

When Art, Science and Technology Interact

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Abstract

One of the objectives of the paper is to ignite a productive debate on the overlapping tendencies of art and the exact natural sciences, as well as to address the educational dimension of these intersections. The paper presents some results of the research realised within the project titled *Useful Symbiosis* carried out in 2014, the main outcome of which was the book titled *Useful Symbiosis: Science, Technology, Art & Art Education* which was published two years later. In this project, we were interested in the relationship between visual arts and sciences and their technical applications. Apart from introductory and rather theoretical overviews, the paper also lists particular examples of these symbioses in which we demonstrate that science sometimes ‘does art’ as well as art can ‘do science’, and sometimes the borders between art and science disappear altogether. The overlapping tendency of science and art is also topical in education. We will also tackle the problem of the isolation of individual educational fields in contemporary education, the relationship between individual subjects, and the process of overcoming the transmissive approach to teaching.

Keywords

Art, science, art education, relationship between art and science, theory of art, theory of science.

Introduction

The paper presents the project *Useful Symbiosis*, the main outcome of which was a monograph titled *Useful Symbiosis: Science, Technology, Art & Art Education* (2016). The project was carried out by a team of pedagogues and PhD students from the Department of Art at Palacký University Olomouc in the Czech Republic. The subject matter of the research, in which the principal researchers gradually involved many of their colleagues from the Palacký University Olomouc as well as the Masaryk University in Brno (Czech Republic), and the University of Southern Indiana in Evansville (USA) was to address the relations between visual arts and sciences and their technical applications. It was highly gratifying to see experts from various corners of the world coming together and starting a fruitful cooperation.

Symbiosis is not possible without understanding. Therefore, the authors of the paper believe it beneficial to first analyse the concept of the scientific approach, and to demonstrate its advantages and limitations. They adopted the same approach to the issue of art. The comparison of both approaches brings – as we believe – better understanding of the specifics of both areas.

Following the theoretical part of the paper, it also offers a number of examples of useful symbiosis that further support the claim of the authors that art and science overlap into one another, at times blurring their respective borders altogether. Examples presented in the paper are not only from the context of art, but also science and most topically from art education. The authors of the paper hope it will bring nourishing food for thought while attempting to widely open the colourful fan of observed intersections between science and art and their mutual

influence.

Science and Art as a Path to Knowledge

Even though art and science are separate areas today, they are both aimed at discovering and the comprehension of the same reality. As P. Bourdieu reminds us (1998), these worlds which are differentiated today (apart from art and science, also philosophy, religion and others) were in ancient societies undivided. No matter the angle we take on the permeation of both areas, there are a number of significant differences between them, which need to be understood completely when considering ‘useful symbioses’.

It is often emphasised that the medium of art is sensuality, while the medium of science, as well as of philosophy, is a conceptual apparatus, a network that can ensnare the world. The well-known French thinker, G. Deleuze (2008), a representative of post-structuralism, was fascinated by the relationship between art, science, and philosophy. He maintained that none of these disciplines is superior to the other and that each of them is creative. Flexibility, which refers to the flexibility of perception and imagination, as well as to the flexibility of meaning and content or the ability to restructure some images or to adapt quickly to new conditions, is another aspect of creativity. We also associate the creative artistic and scientific process with intuition, a kind of hard-to-grasp lightning of insight and a sudden creative idea useful when solving a problem.

If creativity and intuition are common traits to the observed areas, there will also be significant differences. Deleuze (1998) saw the different areas as having different purposes: according to him, the purpose of science is creating functions, while the purpose of art is the creation of sensory aggregates, and the purpose of philosophy is to form concepts. The significant Czech artist, František Kupka (1923), believed that the difference between science and art is in the absolute or, conversely, the relative nature of their subject matter. While the subject matter in science is ‘positive’ with the purpose to analyse and define, it is also unconditional and absolute;

the scientific interpretation and the method of presentation are only relative.

Conversely, in art the only thing which is positive, which means positively ascertainable and definite, is the manner in which the means of implementation were employed in order to express the subject matter or the way it was presented. (ibid) However, this subject matter or content is always relative, and therefore, ambiguous. Furthermore, in the case of art, the manner of presentation and the content are inextricably linked and cannot exist separately, unlike in science, where the manner of presentation can be arbitrary, and still with no effect on the message.

