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The impact of the STEAM methodology on the academic performance of students' in learning the Solar System on elementary school

Impacto de la metodología STEAM en el rendimiento académico de los estudiantes en el aprendizaje del Sistema Solar en la educación primaria

DOMÍNGUEZ-GUTU, Jesús*†, TREJO-TREJO, Gilberto Abelino, CONSTANTINO-GONZÁLEZ, Fernando Exiquio and GORDILLO-ESPINOZA, Emmanuel

Universidad Tecnológica de la Selva, México.

ID 1st Author: *Jesús, Domínguez-Gutu* / **ORC ID:** 0000-0001-8025-6089, **CVU CONAHCYT ID:** 524210

ID 1st Co-author: *Gilberto Abelino, Trejo-Trejo* / **ORC ID:** 0000-0003-2808-3939, **CVU CONAHCYT ID:** 334014

ID 2nd Co-author: *Fernando Exiquio, Constantino-González* / **ORC ID:** 0000-0002-9701 -1990, **CVU CONAHCYT ID:** 79617

ID 3rd Co-author: *Emmanuel, Gordillo-Espinoza* / **ORC ID:** 0000-0002-2467-8209, **CVU CONAHCYT ID:** 657274

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Abstract

The STEAM methodology as a pedagogical proposal in science teaching has been little explored in basic education in Mexico. The present investigation was developed in an elementary school in the city of Ocosingo, Chiapas, Mexico, it focused on applying the STEAM methodology with a focus on inquiry and the development of a group project, in order to demonstrate if this methodology impacts on academic performance of 5th grade students in the learning of the Solar System in the subject of Natural Sciences. The study was carried out under a quantitative approach of a descriptive type with a quasi-experimental design, using as information gathering instruments, tests designed for the study and a survey under the Likert scale that allowed obtaining the perception of the students in relation to the teaching methodology used in its inquiry phases. The results show that the use of this methodology as a didactic tool in the learning of the Solar System, significantly increases the learning of the students, as well as the pleasure to develop their learning through this methodology with the use of technological tools and the development of a group project.

STEAM, Inquiry, Academic performance, Elementary school, Didactic

Resumen

La metodología STEAM como propuesta pedagógica en la enseñanza de las ciencias ha sido poco explorada en la educación básica en México. La presente investigación se desarrolló en una escuela primaria en la ciudad de Ocosingo, Chiapas, México, se centró en aplicar la metodología STEAM con un enfoque en la indagación y el desarrollo de un proyecto grupal, con el fin de demostrar si esta metodología impacta en el rendimiento académico de los estudiantes del 5º. grado en el aprendizaje del Sistema Solar en la materia de Ciencias Naturales. El estudio se realizó bajo un enfoque cuantitativo de tipo descriptivo con diseño cuasi-experimental, utilizando como instrumentos de recopilación de información, pruebas diseñadas para el estudio y una encuesta bajo la escala de Likert que permitió obtener la percepción de los estudiantes con relación a la metodología de enseñanza utilizada en sus fases de indagación. Los resultados demuestran que la utilización de esta metodología como herramienta didáctica en el aprendizaje del Sistema Solar, incrementa significativamente el aprendizaje de los estudiantes, así como, se percibe el gusto por desarrollar su aprendizaje a través de esta metodología con el uso de herramientas tecnológicas y el desarrollo de un proyecto grupal.

STEAM, Indagación, Rendimiento académico, Educación primaria, Didáctico

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*Correspondence to Author (E-mail: jdominguez@laselva.edu.mx)
† Researcher contributing as first author.

Introduction

Currently, one of the main concerns is the lack of professionals in the technological and scientific areas, therefore, it is not possible to meet the needs in jobs that meet the necessary skills to perform them. For this reason, throughout pedagogical history, changes have been made in curricula or initiatives in which various vocations have been developed. At the beginning of the 21st century, the aim has been to develop scientific and technological vocations, as well as competencies related to innovation, in order to improve educational quality and adapt to the changes of a competitive and changing society, with this purpose the STEAM (Science, Technology, Engineering, Art and Mathematics) methodology emerged.

