Art and Science: Toward an Effective Multidisciplinary Approach in Education

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Abstract

Nowadays, different attitudes and new theories are emerging concerning teaching and learning, to improve the current models of education and broaden their horizons. Former studies have proven that human intelligence can reach its highest potential when holistic learning methods are applied. The purpose of this study is to manifest the intense relationship between science and art and to publish the advances made in science in the context of multidisciplinary learning. The review of the three research programs, the zero project of Harvard University, the Association for the Advancement of Art Education in the United States, and the report of the National Foundation for Education Research of the United Kingdom concluded that an integrative curriculum of art and science provides a solid foundation for teaching and learning, and it enhances the goodness of life. The incorporation of artistic disciplines to scientific education in primary and secondary schools strengthen academic performance, facilitate learning, and make teaching more enjoyable. Also, its value can be noticed in career opportunities since it develops the ability to acquire responsible behavior that is attentive to values in a social and ethical context. Such an approach in education teaches students to think in a global and multidimensional way, instead of retaining a large amount of information.

Key words: Art and science education, Teaching and learning, Multidisciplinary approach, Holistic learning

Introduction

Contemporary thinking places art and science in two independent learning fields. On the other hand, several sides of both disciplines came from the same aspirations and sources. The force of driving intelligence, which is curiosity, as well as the human mind, is in a state of permanent search to discover meanings in the spiritual, intellectual, and physical world. This has resulted in significant achievements, expressions, and discoveries of profound creativity. In general, art manifests itself in science in several ways, as science has been acting as an authoritative revelation source for Western arts. It is necessary to reconsider current educational models considering the relationship between the sciences and arts. In this domain, studies show that human intelligence can reach its highest capabilities as a holistic learning method is employed (Van Kuyk, 2009).

Learning and teaching cannot be based on contemporary models anymore; at present, totally various attitudes are emerging regarding the way people learn, and the way they should be taught. It approved that the technology era has improved our lives as it can affect our future. Most of the current work will be done by the technology of the computer soon, so our students need training of an intellectual, emotional, and practical skill level unsuspected so far as to make a living (Van Wie, et al., 2012). Future employees have to be literate and solve problems intuitively, flexibly, and creatively.

Perhaps it is the "education" term that is not valid anymore; maybe the suitable terms are character and

conduct. The underlying assumption that we are trained people to become human beings with different competencies, confidence, and flexibility to handle the world that we still cannot even imagine. Partial of the work that will be necessary for this time is not yet developed, so it is essential to educate a workforce that can acclimate to the upcoming future. According to Joubert (2002), a symbiotic and holistic education in arts and science will improve all potential human aspects. Science seeks ways to explain the normal processes, which are governed through basic laws. These laws that govern the universe and the world behavior are investigated where the results are presented in a mathematical language. The research, as well as the logical deduction that is based on observation, is the power behind achieving scientific discoveries. Art has been the ways used by all civilizations to evaluate and express their culture, ideas, and behaviors by their own artistic languages. The artists usually express their feelings; they don't just reproduce what they observe. These expressive qualities of art appeal to sensations and to the highest abilities of the imagination and mind. Scientists such as Einstein and Newton corroborated, in their era, the importance of the thesis of this article by affirming their need to have vivid images from creative visual experiences to obtain scientific results (Chalmers, 2019).

It is necessary to review the current models of education, broaden their horizons, and encourage new theories to unite learning that, generally, are separated in contemporary educational practice. In some environments, a change in today's worldview in favor of meeting the science

as well as the arts is necessary. Stockwell & et al. (2015) clarified that many examples had been shown in which our perceptions toward these disciplines have improved to let us recognize the fundamental unity of the two fields. Artists and scientists working together in different areas approve that, thanks to this association, more productive results are achieved.

The purpose of this study is to publish the latest advances made in science in the context of multidisciplinary learning and the relationship between science and the arts. In the desire to maximize human capacities, other related issues are presented. Economic, political, social, and spiritual matters are essential equally when taking the scientific education role for the future into consideration. Marginalized communities, including the poor within the developing countries, are at a considerable peril of being abounded, to achieve economic development. Ethical issues regarding scientific education for the future indicate that good knowledge has to be ensured for all (Resnik, & Elliott, 2016).

