Chapter 1
Introduction

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Abstract Human creators are capable of great feats of imagination and inventiveness. History and tradition testify to the masterpieces that have been produced over the centuries. Most of these have been created in human time with the tools that were available. The current digital revolution is providing a new set of tools and environments that creators can use, but this does raise issues such as to how best to preserve traditions and esthetic values that have been built up over many generations. Technology can provide both continuity and discontinuity which has both opportunities and challenges. A number of the factors influencing creativity are summarized, and suggestions made for evaluating the outcomes of the creative process. Mixed interdisciplinary environments offer opportunities for the production of creative works. The rise of commercial art for the Internet and interactive gaming is noted.

Keywords Iterative refinement · Interdisciplinary · Multicultural · Creative augmentation · Digital revolution · Benchmarking

1.1 Traditional Understandings of Creativity

Oxford Languages [1] defines creativity as—"*the use of imagination or original ideas to create something; inventiveness*".

The use of imagination, or original ideas, are assumed in this definition to be by a human creator. Normally what is created involves some kind of tool (e.g., paintbrush, chisel) or process (which may involve other components such as objects or materials) to produce the outcome. It is also assumed that the use of this tool or process is under the direct, or indirect, control of the human. This may involve the need to refine the use of the tool or process as the outcome is being generated, or even change the tool or process. This produces some kind of iteration between the content creator and the outcome. This refinement assumes that the human creator is learning something new during the process of creation and is feeding back into the creative process appropriate changes to the original intentions which result in changes to the outcome. This process is happening in real-time, but it is also human-time and proceeds at an appropriate pace for the human creator. This may take days, weeks, months, or even years.

S. Liggett et al., *Creativity in Art, Design and Technology*, Springer Series on Cultural Computing, https://doi.org/10.1007/978-3-031-24869-6_1

1.2 Creativity and Technology

Direct generation of an outcome may be assumed to be under the control of the creator, with the latter being directly involved in any iterative processes that may be required. Indirect generation may involve the use of an amanuensis or other form of support and assistance. The instructions of the original creator may be formalized into a script with intentions and objectives. This could be implemented by mechanical means, or it may be converted into a form to be used by a computer. This could be an algorithm, a virtual environment, or instructions for generating an image, animation, game, or artifact (e.g., by the stereolithography process). This may change the real-time, and human-time, process substantially. For example, the mis-match between human time and computer time is a well-known discontinuity [2]. Human thoughts are typically 0.5 s—this is the time for information from the external world to be incorporated into human conscious experience [3]. By contrast, a 2 GHz chip in a computer can operate at 2 billion operations per sec. In addition, there is a further discontinuity between human time and Internet time. The industry states that one Internet year is equivalent to seven calendar years [4]. This implies that in an Internet context, events can happen much faster than in the real world. These mis-matches can be a barrier and obstacle in some contexts and a liberator and enabler in others.

In addition, computers also change and develop as new algorithms are produced to meet what are perceived to be current needs. Artificial intelligence is one of these developments. A process that is initially described in well-defined terms may be allowed to receive direct information from the process or environment on which it is working, and change the process to maximize its chances of achieving the particular outcomes that are required. This can introduce a degree of uncertainty and unpredictability into the creative process, but it may lead to new outcomes and greater efficiency and effectiveness. It also raises the question of whether the creative process should be essentially deterministic or allowed to contain elements of randomness.

Therefore, the boundary between the solo production of creative works and assisted production is not always a definitive one. It is not a simple either/or situation. When a painter uses a brush it is an augmentation of the human's natural capabilities. Similarly, the artistic process may be assisted by many different kinds of augmentation, some deterministic and others random. Such tools, facilities, and environments change and develop over time.

1.3 Creativity and Context

In addition, creativity does not exist in a vacuum. Gombrich [5] has shown that painters, sculptors and architects are influenced by a wide variety of factors beyond their own ideas and creativity, including the following:

- The context in which they produce their works
- The social and cultural factors in operation in society at the time

- The traditions and works of artists who have preceded them
- The current trends in the created works of their contemporaries
- The availability at the time of tools, materials, processes, and environments.