One of the first theories underpinning STEAM methodology is the interdisciplinary theory of sociologist Louis Wirtz (1897-1952). The term interdisciplinarity appears for the first time in 1937, the prefix inter (between) is attributed to the sociologist Louis Wirtz, which indicates that between disciplines a relationship will be established, allowing the fact of incorporating the results of various disciplines from conceptual schemes of analysis. Therefore, according to Piaget, interdisciplinarity ceases to be something occasional and becomes the very condition for the progress of educational models (UNESCO, 1973). This theory proposes the training of students in scientific research activity, which implies the development of competencies, skills and values that foster independence, creativity and, in turn, promote knowledge. Therefore, we can say that the STEAM methodology is a structured learning that allows to address the solution of a problem, through the integration in a related way of the different disciplines that compose it, thus, allowing to respond to the proposed challenges of real problems in an interdisciplinary way (Echeverría, 2019) within a globalized and changing society.

On the other hand, the interdisciplinary learning of STEAM methodology is linked to the functional literacy approach. Yakman (2008) considers that the goal of education is to achieve functionally literate people, students who know how to learn and adapt to a rapidly changing environment. In addition, UNESCO promotes the change from traditional literacy programs to functional literacy programs in which, in addition to training in reading and writing, people are trained based on their environment, encouraging students to learn to learn for life, to learn to transform and intervene in reality. Likewise, the digital literacy approach is related to the STEAM methodology, this approach allows using technology as a communication or networking tool to locate, evaluate, use and create information with a critical sense. Undoubtedly, digital literacy allows us to develop skills to read and interpret the media, reproduce data and images through digital manipulation and evaluate and apply the new knowledge obtained in digital environments (UNESCO, 2011), which is why the accelerated growth of science and technological advances have been a challenge to education, so it can be said that this approach has generated a transformation not only in the way of presenting information, but also in everything related to the teaching and learning process.

For its part, the constructivist approach of the psychologist Piaget (1896-1980) is implicit in the interdisciplinary model that characterizes STEAM, Piaget proposed that the subject interacts with reality, constructing his knowledge and, at the same time, his own mind. Knowledge is never a copy of reality, it is always a construction. We can say that learning is an internal process, which is acquired through interaction with the environment that surrounds the student, hence the importance of providing spaces and educational resources that help promote their interlearning; therefore, it is imperative that the activities must contain a coherent structure, so that it is easily used by the student according to the experiences and contexts that surround him. In this way, we can affirm that the STEAM methodology, being under the constructivist approach, is an active methodology that promotes the construction of new ideas and where the most important thing is the process and not the result, promoting the construction of knowledge in a meaningful and collective way between student and teacher.

In addition, the STEAM methodology allows students to have an active participation during the development of the activities that are proposed, therefore, it is also linked to the interactive approach, according to Gutiérrez, Gómez and Gutiérrez (2018), the teacher designs a variety of learning activities where students participate in the process of developing knowledge and understanding, allowing them to reflect and practice using new knowledge and skills, in order to develop long-term learning and deeper understanding. From the above, we can indicate that the interactive approach allows learners to engage with and be aware of their own learning.

For its part, the interdisciplinary nature of STEAM methodology requires the integration of a final product so that the different disciplines converge; therefore, Project-based education (PE) is an approach that is linked to STEAM. PE has its first signs with the pedagogue and philosopher William Heard Kilpatrick (1871-1965) formally presenting his theory on project methodology in 1918, establishing that students should carry out research projects, and that these should be the center of the learning process. It is important to emphasize that the theoretical bases are centered on constructivism. Thus, we can assume that it is a model where students plan, implement and evaluate projects that have real-world application beyond the classroom. Likewise, Project-Based Learning generates contributions for the development of scientific and technological competencies, applying it in two to more areas of STEAM Methodology (Domènech-Casal, 2018).

One of the models used to awaken students' interest in scientific vocations is inquiry learning, this "is a dynamic process that consists of being open to experience amazement and perplexity, and getting to know and understand the world" (Gordón, 2001, cited by Vizcarra, 2022), therefore, it is necessary to design learning situations where students develop scientific competencies from the contents of textbooks (Fuentes, Puentes and Flórez, 2018). Therefore, the STEAM methodology provides an ideal scenario where it allows the development of student learning with a focus on inquiry, to address topics of Natural Sciences.

