Journal Impact Factor (JIF)™ 2022: 0.2 | 5 Year: 0.2 | *Source: Journal Citation Report™ 2023 (Clarivate Analytics)*

RUPKATHA JOURNAL ON INTERDISCIPLINARY STUDIES IN HUMANITIES

ISSN 0975-2935 | Indexed in the Web of Science Core Collection™ Emerging Sources Citation Index (ESCI)

https://doi.org/10.21659/rupkatha.v15n3.11 | Volume 15, Number 3, 2023 | Dynamic Impact Dimensions

Research article

The Interrelation of Art, Science, and Technology from a Cognitive Dimension: Art as a Way of Knowledge and the STEAM Methodology as the Answer

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Abstract

The interrelation between art and science can be understood as a dialogue that emerges from the process of knowledge construction, and consequently, it also defines the human being. The idea may be legitimated from a cognitive perspective. What if we consider this dialogue on the art/science split not as a model of knowing in itself, but as a constructed concept? Thinking as a construct, the advent of technology could have supposed an element to accentuate the divide in this dialogue, as an emerging techno-society may have deepened this separation. However, there is a need to explore the arts -and humanities- trying to find some answers to the challenges posed by the digital paradigm. For this reason, the inclusion of the letter "A" of Arts in the STEM dialogue, resulting in STEAM, is not accidental. From this approach, the entrance of the STEAM methodology into educational models is going to be addressed from the cognitive dimension of art, as a consequence of the conceptual, social, and cultural changes that give it meaning. For that purpose, the issue is addressed through the art cognitive dimension as the theoretical and conceptual foundation supporting it and that leads to the analysis of the named methodology and its contemporary necessity.

Keywords*:* Art; Science; Technology; Education; Cognition.

SUSTAINABLE DEVELOPMENT GOALS **Quality Education**

1. Introduction

Creativity, intuition, innovation, and sensoriality, we may start asking if these concepts are not dimensions that also concern scientists and the scientist processes. Are they not proper human dimensions? Are they not in themselves mental processes of every human being, regardless of

Article History: Received: 27 December 2022. Revised: 08 August 2023. Accepted: 09 August 2023. Published: 26 August 2023.

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Citation: Escribano-Belmar, Beatriz, Raquel Caerols-Mateo, Reynaldo Thompson. 2023. The Interrelation of Art, Science, and Technology from a Cognitive Dimension: Art as a Way of Knowledge and the STEAM Methodology as the Answer. *Rupkatha Journal* 15:3. https://doi.org/10.21659/rupkatha.v15n3.11

whether they are artists or scientists? And could the art/science bifurcation be defended from the cognitive sciences or only from philosophical or sociocultural constructs?

Trying to answer these questions leads to a fundamental basis of this study in order to support or justify the emergence and the need for the STEAM methodology in contemporary education. In relation to these issues, scientific creation is not essentially a confluence of rational and external forces, but a process in constant relationship with the forms of social, artistic, and cultural life.

For this reason, in the first place, this text will address the question of the divisions and/or relationships between art, science and technology. To what extent are they independent of each other in the construction of their knowledge, or are they built from their interaction, from their feedback? To this end, the research begins by addressing how the theory of knowledge or epistemology has shaped different ways of knowing to arrive at knowledge. To what extent can a split of knowledge be justified, or can it only be achieved from the fusion of its own constructs?

But another question arises: what is knowing versus knowledge, versus epistemology? If we start by considering that cognition is action and, therefore, it is the ability to learn and gather information from different cognitive processes, it could be stated that knowledge models should respond to these processes and approach knowledge. From there, the necessary symbiosis between art, science and technology could be justified, even more so in a digital context.

By addressing the nature of the different paradigms of knowledge and how they have been formed, their genesis, and the initial approach to the dialogue between art, science, and technology, one would be in a position to provide the first answer to support the sense of the STEAM methodology and its necessary presence in a digital contemporary setting.

However, to face this task, the limits of the birth of modern thought will be established as a starting point for the study of knowledge models. It is a humanist paradigm of the fusion of art, science, and technology and the science of art. Once this framework has been described, it will be then that this study delves into the STEAM model, drawing its meaning from the field of educational sciences.