Therefore, what is being revealed by a particular created work, outcome, or process, is not something that can be fully understood or appreciated in isolation from other works or from society in general. It is part of a wider story of creativity over time, and needs to be seen as part of that story.

Many other definitions of creativity may be given [6]. For example, in assessing an individual's creative ability, Torrance described this as

> a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results [7]

It can be seen that this can have immediate practical implications. Any company that can devise a mechanism to improve the creativity of its workforce may be able to gain an edge on the competition and produce more appropriate products and services for its customers, and also in a more timely way. Such outcomes may also be at lower cost because of greater efficiency and effectiveness in the processes used.

1.4 Creativity—A Definition

For the purposes of this present volume, creativity may be defined as including one or more of the following aspects:

1. Produce something new
2. Produce new perspectives
3. Produce new understandings
4. Transform the current situation into a new situation.

1.5 Creativity in Mixed Interdisciplinary Environments

Following the Scientific and Industrial Revolutions in the 16th to the nineteenth centuries there has been significant impact on areas outside the immediate disciplines of science and technology. In particular, society has changed as products and services became more widely available. It has also impacted on the arts and humanities by providing new avenues for creativity and exploration. New tools have become available, particularly in the utilization of computers. It has been argued that the rise of computer technology and the Internet constitute in essence third and fourth revolutions, as their effects are so widespread, and also ongoing [8]. As this is part of present experience its long-term effects may not be easy to evaluate or predict.

Technology can provide continuity by making traditional methods and techniques more efficient and effective. In this sense it need not be regarded as an intrusion into traditional practices, but rather adding value to the status quo. It can also provide discontinuity by opening up new perspectives, paradigms, and dimensions of interaction with the observer. This may be regarded as potentially a disruptive force, but it can produce a greater understanding and appreciation of artistic processes and how they are implemented in practice. Utilization of technology can provide an opportunity to reflect on the more manual approaches that preceded it, and the need to preserve the vital and important components from earlier generations.

1.6 Benchmarking the Outcomes of the Creative Process

How then may we value and measure the various outcomes of the creative processes—to determine whether particular tools and environments are meaningful and useful or not? This is a difficult exercise because a degree of subjectivity is involved. In addition, much of current digital content is created to directly serve commercial interests rather than esthetic or philosophical ones. More information is required about the value systems associated with such creative works.

Smith [9] argues that in creating and using digital content, corporations can reflect back to society solely what it wants to see, and which can generate further revenue rather than involve any esthetic values or considerations. What is created and presented is simply a mirror to engage society in its own interests. It has become a commercial exercise. In addition, when considered against the four aspects of creativity proposed earlier, it is unlikely that any of them are satisfied. This could imply it is not genuine creativity in the great traditions of art and design.

> The meaning of the Metaverse, Mark Zuckerberg's virtual realm, has been ridiculed for its dismal aesthetics – but we have got the online world we deserve [9]

1.7 Cultural and Societal Implications

The relationship of creativity with society is increasingly complex. As societies move from monocultural to multicultural there is a wider variety of histories, traditions, and perceptions which are involved.

An Example—Leonardo da Vinci

Artists such as Leonardo da Vinci (1452–1519) were involved with the creation of artistic works and also novel inventions that could have been intended to serve a purpose in the natural world. Both may be seen as aspects of creativity; the former concerned with art and the latter with prototype designs, one of which was a device for a flying machine. However, the principles of flight were not fully understood until 400 years later, at least sufficiently well to be enable an airplane to be constructed

that could fly successfully. This suggests that there was some kind of insight involved in the creation of this work.

It could be argued that this is just evidence that he was a polymath who was gifted in eye and hand in numerous different areas [10]. However, an alternative view is that they were all products of his creative genius which transcended the discipline barriers that later came to be erected to preserve the various subject areas. This in turn led to tension between the arts and the sciences, and misrepresentation [11] which still continues today to some degree - due principally to disciplinary forms of education. In other words, da Vinci's created works can be seen as a continuum which produced new perspectives and new understandings rather than just discrete images and objects to be viewed in isolation (Figs. 1.1 and 1.2).