Background

Bautista (2021) conducted a monographic study, analyzing the validity and effectiveness of the STEAM model in education, as well as the barriers that prevent its application within the school context. Among his findings is that STEAM education is characterized by seeking meaningful learning, eliciting convergent thinking of students (common in STEM disciplines) and divergent thinking (common in the Arts), so he proposes to promote integrated learning of students and/or professional development of teachers.

Ortiz, Greca and Meneses (2021) under mixed methods, analyzed the effectiveness of integrated STEAM education as a possible way to improve the development of competencies in the primary education stage, responding didactically to the complexity of today's world. They found that the STEAM approach not only allows to respond from a didactic point of view to the complexity of today's world, but also constitutes a solid way to improve the development of student competencies, therefore, they affirm that the development of competencies requires a radical change in the way teachers and students conceive the teaching and learning processes, therefore, they propose that integrated STEAM education is one of the most potentially useful and beneficial methodological approaches for the acquisition of competencies demanded by the society of the 21st century.

In the case study developed by Campos et al., (2018), they concluded that the STEAM methodology allows students to be involved in their training, achieving significant learning for a globalized world, which not only requires technical preparation of excellence, but also allows future professionals not only to transform and transfer information into knowledge, but also, to develop in multidisciplinary teams where they face with leadership, critical thinking and creativity, the great challenges that today arise in the industry.

In the project conducted by Garza et al., (2018) conclude that, project-based learning from English Project Based Learning (PBL) facilitates interdisciplinarity and the integration of knowledge, crossing the barriers of fragmented knowledge of disciplines and subjects, being this a method where the student is the protagonist of his own learning, where learning knowledge has the same importance as the acquisition of skills and attitudes. Therefore, we must link PBL together with STEAM methodology to create knowledge and collaboration that allows us to link projects with the real world and provide solutions to the problems that society has.

Another relevant feature of STEAM is the use of active methodologies that contribute to better student performance; therefore, the implementation of a curriculum design based on STEAM that proposes the solution of real problems will allow the development of scientific creativity in students at an early age (Tran et al., 2021), Hsiao, Lin, & Hung, 2021), as well as the implementation of project-based learning will allow teachers to innovate in the planning and execution of activities for students to develop meaningful learning and initiate them in scientific literacy from basic education (Adriyawati et al., 2020). On the other hand, designing a didactic sequence in interdisciplinary subjects, integrating STEAM and Maker education, generates significant learning in students, due to the approach of real problems, increasing self-efficacy in the development of their activities by applying interdisciplinary knowledge (Jia, Zhou, & Zheng, 2021).

For Park, Byun, Sim, Han, & Baek, (2016) implementing STEAM education in classrooms involves providing time, administrative and financial support to teachers, as this type of education helps to develop creative learning in students.

Problem statement

Mexico lacks a scientific culture. In 2009 CONACYT conducted a survey and one of the results it found is that 86.3% of Mexicans trust faith and magic more than science to solve their problems (Aldana, 2009, cited by Martínez, 2019). The above, are regrettable data and this is due to the fact that there is no scientific culture, as indicated by De la Peña (2005), Mexicans accept that science is taught in schools, but they do not want their children to be scientists, in addition, in Mexico there are no educational policies that encourage STEAM skills Science, Technology, Engineering, Arts and Mathematics (Science, Technology, Engineering, Arts and Mathematics) from preschool, therefore, according to UNESCO data we have that in Mexico there are only 244 researchers per million inhabitants (Sandoval, 2019), having a false belief that scientists have boring and lonely lives.

On the other hand, the Organization for Economic Cooperation and Development (OECD) has designed a test to measure academic performance in mathematics, science and reading worldwide, through the Program for International Student Assessment (PISA) where Mexico demonstrates in the results obtained, a very serious lag in the areas being evaluated. The Ministry of Education has tried to implement initiatives and programs, however, these have had little progress.

Education in Mexico presents a large educational backwardness, Chiapas is one of the states that leads these statistics (Martín, 2017). The municipality of Ocosingo is located in the state of Chiapas, at the entrance of the Lacandon Jungle, in addition, it is one of the municipalities with the largest territorial extension within the state. According to data from the State Coordination of Continuing Education for In-Service Teachers (2020) of the Ministry of Education of the State of Chiapas, the percentage of teachers trained in pedagogical topics is very low in relation to the total number of teachers at the basic level, so that, for them, educational innovation is something complex to assimilate and above all to contextualize.