Both areas, science and art, can be regarded as a path to knowledge. Both methods are characterised by their specificity, by different but also identical elements.

The Specifics of Scientific and Artistic Approaches

Using a scientific approach, humanity seeks to find out the way the knowable world works and tries to understand it. Science has given to people the idea of progress and hope that we will liberate ourselves from ignorance, prejudices and superstitions. It has been hailed as one that will discover the ‘truth’ about the world. Science provides us with many fold verification of facts, with the desire to discover the truth and objectivity while attempting to create a reasonable and complex order of things.

The principle of all scientific activities is usually considered to be reason or rationality, though P. K. Feyerabend (1975), a famous Austrian philosopher of science, thinks it to be too coarse a definition. In addition: rationality is also present in other types of learning including arts. According to Feyerabend, not even a scientific achievement can be easily explained – there is no universal path to scientific results. If scientific activity is a creative activity, then it seeks paths yet unproven, not the conventional and describable ones.

From the modern era, science heads towards applications, the advancement of technology, and the control over nature. If we turn to art, we see that it does not set similar goals. It is

rather concerned with the formation and self-interpretation of a human being in its historical and cultural climate. (Henckmann, Lotter, 1995)

Despite all the reservations and restrictions, science is now understood as a driving force of social changes and prosperity. Its task remains to be the detection and formulation of laws governing the phenomena around us, and the formulation of theories based on these foundations. (Durozoi, Roussel, 1994) The definition of its limits and the consequences of its actions may serve to benefit not only science itself, but mainly the society over which science has a dominant power.

The opposite nature of objectivity and subjectivity seems to be of utmost importance for the purpose of defining the difference between scientific and artistic approach. Neubauer (2001) defines subjectivity as an ontological experience of the natural world. He considers it to be perhaps the most original and also the most natural human experience, since birth, a human being is identified with their subjectivity, there lies their nature: a human being is a subject. (ibid) The discovering of a philosopher and artist is subjective and natural. It is based on the internal seeing of purpose as it enters the personal experience of understanding (ibid), which, as we know from Deleuze (1998), a philosopher expresses in concepts, and an artist in sensory aggregates. However, philosophy – just like art – is not subjective in such a way that its findings and ideas have only an individual character, and that they would not be generally applicable. (ibid) Indeed, their relevance and validity are verified in the process of a live communication, in the case of art in the art scene.

In search of an answer to ‘when is art?’, Goodman (2007) emphasises its symbolic function. He argues that there is no art without symbols, or, without any of the three modes of symbolisation, which he denominates as a representation, expression, and exemplification. If an object functions as a symbol, it does not mean, of course, that it can be immediately referred to as art. However, because of the fact that a certain object functions as a symbol (or is able to function

as such), it can become art.

However, science striving to express the essence of things in abstract theories and laws, blurs individual facts and subjects things to only general contexts. It seeks clarity of statement, while the constructive nature of art is in ambiguity or ‘opened’ of its meanings. Not only does art expect the subjectivity of its creator, but it is also dependent on the interpretation, and thus depends on the subjectivity of the recipient and historical contexts of reception. (Henckmann, Lotter, 1995) Science is objective at all times; a certain fact has its validity regardless of the entity or socio-cultural circumstances.

Art as well as science constitutes another basic form through which a human being recognises and interprets the world. (Zhoř, 1998) Art, just as science, is a specific, socially, and culturally determined kind of human activity. A scientific approach aims at producing and applying new knowledge obtained by a rational approach to the world and multi-step verification of facts with the aim of uncovering the truth, objectivity, and a meaningful and complex arrangement of reality. Can the same be done in the case of art?

