in the formation of Concepts

At the level of preschool education and in the early grades of primary school, students struggle to understand the existence of air, as it is an element that cannot be seen, touched, or smelled—therefore, they believe it does not exist. Their ideas are formed based on personal empirical observation and social interaction, as they try to make sense of the world.

Another cognitive difficulty students face is associating the existence of air with its movement. That is, they equate air with wind and believe that a still bottle does not contain air because it has been left outside; however, if it is shaken vigorously, they think it will then be filled with air. Moreover, even at older ages (5th and 6th grade), students are often unaware that when air is heated or cooled, its composition changes.

We therefore believe that, depending on their cognitive level, children should initially begin with the simple realization that air exists even when it is not blowing. Subsequently, we will proceed with demonstrating the properties of this element under study.

3.3. Development of the Plot (Scenario) of the Educational Program and the Underlying Narrative Supporting the Smooth Progression of the Activities and Sustained Student Engagement

3.3.1. Storytelling

The god Zeus, after the tragic fate (drowning) of Icarus, decides to forbid the secret of flight from birds and other winged mythological creatures—unless they manage to solve three riddles. The first riddle concerns the existence of air and is posed by a Sphinx. The second riddle is given by Pegasus, and the third is posed by Zeus himself, disguised as an Eagle.

At the entrance of the museum, students are greeted by a marble lion, which, in the form of a hand puppet, guides them through solving the riddles. The lion informs them of Zeus's decision and asks them to split into groups, with each group tasked with finding a specific exhibit and receiving a riddle. Each group works on solving its riddle, and afterward, they come together in a plenary session to compile all the findings.

4. Planning of the Activities Included in the Educational Program

What activities will the educational program include, taking into account the available space of the specific museum, the rules of the learning community, and the materials that comply with these rules?

The activities included in the educational program are divided into introductory activities and those aimed at achieving the learning objectives related to the understanding of the specific scientific concept. Initially, there will be an activity to help students get acquainted with and become familiarized with the museum space.

4.1. Activity 1

- **Title:** Let's Get to Know Each Other Better and Form Teams

Objective(s)

- To become familiar with the space
- To get to know and feel comfortable with one another
- To form groups of 4 participants
    - **Estimated duration:** 20 minutes
    - **Materials:** Music or tambourine, exhibit cards (4 for each exhibit)

4.1.1 Description

At the teacher's signal, the children move around the space (the museum's antechamber) while the music or tambourine plays. When the music stops, each child says their name to the person closest to them. This is repeated as many times as necessary to help participants become familiar with each other.Then, during the next pause in the music, the educator asks them to form pairs based on who likes the color blue, green, red, etc.Next, each child selects a card from a deck of exhibit cards. Those who hold the same card belong to the same group.

4.2. Activity 2

- **Title:** Zeus' order

Objective(s)

- To learn or recall information/knowledge about the god Zeus and the myth of Daedalus and Icarus
- To learn about their mission
- To follow instructions and respect rules
- To observe carefully
    - **Estimated duration:** 20 minutes
    - **Materials:** Papyrus scroll with riddles or pre-recorded messages, magnifying glasses, exhibit cards, worksheet, camera without flash

4.2.1 Description

The three groups enter the first room of the Museum, where the lion awaits them. With the help of the educator or museum specialist, they listen to the myth of Daedalus and Icarus and learn about the mission they must complete. Then, each group, showing respect for the space, tries to locate the exhibit shown on their card. At that exhibit, they must find a hidden riddle. Once they find it, they read it aloud and try to figure out what natural element it refers to. They are also informed about the history of each exhibit (or they research it later, gathering information about what the Sphinx, Pegasus, etc., are).

- **1st Riddle (Sphinx):** "No matter how much you search to see or touch it, it slips away, and you lose it."

They write the riddle on their worksheet, along with the characteristics of the exhibit.

- **2nd Riddle (Pegasus):**"Move them up and down, and they'll take you where you want to go."

- **3rd Riddle (Eagle - Zeus):**"When it's warm you rise, when it's cold you fall."