2. The Interrelation of Art, Science, and Technology: Transcending Boundaries or a Constructed Division?

The history of knowledge has been shaped by models of knowledge that have either distanced or brought art and science closer in the process of shaping ways of knowing and/or approaching reality. However, upon analysing the paradigms of knowledge that have emerged since the birth of modern thought, it becomes evident that these models converge and integrate in response to the concerns and questions of a given era. This leads to the fact that the division art/science is, in therefore, a construct rather than the conformation of human thought:

> Thus, art and science are inscribed in a common epistemological system where, from the specificity of their field, each one responds to the questions that the general system formulates, being therefore closer than one might initially think for being two different manifestations of the same desire to know. Looking at the keys to knowledge of each era,

> we can see that there is a relationship between art and science that is essential and constitutive for both. (Carretero, 2004, n.p.)

Therefore, to support these claims, it is essential to analyze the epistemological models that have shaped the history of modern thought. The birth of modern thought is marked by the interrelation of art, science, and technology, which was widely recognized by the scientific community as a purely humanistic period. This designation already offers the initial clue to understanding the genesis of knowledge during this period, where knowledge was built through the convergence of knowledge, various disciplines:

> It was in the thirteenth century that artists did occasionally abandon their pattern book altogether, in order to represent something because it interested them. We can hardly imagine today what this meant. We think of an artist as a person with a sketchbook who sits down and makes a drawing from life whenever he feels inclined. (Gombrich, 1999, p.141)

Thus, the great shift towards Modernity began. In this concise description by Gombrich, which may appear as a simple gesture, a new era unfolded for humanity, the era of modern thought. The artisans of that time ceased to merely copy and reproduce exiting schemes. Instead, they took it upon themselves to observe nature directly, as a way of knowing and posing questions about the reality that surrounded them.

They began to question and examine, equipping themselves with the means, tools, instruments, technologies of their time, as well as methods to face the analytical observation of reality. And was not one of those the linear perspective? A scientific approach to observe developed by artists like Brunelleschi, who utilized contemporary technologies such as lenses and mirrors. Technology does not only have to do with the mechanized, with the automatic, but is the result of applied science. This is, without doubt, an example of the necessary interplay between art and science, where the science of art is formed:

> It is here that Brunelleschi responds to a desire to understand nature, reality, and the world. His answer is a method to study objects; linear perspective is the result of a study of the object (of Florentine architecture in the case of Brunelleschi), which is placed as a reference to know reality. This moment can be seen as a new paradigm, the *Objective Vision Paradigm*. (Caerols-Mateo, 2013, p. 27)

This model was formed and configured as an art-science feedback and thus showing that the turns in thought have also been turned in the creative processes in art.

"I don't seek, I find" proclaimed Picasso, and this marked a second turning point in Modernity, defined by a method that no longer focused on trial and error, but on the procedural approach. Although Picasso continued to be attached to the object, he viewed it from the perspective of the subject. That is, knowing reality from and through the subject's lens and, therefore, he referred to the mind's eye as the conceptual basis of cubism. This is how the various «isms» of the first historical avant-gardes will have taken place and on what they were precisely based: on understanding reality from the subject. They are one more example, which represent a paradigm shift, and declare their principles through manifestos.

This transition from object to subject underscored a transcendental shift, affecting all areas of knowledge and revealing that art is also a way of knowing. This is confirmed by the following reflection:

> Studies on the physiology of vision proliferated, and this approach found its translation in the field of philosophy, art, and science. Goethe, in his theory of colors, began to talk about physiological colors and the sensitive-moral effect of colors. Schopenhauer's theories were framed within the so-called subjective idealism, as elucidated in his reference text *The World as Will and Representation*. Kant and his studies on the aesthetic experience in the *Observations on the Feeling of the Beautiful and Sublime* (1974) or in *Critique of Judgment* (1790), as we have already pointed out; as well as the studies of scientists such as Fresnel, Müller, Helmholtz or Chevreul, and their research on color – which played a central role in the experiments of painters like Signac and Seurat – mark a new path, laying the foundations for a new paradigm. (Caerols-Mateo, 2013, pp. 29-30)

As it can be seen, the jump from object to subject represents a new paradigm, since a transformation was taking place in all areas of knowledge and, without a doubt, Art was also there. This transformation gave rise to the new paradigm of knowledge, the *Subjective Vision Paradigm.* Therefore, it can be emphasized that Art provides and contributes to epistemological transformations at the same level as science. The models utilized in both art and science are interconnected and share a similar pattern.

Similarly, the object/subject division articulates the art/science split and, therefore, in relation to this narrative, it is important to reiterate, and it would be assumed, that both paradigms are constructs in themselves. However, it is also evident that both have emerged through a confluence of knowledge. It is undeniable that knowledge can not be purely objective since it emanates from the subject and multiple perspectives. This realization leads to the affirmation that the hierarchies of knowledge themselves would be dismissed, transcending the construct, and thus, the division between art and science. The arts can be regarded as the integrative knowledge that encompasses all forms of knowledge, as it inherently stems from the subject.