As opposed to the logical-scientific relationship to the world that we associate with science, the specificity of art is beauty and sensory pleasure associated with sensory cognition. Cejpek (2007) sees the difference between science and art in the application of a different method when seeking to explore the world: while science processes reality primarily in a rational way, art tries to capture it in a wide range of sensations and emotions. The author also draws attention to the traditional prejudices commonly attached to the relationship between science and art. While we associate science with exactness and logic, art has to rely on the world of imagination and fantasy, which the artist ‘invents’ and which is not in (almost) any way connected with reality. (ibid) In reality scientific knowledge and theories also exhibit to be considerably dependent of its socio-cultural context. Therefore, it does not apply, that they stand above their field and are once and for all ‘true’ and objective. And of course, in science, not only in art, a considerable

degree of intuition and creativity, which is customarily equated with artistic activities, is also applied.

When Science Makes Art and Art Science

While we have shown many fundamental differences between science and art, it happens quite often that both observed fields sometimes produce a result that could easily be categorised as the outcome of the other field. Due to the separation of the world of science and art, it is surprising, but not rare.

A good example of a product that originated primarily from a study, rather than out of artistic efforts, and yet entered the centre of the art field with surprising vigour, may be represented by the book titled *Art Forms in Nature*, which was published in 1928 in Berlin. In the book, the author, a professor of drawing, Karl Blossfeldt, published his large-format paintings of plants and their details, which he created using the relatively new medium of photography.

What made Blossfeldt's photographs disquieting was the fact that the zoomed-in images, perhaps too materially and with a palpable urgency showed what was actually outside the natural human visual perception. Only optics of purely technical means are able to capture such perfect, abstract geometry of an unknown yet quite real and natural world. (Hubatová-Vacková, 2011) For the author himself, these images were the symbols of universal laws of life forms, the image of the creative act of nature and its 'will to a form'. (ibid) The photographs show that every art has its prototype in nature; the fruit of which are also human beings themselves.

Goodman's (2007) belief is thus confirmed yet again. He proposed that if an image, object, or phenomenon has the ability to symbolise, it may become art. And it is exemplified by not only Blossfeldt's photographs, but also by other originally purely scientific images that gained the attention of the participants in the artistic field for their extraordinary visual power and the ability to acquire rich symbolic meanings.



Figure 1: Images from the book *Art Forms in Nature* by *Karl Blossfeldt*, 1928

If science can make art, is conversely art able to produce science? Examples of art that not only uses scientific methods but could also have scientific relevance (if that were the objective of the artists) may be represented by biotech art, usually abbreviated to bioart. It uses 'biological material' for creative activities, such as cells, DNA, bacterial cultures, tissues or animals, and yet it works with various empirical methods. In addition to observation or measurement, it also works with an experiment which in combination with genetic engineering techniques, special laboratory equipment and current technologies often brings shocking results.

Artist named Eduardo Kac, genetically manipulated a fertilised rabbit egg into which he brought the gene for a fluorescent protein from jellyfish. The new born kit, a female rabbit Alba, then had the ability to luminesce in green colour in the appropriate light. Earlier the same artist had a microchip implanted in his body in order to start a debate about the impact of technology on people's lives. (Mihulka, 2007)

Also, the artist Marion Laval-Jeantet deals with the theme of body and biotechnology. During the performance titled *May the Horse Live in Me?*, she had a serum with horse blood injected in her body. The author wanted to explore its therapeutic effects while she attempted to confirm her blood brotherhood with a horse by walking by his side wearing prosthetic horse legs whereby she opened a rather general issue of the boundaries of individual species, the possibilities for their crossing, and the dominance of humans over animals. (Batinić, 2011)

In another project, the artist Amy Karle has created an artwork using the body to explore what it means to be human through a unique negotiation of art, design, science and technology. Her ‘Regenerative Reliquary’ is a bio printed scaffold in the shape of a human hand. This design was 3D printed in a biodegradable pegda hydrogel that disintegrates over time. The sculpture is installed in ‘a bioreactor, with the intention that human Mesenchymal stem cells (hMSCs from an adult donor) seeded onto that design will eventually grow into tissue and mineralize into bone along that scaffold’. (Karle, 2017) Inspired by the generative and parametric design in the body, this piece considers how cells articulate into different forms – what makes a cell become a beating heart, skin, or bone – in naturally occurring “additive manufacturing” created by a multiplier effect. “Regenerative Reliquary” further focuses on the dynamic organ and tissue in our bodies that is constantly remodelling and changing shape to adapt to the daily forces placed upon it: bone. Furthermore, this work offers multi-layered meanings referring also to the issue of cult of relics, the concept of holiness, authenticity and miracle – the miracle of creation, of life, a reproduction as a miracle.