Current studies in the fields of education, science, humanities, and arts show that specialized knowledge areas considerably improve in a multi-disciplinary learning context by partnering with others in areas with which they were not previously linked. This holistic method of learning permits human intelligence reaching a higher potential. Specific training focus on a particular field can diminish the ability to move forward in a world of vertiginous changes. This approach is the most accepted in the new pedagogical theories, which relate to different disciplines that were

previously separated in most curriculums around the world. (Berki, et al., 2018).

This research does not discuss issues related to the multi-disciplinary teaching and learning of science and the arts, but it also deals with applying these theories. Studies with their corresponding applied results are provided below.

From my teaching experience in different countries, a group of data on the latest advances in the arts and science has been obtained. It is necessary to focus on the students' knowledge of specific areas who finish their educational training, and this is valid for the fields of medicine, engineering, mathematics, science, etc. In the next examples, you can see possible alternatives to obtain more productive results in different professions, enable teachers as change agents, and favor the development of CVs oriented to career opportunities.

THE RELATIONSHIPS BETWEEN ARTS AND SCIENCE

1. Arts and Medicine:

Throughout Europe and in the United States, many professionals realize that collaboration with the arts produces better results in terms of less medication and less recovery time in hospital in some therapeutic areas (Macneill, 2011). In the medical field, it is necessary to introduce new approaches in the early stages of teaching. According to Stuckey & Nobel (2011), doctors must know better the arts' broad-spectrum and their role in restoration. Those affairs have been ignored in the old medical practices

and the early secondary education levels, in which possible doctors are directed to branches of science and mathematics.

Artists involving in healthcare settings are distributors of creativity, a well-known source to improve their patient's sense of well-being, their sense of self and their value, and the impacts of these measures on the process of healing are very positive. Healthcare workers and doctors have improved their ability to communication and their treatment to a patient due to working with the artists. Lately, there has been a growing tendency in hospitals to resort to the arts as a supplementary aid for healing, as they offer a visual instrument to improve sanitary care ware (Stuckey & Nobel, 2011).

Hospital architects are working, with proven results, in collaboration with landscape artists, designers, and architects to form harmonious healthcare contexts. These radical hospital designs introduce spaces and gardens for meditation. The architects are collaborating with design professionals and artists to build hospitals that produce a different environment with the resulting positive effect in the healing process (Saunders & Fuller, 2015). Good judgment informs us that a hospital with rooms that open to gardens, overlooking the vegetation, alive with beauty and light, enhances emotional health.

2. Art and Engineering:

The engineers who deal in a scientific context with the usual phenomena as air turbulence and wind, as well as swell circulation models, agree that many works are the result of the artist's perception sensitivity. Norman Zabusky

is known for his theory of solitons, which uses visualization as a guidance instrument to explain nonlinear procedures. The complex phenomena visualization is very hard, and often the help of artists is needed (Cotantino, & et al, 2010). Instead, thanks to the results in physics and engineering, new techniques have been introduced in the arts.

Milton Van Dyke, of Stanford University, has studied for many years the models of turbulence in air and water currents and has published monographs in which he demonstrates the aesthetic and creative nature of those models (Schwartz, 2014). Guido Buresti analyzes the turbulent flow using wavelets, a mathematical instrument that allows a time-frequency analysis, like musical notes. Buresti sees a close relationship with music and is studying auditory perception. One of his projects is to analyze, through the wavelets, the psychological effect of the sound of car engines on riders (Buresti, 2012).

Renzo L. Ricca is an Italian, with excellent scientific understanding and deep concern in the arts. He researches the solar corona structures and the physics of magnetic knots, which are complex and exciting. According to him, it would be useful to compare these scientific knots with the knots used by the Incas in ancient Peru. Werner Jauk is a musician who has investigated the perception subject (Cotantino & et al., 2010). All of this is significant for the scientists who expose their work using visualizations because it makes their audience understand them better. Frequently, only specialists can comprehend what the author

means, so artists who cooperate with scientists or engineers contribute to facilitating communication

3. Art and Sciences:

Several scientists notice the close relationship between their scientific branch and art and design. Frank Oppenheimer, the founder of the Exploratorium in San Francesco, is a good example of how a scientist working with artists give rise to the meaning of the model. According to him, the search for models is fundamental for art as for science (Joubert, 2002).

