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Evaluación de habilidades en la metodología STEM para estudiantes de bachillerato técnico de la Unidad Educativa Alfonso Quiñonez George

Evaluation of skills in the STEM methodology for technical high school students of the Alfonso Quiñonez George Educational Unit

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Palabras claves:
STEAM, Evaluación Educativa, Bachillerato Técnico, Habilidades Técnicas.

Resumen

Introducción. Esta investigación pretende abordar un análisis exhaustivo de las prácticas educativas implementadas en instituciones que adoptan el enfoque STEAM en el nivel de bachillerato técnico. **Objetivo.** El objetivo principal fue el de evaluar habilidades técnicas en la metodología STEAM para estudiantes de la Unidad Educativa Alfonso Quiñonez. **Metodología.** La investigación adoptó un enfoque cuasiexperimental, aprovechando una experiencia pasada en la que los estudiantes se expresaron sobre la percepción de experiencia vivida bajo un proyecto de aula STEAM. Utilizando un diseño de tiempo en corte transversal, se creó una base de datos que fue analizada con SPSS, centrándose en evaluar los resultados de aprendizaje. Basada en un método inductivo, se utilizó una encuesta con una matriz de 10 preguntas estructuradas en escalas Likert, validadas con un alto Alfa de Cronbach de 0,891/1. La muestra consistió en 155 estudiantes de bachillerato que participaron en la utilización de la metodología STEAM durante el último bimestre del año lectivo 2023-2024. Este enfoque permitió examinar cómo los estudiantes percibían el uso de la metodología, proporcionando información valiosa sobre sus beneficios y desafíos. **Resultados.** La investigación contribuye a mejorar las prácticas educativas al identificar los efectos del STEAM en la enseñanza y ofrece perspectivas para futuras investigaciones en el campo educativo. **Conclusión.** Se llegó a la conclusión de que el STEAM es percibido como usable y beneficioso por estudiantes de bachillerato. Su uso está asociado positivamente con el desarrollo de habilidades en el aprendizaje, destacando su relevancia en la educación contemporánea. **Área de estudio general:** Educación. **Área de estudio específica:** Pedagogía formación técnica profesional.

Keywords:
STEAM, Educational Assessment, Technical Baccalaureate, Technical Skills

Abstract

Introduction. This research aims to address a comprehensive analysis of the educational practices implemented in institutions that adopt the STEAM approach at the technical high school level. objective. The main objective was to evaluate technical skills in the STEAM methodology for students of the Alfonso Quiñonez Educational Unit. Methodology. The research adopted a quasi-

experimental approach, taking advantage of an experience in which students expressed themselves about the perception of their lived experience under a STEAM classroom project. Using a cross-sectional time design, a database was created that was analyzed with SPSS, focusing on evaluating learning outcomes. Based on an inductive method, a survey was used with a matrix of 10 questions structured in Likert scales, validated with a high Cronbach's Alpha of 0.891/1. The sample consisted of 155 high school students who participated in the use of the STEAM methodology during the last two months of the 2023-2024 school year. This approach allowed us to examine how students perceived the use of the methodology, providing valuable information about its benefits and challenges. Results. The research contributes to improving educational practices by identifying the effects of STEAM on teaching and offers perspectives for future research in the educational field. Conclusion. It was concluded that STEAM is perceived as usable and beneficial by high school students. Its use is positively associated with the development of learning skills, highlighting its relevance in contemporary education. General study area: Education Specific study area: Pedagogy Vocational Technical Training.

Introduction

The research is reflected in the question of how effective is learning in technical high schools that use the STEAM method? In the contemporary educational field, the emphasis on the integration of STEM disciplines (science, technology, engineering, and mathematics) has generated notable interest in the academic and educational community (Hamad et al., 2024). However, the inclusion of art within this paradigm has given rise to the STEAM method, which promotes a holistic and interdisciplinary approach to learning (Siby et al., 2024). In the context of technical high schools, where preparation for the labor market is essential, the question arises: How effective is learning in technical high schools that use the STEAM method?

This research aims to address this issue through a comprehensive analysis of educational practices implemented in institutions that adopt the STEAM approach at the technical baccalaureate level. For Yang et al. (2024), through a multidimensional approach, the impacts of this method on various aspects of learning will be explored, including academic performance, the development of technical and creative skills, student motivation and their preparation for working life.

