# New Forms of Creative Artistic Expression Through Technology: An Alternative Perspective to Education

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**Abstract.** The paper tries to address the relationship between creativity and technology, having as a basis the idea that implementing cross disciplinarily approaches has a great potential in generating innovation. The recurring theme of the paper revolves around identifying the catalysts of disruptive ideas hence supporting the need of creative thinkers in our society as opposed to hyper specialization of knowledge. We look at the current educational system, analyze different technologies and their impact as well as the influence of technology upon art. Finally, through the NEO-David light art installation case study, we hope to find evidence in supporting the importance of creativity and cross-disciplinary thinking.

**Keywords:** Creativity · Education · Cross-disciplinary thinking
Art and technology · Light installation · Creative expression · Lighting design
Kinetic light · Voxel display system

## 1 Introduction

Since the dawn of human kind, several driving forces have been spearheading the development of our civilisation. This paper focuses on two of these high momentum entities, creativity and technology. Even though in the last couple of centuries these have been perceived as distinct explorative fields, studies based on divergent thinking begin to direct our attention towards a holistic paradigm, which addresses these fields through a cross-disciplinary methodology.

### 1.1 A Brief History of Creativity, Art and Technology

If we are to consider one of the most basic technological developments, such as the harnessing of fire, and its implementation, in the different aspects of the life of early sapiens, we can quickly identify creativity as a development tool. The use of fire as a means of protection, a source of heat and light, or using it as a weapon against others, showcases the ability to iterate upon a technology based on creative input.

An extreme form of creativity, showcasing the highest level of abstraction, has manifested its self throughout history in the form of art. The definition of art has always


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been a controversial subject, during the 20th and in the first decades of the 21st centuries, when the means of expression have evolved, morphed and transitioned, hand in hand with emerging technologies and social development. But one constant has remained during the ages, art appeals to our humanity and it is tied to psychological, sociological and political issues relevant to its time.

The technological and cultural development of proto-societies, such as the production of colouring pigments, the use of burned clay, later ceramics, the desire of "cultural colonisation" of the inhabited space, is a clear example of an emerging symbiotic relationship between art and technology, and their co-evolution as a hallmark of humanity, transcending ages.

It is a common idea that the scientific field and art share many of their core principles, both involving overlapping methodologies, such as the development of ideas, hypothesis and theories which are later tested in an environment, engaging both mind and body, such as the studio or the laboratory [1]. Artists and scientists alike, tackle diverse subjects ranging from materials, people, history, quantum physics etc. to transform the acquired knowledge into something else.

In classical Greek, the word "art" is translated as "techne", from which the words technique and technology would arise, thus presenting us with another ancestral connection between these two fields. [2].

### 1.2 The Shortcomings of the Educational System

Until the middle of the 18th century this connection between creativity and technology was much more evident, then it is today, having an educational methodology relying on a truly holistic approach, the seven years apprenticeship, which combined thinking and making in an unbroken learning experience [3].

Due to the economic changes brought in by the industrial age, and the geopolitical circumstances of the period, a new model was developed, one that would be able to cater to the needs of the era. With the rise of the public education systems, a range of ideas were put in place, mainly having a focus on standardisation, and specialisation of knowledge while at the same time creating a socio-intellectual division between economical classes. This approach has been successfully propagated throughout our civilisation, resulting into a society which fails to see the interconnectivity of knowledge, often marginalising creative efforts in favour of more gainful aspects of productivity.

Now society faces yet another paradigm shift. We are at the moment when we have past the first timid steps into the digital age. The computer has forever changed the social landscape, by slowly eliminating arduous tasks and allowing us to assume creative positions. Unfortunately, the current educational system seems to have forgotten to adapt to these new circumstances. By trying to create professionals whom we consider specialist in a certain area it is often forgotten that the development of innovation relies on an individual's ability for abstraction. If the industrial age needed a workforce which could operate as the brain controlling a machine, the information age needs a workforce which can transcend this role, and regain its humanity through great thinkers, focusing at working with a technology rather than being a part of it. The economy of the 21st century will not be driven by human "drones", but by individuals whom are able to connect apparently invisible dots.

### 1.3 Re In-powering the People

The empowering of individuals through technology has already began to have disruptive consequences, throughout the professional fields. In the case of art and technology we start to identify a reunification of the disciplines. In many cases the boundaries between the technologist and the artist having been blurred to an almost indistinguishable level.