It is clear that these artistic experiments – but also the experiments of scientists – can provoke a controversy. According to some, these are highly unethical activities during which artists take living organisms as mere material and arrogantly interfere with natural life forms and genetic processes just to gain attention. According to others, these attempts are useful – unlike scientific results, understandable only to the community of the given specialisation, they have

a metaphorical dimension, wit and ability to generate the necessary discussion on the current possibilities of humanity.



Figure 2: Eduardo Kac, *GFP Bunny*, 2000; photo by Chrystelle Fontaine

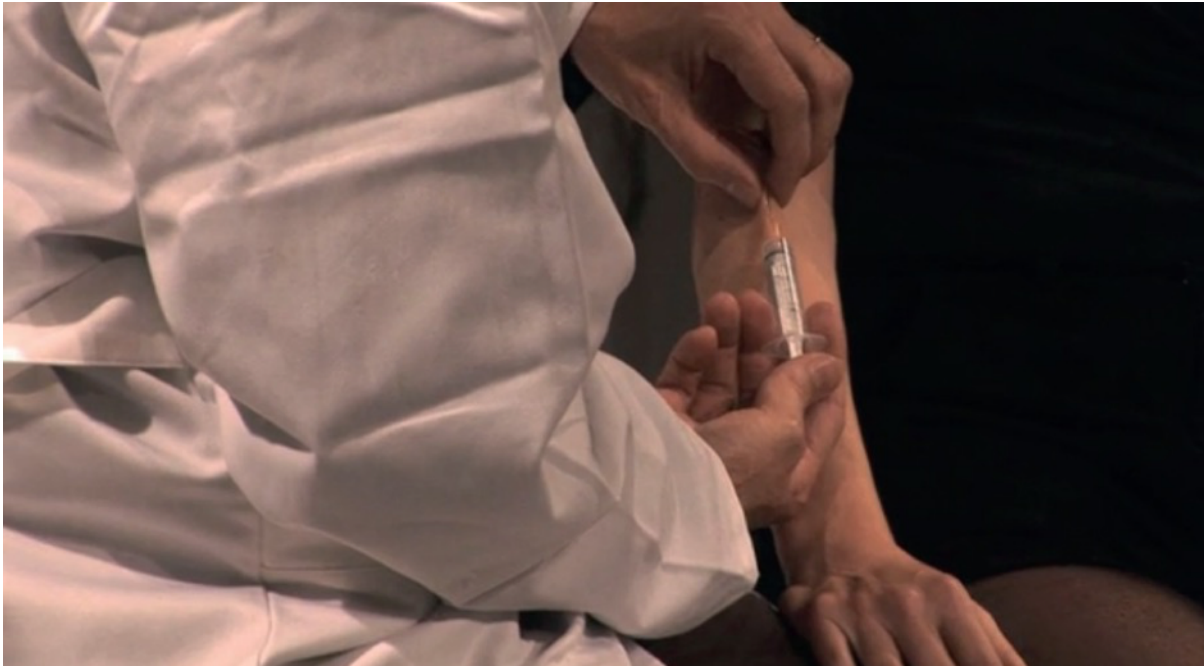


Figure 3 & 4: Art Orienté Objekt (Marion Laval-Jeantet), *May the Horse Live in Me?* (a performance in the Galerie Kapelica, Ljubljana, Slovenia), 2010; screenshots of a video on YouTube

While art is closely linked with science and its applications, what is the case of science? Does it use art? Does it apply artistic methods or results?