The integration of art within the STEM curriculum seeks to foster creativity, innovation and problem-solving, essential skills in an increasingly complex and technologically advanced world (Vaiopoulou et al., 2024). However, rigorous evaluation is still required to fully understand the impact and effectiveness of this approach, especially in specific contexts such as technical baccalaureate (Ješková et al., 2024).

Through this research, we seek to contribute to the existing body of knowledge in the educational field, providing empirical evidence on the benefits and challenges associated with the implementation of the STEAM method in technical high school. Rodríguez et al. (2024), say that this can not only inform educators and policy makers, but also inspire innovative pedagogical practices that promote more effective and meaningful learning at this crucial educational level.

The problem that is intended to be addressed is the lack of a clear understanding about the effectiveness of the STEAM method in technical high school. Although the STEAM approach has gained popularity as a strategy to foster creativity, innovation and interdisciplinary integration in education, there is still a gap in knowledge about how this specific approach affects learning in the context of technical high school (Črnjarić & Trubić, 2024).

In particular, there is a lack of robust evidence demonstrating the tangible impacts of the STEAM method in key areas such as academic performance, technical and creative skills development, student motivation and their readiness for the world of work (Vaiopoulou et al., 2024). The lack of understanding on these aspects may limit the ability of educators and policy makers to make informed decisions on the implementation and development of STEAM-based educational programmes in technical high schools (Effendi et al., 2024).

Therefore, this research seeks to address this problem through a comprehensive analysis of educational practices in institutions that use the STEAM method in technical high school, with the aim of providing a comprehensive assessment of its effectiveness and its potential implications for improving learning at this educational level.

The importance of presenting this research on the STEAM method in technical high school is of utmost importance in the contemporary educational field. This approach, which integrates Science, Technology, Engineering, Art and Mathematics, has emerged as an innovative pedagogical strategy that promotes creativity, problem solving and interdisciplinarity in the learning process (Evagorou, 2024). However, its specific application in the context of technical high school requires rigorous evaluation to understand its impact and effectiveness.

First, technical baccalaureate plays a fundamental role in preparing students for the labour market, providing specialized skills and knowledge in technical and vocational areas (Gumbi et al., 2024). In a constantly evolving economic and technological environment, it is crucial to ensure that educational programs at this level are effective and relevant to the demands of the current and future labour market (Hamad et al., 2024). Research on the STEAM method in technical baccalaureate can provide valuable insights to improve the quality of technical education, equipping students with the skills necessary to succeed in an increasingly competitive and technologically advanced world of work (Tapullima-Mori et al., 2024).

Second, research in this field can inform educational decision-making by providing empirical evidence on the benefits and challenges associated with the implementation of the STEAM method (Toma et al., 2024). The results of this research can guide educators, school administrators, and policymakers in optimizing resources and designing more effective pedagogical interventions. This can lead to the improvement of educational programs, the training of teaching staff, and the adoption of policies that promote the successful integration of the STEAM method in technical high schools (Su et al., 2024).

Third, research on the effectiveness of STEAM in technical high schools can foster educational innovation by inspiring new and more effective pedagogical practices (Chinenye & Legg-Jack, 2024). This approach promotes creativity, collaboration, and problem-solving, essential skills in a globalized and ever-changing world. By presenting solid evidence on the positive impacts of the STEAM method on student learning, initiatives can be promoted that transform the way teaching and learning takes place in technical high schools, preparing students to face the challenges of the 21st century (Bedgood et al., 2024).

Research in this field contributes to the advancement of academic knowledge by providing new empirical data and perspectives on the integration of interdisciplinary approaches in technical and vocational education. This can inspire future research and promote broader academic dialogue on the importance of creativity, innovation and interdisciplinarity in the educational process.

The relevance of this study lies in its ability to address a significant gap in contemporary educational knowledge and provide a deeper understanding of the effectiveness of the STEAM method in technical high school. This interdisciplinary approach, which integrates Science, Technology, Engineering, Art and Mathematics, has emerged as an innovative pedagogical strategy that seeks to foster creativity, problem solving and interconnection between various disciplines (Saphira et al., 2024).

However, its specific application in the technical baccalaureate context has not yet been widely researched, creating an urgent need for empirical analysis to inform both educational practice and policymaking.

The relevance of this study is based on several key reasons. First, technical baccalaureate plays a critical role in preparing students for the labour market, providing them with specialized skills and knowledge in technical and professional areas. According to Alrwaished (2024), in a constantly changing economic and technological environment, it is essential to ensure that educational programmes at this level are effective and relevant to the demands of the current and future labour market.