3. Art as a Way of Knowing: The Dimension of Artistic Knowledge

> The way an artist arranges objects around him is as revealing as his works. I like the photos of him because they are true. The ones you took on Rue La Boétie are akin to drawing blood, thanks to which you can analyse and diagnose the state I was in at that time. Why do you think I date everything I create? It is because merely understating an artist's work is not sufficient. It is also necessary to know when they were created, why, how, and the circumstances that surrounded their production. There will certainly be a science, perhaps known as the 'science of man', which will endeavour to delve deeper into man through the lens of the man-creator. I think a lot about this science and I try to leave as complete documentation as possible for posterity. That is why I date everything I do. (Brassaï, 2006, p.131)

Understanding art from this perspective is the only way that can lead to the development of the "science of man", the conformation of the man-creator. A man of knowledge who perceives and understands art as a means of knowing and recognizes its cognitive dimension.

The fact that Picasso documented all his work, encompassing his entire creative process, was a deliberate and conscious act. He understood that the process itself, along with focused observation, could contribute to the shaping of the "science of the man". The procedural in itself is an investigative fact and, attending to his reflection, it seems that he understood it that way.

Looking at the process is in itself understanding creation as an investigative act, and that the beginning of this process is driven by a concern or a search to find answers to the intricacies of reality. This inquiry unfolds through various paths, methods, and means, all of which are cognitive processes aimed at discovering solutions.

Mental operations of cognitive processes cover, as categorized in Bloom's taxonomy (1971) include remembering, understanding, applying, analyzing, evaluating and, creating, and, just like sciences, the arts encompass these processes. The beginning of any process of knowing, of approaching to reality, and the act of questioning it, is common to any field of knowledge:

> It is this constant search, this sacred discontent, which constitutes the leaven of the Western mind since the Renaissance and pervades our art no less than our science. For it is not only the scientist of the stamp of Camper who can examine the scheme and test its validity. Since the time of Leonardo, at least, every great artist has done the same, consciously or unconsciously. (Gombrich, 1984, pp.139-140)

This shared concern that generates similar processes from the cognitive point of view (examining and verifying the scheme) is the argument that evidences the cognitive dimension of the arts. It is not merely a shared human concern, but also the common root between the artistic and scientific spirits, as noted by Cassirer. Even Galileo himself, the great scientific analyst who carefully distinguishes the empirical from the metaphysical, and the logical from the aesthetic, acknowledged a shared foundation that is common to the artistic and scientific spirits. For him, both mean nothing but two different modes of training, leading him to admit, without hesitation or envy, that the formative force inherent in great artists holds a purely theoretical consideration (Cassirer, 1951, p. 208).

From that shared spirit that finds its concretion in the cognitive processes, the processes of knowing unfold into the activities of the creative processes. Huidobro defends this concept in her thesis (2004), emphasizing interpretation of the situation, generation of all possible alternative solutions, reinterpretation of the situation, execution phase and an additional reworking phase, or return to the solution generation phase (p. 80). They are nothing more than the assimilation of the phases of the creative process that were enunciated by Graham Wallas in 1926 in the publication *The Art of Thought*. Thus, the following reflection, which provides further support for the cognitive dimension of art, makes perfect sense:

> Instead of referring to an 'interplay' between art and science, we must begin to speak of ideas that were developed in common by artists and scientists. The age-old quest of both art and science has been to seek new representations of phenomena beyond appearances. This effort becomes focused at the nascent moment of creativity, when boundaries

> dissolve between disciplines and notions of aesthetics became paramount. Coming to grips with this phenomenon requires delving into the nature of creative thinking. (Miller, 2001, p. 6-7)

Therefore, the approach to enter the cognitive nature of the arts, the very genesis of creative thought that brings together the aforementioned processes and connects directly with mental processes. This shared the spirit of artists and scientists that leads to the conformation of the man-creator and finds expression in various significant milestones in the history of thought, as many others could point out:

> In the intellectual atmosphere of 1905 it is not surprising that Einstein and Picasso began exploring new notions of space and time almost coincidentally. […] Picasso and Einstein believed that art and science are means for exploring worlds beyond perceptions, appearances, beyond appearances. […] Just as relativity theory overthrew the absolute status of space and time, the cubism of George Braque and Picasso dethroned perspective in the art. (Miller, 2001, p. 4)

This description of creative processes mirrors cognitive processes, in which a trans- and interdisciplinary approach can be recognized. Nowadays, it is referred to as STEAM, but it is the basis of humanism that generated fundamental milestones in the history of modern thought. There is no art without science, nor science without art, and the cognitive foundation of the arts developed up to this point supports it. In other words, there is not knowledge without a subject and this is what would lead us to say that, beyond the construct, the art-science split would be dismissed, referring to the arts as the integrating knowledge that springs from the subject.

