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PROPOSAL FOR THE INTEGRATION OF ART IN THE TEACHING OF TYPES OF ENERGY, BASED ON STEAM

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Abstract: Teaching different types of energy in secondary education is a fundamental part of scientific training, although traditional methods based on theoretical exposition and memorization often hinder conceptual understanding and student motivation. In this context, the STEAM (Science, Technology, Engineering, Arts, and Mathematics) methodology is presented as an innovative alternative that combines scientific learning with artistic creativity and problem solving. The aim of this study was to analyze the impact of integrating art into the teaching of types of energy using the STEAM methodology, with the aim of promoting conceptual understanding and cross-curricular skills in secondary school students. To this end, a teaching activity called "Energy Gallery" was designed and implemented, using a qualitative approach with elements of action research. The intervention was carried out with a group of 30 second-year secondary school students in Aguascalientes, Mexico, over six sessions spread over three weeks. The results show 100% student participation and that 93% of the students were able to clearly explain the type of energy studied, confirming the potential of artistic expression as a pedagogical mediator for understanding abstract concepts. Likewise, the public exhibition of the works generated social and family recognition, strengthening the intrinsic motivation of the students and consolidating the school-community link. In conclusion, the experience shows that integrating art into energy education, within the STEAM framework, promotes more active, meaningful, and sustainable learning. It is recommended that this strategy be replicated in other educational contexts and complemented with quantitative assessments and digital resources in order to consolidate

more inclusive and relevant pedagogical models for 21st-century education.

Keywords: STEAM, Energy education, Meaningful learning, Secondary education, Integration of art.

INTRODUCTION

Teaching about types of energy in secondary education is a fundamental part of scientific training, as it provides students with the conceptual foundations that enable them to understand physical phenomena and their applications in everyday life. However, traditional methods, which focus on theoretical exposition and memorization, often limit deep understanding and can generate misconceptions, which raises the need to explore innovative pedagogical approaches that promote meaningful learning.

In this scenario, education based on the STEAM (Science, Technology, Engineering, Arts, and Mathematics) model has proven to be an effective alternative for promoting cognitive and creative skills in an interdisciplinary manner. Recent studies report that a STEAM-based curriculum fosters scientific creativity, particularly in dimensions such as fluency and flexibility (Tran, 2021). Likewise, it has been shown that integrating the arts from the beginning of an educational sequence enhances science learning, especially in students with language difficulties (Hughes, 2022). However, systematic reviews warn of a lack of research analyzing the specific contribution of artistic experiences to the conceptual understanding of scientific phenomena (Sanz & Camarero, 2023).

Given this gap, this article aims to analyze the impact of integrating art into the teaching of types of energy using the STEAM methodology, with an emphasis on improving conceptual understanding in secondary school students. It also seeks to determine whether this approach promotes the development of cross-curricular skills such as creativity and communication, aspects that are increasingly valued in the context of 21st-century education.

In this way, the study contributes to strengthening the literature on educational practices that articulate science and art, providing evidence on how the artistic representation of energy concepts can become a pedagogical mediator for the construction of lasting and meaningful knowledge.

This article is organized into five sections. First, the introduction contextualizes the issue and sets out the research objective. Next, the theoretical framework presents the conceptual foundations of the STEAM approach, energy education, and meaningful learning mediated by art. The third section describes the materials and methods used in the pedagogical intervention. The fourth section presents and discusses the results obtained from the implementation of the *"Energy Gallery"* activity. Finally, the fifth section presents the conclusions, limitations, and recommendations derived from the study.

THEORETICAL FRAMEWORK

This study is based on the STEAM (Science, Technology, Engineering, Arts, and Mathematics) methodology, energy education in secondary education, and meaningful learning mediated by artistic experiences. These three axes allow us to contextualize the intervention proposal and establish its relevance in recent academic literature.

a) The STEAM approach: an integrated pedagogical methodology

The STEAM model emerged as an evolution of the traditional STEM model, incorporating the arts as an essential component for enhancing creativity, innovation, and conceptual understanding. The inclusion of art is not limited to an aesthetic complement, but rather promotes visual representation, abstraction, and creative problem solving (Hughes, 2022). Recent research shows that a STEAM-based curriculum improves students' scientific creativity in areas such as fluency and flexibility (Tran, 2021), and that introducing the "A" early in the teaching sequence enhances science learning, particularly in populations with language difficulties (Hughes, 2022). However, systematic reviews show a gap in the assessment of artistic skills and deep conceptual understanding in secondary education contexts (Sanz & Camarero, 2023).