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Objective

The present research project aims to measure the impact of the STEAM methodology with a focus on information inquiry and the development of a project, on the academic performance of students in the learning of the Solar System in the subject of Natural Sciences in the 5th grade of elementary school.

Methodology

According to Hernández, Fernández and Baptista (2014), this research was conducted under a quantitative approach with a quasi-experimental design, with two paired groups, having STEAM methodology as an independent variable and academic performance as a dependent variable; therefore, the following hypothesis was proposed "The teaching of the Solar System under STEAM methodology with a focus on the inquiry of information and the development of a project, increases the academic performance of students in the 5th grade of the Elementary School Marcos Villanueva López of the city of Ocosingo, Chiapas. On the other hand, descriptive statistics are used to evaluate the application of the STEAM methodology.

The study sample was intentional and consisted of 40 students in the 5th grade of the Marcos Villanueva López Elementary School in Ocosingo, Chiapas. The sample of the study was intentional and consisted of 40 students in the 5th grade of the Marcos Villanueva López Elementary School in the municipality of Ocosingo, Chiapas, divided into two intact groups, with the teachers present only as observers during the study. The age of the students ranged from 10 to 11 years old, of whom 20 were male and 20 female. Table 1 shows the disaggregated data for both groups.

Group	Sex		Totals
	M	F	
A	10	10	20
B	10	10	20
Totals	20	20	40

Table 1. Students by sex and group.
Source: Research data, 2023

Instruments for data collection

For this study, the tests (pre-test and post-test) were designed with dichotomous questions, attached to the contents of the textbook of the Natural Sciences subject, in the topic of Block V. Description of the Solar System, these were validated in content by expert educators in the primary grade where the study was conducted; the reliability of the instrument was verified through the Kuder-Richardson coefficient (KR20) using RStudio software version 2022.07.1, yielding a value of 0.8314 located in the Very High magnitude range, being an instrument with Acceptable reliability coefficient (Ruíz, 2013). The results obtained by the students in both tests were converted into scores with a scale from 0 to 10, in order to perform a statistical test of difference of means to validate the hypothesis.

On the other hand, a two-dimensional survey was designed to know the perception of students on the implementation of the teaching of the Solar System under the STEAM methodology, this was validated in content by experts in educational research; the survey has 21 questions under the Likert scale with answers "Very much", "A lot", "Regular", "Little" and "Nothing", the reliability of the polychotomous instrument was calculated, through Cronbach's alpha, obtaining a value of 0. 9104 located in the Very High magnitude range, making it an instrument with an Acceptable reliability coefficient (Ruíz, 2013).

Development

The intervention was carried out in both groups, designing a didactic sequence centered on the student, which was developed in three phases:

Phase 1. Design

The researchers designed the intervention according to the topic: Description of the Solar System, from Block V of the SEP free textbook for 5th grade of elementary school, through the design of a didactic sequence to apply the STEAM methodology with a focus on the inquiry of information, therefore, the areas of this methodology were analyzed to implement it in the development of a group project.

Phase 2. Intervention

The researchers carried out the intervention to address the aforementioned textbook topic, using an interactive presentation and the NASA Solar System Exploration application.

Figure 1 Teacher intervention
Source: Research Images, 2023

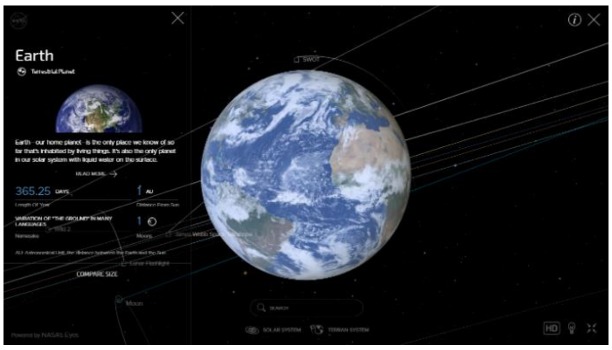

Figure 2 NASA Solar System Exploration application
Source: NASA (2023). Our Solar System. [Photograph]. https://solarsystem.nasa.gov/solar-system/our-solar-system/overview/

On the other hand, the students elaborated a homemade telescope for sky observation and made the representation of celestial bodies as part of the group project, with the help of the Arloon Solar System application, where they applied Science, Engineering, Arts and the use of Technology from the STEAM areas.

