On the Value of Scientific Knowledge and Its Significance

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Introduction

It is no doubt that our society attaches great significance on scientific knowledge—from studying spinning galaxies to spinning electrons, we invested a great deal of time and resources to unveil the mechanisms by which our world works, rendering the topic today a germane one—what is so valuable about scientific knowledge that makes countless scientists dedicate their lives to its pursuit?

Definition

Before delving into the core of the question, two terms should be clearly defined—"scientific knowledge" and "value". "Knowledge", epistemologically speaking, means "justified true belief"(Lacewing 14). "Scientific", on the other hand, means "falsifiable, testable and with predictive power" (Ajayi). The term "value", however, is a controversial one: It refers to worth, how much something is entitled to. Nonetheless,

a key point about this concept arises—is value a transitive concept? To illustrate, if something, say a treasure buried in a desert, has value, and that another thing, say a shovel, can be used to obtain the former, does the value of the former confer value on the latter? This is where the concepts of "intrinsic value" and "instrumental value" come into play—intrinsic value measures innate worth, while instrumental value refers to the utility of the object in obtaining something external to it. When something is treated as a means to a higher objective, it has instrumental value; when it is treated as an end, something worth pursuing in itself, it has intrinsic value. Scientific knowledge, alongside most things, possesses intrinsic and instrumental value alike.

Instrumental Value of Scientific Knowledge

The application of scientific knowledge in real life is the aspect most easily understood by the public: The attainment of scientific knowledge allows humans to understand the causation of phenomena, and through application of scientific knowledge, we can find the means by which we can alter, circumvent, dampen or magnify it to whatever extent we deem favorable. In most circumstances, the end that humans use science as an instrument to pursue is our quality of life, ranging from food, health to convenience. For instance, developing the classic mechanics model makes us understand that a force impressed on an object results in its acceleration (Cohen 53). Application of laws of rotational motion allows us to maximize torque or calculate the energy needed for a circulating object to shift from one orbit to another, producing products as small as a bottle opener and as

grand as a satellite, improving our quality of life by making various tasks more convenient, be it opening a bottle of champagne in a party or watching a live satellite TV broadcast of the World Cup.

One feature of instrumental value is that it is not universal—not all scientific knowledge yields pragmatic benefits, at least to a significant extent, in our daily lives. Although "science" deals with patterns in the observable world, only a minute portion of "things" in the observable world have great correlation to our daily lives. It is thus evident that most scientific knowledge has little instrumental value as it has little room of application in our lives. The discovery of a star galaxies away, for example, may have little to deal with how we live.

Following this line of argument, the instrumental value of scientific value is variable, contingent on external factors, such as the contemporary mode of living or the prevalence of related problems. Instrumental value of scientific knowledge of molecular pathways inside the cell may be little to a medical student, if it has little clinical relevance, with no diseases related to defects in the cell carrying out this molecular synthetic pathway (such as deficiency of certain enzymes); were it not for the potential in creating "better" humans by changing genes or curing genetic diseases like Hapsburg Lip (Watson 98), the discovery of DNA transcription and translation may not be hailed as such a breakthrough by the public.

Intrinsic Value of Scientific Knowledge

The intrinsic value of scientific knowledge is different from its instrumental counterpart in that it is appreciated by few. The majority of the

population pursues utility, an end immediate to them, and lacks appreciation for the intrinsic beauty of things (Poincare 160). This is why the majority of men are reluctant to reflect.

This inborn beauty derived from the unadulterated truthfulness in knowledge, which grants us happiness in knowing what we know to be certain, as well as bravery and righteousness in affirming our beliefs. The caveman's exhilaration after he came out of the cave does not stem from a sense of intellectual superiority, but from learning how the seemingly two-dimensional shadows he saw on the wall are indeed projections by artifacts and fire—he had true appreciation of how the physical laws he discovered can produce the sensible world he observed for his entire life (Plato 8). Alongside happiness, the caveman also has a newfound bravery to he comes back to speak for what is right despite resentment from his fellow cavemen, because he knows it is the truth, a force that could make him die rather than live in falsehood (8). It is no surprise that Newton could defy contemporary common sense and propose a new model of motion, or that Darwin overthrew the creationist view of the world and proposed theory of evolution despite dominance of the Catholic Church… These scientists all felt an impulse to speak for things that can stand scientific falsification. This intrinsic value of science exists universally in all forms of scientific knowledge.