By investigating the effectiveness of the STEAM method in technical high school, this study can provide valuable information to improve the quality of technical education and better prepare students for a successful career in STEM-related fields (Gumbi et al., 2024).

Secondly, the relevance of this study lies in its potential to inform educational decision-making at institutional and governmental levels. The research findings can guide educators, school administrators, and policymakers in optimizing resources and designing more effective pedagogical interventions. This can lead to the improvement of educational programs, the training of teaching staff, and the adoption of policies that promote the successful integration of the STEAM method in technical high school (Evagorou, 2024).

Furthermore, the relevance of this study extends to its ability to foster educational innovation by inspiring new and more effective pedagogical practices. The STEAM method promotes creativity, collaboration, and problem-solving, essential skills in an increasingly complex and technologically advanced world. By investigating its specific impact on technical high school, this study can identify innovative approaches that transform the way teaching and learning are done at this educational level, preparing students to face the challenges of the 21st century with confidence and competence.

The object of the research focuses on examining the effectiveness of the STEAM method (science, technology, engineering, art and mathematics) in the specific context of technical high school. This interdisciplinary approach, which fuses STEM disciplines with art, has gained recognition as an innovative pedagogical strategy that seeks to foster creativity, problem solving and the integration of knowledge in various fields. The purpose of this research is to explore how the implementation of the STEAM method impacts the learning process and the development of skills in technical high school students.

The research aims to analyse the STEAM method in relation to several key aspects of learning in technical high schools. Firstly, it aims to examine how the integration of STEM disciplines with the arts influences students' academic performance. This involves assessing whether the STEAM approach improves the understanding of scientific and mathematical concepts, as well as the ability to apply this knowledge in real and multidisciplinary contexts.

Furthermore, the object of the research includes the exploration of how the STEAM method impacts the development of technical and creative skills in technical high school students. The aim is to understand whether this approach promotes the acquisition of specific technical skills, such as programming, design or manufacturing, while stimulating creativity and innovation in solving problems related to the technical field.

Another fundamental aspect of the research object is to analyze how the implementation of the STEAM method affects students' motivation and commitment to learning. The aim is to determine whether the inclusion of art and interdisciplinarity in the technical high school curriculum increases students' interest in STEM subjects, as well as their willingness to actively participate in educational activities and practical projects.

Furthermore, the object of the research includes the evaluation of how the STEAM method prepares technical high school students for the world of work and professional life. The aim is to analyse whether this approach provides students with the skills and competencies necessary to face the challenges and demands of today's labour market, which increasingly values creativity, the ability to solve complex problems and the ability to work in multidisciplinary teams.

The aim of the research is to examine the effectiveness of the STEAM method in technical high school, analysing its impact on academic performance, the development of technical and creative skills, student motivation and their preparation for the world of work. By focusing on these aspects, the research seeks to provide a deeper understanding of how the integration of art with STEM disciplines can influence the learning process and the comprehensive development of students in the specific context of technical high school.

The objective of this study was to evaluate technical skills in the STEAM methodology for students of the Alfonso Quiñonez Educational Unit.

Methodology

The methodology applied in this research adopted a quasi-experimental approach, taking advantage of a past experience or a specific event in which students were faced with a different teaching methodology such as STEAM, in an academic unit that had not previously used this modality. This approach is aligned with a cross-sectional time design, which seeks to capture data from a single instance in time. To carry out this study, a

database was created that was subsequently analyzed using the statistical software SPSS. In this process, it focused on the measurement of two main variables: STEAM teaching, technical skills.

The research was based on an inductive method, which starts from specific data obtained through the survey technique to derive general conclusions about STEAM Teaching, technical skills. This approach allows to explore and understand educational phenomena from the students' perspective, based on their experiences and perceptions.

The main instrument used in this research was a matrix of 10 questions designed to assess the usefulness and accessibility of the virtual classroom. These questions were structured using Likert scales, which offer respondents the opportunity to express their degree of agreement or disagreement with respect to different statements related to the online learning platform. The questions were grouped into sets of 5, corresponding to the two main variables of the study: the independent and the dependent. Cronbach's alpha accredited its effectiveness and validation with 0.891/1.

The study population, which also served as a sample, consisted of 155 high school students who participated in the use of the STEAM method during the last two months of the 2023-2024 school year. These students were selected due to their direct relevance to the study topic and their practical experience with the online learning platform in the specific context of learning technical knowledge.