Figure 3 Construction of the homemade telescope
Source: Research Images, 2023

Figure 4 Arloon Solar System application
Source: Research Images, 2023

Figure 5 Representation of the celestial bodies of the Solar System
Source: Research Images, 2023

Finally, the students proceeded to assemble the Solar System in the classroom, applying mathematics in the calculation of the distances from the Sun to each of the planets, through an established scale, in addition, they presented what they had learned during the process to their classmates.

Figure 6 Assembly of the Solar System in the classroom
Source: Research Images, 2023

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Figure 7 Exhibition of what was learned during the development of the group project.
Source: Research Images, 2023

Phase 3. Data collection

During the sessions used for the intervention of the study, in the first session, the pre-test was applied to measure the students' previous knowledge about the Solar System; in various sessions in the intervention phase, the survey was applied for the study on the implementation of the STEAM methodology in the development of the group project; and in the last session, the post-test of the study was applied to obtain the results of the students' learning.

Figure 8 Application of the pre-test
Source: Research Images, 2023

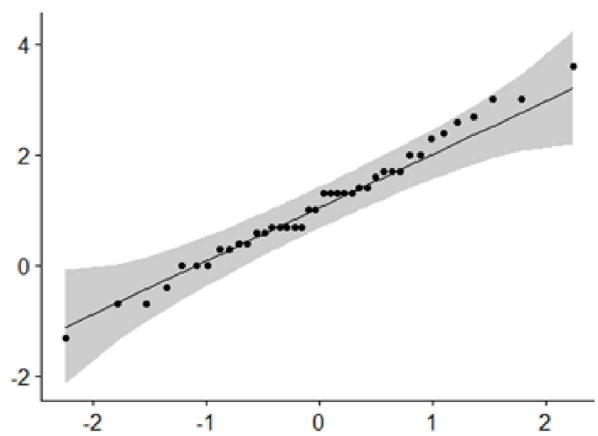
Figure 9. Application of the survey
Source: Research Images, 2023

Figure 10 Post-test application
Source: Research Images, 2023

Results

Instrument 1

To determine the hypothesis test to be used; first, the normality of the data was verified, through the Shapiro-Wilk test with RStudio software, where a value of $p = 0.9475$ was obtained, higher than the established significance level value of α=0. 05, concluding that the data behave normally, as shown in Graph 1; next, the equality of variances was verified through Fisher's test, obtaining a value of $p = 0.9838$ higher than the value of the established significance level of $\alpha=0.05$, indicating that the tests (pre-test and post-test) present equality of variances; therefore, the calculation of the t-Student test for dependent groups was performed.



Graphic 1 Quantile plot for the normality of the data
Source: Research images, 2023

Finally, for the validation of the research hypothesis, the t-Student test for dependent samples was performed, obtaining a value of p = 0.0033, which is lower than the established significance level of α=0.05, so it is concluded that there is a significant difference, rejecting the null hypothesis and accepting the hypothesis of this research, in which the teaching of the Solar System under the STEAM methodology significantly increases the academic performance of students in the 5th grade of elementary school in the elementary school Marcos Villanueva Lopez in the city of Ocosingo, Chiapas.

The above result agrees with the study conducted by Asrizal, Dhanil and Usmeldi (2023), who demonstrated that the use of STEAM increases the students' capacity in understanding the subject and improves their learning, in the teaching of science in elementary schools. Likewise et al., (2021) demonstrated that the use of augmented reality with STEAM improves students' learning in natural science in primary education.

Instrument 2

The results obtained from the instrument to know the students' perception of the implementation of the STEAM methodology with a focus on the inquiry of information and the development of a project, is divided into two dimensions; in the first dimension, the 5 Phases of the inquiry where the topic "Description of the Solar System" was addressed are analyzed; in the second dimension, the scientific vocation demonstrated by the students during this study is analyzed.