It is through this mashup that innovation can emerge. The so-called thinking outside the box or divergent thinking is what allows individuals to make unusual cross-disciplinary connections. To pursue such endeavours, knowledge has to be mixed and span different fields, hence the argument for an approach combining the extremes, art and technology. The bridge connecting these fields is the proving ground of our future.

## 2 The Relationship Between Creativity, Technology and Innovation

The relation between creativity and technology has been a subject of debate between scholars for decades if not centuries. Taking into consideration this complex relationship, the paper tries to analyse different aspects of how creativity drives innovation in technological development.

It seems to be quite ironic that innovation has always made its self-present, when individuals have taken established concepts and applied them to new domains. A curious fact is that of the establishment of the Theory of Natural Selection [4]. Darwin's magnum opus, was not the direct result of his knowledge in biology, but his power of abstraction, his investigation of an economic paper by Thomas Malthus, demonstrating that populations grew faster than the resources to sustain them, Darwin realised that only the best adapted to their environment would be able to survive. This curiosity presents us with evidence the catalyst for innovation can often lye outside of the inquired subject, while at the same time proving the need of creative thinking in extrapolating information.

The rapid spread of technology is an irrefutable fact, as computing power rises, devices get cheaper, and access to information is made available to the masses, our perspective is shifted towards other aspects of human development.

The availability of high-end technology to the general population, results in routine tasks being a thing of the past rather than the future. This expansion of possibilities, leaves us more time for experimentation and allows us to fail in a safe environment. If throughout recent history creativity has been regarded as a "luxury", it is the unburdening brought by technology, that expands our creative power. It is in many ways a transition from a creative "oligarchy" to a creative "democracy", in the sense of making more space for individuals to be at the discussion table.

Such a process of democratisation has a direct impact on the way we work and deal with problem solving. Meaning that due to technology we now have access to specialised knowledge, in a matter of seconds, however it is up to us to put together this figurative puzzle.

One of the most turbulent technologies, when having a focus on art, has been the invention of the photographic process. From its very early beginning in the 19th century it has had a very controversial position within the art world. This technology allowed individuals to bypass years of training in mastering the craft of image reproduction, yet allowing the artist to focus on the aesthetic message he or she intended to communicate.

The controversy around how photography qualifies as art has been an ongoing discussion since the development of the first images. If in the beginning artists were trying to imitate traditional landscape oil paintings, this quickly matured towards embracing the qualities of the medium, working with, rather than against it. As an example, conceptual photography turns an idea into a photograph. Even though what is depicted in the photographs are real objects, the subject is strictly abstract, trying to establish an emotional relationship with the viewer [5].

The general availability of technology has given amateurs the opportunity to experiment as well as allowing them the chance to express themselves creatively, thus further encouraging a liberalisation of the arts, sparking an initial wave of techno-artistic democratisation.

Furthermore, iteration on the photographic technology lead to another crucial cultural development. The Kinetoscope is an early motion picture device; it introduced the basic principles on which cinematography would be built. As soon as moving images were available, their commercial value was immediately identified. First as a technological curiosity and soon after it reached a certain maturity it became an artistic medium. Transposing theatrical live performance to this medium was imminent. As such, an art form dating back to antiquity, got the opportunity to morph and evolve into a similar yet much more accessible means of entertainment. Cross-disciplinary thinking, is the catalyst for, what a century later would become, one of the most lucrative entertainment industries.

In the field of computer science, an important piece of it has been absorbed by the video game industry. In the early sixties, developments were setting the stage for this "brave new world" and in 1962 one of the first video games, Spacewars [6], was developed by Harvard and MIT employees Martin Graetz, Steven Russel and Wayne Wiitanen [7]. This initial proof of concept showcased the possibility of a new form of creative expression, one which could combine narrative elements, visual design and user interactivity. By the 1980 this became a booming industry, which resulted in the birth of countless employment positions focused on creative aspects. In 2015 the revenue generated by the video game industry summed up to 91.5 billion US$ [8].

It seems that a pattern could be identified, when looking at the link between creativity and technology. It can be explained as follows, firstly a technology is developed, due to previous conditions. As soon as the technology in question reaches a certain maturity its application is questioned, at this point creatives begin a process of infusing human centred qualities. If this initial process proves to have economic potential, it is then when the technology goes in a second stage of development it reaches its to full maturity. At this second stage of development creative input is one of the major driving forces, it is also responsible for the development of spin-off technologies. the process then is repeated until the technology becomes obsolete (Fig. 1).