However, what happens from modern thought? Once again, the inherently human context is the vehicle to transcend the limits of this imposed and constructed division.

4. The socio-cultural context as a vehicle to go beyond the limits of a constructed division

During the 20th century, electronics for home use began to fill everyday space. Radio followed and, with it, the popularization of broadcasts and communications. After World War II and as a consequence of it, numerous patents were paused until, around the 1950s, television arrived. According to Asa Briggs and Peter Burke in the publication *From Gutenberg to the Internet. A social history of the media*, "[…] television preceded computers in precisely the same way that the printing press preceded the steam engine, the radio preceded television, and the railroad, and the steamboat preceded automobiles and airplanes" (Briggs & Burke 2002, p. 123).

This scientific and technological revolution penetrated the artistic field, giving rise to interdisciplinary practices that crossed the boundaries, although the market and the artistic field were initially reluctant to assimilate it. That divide built in the past became more evident. From Futurism to Suprematism, to Constructivism or to the Bauhaus, among other currents and movements, the machine, the electrical effect of light and its manifestations, technology, became a subject and concern of artists.

Continuous experiences followed, bringing an end to the representation of nature and traditional narrative structures, ushering in interdisciplinarity and creative freedom. Artists had to become

inventors in order to be original and draw attention, rather than following the mastery of the great artists of the past (Gombrich, 1999), tied to classical conceptions. As a consequence, an aesthetic or iconography was promoted that took the virtues of industrial technology as a model, such as speed, movement, energy, or the analysis of light.

That fascination for the mechanical in the 1920s of the last century reached its apogee with the exhibition "Machine Age" (1927), organized by Jean Heap at Steinway in New York. The exhibition aimed to celebrate the machine and its use, encouraging the collaboration of artists and engineers in artistic creation, thus uniting art, science and technology.

From the middle of the 20th century, domestic electronics began to fill every space with innovations like satellite transmission, computers, etc. This same context saw the birth of Postmodernism and art reacted against pre-established forms, including disciplines, the splitting of cognitive fields.

In the experiences with these new automatic technologies, there were, on the one hand, artists concerned with representation, the sign, and creative approaches full of paradoxes. On the other hand, artists linked to an aniconic trend of development, more interested in experimenting with technological possibilities. On many occasions, these artists have been considered imbued with a position of isolation, but analysing some of the manifestos of the time supporting their activities, reveal the different networks and connections existing between the protagonists of that supposed split between art, science and technology (Escribano-Belmar, 2017).

Moreover, from 1966, collaborations, associations, or groups between artists, engineers, or scientists became more and more frequent. This is the case of groups or associations such as Experiments in Art and Technology (E.A.T.) or Electronic Arts Intermix (E.A.I.), brought together artists, engineers and industry. E.A.T. even received sponsorship from Bell Telephone Laboratories Inc., and experimented with all the technical means at their disposal, breaking old artistic paradigms.

Another example is the numerous projects and educational departments focused on this interdisciplinary and technological research, using a methodology close to STEAM. For instance, the Generative Systems Department of the Art Institute of Chicago (1970), the seminars organized at the Computer Center of the Complutense University of Madrid (1966), or the Art and Technology (A&T) program introduced at the Los Angeles County Museum by Maurice Tuchman (1966). As another fact along the same lines, it should not be forgotten that *Leonardo* magazine was founded in Paris in 1968 by Frank Malina, a kinetic artist and pioneer in space navigation. It remains one of the most important scientific journals specializing in research on the transversality between art and science disciplines. Efforts in the 1960s were also made in Southern countries, such as Argentina, with multimedia projects sponsored by the Instituto Di Tella and conceived by Martha Minujin. Later the Centro de Arte y Comunicación or CAYC organized the exhibition "Arte y cibernética" in 1969. In Brazil and Mexico artists also made early explorations with computers, by artists like Waldemar Cordeiro with photography and computers using binary code, all this was conceived within the *Arteônica* project in 1971 (Alonso, 2015). In Mexico, Manuel Felguerez used computer programs with the help of the American engineer Mayer Sasson during his research at Harvard University, resulting in hundreds of artistic pieces materialized in paintings, sculptures, engravings, and elements for a performance and film. The whole project was entitled *La máquina*

estética (The Aesthetic Machine). Felguerez concluded his project in 1976 and never again used a computer for artistic purposes (Felguerez, 1988).

