6. COLLABORATION ON CONVERGING TECHNOLOGIES: EDUCATION AND PRACTICE

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Abstract: Interdisciplinary collaboration of the sort required by convergent technologies, which will have to include ethics and social sciences as well as multiple fields of physical science and engineering, raises the problem of incommensurability. Different disciplinary cultures may be unable to understand one another, making it impossible to agree on goals. This chapter develops a framework for overcoming apparent incommensurabilities to pursue goals that promise social as well as technological progress. Even cultures with very different perspectives can trade, and from such trades, deeper understandings can grow – if participants in the trading zone exercise moral imagination. In order to shape converging technologies, students need to be taught not only disciplinary depth but also the ability to become interactional experts who can facilitate trades across disciplinary cultures. The chapter concludes with a list of techniques for encouraging and monitoring the development of this kind of interactional expertise, including a simulation that puts students in the role of policy-makers.

Introduction

Converging technologies will require collaborations among disciplines on an unprecedented scale. Because converging technologies hold the potential to dramatically change human capabilities, such collaborations will have to not only stretch across multiple technical fields but also include ethics and social sciences. Most scientists, engineers, ethicists, and social scientists are not trained to do this sort of collaboration, because their education focuses on disciplinary depth.

Thomas Kuhn argued that scientific breakthroughs produced new paradigms, or perspectives linked to sets of practices. Those scientists still in the old paradigm literally could not understand the central features of the new one. So, for example, there were very few scientists who understood relativity theory after Einstein published it, and those who did found it hard to communicate with those who did not.

Kuhn referred to this as the problem of incommensurability. He illustrated it with a classic experiment in Gestalt psychology, in which participants were asked to identify cards at very short exposures. Most were trivial, but the experimenters snuck anomalies into the deck – a black four of hearts, or a red six of spades. Initially, participants classified the heart as red and the spade as black, but as exposures grew longer, they became increasingly
uncomfortable, and then at one point switched to a new view. Once they realized anomalous cards were possible, these participants were able to identify them quickly. They were, in a sense, operating in a new paradigm; they saw possibilities that someone from the old paradigm would not.

Now, these experimental participants could have communicated the shift easily to other potential participants – “this crazy experimenter is going to stick in some black hearts and red spades, so look out.” Kuhn’s point is that the scientist, trained in the traditional paradigm, does not have the tools or the training to detect a red spade. This view may be an exaggeration; there are cases, such as plate tectonics, in which theoretical groups do navigate the change from one view to another (Giere, 1992). However, Kuhn has captured an essential problem that makes interdisciplinary collaboration difficult. Disciplines are cultures, with embedded practices and ways of thinking that have been successful at tackling certain kinds of problems. When a new problem or opportunity arises that does not fall into one of the traditional disciplinary bins – such as converging technologies – then practitioners from different fields may find they have fundamentally different perspectives on it, including whether there really is an opportunity. An example is the deep divide between chemists and nuclear physicists regarding the possibility of cold fusion: Many of the former thought it might be possible, whereas a member of the latter community, after seeing one of the cold fusion experimenters standing next to his fuel cell, noted that the radiation byproducts should have caused body parts to fall off (Close, 1991: 114).

In this chapter, we will use the literature on science and technology studies to develop a framework that shows how deep, creative collaborations can be formed around converging technologies. We will conclude with some observations about education and NBIC.

Superordinate Goals

Social-psychologist Muzifer Sherif once reminisced:

As an adolescent with a great deal of curiosity about things, I saw the effects of war: families who lost their men and dislocations of human beings. I saw hunger. I saw people killed on my side of national affiliation; I saw people killed on the other side. . . . It influenced me deeply to see each group with a selfless degree of comradeship within its bounds and a correspondingly intense degree of animosity, destructiveness, and vindictiveness toward the detested outgroup – their behavior characterized by compassion and prejudice, heights of self-sacrifice, and bestial destructiveness. At that early age, I decided to devote my life to studying and understanding the causes of these things. (Sherif, 1967: 9)