b)Teaching energy in secondary education

The concept of energy is a pillar of scientific education, explaining everyday phenomena such as how engines work, how electricity is generated, and how light and sound behave. However, due to its abstract nature, teaching energy often causes difficulties for students, stemming from methodologies focused on memorizing formulas and definitions (Duit & Treagust, 2012). This limitation has prompted the search for innovative approaches that promote conceptual understanding through meaningful experiences. In this sense, the STEAM methodology offers a way to overcome these barriers by integrating creative projects where students explore types of energy through artistic representations and practical applications (Hewitt, 2015; Gomez & Rodríguez, 2019).

c)Meaningful learning and the integration of art

Meaningful learning, as proposed by Ausubel (1968), occurs when new content is substantially related to the student's prior knowledge. The integration of art into the STEAM approach enhances this type of learning by transforming abstract concepts into concrete and personal experiences. Activities such as creating visual models or art installations allow information to be manipulated and reinterpreted, facilitating both deep understanding and long-term retention (Sanz & Camarero, 2023). Furthermore, by linking science with artistic expression, learning takes on an emotional and motivational dimension that strengthens creativity and communication.

d)Digital competencies as a cross-cutting framework

Although the study focuses on the integration of art, it is relevant to incorporate the Digital Competencies Framework (ISTE, 2021) as a cross-cutting reference. The creation of STEAM projects often involves the use of digital resources for information search, design, and communication of results. Evaluating how students use technology ethically and creatively enriches the understanding of the competencies developed, while placing the experience within the framework of 21st-century digital literacy.

MATERIALS AND METHODS

Methodological design

The study was conducted using a qualitative approach with elements of educational action research, as it sought to improve teaching practices through the implementation and evaluation of an innovative classroom activity. The proposal, called "Energy Gallery," was designed as a situated, collaborative, and interdisciplinary learning experience aimed at promoting conceptual understanding of different types of energy through artistic representation, in line with the principles of the STEAM approach.

Context and participants

The intervention took place at Escuela Secundaria General Nº 10 "22 de Octubre," located in Aguascalientes, Mexico. The participating group consisted of 30 second-year students (2º A), aged between 13 and 14 years old ( ). The heterogeneity of the group—in terms of learning styles, levels of understanding, and socio-emotional contexts—was taken into account from the planning stage, in order to ensure the inclusion and active participation of all students, regardless of their previous artistic abilities.

Materials

Accessible, inexpensive, and environmentally friendly materials were used in order to democratize the experience and ensure the participation of all students. The supplies used included:

- Shell paper (one per student).
- Printed copies of visual models representing each type of energy.
- Number 8 pencil and crumb eraser (for lines and shading).
- Glue, labels, and mounting materials for the exhibition.

The model illustrations included iconic representations of mechanical, thermal, wind, radiant, and sound energy, among others, facilitating the understanding of abstract concepts through visual resources. Figure 1 shows some of the model illustrations displayed for the students.

Teaching procedure

The intervention was carried out over six two-hour sessions, spread over three weeks. The teaching sequence was structured in the following stages:

- *Theoretical introduction (Session 1)*: Interactive presentation of the 30 types of energy, with thought-provoking questions and examples from everyday life.
- *Model selection (Session 2)*: Each student chose a model illustration of a type of energy and received the working materials.
- *Initial sketch (Session 3)*: Creation of a first sketch on tracing paper, replicating the selected model.
- *Shading and volume (Sessions 4 and 5)*: Application of basic shading and contrast techniques with pencil, promoting artistic experimentation.
- *Assembly and exhibition (Session 6)*: Organization of a gallery in the civic courtyard, where each work was accompanied by a label with the student's name , the type of energy represented, and a brief written explanation.

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Recording and evaluation

The process was documented through ethnographic recording (participant observation, field notes, and photographs). Evaluation was carried out using a qualitative rubric that assessed:

- Conceptual understanding of the type of energy represented.
- Effort and dedication in the artistic creation.
- Clarity of the written explanation.
- Participation during the exhibition.

In addition, an open feedback instrument was used to gather students' perceptions of their experience, learning, and assessment of the exhibition in front of their families and peers.