Dimension 1

Phase 1. Inquiry

In this phase the following questions were asked: Q1. How much do I know about our solar system?, Q2. How much do I know about the characteristics of the celestial bodies, that is, planets, moon, meteors, meteorites found in our solar system?, Q3. How much do I know about the instruments and techniques used to study the celestial bodies of our solar system?

Table 2 shows that 40% of the students have the perception of knowing regularly the characteristics of the celestial bodies of the Solar System and the instruments required to study them; however, 42.5% think they know a lot and very much about our Solar System, being the majority of the group.

Item	Very Much	Very much	Regular	A little	Not at all
P1	8	13	15	4	0
P2	4	16	14	5	1
P3	4	6	19	10	1
Total	16	35	48	19	2

Table 2 Perception of students in relation to the Inquiry Phase
Source: Research data, 2023

Phase 2. Development of the Inquiry

For this phase the following questions were asked: Q4. When I researched about our solar system, how clear was I about the information to look for, Q5. When I investigated about our solar system, how clear were the steps to follow to obtain the information?, Q6. How much information did I investigate about the characteristics of the celestial bodies of our solar system?

In Table 3, it is observed that 42.5% of the students have the perception of being very clear about the information to look for and the steps to follow to obtain it; however, there are 21.7% of the students who know how to carry out an information research.

Item	Very Much	Very much	Regular	A little	Not at all
P4	10	21	7	2	0
P5	11	15	13	1	0
P6	5	15	16	4	0
Total	26	51	36	7	0

Table 3 Perception of students in relation to the Inquiry Development Phase
Source: Research data, 2023

Phase 3. Organizing and structuring the Inquiry

For this phase, the following questions were asked: Q7. How well do I identify the shapes and colors of the celestial bodies of our solar system?, Q8. How well do I know the technological instruments used to study the celestial bodies of our solar system?, Q9. How well do I differentiate between the different ways of studying celestial bodies, for example, with the naked eye, a home telescope or a space telescope?

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Table 4 shows that 36.7% of the students have the perception that they have managed to identify a lot, the shapes and colors of the celestial bodies of the Solar System, the technological instruments used to study them and the ways in which they can be studied (with the naked eye, home telescope and space telescope), however, there are 20% who think that they identify a lot the characteristics, instruments and ways to study the celestial bodies, organizing the information in a poster, but 35% do it regularly.

Item	Very Much	Very much	Regular	A little	Not at all
P7	11	8	18	2	1
P8	7	16	14	2	1
P9	6	20	10	3	1
Total	24	44	42	7	3

Table 4 Students' perceptions regarding the Organizing and structuring the Inquiry Phase
Source: Research data, 2023

Phase 4. Results of the Inquiry

For this phase, the following questions were asked: Q10. How much did I learn how to handle the types of colors that exist and how to create them? Q11.With respect to the planet I built, how many characteristics and colors did I apply, Q12. With respect to the planet I built, how much did I learn about calculating distances to locate the planets in relation to the sun, Q13. How much did I collaborate as a team to build our giant solar system?

Regarding the results of this phase, where the students built the Solar System in the classroom and the construction of a homemade telescope, Table 5 shows that 37.5% of the students liked very much the handling of colors and how to create them, the amount of colors applied in the construction of their respective planet, knowing how to calculate distances to locate the planets in relation to the sun and how much they collaborated with their team, on the other hand, there is also 35.6% who said that they liked it very much.

Item	Very Much	Very much	Regular	A little	Not at all
P10	17	12	9	2	0
P11	15	16	6	3	0
P12	9	15	9	7	0
P13	16	17	3	4	0
Total	57	60	27	16	0

Table 5 Perception of students in relation to the Organizing and structuring the Inquiry Phase.
Source: Research data, 2023

Phase 5. Metacognition

For this phase the following questions were asked: Q14. How much did I enjoy investigating the information about our solar system?, Q15. How much did I learn to differentiate the sizes and dimensions of the planets?, Q16. How much did I learn to measure the distances between the sun and the planets? Q17. How much did I enjoy using art materials to color my solar system work?, Q18. How much did I enjoy building my telescope?, Q.19 When I presented my work to my classmates, how satisfied did I feel?, Q20. How enjoyable was it to work with my classmates?, Q21. How much relevant and important information about our solar system did I learn?.