The quasi-experimental approach adopted in this research allowed us to examine the effects of STEAM on technology learning in an educational environment previously unfamiliar with this modality. By focusing on the evaluation of the usefulness and skills developed, it was possible to identify how students perceived and used this tool in their learning process. The results obtained from the data analysis provided valuable information on the benefits and challenges of the hands-on approach, which can contribute to improving educational practices in the future.

Variables and Dimensions

The relationship between the designed questions and the variables of interest regarding the use of the STEAM (Science, Technology, Engineering, Art and Mathematics) approach in learning is established. In this context, the independent variable is the use of STEAM, and the related specific objective is to identify its usability. The questions posed seek to evaluate various dimensions of this usability, including interest, accessibility, ease of use, accessibility for students with different skill levels and its impact on learning.

On the other hand, the dependent variable is the perception of learning skills, with a specific objective of evaluating this perception. The questions associated with this variable explore how the use of STEAM influences the understanding of concepts, the

practical application of knowledge, the usefulness of the resources provided, confidence in technical skills and the enrichment of learning.

As with the independent variable, responses are categorized on a five-point Likert scale: Strongly Disagree, Disagree, Indifferent, Agree, and Strongly Agree.

Table 1

Relationship between questions and variables

Variables	Specific objective	Questions	Categories
Independent: use of STEAM	Identifying STEAM usability	I found the STEAM method very interesting to learn STEAM allowed me to access educational learning. I find the STEAM approach easy to use. I find STEAM accessible to students of all skill levels. I think STEAM significantly improves my learning. Using STEAM improves my understanding of the concepts I was taught. I find that STEAM facilitates my ability to apply knowledge in practice.	1. Strongly disagree2. Disagree.3. Indifferent4. Agree5. Strongly agree
Dependent: Learning skills	Assessing the perception of learning skills	I believe that STEAM provides useful resources for solving problems in the classroom. STEAM increased my confidence in my technical skills. I feel that STEAM enriches my learning.	

The table shows the evaluation of the usability of the STEAM method and its impact on students' learning abilities. For the independent variable "use of STEAM", the questions address various facets of its usability, such as the interest generated, accessibility to learning, ease of use, accessibility for students with different ability levels, and improvement of learning. The results indicate that most students agree or strongly agree that the STEAM method is interesting and facilitates access to educational learning. However, some responses show variability in the perception of ease of use and accessibility of STEAM for students with different ability levels.

Regarding the dependent variable "learning skills", the questions focus on how STEAM affects the understanding of concepts, the practical application of knowledge, the

usefulness of resources to solve problems, confidence in technical skills, and the enrichment of learning. The results reflect a mostly positive perception, with a significant tendency towards the categories "Agree" and "Strongly agree", suggesting that the use of STEAM significantly improves students' learning skills and enriches their educational experience.

Descriptive results

The first data to be analyzed is the descriptive data, which is presented in Table 1.To analyze the percentage table provided, we can observe the general trends of the "Against" = (and "In favor" = (responses for each of the questions in relation to the use of STEAMΣ$muy\ desacuerdo + desacuerdo$)Σ $De\ acuerdo + Muy\ de\ acuerdo$)

Table 2

Descriptive data

Questions	Coding	Strongly disagree	Disagreement	**Against**	OK	I totally agree	**In favor**
1) Using STEAM improves my understanding of the concepts I was taught.	VD1	5.2%	41.3%	**46.5%**	42.6%	8.4%	**51.0%**
2) I find that STEAM facilitates my ability to apply knowledge in practice.	VD2	15.5%	10.3%	**25.8%**	32.9%	18.1%	**51.0%**
3) I believe that STEAM provides useful resources for solving problems in the classroom.	VD3	18.1%	23.2%	**41.3%**	34.8%	11.0%	**45.8%**
4) STEAM increased my confidence in my technical skills.	VD4	28.4%	18.1%	**46.5%**	16.1%	34.8%	**51.0%**

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Table 2

Descriptive data(continuation)