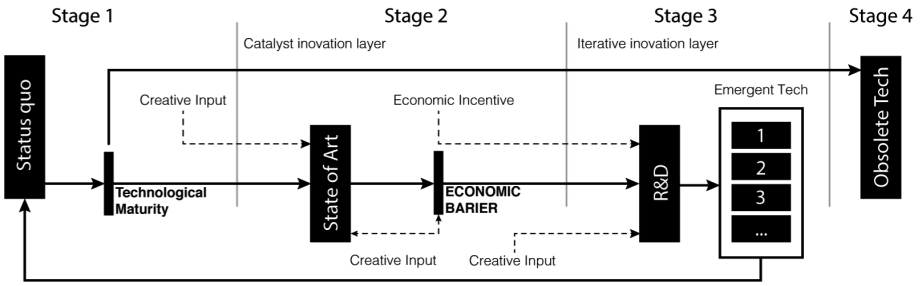


**Fig. 1.** Showcasing the process of innovation and its necessary inputs

In the world of fine art, particularly installation based art, modern technology has had several timid attempts at a holistic implementation. It somehow seems that arts enter more easily in the world of technology then the other way around. However, general availability and low cost is slowly making this a reality. One of the very first modern technologies used in the art world has been the light emitting diode. Since its wide commercial availability at the beginning of the 1970s it has been a catalyst for the development of light-art installations. Artists such as Jenny Holzer [9] have used them to create public works, in many cases occupying the position of advertising billboards, which have managed to draw the attention of the public to art, outside the exhibition gallery, hence making art available to a wider audience. The creative possibilities brought to the creative field by technology has inspired an entire generation of artists. A great leap forward has been the introduction of programming in the context of installation art, allowing individuals to further express their creative ambitions. In 2003 Cerith Wyn Evans marries his interest in ciphered communication and literature in the work entitled "Diary: How to improve the world (you will only make it worse)" [10]. He uses a plasma screen to reveal letter by letter, the English translation of the Morse code that is being conveyed through the flickering lights of an opulent chandelier. Such a work even if not truly technically impressive is showcasing a tendency to shift the trajectory of art towards a holistic approach to technology, in the hopes that the artistic scope can reach the apotheosis of the work in question.

One of the most interesting works combining advanced technological concepts with artistic sensibility, makes its self-known in 2006. Mariko Mori's Tom Na H-iu [11] is a monolith like, free-standing sculpture. It has been designed having in mind the symbolism of light as a representation of the soul, and translates that through a very unusual connection. The mysterious internal light of the installation is driven by the data-output generated by the Kamiokade neutrino detector. Which means that the neutrinos, governing the aesthetic effect of the installation come from a dying star. Such connections across the scientific field and fine art serve to further demonstrate the value and power of cross-disciplinary thinking and the empowering effect of technology within socio-cultural activities.

In 2009 on a remote forested hilltop, artist Doug Aitken produced a work which can only be described as a "sonic earthwork" [12]. The work implied the drilling of a 30 cm in diameter shaft with depth of 1.6 km on top of which a pavilion was standing. By lowering a series of microphones and accelerometers at different intervals, the artist was attempting to translate the movement of the earth to sound, hence establishing a new relationship to our planet.

No matter what the chosen means are, whether using light, sound, moving images electronics or all of them together, artists have repeatedly challenged the boundaries of their media and have expanded their possibilities in artistic expression exponentially throughout the last two decades. This has been a direct result of the general availability of powerful yet easy to use technology and most importantly the human factor, generally relying on cross-disciplinary thinking and knowledge.

## 3 Conceptual Framework of the NEO-David Installation

To further understand the creative process and how it is involved in the development of a project we will look at a specific case study. Our case follows the creative approach in producing a feasible, yet strong concept rooted in the fields of art, technology and lighting design. The Neo-David installation was the result of a theoretical investigation and physical experimentation in the possibility of form and movement representation using the medium of light.

In 1501 the Renaissance Italian sculptor, painter, architect, and poet Michelangelo di Lodovico Buonarroti Simoni begins work on what would become one of the most celebrated masterpieces in classical sculpture, widely known as David. The piece is a celebration of the human figure and stands as a testament to the understanding of form in it's most realistic representation. However, "David" deals only with form, but fails to address the issue of movement, in the sense of a changing form, therefor David will forever be frozen in time. Movement is a critical aspect of an individual's identity, it is a form of expression, which cannot and should not be ignored. Movement expresses freedom and through abstraction it can embody a physical manifestation of uncensored democracy. Hence the installation should communicate movement to holistically celebrate an individual.