Kepler discovered a model in the movement of the planets, recognizing the key to explain their repetitive rotation around the sun, taking the shape of an ellipse. There is a model in the poetry structure and the musical melody. Physicists find model and rhythms in color, and botanists claim that some upper parts of the flowers show perfect design solutions and engineering. These fundamental models of natural development have extraordinary balance, harmony and beauty, and they can be compared with the model and design in the creative art field (Robertson, 2017).

4. Art and Architecture:

Koop Himmelblau, Richard Rogers, Frank Gehry, Norman Foster, Zaha Hadid, and Rem Koolhaas are good examples of architects who are equally interested in art and architecture science. Koolhaas believes in social growth and reaffirms the relationship between growth and technology. Foster Associates' high tech vocabulary reveals a demanding exploration of forms and technological innovations. The constantly innovating types of Zaha Hadid

amaze the universe, and she has become famous for her drawing that are representations of possible constructions. Hadid tells her projects through a series of media, such as paintings, line drawings, photographs, collages, models and computer presentations (Sebastian & et al., 2018). According to Postal (1997), The Guggenheim Museum in Bilbao that was designed by Frank Gehryby has been considered the most important building of our time and the best building of the century. Primarily conceived as a sculpture with an agglomerate of shapes and materials, it was going to represent the museum's first work of art. Frank Gehry has persecuted seven notions of freedom and openness rather than precedence and architectural doctrine. The non-rational, non-linear forms of the architect sharpen the feelings and increase the perceptions of visitors giving them trust in their senses and emotions. It is a vital input to art and architecture science.

RELATING ARTS AND SCIENCES TO MUSEUMS

Museums that follow the principle of relating science and art offer abundant support material for the holistic artistic and scientific education paradigm, for both the general public and schools. The artists who have received scientific training in addition to artistic make many very ingenious exhibitions that captivate the imagination and inspire in their audience the desire to know (Falk, 1999). Some exhibitions dependent on the San Francisco Exploratorium include the *Ola Organ*, an acoustic sculpture, activated by a wave, located on a breakwater in the San

Francisco Bay; the *Magnetic Field Stone*; the *Wind Landscape;* the *Confused Sea;* the *Chaotic Pendulum*, to name a few examples. The artists' work satisfactorily with the scientists to mount the exhibitions, realizing the dream of the founder, Frank Oppenheimer, that the collaboration between science and the arts would result in a better world (Schnugg, 2019).

Jim Tattersall's who works at a Museum in New York City, mixes computers, holography, and scientific information to mount very audacious exhibitions. The educational and visual stimulus produced by their techniques is radical. For example, *The Female Holographer* describes the female anatomy using current technology. Art and science are integrated fully as harmonic forces to validate the invention spirit and novel ways to see the world (Schnugg, 2019).

ART OF MODEL AND MATHEMATICS

In nature, there is an extraordinary series of models, and the structure of their constructions can be clarified through mathematical and fractal equations. Benoit Mandelbrot, a mathematician, developed a geometry that could quantify and analyze the turns, the waves, and the branches that are in nature. He called this new mathematical specialty geometry fractal. Since then, scholars and mathematicians have used fractals to locate the system in natural composition, which resisted the analysis previously (Bush, 2019). A rocky coast is an appropriate example of fractal analysis. The fractal geometry analysis of natural forms has resulted in the fractal imitations creation: computer-generated images, which resemble types of the

natural world. At the core of any computer-generated fractal, there is a mathematical equation. Through the use of different equations, computers have produced images, which look like clouds, landscapes, and trees. These images beautifully demonstrate the overlapping and beauty of art and design in nature (Loveday, 2019).

THE SCIENTIFIC ARTIST

Throughout history and to this day, great works of art have been made to represent and explain the sciences of botany, natural history, and anatomy. Artists ranging from Paleolithic hunters to the men of the twentieth century have made magnificent contributions to science and art. Achievements by these artists can be found in all the world's major collections, such as the *Mellon Collection*, *the British Museum*, and the *Smithsonian.* These examples shed light on the science of explaining nature through art. Albrecht Dürer, da Vinci, and Georgia O'Keefe are some of these artists. There are illustrations of natural and botanical history discoveries from the time of Columbus's travels to those of Charles Darwin, Galapagos Islands; from the Roman emperor Rudolph II, Australian indigenous peoples; from Sydney Parkinson, Captain Cook's Endeavor Travel Artist, to Walter Hood Fitch, one of the leading prolific botanical artists ever (Gardner, & et al., 2004)