Questions	Coding	Strongly disagree	Disagreement	**Against**	OK	I totally agree	**In favor**
5) I feel that STEAM enriches my learning.	VD5	28.4%	31.0%	**59.4%**	12.9%	27.7%	**40.6%**
1) I found the STEAM method very interesting to learn	VI1	20.6%	36.1%	**56.8%**	16.1%	21.9%	**38.1%**
2) STEAM allowed me to access educational learning.	VI2	10.3%	36.1%	**46.5%**	27.1%	11.0%	**38.1%**
3) I find the STEAM approach easy to use.	VI3	18.1%	23.2%	**41.3%**	18.7%	5.8%	**24.5%**
4) I find STEAM accessible to students of all skill levels.	VI4	5.2%	33.5%	**38.7%**	29.0%	21.9%	**51.0%**
5) I think STEAM significantly improves my learning.	VI5	31.0%	20.6%	**51.6%**	2.6%	43.2%	**45.8%**

After analyzing the results of the survey conducted with high school students, several important interpretations can be drawn about the students' perception regarding the STEAM method. Firstly, it is evident that there is a majority favourable tendency towards the STEAM method in most of the questions. For example, more than 50% of students are in favour of using STEAM to improve their understanding of the concepts taught (51%), facilitate their ability to apply knowledge in practice (51%), increase their confidence in related technical skills (51%), and find STEAM accessible to students with different ability levels (51%). These results suggest that most students see the STEAM method as an effective tool to improve their learning and develop practical technical-related skills.

However, there are also some reservations and discrepancies in students' responses. For example, although more than 50% of students are against the claim that STEAM enriches their learning (59.4%), a significant percentage are still in favour (40.6%). This result suggests that while most students see benefits in the STEAM approach, there is also a considerable proportion who are not convinced of its enriching added value.

Furthermore, it is important to note that responses vary depending on the specific question. For example, although over 50% of students consider that STEAM facilitates their ability to apply knowledge in practice (51%), only 25.8% disagree with this statement. This suggests that there is greater acceptance and agreement among students about the practical usefulness of STEAM compared to other aspects, such as learning enrichment.

Regarding the ease of use and accessibility of the STEAM method, the results show that there is a division of opinions among students. For example, while more than 50% of students are in favour of the statement that STEAM is accessible to students with different ability levels (51%), there is a significant proportion who disagree (38.7%). Similarly, regarding the perception of the ease of use of the STEAM approach, the percentage of students against (41.3%) is considerably higher than those in favour (24.5%).

The survey results reflect a generally positive perception towards the STEAM method among high school students, with a majority recognizing its benefits in terms of understanding concepts, practical application of knowledge and development of technical skills. However, some areas of concern are also highlighted, such as the lack of consensus on the enrichment of learning and the perception of STEAM's ease of use and accessibility.

Correlation results

For correlation analysis, the mathematical operation of adding variables was performed. Thus, considering the coding:

For independent variable is IV = $(\Sigma VI1 \ldots . VI5)/5$. (1)

For dependent variable is VD = . (2)$(\Sigma VD1 \ldots . VD5)/5$

Table 3

Correlation of variables

Spearman's Rho	Dependent variable: learning skills	Independent variable: use of STEAM
Independent variable: use of STEAM	1,000	,845**
Dependent variable: learning skills	,845**	1,000

Spearman's correlation analysis between the independent variable "Use of STEAM" and the dependent variable "Learning Skills" shows a positive and significant correlation with a coefficient of 0.845**. This indicates that there is a strong relationship between these two variables, suggesting that as the use of STEAM increases, the level of students' learning skills also tends to increase.

The Spearman correlation coefficient value of 0.845** indicates a very strong positive correlation between the two variables. This value close to 1 suggests that there is a significant and consistent association between STEAM use and the level of student learning skills. In other words, the data suggest that as STEAM use increases, students' learning skills are likely to increase as well in the assessed context.

It is important to note that the "**" symbol indicates that the correlation is significant at the 95% confidence level or higher, further confirming the robustness of the relationship between the variables. This suggests that the relationship between STEAM use and learning skills is very unlikely to be the result of chance.

This result has important implications for educational practice and policy formulation. It indicates that the use of STEAM can have a positive impact on the development of students' learning skills. Therefore, promoting the effective implementation of STEAM in the educational curriculum could be a valuable strategy to improve students' learning skills.

However, it is important to remember that correlation does not imply causation. Although these results suggest that there is a significant relationship between STEAM use and learning skills, we cannot conclude that STEAM use directly causes an increase in learning skills. Other factors could be contributing to this relationship, and further research, such as longitudinal studies or controlled experiments, would be needed to establish causality with greater certainty.