RESULTS AND DISCUSSION

The results obtained during the implementation of the "Energy Gallery" activity show a high impact on the teaching-learning process of second-year secondary school students. First, 100% of the students participated**,** which is significant in the context of secondary education, where varying levels of involvement are common. This data suggests that the methodology based on the STEAM approach and the Classroom Tea-

a) Thermal energy.

b) Wind energy.

c)Solar energy.

d) Electrical energy.

Figure 1. Model illustrations of some types of energy.

ching Project (PDA) was a motivating factor and created an environment conducive to active interaction. The enthusiasm shown by the students was reflected not only in the creation of artistic products, but also in their commitment during oral presentations and their willingness to collaborate with their peers.

In terms of conceptual learning, the results show that 93% of the students were able to clearly identify and explain the type of energy assigned during the oral presentation**.** This finding is relevant, as it allows us to infer that the graphic and artistic representation of scientific content acted as a pedagogical mediator that facilitated the understanding of abstract concepts**,** which are traditionally difficult to assimilate in the science classroom. The relationship between theory and practice, coupled with public presentation, favored the development of communication and scientific skills, in accordance with the principles established by the New Mexican School and the approaches of situated and collaborative learning. Figures 2, 3, 4, and 5 show some representations of types of energy created by the students.

At the same time, the **educational community expressed surprise and recognition for the artistic and innovative quality of the activity.** This aspect is significant, as it shows how learning transcends the classroom and acquires social value when it is shared and validated by a wider audience. Such recognition

reinforces the intrinsic motivation of students and promotes the construction of an academic identity linked to the scientific-artistic field. Likewise, the integration of families allowed **for a closer school-community relationship,** a factor that specialized literature identifies as essential for improving school performance and retention.

On the other hand, families valued the relevance of this approach, considering that it not only contributes to the **motivation of adolescents** but also strengthens emotional and communication ties with the educational institution. This result coincides with previous studies that highlight the importance of **STEAM** projects as catalysts for youth interest in science and as a strategy for **developing social-emotional skills.** In this sense, the project made it possible to highlight the importance of generating activities in which students not only memorize concepts, but also **construct, represent, and socialize** them **in a meaningful environment.**

CONCLUSIONS

In conclusion, the findings show that the pedagogical proposal not only met the expected learning objectives but also generated positive collateral impacts in terms of motivation, social cohesion, and community appreciation. The experience reinforces the premise that science learning, when articulated with artistic expressions and the active participation of the community, acquires a **comprehensive, meaningful, and sustainable** character**.**

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Figure 2. Student representation of thermal energy.

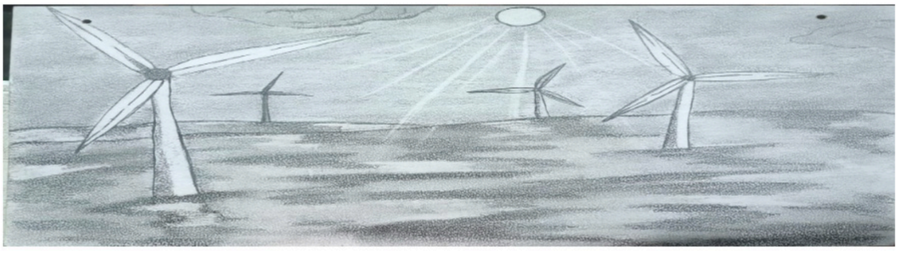

Figure 3. Student representation of wind energy.

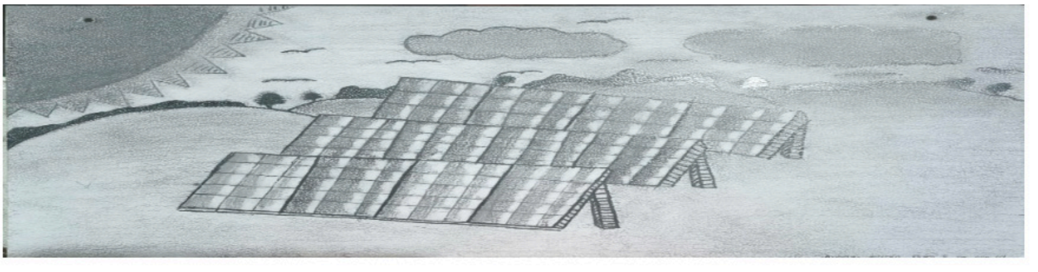

Figure 4. Student representation of solar energy.

Figure 5. Student representation of electrical energy.

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