Lastly the installation had to establish an emotional relationship with the individual with which it was interacting, as such, the idea of mirroring was introduced. As a conceptual statement, there is no higher praise to one's self then the literal staring in a mirror. This allows the creation of an alter ego, a manifestation of the individual which could be translated to the installation using light. Thus the alter ego, receives a new identity, a pure manifestation of energy.

Conceptually all these parameters involve a high degree of abstraction but irrefutably cater to the desired intention, while allowing the potential apotheosis of an individual's sculptural representation.

## 4 Design Challenges

As the concept idea was established, it has drawn inspiration from the art world, psychology and philosophy, having a wide cross-disciplinary span over humanistic "sciences", it is now time to expand our research over how NEO-David was seeking to become a reality, and what will its physical manifestation be.

Traditional sculpting technics rely on the addition or subtraction of material with the goal of unveiling a form. This is a critical principle, which we will need to understand, as it means that we will need to do the same with the material of our choice. In our situation, the "material" will be light. Unfortunately, light has several disadvantages such as it's lack of plasticity in creating a form, and the fact that we cannot see light, just its effects on different surfaces.

In this context, the sculpture must be composed by two elements: An interaction area and the display area. The first element is defined by a physically delimited area. It is the interaction zone of the sculpture where the individual's form and movement is analyzed with the help of depth imaging. The second element is the display area. Here a three-dimensional model is displayed through the individual manipulation of the constituting voxels.

### 4.1 Anthropomorphic Form Generation

To generate a form that could later be used as an output, we need to employ some advanced technological means, by which we refer to scanning methods, particularly the generation of cloud points or depth maps. To keep things simple, we will not discuss the technical details of such operations, but we will limit ourselves to a short conceptual description. The generation of a real-time three-dimensional model can be achieved through several means, one of which could be the use of electronical components which now are readily available.

The Microsoft Kinect [13] was first introduced in November 2010 and ever since has been used a wide variety of applications, and has generated a great interest in technological oriented artistic circles. Using IR imaging it has the capacity to generate a real-time point cloud which can be translated to a partial 3D model of an environment. It is to be emphasised partial as the Kinect has the limitation of "not seeing through objects". A visual comparison of the resulting real-time 3D output of the Kinect could be that of a bas-relief. In order to overcome this issue and create a fully tree-dimensional model we will need to make investigations in the field of trigonometry, particularly triangulation methods. Through the employment of such technics we can develop a computational model which is able to generate the data set required for driving the display area of the project.

### 4.2 Display Area and Output Method

After the issues in generating form have been solved we need to look at how it can be translated to a system able to communicate form and movement. Yet again we are obligated to analyse form in an abstract manner to understand how we can physically reproduce it.

Mathematically a form is the equivalent of a volume, which can be described as a quantity of three-dimensional space rapped by a closed surface, and it can be numerically quantified using cubic meters [14]. However, what we are particularly interested in, is what the constituent components of a volume are. Further inquiry requires us to borrow notions from Euclidian geometry, in which three-dimensional space is a geometric setting, in which three values, also known as parameters, are required to determine the position of an element. Such notions allow us to understand physical space as a three-parameter model in which all known matter exists. This mathematical notion leads us to a relatively abstract conclusion which is, that a volume can be represented through a collection of such parameters, that visualized as a group can perform the task of mimicking a volume, this collection of parameters can be identified in mathematics as a three-dimensional matrix or grid.

Previous research in the domain on volumetric displays has been done at ETH Zurich, through the development of the NOVA system [15]. The investigation was very successful from a technological perspective, however the lack of 3D content available was limited and its development hindered by a slow adoption rate of users. This issue however does not concern NEO-David as it is limited to the content previously discussed (Fig. 2).