Other significant events emphasized the need to break boundaries, as established by Professor Shanken (2009), among others, in 1968 two important exhibitions were inaugurated: "Cybernetic Serendipity", at the Institute of Contemporary Art (ICA) in London, exploring the relationship between creativity and technology, from the first graphics, sculptures, texts, and music generated with technology. And "The Machine as Seen at the End of the Mechanical Age", at the Museum of Modern Art in New York, showcasing first intersections between art and technology, and artists and engineers, from the fifteenth to the nineteenth century, including the drawings of Leonardo Da Vinci's flying machines to projects developed by artist-engineers who had been selected through a competition organized by E.AT. During the 70s and 80s, exhibitions like "Electra" or "Les Immatériaux", held in Paris 1983 and 1985 respectively, further exemplified the visual representation of the hypothesis discussed in this work.

Therefore, as also argued through artistic facts, there is a rich history that supports the cognitive dimension of the arts, the integration of automatic and digital technology, and the natural relationship of artists, scientists and engineers to experiment and learn. All of this has made methodological transformations more necessary, as the digital revolution has had a central impact on all processes and ways of knowing and bringing knowledge closer.

5. The STEAM methodology: a necessary answer. Towards the creation of the science of a "man-creator".

Taking this foundation into account, a response to this change in the conception of art, science and technology as interdisciplinary and transdisciplinary was also required in education. In fact, all the discussions generated on educational issues reflect the values of society, and this has been manifested in Art Education, as art transmits values to the viewer. The digital revolution has made this methodological transformation in education more evident and necessary, primarily through interdisciplinarity.

Thinking about attempts in education to establish a context that allows this interdisciplinarity from Art Education, leads to the Theory of Multiple Intelligences by professor and psychologist Howard Gardner. The theory is recognized by many and criticized by others for its lack, perhaps, of the rigor expected in science. Enunciated in 1983 by Gardner, a professor at Harvard University, in *Frames of Mind: The Theory of Multiple Intelligences*, suggests that each person has a series of diverse intelligences, understanding intelligence as a set of skills, abilities or talents that determine cognitive competence. Gardner proposes eight intelligences (although he currently defends the existence of nine) that every person can develop. This theory seeks to break the social distinction between an intelligent person vs. a talented person and, therefore, end the dichotomy between someone with great capacity for science or mathematics (intelligent) and the person with greater capacity for art (talent) (Gardner, 2011).

The proposed intelligences (naturalistic, logical-mathematical, intrapersonal, interpersonal, bodily, linguistic, musical and visual-spatial) that everyone can develop lay the foundations for multidisciplinarity and interdisciplinarity, leading to transdisciplinarity in society and in response

to education. Thus, it is possible to consider teaching from each of the traditional disciplines, motivating the development of these intelligences. For example, visual-spatial intelligence (related to art) could be worked on from Mathematics, Technology, or Science; or logical-mathematical intelligence could be developed from Artistic Education, Science, or Technology, to point out those that concern this article. In this sense, these are practical examples of how to apply STEAM methodology, too.

A decade after Gardner's theory was introduced, in the 1990s, the National Science Foundation (NSF) coined the acronym STEM (Science, Technology, Engineering, and Mathematics) in response to economic and social needs, especially in the world of work and industry at that time (Cilleruelo & Zubiaga, 2014; Zamorano, García & Reyes, 2014). A decade later, in 2006, Georgette Yakman added the A for Arts (and creativity) forming STEAM and underlining the importance of these five areas and their interdisciplinarity. These areas respond to a period characterized by robotics, artificial intelligence, the Internet, hyperconnectivity, and digital microfabrication (Zamorano, García & Reyes, 2014), and that travel to a present day characterized by hyperconnected and instantaneous education. The social moment and the new educational needs make a STEAM methodology necessary to develop individuals prepared, in the cognitive sense, for the current world.

