

STEAM: Methodology to Promote Sustainable Development in the New Mexican School

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Abstract

The purpose of this qualitative research with a case study was to analyze the development of the STEAM methodology according to the New Mexican School model based on the problem of water scarcity in a fourth grade group at the primary level. In an urban school with a complete organization. Observation and survey techniques were used to collect data. The instruments used were the observation record and the interview, Atlas Ti software was used to code and categorize the data. The results obtained are the following: the development of educational projects represented a challenge for teachers from the moment of planning and during pedagogical mediation, in students it aroused curiosity and interest in the change in the dynamics in which they work. In the classroom, it favored the search for various procedures and concepts to solve problems for the care of the environment, especially the care of water, an adequate learning environment was created that allowed the exchange of knowledge, collaborative work for inquiry and the presentation of arguments as part of the development of communication skills and mathematical competencies in accordance with the STEAM methodology.

Keywords

STEAM Methodology, sustainable development, New Mexican School

1. Introduction


Given the educational demands of today's society, it was necessary to think of a model that involves considering the multiple ways in which girls, boys and adolescents understand the world around them, and based on their reality, implementation becomes necessary. of an analytical and interdisciplinary approach that implies the reformulation of methodologies considering as a point of comparison the way in which Western social sciences have operated for a long time, this reformulation transcends the approach of the New Mexican School (NEM).

The NEM bases the commitment assumed by the State to provide quality education to Mexicans from 0 to 23 years of age. It is characterized by promoting excellent, inclusive, pluricultural, collaborative and equitable learning for the entire population, prioritizing the attention of disadvantaged populations and guaranteeing conditions of excellence in the educational service with the aim of achieving well-being and inclusive prosperity. .

The New Mexican School proposes a new paradigm in the country's educational system in search of the cultural transformation of society and future generations, therefore, the current educational model has as its starting point a sociocultural paradigm with the use of various methodologies that They favor the construction of activities with a socio-critical approach.

Given this scenario, it is relevant to address the issue of the educational model of the New Mexican School and the STEAM methodology for the development of educational projects in order to identify its relevance by promoting reflective analysis and assessment of its impact on educational quality.

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1.1 Research question:

¿How can the STEAM methodology promote actions in favor of sustainable development from the New Mexican School model?

1.2 Research objective:

The objective of this case study was to analyze the development of the STEAM methodology according to the model of the New Mexican School, based on the problem of water scarcity in a fourth grade group at the primary level, in an urban school, and complete organization.

2. Theoretical Foundations:

The review of the theoretical contributions allows us to have a broader and more precise vision of what was investigated, as well as to make comparisons between the different perspectives of the professionals in the key words of the research, which were organized into three themes.

- The New Mexican School
- The STEAM methodology
- Sustainable development

The Ministry of Public Education conceives the New Mexican School as the implementation of a deeply humanistic, technological and scientific education, its main objective is to democratize socio-educational participation and contribute to improving teaching-learning processes in an equitable, inclusive and inclusive.

The principles on which the NEM is based are:

- The promotion of identity with Mexico
- Citizen responsibility
- Honesty, participation in the transformation of society
- Respect for human dignity
- Promotion of interculturality
- Promotion of the culture of peace
- Respect for nature and care for the environment. (Secretary of Public Education, 2019)

According to the interdisciplinary approach of this new educational model, the way in which the contents are integrated goes beyond the fragmentation of subjects and is characterized by linking the learning processes with the community context. It adopts a critical, humanistic and community approach, focusing its objectives on social, economic, scientific, technological and cultural advancement in general, favoring the integral development of the human being with a shared vision, therefore, it suggests the development of projects integrators that articulate knowledge, but are not conceived as a product of finished content, in this sense, they become the starting point for the exchange of knowledge and the encounter with the other, that is, they are opportunities that impact the teaching performance by promoting encounters and exchanges between teachers regarding the reality experienced in their school contexts.

STEAM inquiry-based learning refers to the diversity of ways in which scientists study the natural world and emphasizes the importance of arguing their answers based on evidence.

It is important to recognize that the activities designed for students must provide moments of reflection that allow them to develop knowledge and understanding of scientific assumptions, as well as understand the way in which scientists study the natural world and what this implies (see Figure 1).