ART OF MUSIC AND MIND

The beneficial results of the relationship between the arts and sciences in a multidisciplinary teaching-learning process are evident when studying the work of scientists and

musicians who analyze the musical experience. Paul Robertson's study in the field of neurology and his techniques answered the common questions about the music world. Robertson, who is a visiting professor of Psychiatry and Music at Kingston University - the United Kingdom, along with some American researchers, has become famous, claiming that listening to Mozart increases intelligence (Cuadrado, 2019). This however extraordinary it may seem, coincides with the thesis of this article. Research confirms that playing or listening to music makes students achieve better scores on intelligence tests by exposing the nerve columns of the brain for inventive functioning; They also show unusual increases, of more than 47%, in the capacities necessary for the tasks of fitting objects, for example, order the pieces of a puzzle. These outcomes were accomplished by children who took piano lessons in front of a control group that had not received them (Hallam, 2015).

One may wonder why intelligence is influenced by playing or listening to music. According to Hallam (2015), the auricular system is the answer, which has the mission of deducing and detecting patterns; it interprets them quickly, perceiving them as rhythm and puts them in relation to the beats of the body itself. This study supports the assumption that listening to or studying music stimulates our thinking and actively increases abstract reasoning. Again, the introduction of this artistic modality in education improves the intellectual capacity of the student.

THE COMPREHENSIVE LEARNING METHODS

In the educational reforms of the last century, the concept of holistic education has been lost, which means the insertion of arts in the school curricula, since the norm has been to focus on specialized learning and divided into options (Campbell, 2011). It is a curriculum for the student to learn alone, sitting at a desk, and try to find a sense of the experience of someone from outside, condensed, and summarized in the form of a textbook.

Current secondary education guides students to specialized areas. The latest research suggests that performance in specific fields improves significantly when the arts are integrated into the humanities and sciences (Hare, 2010)

Art, if integrated into the conventional science curricula, can act as catalysts to beat pre-defined attitudes and obtain much higher rates of retention in the classroom. It also increases attention on a topic, improves students' self-confidence, and provide new methods of learning (Campbell, 2011). Moreover, above all, by incorporating the arts into teaching, students feel more motivated to learn, and a subject becomes automatically more desirable.

THE RESEARCH JUSTIFIES A MULTIDISCIPLINARY CURRICULUM

The National Foundation for Education Research (NFER) of the United Kingdom, the Harvard University Zero Project and the review of the Association for the Advancement of Arts Education (AAAE) in the United States have carried out extensive research programs whose results can make the educational field redistribute according to specific social, political, economic and technological environments (Lawton, 2012 & Newseditor, 2009)

Lawton (2012) affirms that these research programs provide a persuasive debate for a modification that can lead to a fundamental review of the organization of schools for learning and teaching. Educators will have to reconsider the traditional concepts about what should be taught and how it should be taught. This means an emphasis on expression more clearly, restrict, and interdisciplinary curricula that value and recognize the support of all sectors of a determined society.

Research on theoretical experiments and studies based on the theory carried out by the Reviewing Education and the Arts Project (REAP), the part Project Zero member, concludes that when academic innovations of artistic content are introduced in schools, they are a source of motivation and responsibility towards academic study for the numerous students that do not adapt to the cultures and structures of the modern school (Hetland, & Winner, 2001).

This same fact can be used for students in developing countries who must overcome many obstacles. Education

has to be relevant to its demands, cultural traditions, and values, and take into account their economic and social realities at the local level.

Harvard REAP states that when a subject acquires an artistic bias, the disposition towards it increases. Greater confidence leads to greater motivation and more significant effort that results, in turn, to better performance (Hetland, & Winner, 2001). Common sense tells us that it is logical that an integrated approach to the arts be beneficial for all students, even for those who get good results, simply because this type of approach makes any subject more interesting.

RESEARCH IN SCIENTIFIC AND ARTISTIC EDUCATION

Harland et al. (2000) presented an article published by the National Foundation for Education Research that provides a summary of the report Arts Education in Secondary Schools: Effects and Effectiveness. The report discloses the outcomes of a three-year research on the effectiveness of art education in Kent and Medway high schools. The investigation was carried out in 1997 by the NFER commissioned by the British Royal Society of Arts. The main objectives of the study were:

- Investigate in secondary schools all the effects attributable to artistic education, especially the hypothesis that engaging in a creative task can raise overall academic performance;

- Analyze the processes and key factors that cause these impacts, including the description of effective practices and identification.

