3.3.2 Empathic visualization in social implementation of science and technology (tentative)

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Abstract

Since the mid-twentieth century, Information and Communication Technology (ICT) has played an increasingly important role in visualizing various phenomena in society and in helping people make decisions. The use of ICT to visualize scientific evidence is necessary for problem solving in various situations, including policymaking. For example, local governments need to visualize the results of near-future projections using scientific and technological calculations, and involve local residents in discussions about the ideal future of each municipality when developing measures to adapt to climate change. Moreover, conflicts of opinion often arise in situations involving a diverse range of stakeholders. Empathic visualization plays an important role in overcoming such conflicts and finding common solutions. While ICT-based visualization has come to be used in a variety of situations, the development of ICT has given rise to new challenges, such as the ethical, legal and social problems in artificial intelligence research. In this paper, we discuss the relationship between ICT and society and the social acceptance of science and technology from the perspective of scientific visualization.

Keywords

ICT, scientific visualization, empathetic visualization, decision support, climate change adaptation, artificial intelligence research

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Main Text

The era of open data has begun, with data of public scientific origin from around the world being released via the Internet. The era of open science is approaching, where citizens can access open data and participate in science. Furthermore, as the age of artificial intelligence approaches, it seems likely that citizens will be challenged to be more creative in order to make their presence felt. In this age of open science, citizens need to be actively involved in the scientific method, rather than merely being bystanders. However, Japanese educational programs do not explicitly include the acquisition of the scientific method. The scientific method involves the observation of an object, the formulation of a problem, the construction and testing of a hypothesis, and its subsequent implementation in society; data visualization and analysis techniques are now involved in almost all of these processes. Visualization plays an important role in ensuring understandability (i.e., empathy) from the perspective of the people involved, particularly during the last stage of social implementation. However, in many cases, "visualization" is used in the sense of creating data, and not necessarily in the sense of technology for the human recognition of data.

When introducing the scientific method at a society level, it is desirable to include relevant data and visualizations in order to improve its understandability. In concrete terms, in addition to data, the use of ICT and other techniques to visualize tested hypotheses can improve the empathy of the communities in which they are presented. Here, ICT is a generic term for information and communication technologies. The kind of related data added and how such data are included often depend on the ideas of the person performing the visualization, and the person on the receiving end of the results may feel antipathy rather than empathy. When presenting the results of visualization to stakeholders from various backgrounds, it is advisable to open up the visualization process to people with their respective backgrounds, and ask them to participate if possible.

Another important detail about empathic visualization is worth illustrating here, namely, the question of how to promote common understanding of something whose cognitive structure is inherently conflict-ridden. Suppose that the cognitive structure of visualization technology has been evaluated using the evaluation grid method, which can be used to measure visualization efficacy. To extract the original evaluation items, suppose we begin by presenting two pairs of visualization images as stimulus elements and asking which one is better, and we obtain the evaluation structure for the visualization technique according to the method described above. Suppose that in the subordinate concepts of the evaluation structure, we have extracted seemingly opposing pieces of information, such as "three-dimensional visualization is good" and "two-dimensional visualization is good." Conventionally speaking, if these pieces of information had been extracted independent of each other, they would cause an emotional reaction in those who supported these respective statements. Let us suppose that in visualizing the evaluation structure, we discover that "clarity is desirable" in its superordinate concept, which is connected to the items "three-dimensional visualization is good" and "two-dimensional visualization is good," respectively. In such a case, that there will be axes of conflict is inevitable, but the hope is that all stakeholders will find a silver lining in the sense that they will have shared superordinate(s), tempering emotional reactions, promoting mutual understanding and eventually leading to greater empathy.

Computing power is expected to surpass that of humans by 2045, and the relationship between machines, including computers, and humans is once again being questioned. As computational capability is related to the performance of artificial intelligence, which has recently been the focus of much attention, several lists of jobs likely to be lost to artificial intelligence in the future have been published. However, many of these jobs are simple tasks. Nonetheless, it is understandable that an increasing number of people reading such lists worry that artificial intelligence will advance to the extent that humans will no longer be needed. Moreover, the realistic portrayal of apocalyptic futures in which artificial intelligence and advanced science collude to destroy humanity by movies and other media will result in a growing recognition that regulating artificial intelligence research in some form will be necessary if humanity is to survive.

In fact, AI-based lawyers and doctors have recently emerged. While these are professions held by highly specialized craftspeople, in terms of content, they use formal knowledge to solve problems, and are thus considered to be areas in which artificial intelligence excels. Moreover, artificial intelligence is making inroads into the world of science, with reports that it has reproduced the Bose-Einstein condensation experiment, which won the Nobel Prize in Physics in 2001, in less than an hour. However, the essential part of the scientific method is formulating a research question and constructing a hypothesis for it, and we would like to believe that human beings can still play an important role in such intellectual activities. As such, even in an age of rapidly evolving artificial intelligence, we should expect humans to continue coexisting with artificial intelligence, as well as contributing in crucial areas that artificial intelligence would be unable to handle alone. In order to meet these expectations, the role of visualization is expected to become increasingly important.

The government should formulate policies based on the recognition that visualization technology is a major pillar of the basis upon which humans will create scientific knowledge together with artificial intelligence in the age of open science. Moreover, in respect to the use of the scientific method in policy decision-making, we should actively work on using visualization technology in light of its usefulness in identifying evidence from vast amounts of data.

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