Scientific knowledge is beautiful in its simplicity. Scientific knowledge describes the causes for the repeated patterns that we observe in the sensible world, and more often than not, it is very simple (Poincare 161). As Newton puts it, "Nature is pleased with simplicity, and affects not the pomp of superfluous causes", interactions in the colossal physical world are governed by a very small number of laws. However, due to the great complexity

of the world, most people find it hard to deduce universal laws of nature from thousands of seemingly unrelated elements, thus their perception of the world often deviates from the truth. People who appreciate scientific knowledge, however, learn to admire the resemblances and dissimilarities of the world, and attempt to understand the causation of these similarities and differences, and the harmonious order underneath seemingly conflicting elements. "The scientist does not study nature because it is useful to do so. He studies it because he takes pleasure in it, and he takes pleasure in it because it is beautiful" (Poincare 163), this innate quality is what fuels scientists to toil ceaselessly, notwithstanding repeated experimental failures and overwhelming frustration. How foolish would it be to say that Francis Crick dedicated the last three weeks in his life to the study of consciousness because it helped him make a living, when he was already teetering on the edge of death (Kandel 187)! There must be something greater than life itself in science that made this man give up all the ordinary pleasures of life.

Scientific knowledge is beautiful also in its complexity. The diversity and depth of scientific knowledge is intimidating—not only do facts outstrip us in number (Poincare 159), but the interconnectedness between them also overwhelms us. More often than not, a state of being, observable by human senses, is caused by multiple factors through unobservable pathways; but a factor, on the other hand, also affects multiple states of being. To add to this complexity, these factors often influence one another. Through a reductionist method, a scientist may be able to figure out how one factor influences a state of being by isolation of variables (Needham 214), but never can he make precise predictions when all factors are put into the picture. Where the reductionist approach fails, the only thing scientists understand is that they have a lot of things yet to be understood: How

could one design an experiment with constant variables when all factors are interdependent? This is where the beauty of scientific knowledge lies: They teach us that it is fine to live and not know. It is humbling to admit that many things cannot, and perhaps never would, be explained by scientific knowledge.

The above is not to say that one form of value is superior than the other—instrumental value and intrinsic value are both indispensable to scientific knowledge itself. Without intrinsic value, no one would appreciate the mechanisms by which the world works, and scientists would lose the perseverance and motivation to push the frontiers of scientific knowledge. Without instrumental value, however, scientific knowledge would lose recognition in society, and the scientists would lose support for their research.

The difference in conditional existence between instrumental value and intrinsic value also gives rise to the interdependence between the practical and theoretical aspects of science. As we see in Table 1, existence of instrumental value often depends on external circumstances. For instance, when mathematicians develop calculus to solve 3 dimensional problems, there are no practical applications of this mathematical tool. However, when physicians or chemists do encounter problems in their fields that require calculus, be it the electric field of a moving charge or the probability function of an electron, calculus gains instrumental value. Scholars then realize the significance of calculus in various scientific fields, which prompts mathematicians to develop more advanced tools in calculus, such as 3D vector calculus. Intrinsic value of scientific knowledge starts out as the primary appeal for humans, and when circumstances are right, the society appreciates their instrumental value, which in turn produces more scientists who uncover the intrinsic value of scientific knowledge.

Table 1 Implications of the Distinctions between Instrumental Value and Intrinsic Value

	Instrumental value	Intrinsic value
People who could appreciate	Vast majority of the population	Only scholars and scientists
Uniformity for all scientific knowledge	Non-uniform, only some scientific knowledge has this value	Universal
Condition of existence	Conditional	Unconditional

Why Does This Implication Matter? Or, Does It Not?

Let us return to the original question, "What is so valuable about scientific knowledge that makes us pursue it?" One may question why the motive matters, as we pursue scientific knowledge no matter which form of value we appreciate. This circulates back to Poincare's question—do we pursue science for science's sake, or do we use science as an instrument for external ends (Poincare 159)? Perhaps the answer is both: While the pioneers of science pursue science for science, they are sometimes under influence of the society, which prompts them to apply the scientific knowledge to maximize utility. The ratio of these two motives, and to what extent it affects the selection of facts, however, remains veiled.

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Teacher's comment:

In recent years, an increasing amount of resource has been allocated in scientific research worldwide. So, what is the underlying value of pursuing scientific understanding of the natural phenomena? In this essay, Wai Yan did a precise analysis of the instrumental and intrinsic value of scientific knowledge. Furthermore, he gave an insightful discussion of the interdependency of the two dimensions of value. This essay is clearly structured, and the arguments are well supported by relevant evidence. Wai Yan successfully brings readers to reflect on the value of scientific inquiry. (CHEUNG Hang Cheong Derek)