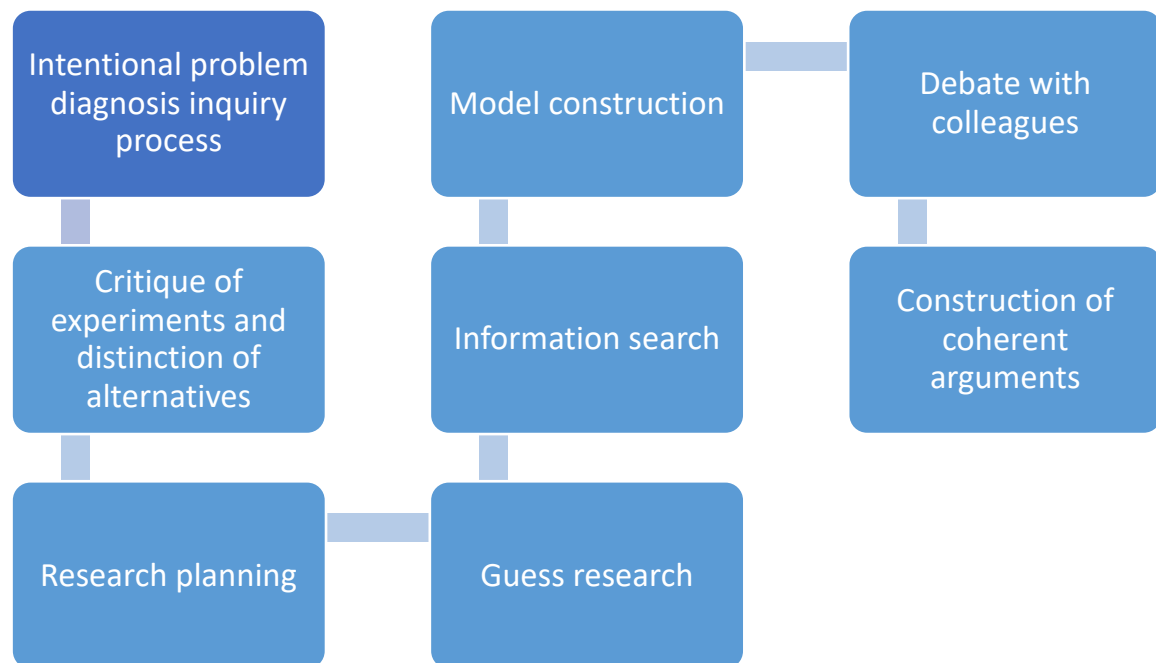


Figure 1. The way scientists study the natural world.

Note: SEP (2023). Methodological suggestions for the development of educational projects for the 2022-2023 School Year.

The STEAM methodology integrates science, technology, engineering, arts and mathematics, each with a specific role. Within the NEM, this methodology is suggested in the training field of scientific knowledge and thinking, which is consistent with the interdisciplinary and transdisciplinary approach that favors explanation from the sciences and knowledge of the communities.

UNESCO (2019) states that “STEM disciplines are the basis that supports the 2030 Agenda for Sustainable Development and education in these subjects can provide those who study them with the knowledge, skills, attitudes and behaviors necessary to create inclusive and sustainable societies” (p. 11). Therefore, this type of methodology used in primary education represents a great opportunity to trigger the interest of girls, boys and adolescents in STEM subjects and promote equal opportunities in access to quality education.

Wang (2012) states that the main objective of this methodology is to show the relationship of disciplines with real life, and how it directly affects human life. In this regard, Luna (2013) recognizes transdisciplinarity as an "attempt to capture the knowledge that is defined in the movement of a reality that is not finished, directed to a complex thought" (p.3). In addition, it encourages critical thinking and promotes research as a learning strategy.

The 2030 Agenda defines sustainable development as “The process capable of meeting the needs of present generations without compromising the ability of future generations to meet theirs.” This concept applies to conditions at different economic levels, in the ecological and social aspects. Leal (2016), conceives sustainable development as "that which improves the quality of human life without exceeding the carrying capacity of the ecosystems that support them" so it is understandable that man, faced with the need for survival, is forced to exploit ecosystems, however the use of resources must be rational.

In this sense, it is relevant to address the environmental problems that impact the sustainable development of the country from the educational field, making use of the STEAM methodology in the development of projects in the training field of knowledge and scientific thinking.

3. Methodology:

In the present study, it was considered to use the qualitative approach, because it favors the observation and detailed analysis of the processes experienced in the classroom, with the researcher being a participant in the reality that the subjects experience. This allowed us to interpret useful data for the identification of the strengths and areas of opportunity that teachers have when implementing the STEAM methodology. In this regard, Creswell (2009) noted that “qualitative research is interpretive, so the researcher generally becomes substantially involved in an intensive experience with the participants” (p. 199). That is, the researcher collects data directly from the participating subjects.

