Chapter 12
Epilog

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Abstract Various aspects of creativity are summarized. Some have known constraints and others have unknown constraints. The ways in which technology have been utilized in the creative process are summarized. Technology that offers the facility of interaction with the user enables iterative production of designs and creative works. The relationship between creativity, art, design, and technology is summarized in a set of propositions.

Keywords iPad paintbrush · Unconstrained creativity · Constrained creativity · Virtual environments · Connectivity · Internalizing images

12.1 Freedom to Create

Today's mixed interdisciplinary environments offer artists and designers significant opportunities to create new art forms and designs. They can also provide new ways of collaboration and connectivity which can be valuable for various kinds of creative works. In addition, multidisciplinary teams are able to share concepts and ideas over the network and work in the same design space via technology.

Each of the previous chapters contains a conclusions section which summarizes the main points in the chapter. It is not the purpose of this final chapter to repeat these conclusions, but rather to view the subject from a higher perspective. It seeks to understand why Leonardo da Vinci's creative ideas and drawings with regard to flight referred to in Chap. 1 took over 400 years to be realized in practice. This provides a relevant case study in seeking to understand the various elements of the relationship between creativity, art, design and technology.

12.2 Creativity Under Known Constraints

Painters may choose different brushes, or modify an existing brush, in order to achieve a particular effect in the artwork. Hockney was able to modify an iPad 'paint brush' with academic assistance in order to obtain the visual effect that he desired [1–3].

The iPad also enabled the natural environment to be 'painted' more quickly so that various images could be produced for different times of the day.

> There is a fear that any artwork which utilizes technology, especially in a digital manner, creates a distance between the artist and their media, says Creed, 'but there is an accessibility to these prints because you can imagine how they were created. With Hockney's paintings so much of the process is hidden, but with the iPad there's much more evidence of mark making.' Almost paradoxically, Hockney's use of technology reveals the more tenuous human imperfections not found in his older acrylic works. It gives a window into how he moved his brush — or hand — across the tablet, through which we can clearly see the performative, gestural approach taken while creating these prints [4].

Proposition 1—Creativity and Computer Images

Where appropriate technology is utilized by an artist, the outcomes can be significant in their impact and value, as is evidenced by the iPad images produced by Hockney. This may be especially the case when these images are seen at a large scale in an exhibition. It is much more than a set of photographs and does allow the observer to internalize the experience of viewing the images.

Proposition 2—Creativity and Technology Dependencies

Some creative initiatives and outputs are reliant upon developments in the external environment. For example, it is unlikely that Hockney's iPad paintings would have been produced in their form and content without the prior development of the iPad.

Proposition 3—Creativity and Unexpected Outcomes

Developments in technology may not anticipate how they may be utilized in creative applications. Nevertheless, they can have unexpected advantages and benefits that may go far beyond the initial intentions of the technology.

12.3   Creativity Under Unknown Constraints

Three design scenarios are considered in this section. Their relationship to Leonardo da Vinci's drawings in the fifteenth century is explored. These drawings all had interesting and novel features but lacked a source of power or energy to enable them to function in the real world. Therefore, the constraints for their operation in the real world were not known or understood. Three sources of power are considered as follows:

- Steam engine
- Internal combustion engine
- Jet engine.

The first point to note is that prior to the Scientific Revolution (sixteenth to seventeenth centuries) it was not known how humans might be able to generate a flying machine. They had observed the flight of birds and deduced that heavier than air flight

should be possible [5]. By a recognition of natural laws and utilizing the processes of observation, analysis and experiment, it was possible to make more systematic progress in understanding nature and how its properties might be harnessed for the benefit of society.

Leonardo da Vinci in the 1480s had over 200 drawings and sketches that showed how he understood flight [6]. However, these did tend to concentrate on the flapping of wings, no doubt to mimic how birds appeared to fly. This illustrated the power of observation coupled with imagination and creativity. However, subsequently it was shown that these did not work in practice because they did not satisfy a number of design constraints which were not known until much later. These constraints were linked to a scientific understanding of the natural world.

