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General Article

Artscience, STEAM, SciArt, SEAD and much more: multiple names for a complex and transdisciplinary research field

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Abstract

This article explores the lack of unanimity regarding the nomenclature used to refer to the field of research that explores the intersection between art and science. A series of examples of nomenclatures and the context in which they are applied are listed and referenced. The diverse terminology reflects the heterogeneity, transdisciplinarity, and complexity of a research field in full expansion.

Keywords

art; science; Artscience; SciArt; STEAM.

Short Biography of The Author

Educational consultant, researcher, artist, and entrepreneur. Obtained his B.S. in pharmacy from Federal University of Santa Catarina (2004), master's degree (2014), and Ph.D. (2018) in Education, Management, and Science Communication from Federal University of Rio de Janeiro. Was a fellow at Harvard University between 2017 and 2019. In the field of arts, João has an experience of 29 years as a dancer and choreographer on tours around the world and over 4000 career shows. Currently, João lives in France working as a Learning Specialist at Axens – IFP School (France), is a research fellow at the University of Texas at Dallas (USA), and works as an independent consultant.

Understanding the scope of art and science together

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Between 2012 and early 2019, I dedicated myself to explore the existent bibliography in the field of interaction of art, science and technology, mainly in the English and Portuguese languages. If on one hand, it was possible to find rare information hubs regarding the theme, such as the publications of Leonardo/The International Society for the Arts, Sciences and Technology (Leonardo/ISAST), on the other hand, mining articles on this theme in other publications is an epistemological and methodological challenge of great proportions. After all, how is such field of knowledge referred to by researchers who produce work in the intersection between art and science?

Before understanding the use of the words art and science together as one field, some brief considerations are necessary regarding the use of each of the words separately, once each have very broad meanings and are applied in different contexts.

The word art in the dictionary [1], may be defined as *"the making of objects, images, music, etc. that are beautiful or that express feelings; the activity of painting, drawing, and making sculpture; an activity through which people express particular ideas; the making of things such as paintings or drawings, or the things that are made; a skill."*

From Latin, "ars" is equivalent to the Greek "tékne", the term art is intrinsic to the technique, the mode of production. Plato defined art as a capacity to do things in an intelligent way through learning, being a reflex of the creative capacity of the human being [2].

According to Azevedo Júnior (2007) [3], art can be defined as knowledge and one of its first manifestations in mankind, to mark the presence in space and represent living in the world. But for Gombrich (2000) [4], there is no such thing as art, since for the author there are only artists. The composition also arises from possible definitions for philosophers such as Deleuze and Guattari (1992, p. 247) [5]: "Composition, that is the sole definition of art. The composition is aesthetic, and what it is not composed, therefore, it is not a work of art".

For researchers such as Adilson Koslowski (2013, p. 8) [6], "there is not in the Art Philosophy such an explicit definition for the term that does not present

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counter examples". Still, the researcher believes that the search of the nature of art is important to allow learning regarding the complexities of the subject.

The word **science**, in an English dictionary, can be defined as the study of the nature and behavior of natural things and the knowledge that we obtain about them. Also, a popular branch of physics, chemistry or biology [7].

The word comes from the Latin term *scientia*, which means knowledge and erudition. For some authors, the term reflects everything that is connected to human knowledge. For others, the work science should be understood as "a group of theoretical knowledge regarding natural phenomenon, based on methodology and experimental rationale" [8].

To explore a bit more of the complexity regarding the terminology that the area of science and art provides, it is still necessary to also conceptualize the term **technology**: groups of processes, methods, techniques and tools related to art, industry, education, technical and scientific knowledge and their applications to a particular field, application of scientific knowledge to general production; the art to apply scientific knowledge to invention, improvement or use of industrial technique in all its determinations [1].

For Strosberg (2015) [9], art and science share the same tools and materials, being technology its main link. It is important to remember that, throughout History itself, the words art, science and technology have had different meanings to multiple relations with philosophy, metaphysics and even theology.

Since the words art and science have broad meanings, which can be applied in several contexts, to find a suitable term to refer to the interaction between such areas is a complex challenge. The work *"Art and science in SciELO: study of abstracts of papers that use the words "science" and "art" in Brazil"*[10], published in Portuguese, investigates the names used in articles that involve the themes "art and science" or "science and art" in Brazilian Portuguese according to the SciELO Electronic Online Scientific Library. The question regarding names or keywords seems crucial for future investigations in the field of interaction between art and science. This work gives us parameters that there seems not to be a consensus regarding which names should be used in articles involving the theme "art and science" or "science and art" in the Portuguese language in Brazil.