There is certainly less influence of art on science, but it can be traced. Leaving aside the well-known research method of empirical science, the experiment, which was created in painting and music, and which was taken from arts into science (Henckmann, Lotter, 1995), we sometimes hear the cry after an overall ‘artification’ of science. The author of one of them is Feyerabend (2004), who, after his criticism of a well-established understanding of science, invites scientists to pursue a free formulation of hypotheses that will contradict validated and accepted theories in an anarchic way. In this context he asks: is it possible to continue using outdated terms for the description of perceptions? Would it not be better to introduce and apply a new language? And could poets not help with finding such a language? (Feyerabend, 2004)

While in natural sciences it is difficult to find influences of art, another situation occurs in social and human sciences. This is not just about today’s extensively discussed artist-led research, but also about finding alternative ways of presenting research results. It turns out that these can be presented in a different, experimental form, e.g. involving fictional, literary texts, which are verified especially in psychology. (see Lášticová, Petrjánošová, 2010, Neusar, 2010) A literary text, namely a poem can also be used as a primary source of information about the observed entity (i.e. as research material) or it can be a kind of semi-finished product, i.e. an analytical tool with several useful advantages. These include a shortening of the text, its more concise encoding, and the presentation of an emotional content. A poem, however, may also be the result of the research itself – representing a complementary, or even the main result. (Neusar, 2010, p. 54)

Whether or not similar ideas sound more or less peculiar, attempts to give academic texts other forms such as the one of fictional prose or auto-ethnography appear on multiple sides. They all readily admit that most scholarly articles cannot be read at all, because the current

convention dictates to write in a disorganised and unreadable manner. Besides classical academic texts, which van Maanen (1988) referred to as realistic stories (these are the well-known texts formulated impersonally by an expert authority), various reflective confessional tales are also used, in which the author explains his views, the perspective when observing a selected phenomenon, and its interpretation. This way of writing responds to the disillusionment of the strict objectivity of the researcher, it admits the impossibility of the achievement thereof, and intentionally reflects the subjective ‘personal’ circumstances of the research.

Another type of similar texts is the so-called impressionist tales. They are written in a dramatic form and their aim is to comprehensively and with a high degree of subjectivity deliver to the reader the ‘story’ of the research and everything the researcher saw, heard, and felt during his/her research. Knowledge is therefore presented in a fragmentary manner, often using narratives and the reader is kept in suspense. (Lášticová, Petrjánošová, 2010) Today there is even an entire spectrum of genres different from traditional academic texts: fictitious (ethnographic) prose, poetic representation, (ethnographic) plays, mixed genres. (ibid)

Useful Symbiosis in the Context of Education

Current curriculum calls for the implementation of interdisciplinary extensions and the development of such educational projects, which would naturally interconnect the knowledge of various disciplines and their methods. Although we have shown in previous chapters, many examples of various fields’ interaction and their specific symbioses, in schools the educational content still remains divided into separate educational fields, and it is as such presented to students – regardless of the often-felt artificiality of this division. For cognition and learning do not usually lie neatly packed in several boxes, which are to be gradually opened by a teacher and their students. It is rather a confusing pot of interconnected and sometimes even contradictory findings. By opening separate packages, we will certainly not reach the much-needed synthesis of

knowledge. Excessive specialisation of fields of study and their strict separation leads to the fragmentation of knowledge and the misunderstanding of their mutual relations.

Although the education system is rightly reproached for giving preference to science before art, artificially isolating individual fields of study, favouring the transfer of finished sums of knowledge before heuristic methods and memorizing before experimenting, it must be said that the power of overcoming this undesirable situation lies largely in the hands of the teachers. As indicated in the previous chapter, the role of a ‘creative artistic teacher’ whose field of reference (arts) is of a strong transdisciplinary nature is therefore still more important. Projects presented perhaps provide the necessary inspiration and show that it is possible to integrate contents into meaningful units.

Pre-school is the ideal period in which the integration of educational contents of different disciplines happens quite naturally. The project titled *Mravenci, královna a mravenčanata* [Ants, the Queen, and Little Ants] can serve as an example of an educational project in which the contents of art and biology are being integrated in the process of education. The project was realised with a group of fifteen children aged 4 to 6 years in the Olomouc Studio Experiment, and with complementary worksheets that playfully make the theme of life in an anthill accessible to the participants.