This methodology also has its roots in the moments in which the concept of creativity began to be generalized as a quality that everyone can develop. Around 1950, Joy P. Guilford used "creativity" to refer to the set of mechanisms necessary to solve problems in any field, in a context marked by the Cold War, which sought competent, adaptive and creative professionals. Based on the research by Jean Piaget or Jerome Bruner, scientific knowledge and methods also prevail in artistic education, the active participation of the student in the teaching-learning process and the construction of *learning by discovery*. Pure science has a component based on innovation that multiplies when the subject develops qualities such as creativity.

Precisely during the 1960s and 1970s, Bruner advised the National Science Foundation on the preparation of curricular proposals for science education for the American educational system. As a consequence, the "discovery science learning approach" was formulated (Camargo & Hederich, 2010, p. 338), favoring problem-solving through research and discovery, and, above all, with forms of learning and teaching sciences that will encourage the use of imagination or creativity for that resolution. Students must ask questions and formulate hypotheses, experiment, and solve problems, while the teacher assumes the role of guide or facilitator (Wood, Bruner & Ross, 1976). Bruner's position reflects this possibility of linking art and science from the perspective of science.

In a digital context that reflects its needs through a global pandemic, STEAM is the answer to digital knowledge and literacy and, therefore, also to the digital objectives and skills that all formal education regulations. In other words, the objective is to provide cognitive knowledge related to artistic knowledge to the field of science and technology, linking the contents with the life of the student (Zamorano, García & Reyes, 2014).

Therefore, at an educational level, STEAM encourages collaboration and multidisciplinary teams coordinated from their fields, and complements the use of active methodologies that advocate for Problem-Based Learning (PBL), Project-Based Learning (PrBL), the Maker culture or gamification, among others. It enables students, at any educational stage, to find creative

solutions to real contexts where problems can be addressed with the help of these five areas. This approach responds to the common cognitive processes in these areas and is necessary for developing well-prepared individuals in a technological and digital society. This contributes to the development of social skills in education: promoting teamwork, cooperation, effective communication, actively listening, respecting diverse perspectives, expressing emotions, among others.

From the dimensions of art, STEAM can contribute to improve emotional skills, since Art provides a powerful outlet for students to express and communicate emotions, thoughts and feelings; and act as a stress-relief activity, promoting emotional well-being and mental health. Furthermore, STEAM helps to the development of critical thinking and problem solving with artistic exploration of various artistic mediums, through design-thinking approach, and by analysing and reflecting. Art in STEAM allows students to unleash their creativity and imagination, fostering innovative thinking and outside-the-box ideas. Combining art with other STEAM subjects encourages students to find innovative connections and novel approaches to problem-solving. Art can be a powerful tool for exploring and representing diverse cultures and perspectives, promoting cultural awareness and sensitivity.

Moreover, working from a STEAM perspective can significantly influence the achievement of the Sustainable Development Goals (SDGs) from education. By integrating these fields of knowledge (Science, Technology, Engineering, Arts, and Mathematics), students can develop a deeper understanding of global challenges and contribute to finding sustainable solutions. For example, as a result, STEAM promotes an inclusive and quality education that equips students with the skills to thrive in the modern world. Additionally, this methodology encourages the participation of girls and women in traditionally male-dominated fields (science, technology, engineering, and mathematics), breaking down gender stereotypes and promoting diversity. Also, STEAM fosters creativity and critical thinking to developed sources and efficient technologies, as well as prepares future innovators and entrepreneurs to design and implement sustainable solutions. By integration arts and creativity, students can communicate the urgency of climate action through various media. In this way, STEAM promotes critical thinking, ethical considerations, and respect for diversity. Students learn to address social and political challenges through innovation and creativity, contributing to more just and peaceful societies.

6. Conclusion

Since the entry of automatic and digital technologies, the context of art, science, and technology has once again become exponentially interconnected, much like it merged into a set of knowledge during the humanism of modern thought. Artists, scientists, and engineers seek interdisciplinary and transdisciplinary responses to the paradigms that arise in society. Working in a trans- and interdisciplinary way is not imposed but rather a sudden and inevitable need in the search to generate answers through common cognitive processes, as confirmed in this study. Numerous exhibitions, events, groups, and other associations created between these areas of knowledge attest to this fact.

The STEAM methodology emerges in the educational context to address these needs, in a context where divisions can only be dissolved and sustained through different approaches and/or theoretical positions. It appears to train future professionals while confirming and underlining the importance and relationship of the processes of knowing within the five areas. Only by emphasizing methodologies of this nature will we be able to respond effectively to the demands of a technological and digital society.

Declaration of Conflicts of Interests

The authors declared no potential conflicts of interest.

Funding Disclosure/Acknowledgement

The research did not receive any funding.

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