THE OUTCOMES OF THE STUDIES THAT ANALYZED THE EFFECTIVENESS OF ART EDUCATION

The impacts of art education are divided into nine categories; six of them deal with direct learning findings, while the other three refer to different types of effects (Harland et al., 2000). The outcomes attributed to the arts and pertinent to the purpose of this study are listed below.

RESULTS ATTRIBUTABLE TO ART EDUCATION
Effects on Students:
1. A great sense of excitement, enjoyment, fulfillment, and relaxation of tensions. 2. High awareness of cultural and social issues. 3. An increase in the practical and theoretical knowledge of specific artistic branches.
Development of Creativity and Reasoning Ability:
4. Improvements in personal and social ability. 5. Enriching communication and expression capacity. 6. Effects on other areas, such as learning other subjects, career launch, and cultural activities beyond school.
Other Impacts:
7. Effects on local community including authorities and parents. 8. Institutional effects on school environment and culture. 9. Being creative in artistic skills.

In schools famous for their dedication to the arts, students who performed well in at least one artistic branch reported many and varied effects. The most frequently mentioned type of influence was, by far, the one concerning progress in terms of technical capacity and knowledge of certain artistic branches. Besides, clear testimonies of many other effects were collected, such as:

- Self-confidence.
- Feeling of accomplishment.
- creativity and self-expression
- Social competencies that are necessary to work in a team effectively.

To understand the advantages of new advances in science teaching with the incorporation of artistic disciplines, it is necessary to observe the outcomes of case studies taken from the significant research programs cited in this article. For example, issues of improving social development and self-esteem are essential for the task of combating uprooting and social exemption among youth.

CONCLUSION

The incorporation of artistic disciplines to scientific education in primary and secondary schools facilitates learning, making teaching more enjoyable thanks to creative experiences and thus allowing students to realize the significance of humanity; to practice what only the human being is capable of achieving, which is to shape a vital

experience through a series of aesthetic and scientific symbols and knowledge.

Researchers have confirmed the assumption that enhancing artistic disciplines in the secondary education curriculum really improves academic performance. The convenience of incorporating arts into the science curricula to strengthen academic performance versus the non-integrated scientific curriculum seems evident. Academic researchers will persist in studying how art can be a mean of transmission, allowing educators to put in practice artistic and scientific curricula.

The three research programs, the Zero Project of Harvard University, the review of the Association for the Advancement of Art Education (AAAE) and the report of the National Foundation for Education Research (NFER), reach very similar results in terms of the two principles:

1. Integrating the arts in the humanities and science curricula provides a solid foundation for teaching and learning.
2. Developing a value structure and living according to it will enhance the goodness of life.

The memory will not be essential to retain vast amounts of information in the future. The technology of computers has modified the world of teaching and learning by making all the information we may need more accessible. All we need is the power to think clearly and cleverly, which is different from retaining large amounts of data. That is only reasonable if we teach students to think holistically, in a global and multidimensional way, and if all

disciplines are taught simultaneously: arts, science, literature, and history. For better learning, students do not need the educational path that traditional school has imposed for so long. This other learning method offers more guarantees to continue with the student evermore and allow him to realize all his abilities.

The value of an integrative curriculum of arts and sciences in primary and secondary schools, and its ability to realize the intellectual capacity of the student can be noticed in the examples of career opportunities. An integrated program of Science and arts, as the results of the research show, also develop the ability to acquire responsible behavior that is attentive to values in a social and ethical context.

To fully realize the notion of ethical interests and acquire accountable behavior, it is significant to concentrate on the essential values of social responsibility and of being a conscientious and a human. An academic effort is necessary, but it has to be responsible and of high quality.

In the early years of primary school, responsible education can't be fully achieved, whereas, in the years of secondary level, it reaches its highest incidence because of adulthood. Teachers and Parents should assume responsibility in their own lives and try to instill a feeling of accountability in young students.

Currently, The advanced world favors scientific explications. Emphasizing a responsible, wise, and clear path for the future will depend on integrating the best of arts and science with the best of ethical values.

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