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Multiple denominations

There are several abbreviations, expressions and terminologies to refer to the interaction of art and science around the world. The lack of consensus regarding the name is an enormous obstacle for bibliographic research and also, with the purpose of identifying artists, scientists and researchers that produce work in this field.

Regarding the English language, just like Portuguese, there seems to be not an unanimity regarding the adopted nomenclature. Although, terms such as *artscience* and *art and science* are frequently used. However, there are different forms as how those terms are used in each area.

I'll proceed with a series of examples of how different ways are used to refer to this field in English. As it can be seen, there is an infinity of possible variables regarding the order of words, to abbreviations and to the possibilities of creating acronomies.

The order of the words sometimes provides some clues about the main area of acting of the creators of the research groups, projects or works. It can also indicate the formation of the author, in case of publications. However, in the middle of all this diversity, this is far from being a rule.

Although this is a non-exhaustive list of all the existing terminologies, I hope that this can be used as a reflection over how those that identify and self-relate as workers in this complex and transdisciplinary interaction field between art, science and technology. For each one of the expressions, at least one example of its use is quoted. Still, it is important to observe that, in some cases, the same author uses different terminologies.

Artscience

Among all lack of consensus over the proper naming, the term *artscience* is one of the only forms of writing for which there are authors who justify its use through the ArtScience Manifest: *Integrative Collaboration to Create a Sustainable Future* [11]

It is not easy to prove who first used the term. Although it is possible to find the use of this term in the 19th. century [12], it is more likely that Todd Siller

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was the first to use such form of writing in contemporary times. Here lies a summary of the main publications that use such terminology.

- 1990 – Todd Siler publishes the book *Breaking The Mind Barrier: The ArtScience of Neurocosmology*
- 2004 – Robert Root-Bernstein signs the editorial of the journal Leonardo *Artscience: the essential connectio*n
- 2008 – David Edwards publishes the book *Artscience, Creativity in the Post-Google Generation*
- 2011 – The journal Leonardo publishes the Manifest *ArtScience: Integrative Collaboration to Create a Sustainable Future*

Artscience can be easily translated to *Arteciência*, term which I propose to refer to this field of research in Portuguese [13]. In Brazil, the physics and researcher Roland de Azevedo Campos published in 2003 the book *Arteciência: Afluência de Signos Co-moventes.* In 2008, the National Arts Foundation (FUNARTE) launched a project untitled ArteCiência. [14].

The researcher Tânia Araújo-Jorge uses the term in the project of Fundação Oswaldo Cruz (FIOCRUZ) started in 2012 [15]. Posteriorly, Sawada, Ferreira e Araújo-Jorge (2017) [16] published the article untitled *Cienciarte ou ciência e arte? Refletindo sobre uma conexão essencial*. In this work, the authors showed a needed reconciliation between science and art in our time, in order for both to be able to share and contribute with essential elements for teaching and development of society. In addition, it reinforces the concept of the manifest *ArtScience* and propose the use of the concept, in Portuguese, *Arteciência or Cienciarte*.

Art and Science

The use of the word *Art* together with the word *Science*, in most cases, does not mean an interaction between the areas in a work, project or publication.

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This is due to the fact that there are several courses, graduation colleges and universities which present *Art and Science* in their names, without necessarily promoting an integration.

However, there are several examples of courses, colleges, universities, publications and other that use the terms *Art and Science* to refer to an integration between such areas, as in the University of Concordia [17], in Canada, for instance, which offers a certification in the field.

Art-science

This way of referring to this acting field has already been used in publications [18, 19, 20] and also gives names to galleries such as The National *Center for Atmospheric Research (NCAR),* in the state of Colorado, USA [21].

Art + Science

Art + Science Now (2013) [22] is the name of the book that presents a global view of different forms that contemporary artists can consider regarding scientific and technological developments to explore new forms of creative expression. Stephen Wilson (1945 – 2011), author of the book, performed one of the most important works of mapping and listing of projects involving art, science and technology around the world [23], and also published several papers.

This form of writing is widely used to refer to projects, festivals, call for papers, among others.

Art & Science

The sign *&* is widely used as a form to indicate connection between the two areas, such as in *Art & Science Collaborations Inc.* (ASCI) [24], which is a New York association that gathers artists, scientists and researchers around the world. Still, there are universities that use the sign, such as the *Washington University in St. Louis* [25] and the *University of Applied Arts Vienna* [26].