In relation to this phase, it is the result of the learning obtained by the students, through the implementation of the STEAM methodology, in Table 6, it is observed that 41.9% have the perception that they liked very much to investigate, differentiate the sizes and distances between planets, the art material for coloring, the elaboration of the homemade telescope, the presentation to their classmates and collaboration with their work team, as well as the relevant and important information learned about the Solar System, and 37.8% liked very much the development of these activities to generate their learning.

Item	Very Much	Very much	Regular	A little	Not at all
P14	17	18	3	2	0
P15	8	20	10	2	0
P16	15	11	11	1	2
P17	32	8	0	0	0
P18	25	11	3	1	0
P19	12	17	10	1	0
P20	17	16	6	1	0
P21	8	20	9	3	0
Total	134	121	52	11	2

Table 6 Perception of students in relation to the Metacognition Phase
Source: Research data, 2023

Dimension 2

In this dimension, the scientific vocation developed by the students during this study was evaluated through the following questions: Q22. How curious and interested am I in learning what celestial bodies exist in our solar system?, Q23. How much do I observe the sky to see what happens in space?, Q24. How interested am I in learning about the professions dedicated to science and technology to study space?, Q25. By doing this work, how much did it allow me to think about what I want to do when I grow up, Q26. How much would I like to use technology to build things?

Table 7 shows that 46% are very curious to learn information about the celestial bodies of the Solar System, have frequently observed the sky to know what happens in space, have awakened interest in knowing what professions study the universe and what they would like to be when they grow up, as well as the use of technology to build things, likewise, there are 37% who thought on the scale of very much, being the great majority of the students.

Item	Very Much	Very much	Regular	A little	Not at all
P22	21	15	2	2	0
P23	12	16	11	0	1
P24	13	16	11	0	0
P25	19	16	4	1	0
P26	27	11	1	1	0
Total	92	74	29	4	1

Table 7 Perception of students in relation to scientific vocation
Source: Research data, 2023

Regarding the results obtained in question 25, it is observed that 87.5% made them think about what they would like to dedicate themselves to when they grow up, that is, they could work in professions dedicated to science, these results are similar to the study conducted by Muñoz (2020), when asking the question "*When I grow up, I want to study something that has to do with science*", within the group of questions to measure enthusiasm, he found that more than 50% of the students were enthusiastic about science.

Contrary case found by Verde et al., (2013), where they conducted a study to know the scientific perception at the end of primary education, it is highlighted that more than 77% would not like to dedicate themselves to the study of science, however, when asked the open question "*Explain how you usually worked in the class of Knowledge of the Environment?*" more than 59% mentioned that through the "*Traditional methodology (as usual, with the book doing exercises, the teacher explains, homework, nothing, studying)*" and "*Neither experiments nor outings*", so implementing the STEAM methodology is an opportunity for the development of scientific vocations from primary education.

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Conclusions

The results obtained in the study show that using the STEAM methodology with a focus on the inquiry of information and the development of a project, allows to increase the academic performance of students in the teaching of the Solar System, due to the interdisciplinary nature of the areas of this methodology, in addition to the development of communication skills and teamwork.

The perception obtained from the students during the phases of the inquiry shows that 30.6% liked learning through this methodology very much, 37% liked it very much, 24.4% liked it regularly, 7.1% liked it a little and 0.8% did not like it. 8% did not like it; therefore, it is concluded that this type of methodology can be applied in the learning of the Solar System in the fifth grades of elementary school, in addition, it offers the possibility of being implemented in lower and later grades, through the inquiry of information and the development of a large-scale group project.

Therefore, the implementation of this methodology requires a change in the attitude of elementary school teachers to be trained in the use of current pedagogical strategies and the inclusion of ICT in the classroom, which allows exploring situations that cannot be contextualized daily in a classroom, since several studies have shown an increase in learning, creativity, critical thinking, communication and teamwork of students.

Federal and State Education Authorities are urged to make joint efforts to provide training to teachers for teaching under STEAM methodology, inquiry-based learning and project-based learning and implement them in the classroom, in order to develop scientific skills and abilities at an early age, and increase scientific development in Chiapas and Mexico, as well as, in the future, to increase the number of scientists in our country.

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