Spearman correlation analysis indicates a positive and significant relationship between STEAM use and students' learning skills. These findings underline the importance of

STEAM in developing learning skills and suggest that its effective implementation could significantly benefit students in their educational process.

Discussion

The discussion of the results obtained from the last two tables analyzed offers an in-depth insight into the perception of high school students regarding the STEAM method and its correlation with the development of learning skills. These results are relevant in the current educational context, where there is a search to promote innovative pedagogical approaches that foster creativity, interdisciplinarity and the development of practical skills among students. These results are discussed in detail below, highlighting their implications and possible areas for improvement.

First, the survey results show a general trend towards a positive perception of the STEAM method among high school students. Most students express their support for using STEAM to improve their understanding of concepts, apply knowledge in practice, solve problems in the classroom, and increase their confidence in technical-related skills. These findings suggest that the STEAM method is widely recognized by students as an effective tool to enhance their learning and skill development.

However, there are also some areas of concern and discrepancy in student responses. For example, although the majority of students are in favour of using STEAM to enhance their understanding of concepts, a considerable percentage are still against it. Similarly, although the majority are in favour of using STEAM to apply knowledge in practice, some students express a contrary opinion. These discrepancies could indicate a lack of consensus or complete understanding among students about the benefits and applications of STEAM in the educational context.

Furthermore, the results show that some students have reservations about the ease of use and accessibility of the STEAM method. Although the majority agree that STEAM is accessible to students with different ability levels, a significant percentage of students express doubts about the ease of use of the STEAM approach. This suggests that although students recognize the importance and usefulness of STEAM, they may face challenges in its effective implementation due to perceived barriers in terms of accessibility and ease of use.

On the other hand, the results of the Spearman correlation between STEAM use and the development of learning skills offer valuable information about the relationship between these two variables. The positive and significant correlation coefficient indicates a strong association between STEAM use and the level of students' learning skills. This finding suggests that as STEAM use increases, students' learning skills also tend to improve.

These results are consistent with existing literature supporting the benefits of the STEAM approach in developing practical, creative, and problem-solving skills among students. The interdisciplinary approach of STEAM provides students with opportunities to apply knowledge in real-world contexts, thus fostering more meaningful and transferable learning. Furthermore, integrating art and creativity into the STEAM curriculum can increase student motivation and engagement, promoting a more stimulating and enriching learning environment.

However, it is important to note that correlation does not imply causation. Although the correlation results suggest a positive relationship between STEAM use and the development of learning skills, we cannot conclude that STEAM use directly causes an increase in these skills. Other factors, such as the quality of STEAM implementation, the educational context, and individual student characteristics, could be contributing to this relationship and should be considered in future research.

Furthermore, it is important to acknowledge the limitations of this study. The survey relies on self-reported perceptions of students, which may be subject to response bias and measurement error. Furthermore, the sample may not be representative of the broader student population, limiting the generalizability of the results. Future research could benefit from a longitudinal design that allows for examining how STEAM use impacts skill development in learning over time, as well as qualitative studies that delve deeper into the experiences and perspectives of students and educators.

The results of this study suggest that the STEAM method is perceived favorably by high school students and is positively associated with the development of skills in learning. These findings have important implications for educational practice, highlighting the importance of promoting innovative pedagogical approaches that foster creativity, interdisciplinarity, and the development of practical skills among students. However, further research is required to fully understand the underlying mechanisms of this relationship and to address potential limitations of the study.

Conclusions

- The usability of STEAM in the educational context has been identified as favourable according to the perception of high school students. The results of the survey indicate that most students find the STEAM method useful and accessible for their learning. This suggests that STEAM can be effectively implemented in the classroom, providing students with tools and resources that facilitate their learning process.
- The assessment of perceived learning skills reveals that STEAM use is positively associated with the development of these skills among high school students. Spearman correlation findings show a significant relationship between STEAM

use and students' level of learning skills. This indicates that the STEAM approach can contribute to the development of practical, creative and problem-solving skills among students, thus enhancing their ability to learn effectively.

- In conclusion, the results obtained suggest that STEAM is a valuable tool in the educational context, both in terms of usability and impact on the development of learning skills. These findings support the importance of promoting innovative pedagogical approaches that integrate STEM disciplines with art, providing students with opportunities to explore, experiment and learn in an interdisciplinary way. However, it is important to recognize that further research is needed to fully understand the underlying mechanisms of this relationship and to address potential limitations of the study.

Conflict of interest

The authors declare that there is no conflict of interest in the development of this study.

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