After recording the riddles and any other clues they think will help, the students head to the multipurpose room for the next activity.

4.3. Activity 3

- **Title:** I do experiments to see how I'll learn to fly.

Objective(s):

- To realize through experimentation that air is present everywhere
- To experiment and discover
- To understand the effect of temperature differences on the composition of air
- To reflect and form new knowledge
    - **Estimated duration:** 30 minutes
    - **Materials:** Observation recording worksheets, containers with hot and cold water, empty transparent glass bottles, two balloons, A4 paper

4.3.1 Description

In the multipurpose room, students solve the riddles (1st: Air, 2nd: Wings, 3rd: Hot air, cold air) and identify the common characteristics of the exhibits.

1st Experiment

The educator asks the questions: "Is there air, and where?" "How can we perceive it? Students, working in groups, record their opinions and form hypotheses. The educator asks them to compile all answers on a board using post-it notes (initial and final assumptions). Then, the educator asks the students to flap their arms up and down like birds, asking: "What do you observe? What do you feel?" (The most likely answer: the presence of air). Alternatively, the students can be given paper to make fans, which they wave and then describe or write down their observations.

2nd Experiment

We place hot and cold water in two bowls, respectively. We place a balloon over the opening of a medium-sized glass bottle and put the bottle in the bowl with hot water. We ask the students: "What do we observe? Why is this happening?" Then, we place the bottle into the container with very cold water. "What do we observe? Why is this happening?" Students record their answers.

3rd Experiment

We inflate a balloon and heat the room using the air conditioner. Then we ask: "What do we observe?" Afterward, we cool the room and observe again. This experiment leads to the final discussion: "How do birds fly? What role does air temperature play in movement?"

4.4. Activity 4

- **Title:** Playing and having fun with the air.

Objective(s)

- To create their own story using the exhibits
- To engage in role-play
    - **Estimated duration:** 30 minutes
    - **Materials:** A4 paper, pencils or pens, images (for younger children), word cards related to air and the exhibits

4.4.1 Description

In the classroom or in the museum's event room, students can create their own new story and illustrate it, or make a riddle book related to air and its properties. They can also engage in role-play based on the original story of the program or their own version.

5. Evaluation of the Scenario

- **Estimated duration:** 20 minutes
- **Materials:** Questionnaire, Observation Sheets, Worksheet

The evaluation depends on the educational level of the students participating in the program. Two types of evaluation will be implemented: formative and summative. The **formative evaluation** will concern the execution of the activities by the students and will be conducted through observation by the facilitator – educator or museologist.

The **summative evaluation** will also include assessment of the program through the completion of a questionnaire by students and accompanying teachers, aiming to identify gaps and other weaknesses and to further improve the program on a scientific, organizational, and recreational level.

Additionally, with the help of the educators, a corresponding worksheet may be created to evaluate students' understanding of the physical science concepts involved.

6. Selection of Pedagogical Methods and Educational Techniques

In this program, a variety of methods can be used: group collaboration, experiential learning, experimentation – discovery/inquiry-based method, and role-playing.

The **group collaboration method** is essential for implementing the activities, as it promotes initiative, authentic thinking, knowledge, emotions, and student engagement. It also fosters cooperation and constructive dialogue, while offering students – as members of a group – the opportunity to engage in discussions, pose questions and inquiries, and most importantly, to work collectively by combining their knowledge and experiences (Matsagouras, 2003:238).

Experiential learning, on the other hand, draws on children's past experiences while encouraging new ones. It also motivates students to actively participate in the learning process and encourages them to investigate, discover, and activate both their imagination and creativity.

Role-playing is an experiential technique in which participants – in this case, the students – are invited to assume roles in a given situation (Dedouli, 2002:148).

Finally, the **experimental – discovery/inquiry-based method** is based on the principle that new knowledge emerges from the students themselves through appropriately designed questions posed by the educator, who acts as a facilitator and motivator of the learning process (Kariotoglou, 2009:109–113).