Fig. 1.1 Portrait of a Musician Leonardo da Vinci 1483–1487 (*Courtesy of* https://www.wikiart.org/en/leonardo-da-vinci/all-works#!#filterName:all-paintings-chronologically,resultType:masonry). Public domain—https://www.wikiart.org/en/leonardo-da-vinci/portrait-of-a-musician-1485

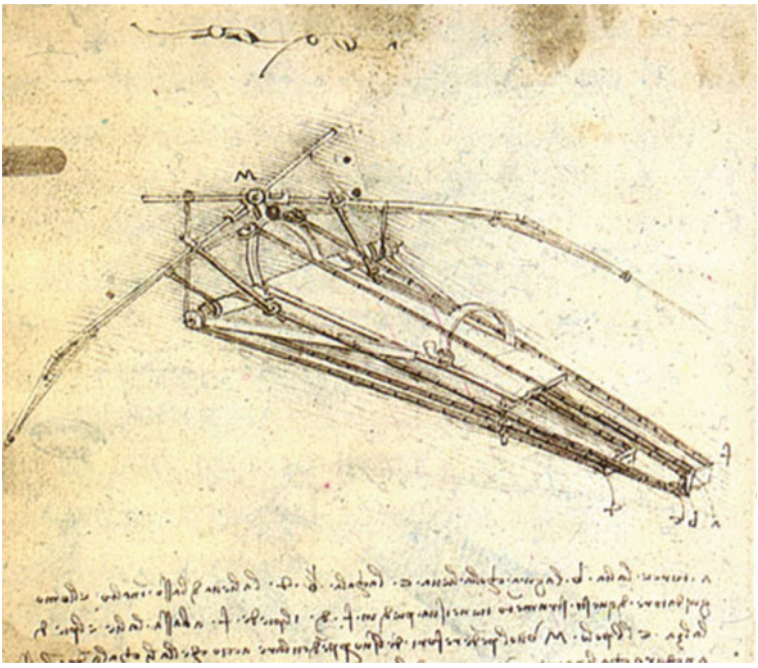

Fig. 1.2 Leonardo da Vinci's design for a flying machine. Public domain—https://commons.wikimedia.org/wiki/File:Design_for_a_Flying_Machine.jpg

1.8 Challenges and Opportunities

The digital revolution may be regarded as intrusion into traditional art practice. However, it can also be an opportunity. For example, it can widen the appeal and the audiences for art and design. Digital technology can also support new dimensions of content—both static and interactive.

Hockney used an iPad to create art works using a brush application created as a software app [12, 13], and submits that technology has transformed his practice. A number of these art works have been exhibited at the Royal Academy of Arts in London [14, 15]. However, this does raise the question of how a 'digital brush' may be compared with the traditional paint brush used by painters down the centuries. Clearly, it has some augmented capabilities and can be changed to produced different effects. Yet it is still a tool, and the artist is free to use it in any way they wish.

Virtual environments are also being used to create digital content both to view and interact with [16].

1.9 Previous Work

An earlier Open Access volume [17] explored emerging aspects of the relationship between artists (and other creatives) and their created works, and also how a variety of tools and environments have facilitated and extended these processes. Such tools encompass computer technology, computer environments, and interactive devices, for a range of information sources and application domains. They also provide new kinds of created works which are able to be viewed, explored, and interacted with, either as an installation or via a virtual environment such as the Internet. This introduces new dimensions of understanding and experience for both artist and the public's relationships with the works that are produced. This has raised a variety of interdisciplinary opportunities and issues. From Leonardo da Vinci to David Hockney the opportunities for artistic and creative expression have transformed the worlds of information of which they are an integral part.

1.10 Conclusion

This present volume continues the analysis and exposition on the themes of art, design and technology, concentrating particularly on creativity.

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