It should also be said that learning about the life of insects serves here as a springboard to broader knowledge – questions of purely human character come to mind as an interesting comparison: how we people live, what we eat, what work we do, how we take care of small children, what makes us happy. Comparing individual testimonies – both artistic and verbal – has become another important creative element of this educational program. Children communicated among themselves, listened to testimonies of their peers, and responded to them – and it is precisely in the process of communication where we can see the greatest benefit.

The program consisted of several activities each addressing different aspect of the life in an

anthill. The first one focused on *What does an ant look like?* On the basis of their drawings children worked with clay and created simple sculptures. Another activity was the *Ant Queen*, where the story of different types of adult ants (female, male, and labourer) served as a motivating narrative along with the use of visual materials and worksheets. By making drawings using markers and ink, children expressed their own imaginative ideas about the life of the ant queen. Another activity, titled *Ants Working, Ants Sleeping*, continued with the gradual introduction of life in an anthill and roles, which are naturally taken on by ant individuals. Children were told about the types of work which are necessary to sustain the life of an anthill, and children themselves suggested different professions, needed to support the anthill (guards, soldiers, suppliers, childminders, etc.). Children then transformed their ideas onto drawings using coloured markers, a technique which was used as a means of gradual transition towards painting. In another reflection, children studied their work and talked about the profession their ant in particular is performing in the anthill. They also discussed what profession is most interesting in our human world. What children want to be when they grow up?



Figure 5 & 6: Photos of an education project for pre-school children titled *Ants, the Queen, and Little Ants*; photo by Petra Šobáňová



Figure 7–10: Photos of an education project for pre-school children titled *Ants, the Queen, and Little Ants*; photo by Petra Šobánková

Conclusion

It seems as though with the influence of post-modern erosion of traditional rudiments of both of the observed fields, their intersections and mutual influence grow more frequent. However, art and science remain independent worlds with their own laws and particular methods. While both of these fields aim at knowledge and independent learning of the reality, the objectives and procedures are different for each of them.

As for science, it continues to be based on rational thought combined with doubt and self-correction, as well as the quest for order in nature and its representation in the form of a system

of objectively achieved and verified findings. Feyerabend (2004, p. 75) believes that sciences differ from arts (and philosophies) by the efforts they extend to connect qualitative development with quantity. The aim of science is to achieve a large number of findings and only those that imply further predictions are considered to be of any value. Science is to be understood rather as a cultural and social phenomenon dependent on historical contexts.

Such a rule can be also applied to art, which is established only by its own activity, that is, the activity of the art field and its players. Despite the difficulty to understand the very essence of art (as every new art expression can easily invalidate the current definition of art which had been formed with much pains), its fundamental roles and potentials are coming to light. One of them is its ability to symbolise as well as to thematise important social phenomena.

It is rather clear that both science and art are part of the same culture and of the human quest for knowledge. However, they differ in many aspects: by the perception of the truth or the different attitude to the objectivity, that is, the subjectivity of knowledge. The truth, which remains to be the very goal of scientists, has no connection to being objective when it comes to art. The verifier is the very subjective artist her/himself, and not a scientific academia with the possibility to repeat certain measuring or experiment which led to a given result. Compared to this, the result of an artistic activity is unrepeatable and unique. Art may not be repeated or reproduced without losing its authenticity or aura. However, the value of artefact does not lie solely in its authenticity. Art must also be able to reflect on important phenomena of human existence, as well as metaphysical and spiritual issues to which science is completely indifferent.

The symbiosis of art and science proves to be of utmost importance for the current attempt to overcoming the dichotomy of scientific and artistic approach to the world by means of post-modern education through art. The priority of art education in primary and secondary schools is interdisciplinarity. Special programs are designed to this end in universities, where future artists and art teachers study. New disciplines such as intermedia, body design, visual communication,

syncretic projects, etc. are being developed. All of these trends, resulting from innovation of education through art, lead to the emancipation of cognitive and intuitive approach to exploring the world.

In nature just as in culture, symbioses have various functions. Symbionts are mutually beneficial to one another; they share their new knowledge, as well as influence, enrich and help each other. If it proves to be beneficial, also the symbiosis of art and science shall continue to exist and produce remarkable results.

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