Art/Science

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The use of this form of writing is rarely used, but appears in some publications, such as Ox and Lowenberg (2013) [27], in the article *What is the challenge of art/science today and how do we address it?*

Artsci

For Arthur Miller (2014) [28], author of the book *Colliding Worlds: How Cutting-Edge Science Is Redefining Contemporary* Art, terms such as "artsci", "sciart" and "art-sci" seem inappropriate to transmit the beauty and subtlety of the art that is influenced by science or by technology, although the author uses the former. For him, there are no doubts that in the future such works will be known solely by “art”.

The *ArtSci Salon* [29] is a *hub* for the community of arts and science in Toronto and surrounding areas. Although in its own website, it is referred as the union among areas such as *Art & Science,* the term *artsci* is the most used by the authors of the project. There is also a series of academic publications with this term, such as *Walking the integration talk: an artsci project* [30].

Art-Sci

This form of writing is used by some authors and institutions such as the *Land Heritage Institute (LHI)*, which produces the *LHI Art-Sci Symposium,* every two years and is in its fifth edition [31];

Art/Sci

The form art/sci is used by the magazine of the former students of the Arts and Science College from *Case Western Reserve University* [32]. Another example is the independent platform *Art/Sci Nexus*, although the term *artsci* has also been used in the same location. This is an independent group that promotes curiosity in and among humanities, arts and sciences, presenting professionals and public to new creative ways of thinking [33].

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Art|Sci

Used to refer to the area by a reference center in the integration field between art and contemporary science, in the California University, Los Angeles [34].

ArtBio

The Brazilian Society for the Progress of Science (SBPC), through the Institute Science Today (ICH), has organized a project of science spread called *ArtBio* [35]. This name is also used by the Brazilian organization ArtBio [36], which develops projects that join disciplines, creates bridges and connects people under different platforms.

Art+Bio

Used by an nonprofit organization [37], lead by artists and scientists who promote the integration of science nature and art through new collaborations, political engagement and education. The SciArt Magazine has published an article from Allison Palenske and the project [38] is set in Cambridge, MA.

Art and Technology

Art and Technology is a vast area of acting and, within this area, there is an infinity of other possible names in English and Portuguese. The actors in such area may use series of classifications to refer to projects such as *games*, *telematic, technoetic, cybernetic, and syncretic* or digital poetry, virtual reality, hacking, holographic, wearables, among many others. Created in 1979, the Ars Eletronica, in Austria, is among the main reference centers in the world of *Art and Technology.*

Art, Science and Technology

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There are groups of universities, institutes, events and publications that use such terminology. To mention just a few examples, it is possible to mention the *Center for Art, Science & Technology (CAST)* [39] and the Waag Society – institute for art, science and technology [40].

CAST is a center created in the *Massachusetts Institute of Technology (MIT),* and the Waag Society – institute for art, science and technology is a dutch society with over 22 years of exploring emergent technologies and empowering art and culture as a center role in the conception of new applications to new advances in science and technology.

Still, the journal *Leonardo* itself is published by an nonprofit association, called the *International Society for the Arts, Sciences and Technology.*

Science, Art and Technology

The word *science* in front of the word *art,* is used by the *Art Institute of Chicago,* for example, to name a course for students from public schools [41].

Science-Art

A term less frequently used, but publications are found with such writing, as in *Ten Trenches: A Science-Art Collaboration* [42], for example.

Bioart

Bioart is a term probably stated by the artist and researcher Eduardo Kac (2007) [43]. Eduardo gained international in the 90's and produces impacting work until today, sometime polemic, though. However, it is natural that other artists and researchers require authorship.

Just as Art and Technology, this is a vast field of acting with many ways to refer to specialties. For the artist Adam Zaretsky [44], there are infinite possibilities of classifications, which he calls by *Vivoarts,* which provides over 30 naming possibilities, such as *Ecology Arts, Gastronomy Arts, Art and Biology, Ethology Art e Phusiological Art* [45].

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Sciart

This term is associated to one of the most important foundations of fosters in this field, the *Wellcome Trust*, England. The *Trust's Sciart funding program*, founded in 1996, promotes projects of visual arts, which involves artists and scientists in collaboration. This has the intention of developing and producing works that explore the biological and medical contemporary sciences [46].

SciArt is also adopted by *SciArt Center* and *SciArt Magazine*, in New York [47].