Proposition 4—Creativity Under Unknown Constraints

In order for creativity to result in successful outcomes in particular practical situations, there is a need for an understanding of how it may be limited by the constraints inherent in those situations.

Prior to the Industrial Revolution (eighteenth to nineteenth centuries) it was not known how technology might change traditional practices because it had not yet been invented. The development of the steam engine during this period enabled significant amounts of power to be generated using natural resources (water and coal). However, containment and transmission of this power needed strong and heavy materials. They were used very successfully in engines for trains, cotton mills, and pumping stations. But they were far too heavy to be used in a flying machine.

However, the invention of the internal combustion engine in the nineteenth century using liquid fuel enabled the power to weight ratio to be significantly improved. Such engines were used in a variety of applications [5].

Between 1899 and 1905 the Wright brothers devised research and experiments that led to the first powered airplane in 1903 and a flying machine in 1905 [7].

The key design constraints that had to be understood were the design of the wings and also the speed of a fixed wing through the air that was needed to generate an appropriate amount of lift. Thus, although creativity had produced many ideas and designs prior to this, they did not work in practice until they also aligned with the physical laws to do with flight, and also the capabilities of industry to produce a design according to a specification.

Proposition 5—Creativity and Appropriate Use of Technology

There is an important relationship between creativity, design and technology. In order for the results of creativity to be harnessed in an optimum way, they need to synchronize with the requirements and limits of technology, and also the interfaces and designs necessary to utilize the technology successfully.

A further example is the design and development of the jet engine for airplanes by Whittle [8, 9] and others. It was capable of producing much more power than the internal combustion engine. However, because it was sufficiently different from the traditional internal combustion engine airplane with a propellor, the authorities in the UK were not sufficiently convinced to invest in it. This is an example of

where creativity allied with a correct understanding of science and technology was too advanced for the authorities to fully understand. Had it been recognized, the outcome of events at the time could have been completely different.

In a conversation with Whittle after the war, von Ohain stated:

> If you had been given the money you would have been six years ahead of us. If Hitler or Goering had heard that there is a man in England who flies 500 mph in a small experimental plane and that it is coming into development, it is likely that World War II would not have come into being [10].

Proposition 6—Creativity and Overcoming Difficulties

Some creative outputs are unable to reach their full potential if there is opposition within the society in which they are being created. In such cases, it could take months or years for such blockages to be overcome.

12.4 Creativity and Virtual Environments

Virtual environments can provide a 3D environment within which artists and designers can explore the use of different colors and materials [11]. Architects can try out different designs for buildings and explore how they fit into the surrounding environment, and also how they are perceived by people who walk within them. This can be very useful information to consider before they are built. Additional constraints such as the use of sustainable building materials, carbon footprint, and ecological factors can be incorporated into the project at the design stage.

It can be argued that a virtual environment is artificial and not a real-world environment. It is therefore only a representation of the real world. However, the output of an artist or a designer's building plans are also representations of the real-world. As such, it is simply a tool for artists and designers to use in any way they wish. It has been claimed that the use of technology can make it more difficult for the creator to establish an emotional connection with their creation. However, while this might be the case in a first application, successive uses will allow the creator to appreciate the opportunities and potential of the tool being used, just as the early painters adapted to the use of the paintbrush.

Such facilities can also support the use of audio and animations. These can add value to the visual image.

Proposition 7—Creativity and Virtual Environments

Virtual environments can offer new creative opportunities for artists and designers and enable them to immerse themselves more completely in various forms of representation and interact with them.

12.5   Conclusion

Science and technology may often be perceived as the primary drivers in a material world, resulting in the arts and humanities being forced into a more reactive position. However, when questions are asked about the values of the science, or the meaning that technological developments have uncovered, these disciplines are often at a loss. It may be regarded as 'beyond science'. This is where art can make a valuable contribution in being able to connect us with worlds outside science. At the same time, art practice has been forced by these developments to think of knowledge acquisition outside that of art alone. Therefore, all parties can be beneficiaries of collaboration and mutual understanding.

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