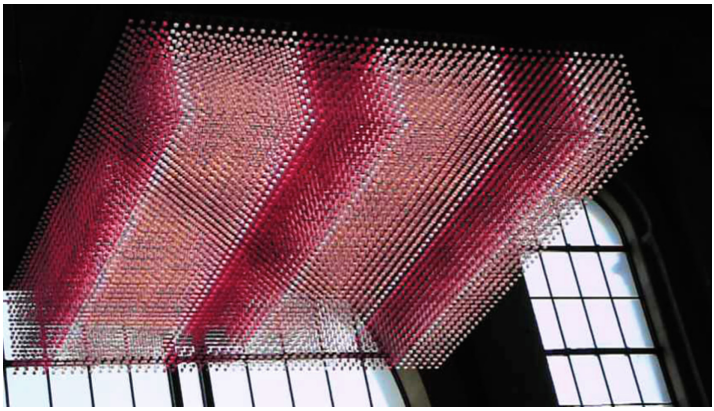

**Fig. 2.** Showcasing the NOVA system displayed in the Zurich main train station

### 4.3 Design Research Outcome and Potential Applications

The system designed for the implementation of the NEO-David installation, has proven to be dealing with highly complex issues and as such the process has been one requiring new ways of using technologies and creative means. As a result, the research done in these directions has proved very useful in the development of further research across different fields as well as applications.

One of these directions refers to the development of real-time modelling techniques, based of scanning technologies, further development and research in this direction could potentially lead to improvements in fields of computer science, medicine and spatial navigation via augmented reality.

Secondly, based on findings in projects such as the NEO-David display system and previous research in the NOVA system, strongly suggest the need for further research on the aesthetic and utilitarian aspect of volume lighting solutions. Applications can include dynamic lighting systems, media facades and implementation of voxel screens within the modern architectural language.

The last point is with regards to the cross disciplinary research methodology and development process as a perspective towards how educational institutions can develop a teaching model in response to the socio-economical changes of the 21st century.

## 5 Conclusion

The paper at hand has dealt into many aspect of creativity and its irrefutable connection with technology, as result of this investigation we can draw a series of informed conclusions regarding several aspects.

Concerning the NEO-David installation, we can state that without a cross-disciplinary approach, having an emphasis on creative thinking, its development would have been highly unlikely. From the highly abstract concept, relating to a theoretical model, to the development and physical implementation of a prototype, none of these could have been possible without employing a process of borrowing, and expanding as well as the mutation of knowledge coming from an array of scientific and artistic fields.

As the NEO-David installation has been developed in the context of a Master's Thesis in the Lighting Design Master's program at AAU Copenhagen, we can also draw conclusions on the programs cross-disciplinary approach. By combining three fields of study, architecture, lighting engineering and media technology, the program succeeds in bringing together students from all the above-mentioned domains. This cultural and knowledge based melting pot becomes a catalyst for the development of bold projects and encourages individuals to think and work outside of their own comfort zone through the uses of collaborative methodologies. This educational model, although not perfect, proves to be cultivating innovative professionals, ready to tackle the controversies of the 21st century.

As we have seen in the previous discussion, technology has been a clear means through which individuals have been pushing de boundaries of conceptual thinking. This process has given birth to new ways of interaction between the public, art and technology, bringing new valences to the creative intent and broadening experiences from both a conceptual perspective as well as a sensorial one.

It seems that art and technology have a bright future ahead, and that the relationship between the two is a symbiotic one, stimulating each other and pushing each other's boundary having as a main catalyst creativity, both fuelled by cross-disciplinary thinking and the desired to improve our lives.

## References

1. The Art Institute of Chicago. http://www.artic.edu
2. Definisions of Technology. http://web.engr.oregonstate.edu

3. Sennete, R.: The Craftsman, pp. 53–81. Yale University Press, New Haven (2008)
4. Darwin, C.: The Autobiography of Charles Darwin, London (1887)
5. Clarke, G.: The Photograph: A Visual and Cultural History, pp. 32–44. Oxford University Press, Oxford (1997)
6. Ceruzzi, J.: A History of Modern Computing. MIT Press, Cambridge (2003)
7. Spacewar. https://en.wikipedia.org/wiki/Spacewar!
8. Game Market World Revenue in 2015. https://www.statista.com
9. Moszynska, A.: Sculpture Now, pp. 64–65. Thames & Hudson, London (2013)
10. Arts Council Collection. http://www.artscouncilcollection.org.uk/
11. Benesse Art Site Naoshima. http://benesse-artsite.jp/en/
12. Moszynska. A.: Sculpture Now, pp. 155–156. Thames & Hudson, London (2013)
13. Microsoft. https://developer.microsoft.com
14. Math Open Reference. http://www.mathopenref.com/
15. Schubiger-Banz, S., Eberle, M.: The NOVA display system. In: Adams, R., Gibson, S., Arisona, S.M. (eds.) Transdisciplinary Digital Art. Sound, Vision and the New Screen. CCIS, vol. 7, pp. 476–487. Springer, Heidelberg (2008). https://doi.org/10.1007/978-3-540-79486-8_37