Taylor and Bogdan (1987) stated that by studying people qualitatively, it is possible to know them personally, in addition to understanding what they experience on a daily basis (p. 21). Due to this, it was possible to know the processes generated in the classroom.

The strategy used was the case study, which favored the active intervention of the researcher, in the discovery of new relationships and concepts on the topic addressed. Creswell (2009) defined it as “a strategy in which the researcher explores in depth a program, event, activity, process, one or more individuals” (p.19). This methodology gives confidence to the researcher by allowing him to be immersed in the context of the problem.

The school where the research was carried out is urban, with a complete organization, with a morning work shift, located on the outskirts of Victoria city, Tamaulipas; The property is shared with another school in the afternoon shift. The school population it serves is 366 students from the neighborhood and surrounding areas. In this research, the participating subjects were two teachers and 64 fourth grade students between 9 and 10 years of age.

Techniques and instruments were used that allowed data collection, as well as their analysis. Data collection is part of the procedure to carry out qualitative research. The constructs were defined based on the purpose of the research and three experts validated them: (a) The New Mexican School (b) STEAM Methodology and (c) Sustainable development.

The interview and observation record served to identify the difficulties that fourth grade primary school teachers face in the teaching process using the STEAM methodology.

Face-to-face interviews were conducted with the 64 fourth grade students at the primary school where this research was carried out, to learn from their point of view how they developed the project focused on sustainable development.

The observation record was used during the development of the project called “Genios caring for the environment”, where the topic of measuring capabilities was developed based on the problem of water shortage in the community.

The development of the project was through the STEAM methodology, seeking to promote interaction between equals as an opportunity to develop ecological awareness and scientific learning in children in the fourth grade of primary education.

It began with a horizontal dialogue between teacher and students in which the effect of human activities on the depletion of water in their community was recognized. Students were also motivated to apply critical and scientific thinking to address the problem, conducting research in various sources of information, such as books in the school library and on web pages.

Students motivated by curiosity designed a rainwater harvesting system to mitigate water depletion. They used different materials for their construction, mainly recycled such as plastic bottles and cardboard, they designed various prototypes to scale and with characteristics typical

of their homes, the purpose of the project was to motivate their curiosity, interest, analysis, reflection and critical thinking in the care of real problems in your community.

There were three learning stages of the project, where the participants interacted with their classmates in an active and dynamic way:

- Stage 1. Find the why and how: the students were invited and motivated to enjoy this learning adventure, they were presented with a video where they observed how human activities affect the depletion of water in their community, in this way way they managed to recognize in which situations they affect the environment and why.
- Stage 2. Creation of prototypes for water collection: the participants worked collaboratively on the design and creation of a prototype to observe its operation and ability to address the problem.
- Stage 3. Observe and reflect: organized in teams, they shared their experience and practically presented their prototype and innovations made to it.

In the data analysis process, the interviews conducted with the 64 students were transcribed. In the analysis of the observation record, significant segments were located for coding and grouping into categories. These categories allowed the results to be organized and presented clearly and in order to demonstrate their relevance, empirical data obtained from the applied instruments were included. Atlas ti software was used for data analysis.

Coding was used to identify each of the participating subjects without jeopardizing their confidentiality and anonymity.

4. Results:

The results found are described according to the constructs of: (a) The New Mexican School (b) STEAM Methodology and (c) Sustainable development

- A. The New Mexican School, in this regard, identified that teachers still do not appropriate the approach, however the transversal and interdisciplinary work that it suggests facilitates meaningful learning for students.
- B. STEAM Methodology, the teacher has complications in developing the planning, when carrying out his teaching mediation he omits important parts of the methodological process due to lack of knowledge and on some occasions because he considers that there is not enough time. A favorable environment was created that motivated students to participate in the search for results through various resolution processes. Importance was given to collaborative work in the classroom with classmates to find the link between the topics addressed and interdisciplinarity. Collaborative work allowed students to work together to create and restructure various knowledge. Argumentation and validation are a core part of the STEAM methodology, because it allowed the student to make a critical-reflective analysis of the knowledge, procedures and results found.
- C. Sustainable development, the approach to the problem favored reflection and critical analysis, allowing the students to develop their understanding of the problem; It was a way to get the students to think actively about what they were trying to learn, and it also generated curiosity in them to check the veracity of their results and detect where their actions would have a greater positive impact.

The STEAM methodology encouraged students to use their skills, knowledge, attitudes and values in order to provide solutions to the problems developed. They managed to create and

apply knowledge consistent with the problems posed, through argumentation and scientific evidence.

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