Science & Art

It is used in projects such as the Science&Art @ School from physics and artist Michael Hoch, which enables the involvement of students with stories of physics of particles [48].

Science-Art

Science-Art is used, for instance, by the project from *Guild of Natural Science Illustrator*s, American association that proposed to connect artists with buyers interested in sciences, nature and medical subjects [49].

CienciArte

Researchers Tania Araujo-Jorge and Anunciata Sawada have used this term in their projects and presentations. Although they have already proposed the use of the term *artscience*, in their last publication on the theme, the authors preferred to use the term CienciArte [16].

In the website called *Cienciarte* [50], few available projects, artists and companies present a relationship between the areas. However, the website refers to itself as a site for popularization of science and art.

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STEAM

Initials for *Science, Technology, Engineering, Art and Mathematic*s in English, which came up from an inclusion idea based on the acronym *STEM* (*Science, Technology, Engineering, and Mathematics*). This is regarding an educational program that fosters creativity and learning through real-life problems.

The STEM movement has gained strength and even representation in the American Congress [51]. The *Road Island School of Design* is one of the references in the initiative *STEM to STEAM* and has created an interactive map of institutions that support the movement around the world [52]. STEAM fosters creativity and social empowerment of students through learning without barriers between disciplines [53].

SEAD

This acronym refers to *Sciences, Engineering, Arts, and Design* (SEAD). *SEAD Network* was created in 2010 from a *National Science Foundation* grant. In its website [54], is is possible to understand the vision of the authors on the division of the disciplines the existing gaps and a future of possibilities of integration between art, science and technology.

The initial is used in publications [55] and in projects, such as *SEAD Exemplars* [56].

Polymathics

This term is used in publications of Root-Bernstein (2003) [57] and Gombrich (2016), when they refer to art, science and humanities. In 2017, Roger Malina wrote in his blog [58] about the revival of an old term and its advantages regarding its use when compared to *STEAM* and also mentions the *Polymathic Scholars Program* of the University of Texas, in Austin [59].

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Final Considerations

It is important to mention that there are a number of works that involve art, science and technology, which do not use any of the naming used in this list. The use of an author's own terminology in articles, abstracts and keywords make some of these works difficult to be found, but do not diminish their relevance and quality.

Some examples may be quoted to illustrate such affirmation as in the works performed by the *Wyss Institute for Biologically Inspired Engineering*, from Harvard University and other sponsored by the *Science Magazine,* the *American Association for the Advancement of Science* and the *HighWire Press*.

In the Harvard work, researchers Charles Reilly and Donald E. Ingber created a sperm cell animation as a Star Wars parody. The project allowed the development of a simulation technology highly widespread, which has nanoscience use and to any other area of scientific research involving multi-scaling in the analysis of complex systems [60].

The project of *Science Magazine*, *Dance your PhD,* is an annual contest which challenges scientists to interpret their PhD research as dance. The idea behind the project is to answer, creatively, to the question "What is your doctorate thesis about?". The project is widely spread through the media around the world and has an important role regarding scientific communication. However, for Myers (2012) [61], the project is much more than that. For the author, *Dance your PhD* has a massive contribution to science for its kinesthetic skills, which scientists acquire throughout training and makes the scientist's capacity capable of expanding, as well as saying, imagining and feeling.

In addition to this lists of names, which is probably incomplete, due to the diverse possibilities of names that can be used to refer to this interaction field, it is also important to mention that the *Media Labs* and *Maker* spaces spread throughout the world produce a high number of diverse works that sometimes use names quoted before and sometimes not. Media Labs are open spaces to a broad spectrum of works that catalyze ideas and forefront projects.

The high number of possibilities of such spaces was defined by Joichi Ito, in the case of the MIT Media Lab, as antidisciplinary [62]. The Maker Movement, which can be also called as *Do It Yourself*, or can even be called

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Fab Lab's or *Bio-hacker,* frequently involves areas of technology, science and/or art. According to Samangaia (2015) [63], the innovations that such proposal has, associated to the open possibilities in the web, may launch a process similar to what the industrial revolution was in the 19th. century.

The lack of consensus over which names should be employed for the interaction field between art and science composes a challenge for researchers that work in such field. The multiple terminologies used by works that involve art, science and technology reflect diversity, transdisciplinarity and complexity of such works.

The lack of consensus regarding the names that should be used is a barrier that must be overcome, or, at least, discussed by the actors in the field. However, the diverse nomenclature may be another indicative that, in contemporary times, art, science and technology together form a research field in full expansion.

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