6.1. Determining the role of the facilitator

The educator will act as a guide and facilitator. Without providing ready-made answers, they will pose questions for the students to explore and answer. They will also be responsible for organizing the space and offering assistance or clarification when needed.

6.2. Selection of the Evaluation method

When completing the educational program, that is museum visit and further classroom extension, questionnaires can be distributed, depending on the age group of the participants.

For preschoolers who have not yet developed writing skills, the kindergarten teacher can record their responses on worksheets, or the children can draw what they liked. Indicative questions:

- What did you like the most?
- What did you like the least?
- What was difficult for you?
- What else would you like to do?

For school-age children, an evaluation sheet can be given to assess newly acquired knowledge. This may include multiple-choice questions or true/false statements.

6.3. Before the visit to the Museum

It is important that at least one prior visit to the museum has taken place, so that students become familiar with museum visit protocols, learn from experts what is and isn't allowed, and get the chance to view the exhibits. They can also become familiar with the layout and learn how to move within the space. This is especially important for younger students. The visit can be scheduled toward the end of the school year, when body coordination, spatial awareness, and physical orientation skills are better developed.

On a conceptual level, it is helpful to have already introduced the concept of air and its presence even when it's not in motion. For example: Where is air found and how can we detect it? (e.g., by making a wind vane, observing trees), or through simple experiments detecting air in the ground, water, etc.

6.4. After the visit – Extension

Depending on the age of the students, the educational program can be extended into the classroom. For example, students can conduct additional experiments related to the properties of air. Using the exhibits as inspiration, they can also choose additional items to compare and contrast past and present creatures, opening new scientific themes such as the evolution of species over time and their classification. They can create concept maps on cardboard or digitally, enriching them with new discoveries as they explore further.

7. Conclusion

In the present paper, an effort was made to design a museum education program for students, utilizing the exhibits of the Archaeological Museum of Nikopolis in relation to the scientific concept of air. The program was based on and adapted according to the principles of the curricula for preschool and early primary education, as well as the students' pre-existing conceptions regarding scientific concepts. This particular program was disseminated to local school units, as it can serve as a teaching proposal for cultural education programs, a hands-on activity-based approach to science concepts, or even as a suggestion for a skills development workshop.

References

[1] Dedouli, M. (2002). Experiential learning – Possibilities for its application within the framework of the Flexible Zone. Review of Educational Issues, 6:145–159.

[2] Filippoupoliti, A. (2023). Education and learning in museum environments. Research in Education, 12:E1–E6.

[3] Georgopoulou, P. (2022). Design and evaluation of "Educational Islands of Science and Technology" as non-formal learning environments in an archaeological museum (Doctoral dissertation). University of Patras, School of Social and Human Sciences, Department of Educational Sciences and Early Childhood Education.

[4] Kariotoglou, P. (2009). Content and method for approaching natural sciences in preschool and early primary education. In Proceedings of the Conference: The Teaching of Science in Education: Creating communication bridges between Kindergarten, Primary, and Secondary School (pp. 109–113). Thessaloniki: Electronic Proceedings.

[5] Kokkotas, P. & colleagues. Basic principles of Science Teaching. Athens: University of Athens@2004 Available from http://old.primedu.uoa.gr/sciedu/new_ant/new_ideas.htm

[6] Kornelaki, A.-Ch. (2023). The educational value of museum exhibits as bridges for connecting them to natural sciences and designing educational programs. Research in Education, 12:133–144.

[7] Kotsis, K. (2005). Teaching Physics and Experiment. University of Ioannina.

[8] Matsagouras, H. (2003). Interdisciplinary in the classroom. Grigoris Publications.

[9] Pedagogical Institute. (2011). Curriculum for the teaching of literature in compulsory education: Teacher's guide. In NEW SCHOOL (21st Century School) – New Curriculum, Priority Axes 1, 2, 3 – Horizontal Action, MIS Code 295450, Subproject 1: Development of Curricula for Primary and Secondary Education and Teacher Guides "Teaching Approach Tools". Athens: Pedagogical Institute.