Is Understanding the Scientific Development Necessary?

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I. Introduction

Students at universities enjoy a high autonomy in their education, a myriad of courses are opened to enroll. Yet, interestingly, studying the course "In Dialogue with Nature" is undisputedly a common learning experience among every student's education trajectories in CUHK as it is compulsory. Are there any justifications in making it a core subject? Why is it necessary to understand scientific development for all students coming from different faculties?

II. Three Criteria of Education

The three criteria of education proposed by R.S. Peters can serve as an accountable parameter in the evaluation of the knowledge imparted by learning scientific development. By applying a task-achievement concept to education, it is assumed that education must attain certain effects to the learners. We can review the effect of education from its worthwhileness, cognitiveness and voluntariness. Worthwhileness concerns about the desirability of value being imparted; cognitiveness addresses not only the

legitimacy of the material, but also the comprehension of the underlying principle of the knowledge; voluntariness focuses on the willingness of being educated. (Peters 1–16) Hence by placing the outcomes of understanding scientific development against these three criteria, we would arrive to the answer of the justification and the necessity of understanding scientific development.

III. Learning Outcomes of Understanding Scientific Development

i. Critical Thinking

The history of science is a major component in studying scientific development. There are many controversial subjects along the history that spark intense discussions. For example, in *The Birth of a New Physics*, Newton expressed his conservation on crediting Hooke's idea of $F \propto \frac{1}{D^2}$ as Hooke did not undertake the intellectual rigor of proving the statement mathematically. (Cohen 51) However, some students disagree as Hooke's insight occupied a fundamental role in Newton's *The Principia* and credit should have been given as a gesture of goodwill and expression of gratitude. Another example can be drawn for the discussion concerning the journey to the discovery of DNA structure. The rivalry between Watson & Crick, Linus Pauling, Rosalind Franklin and Maurice Wilkins lead to the student discussing over the nuance of motivation for scientific discoveries: should it merely be the pursuit for the knowledge itself or individual achievement also plays a substantial role? Students further the discussion whether if the latter can result a progressive scientific discovery as the vigorous competition pushes the scientists to their best or rather hamper it as competitors refuse to share their findings in the fear of being

taken advantages of. Through these exchanges of ideas, students learn to formulate their own point of views, support them with cogent reasons and most importantly learn to not just comprehend but respect opinions differ from theirs. The process sharpened the students' acumen and provided a platform to exercise their critical thinking. Critical thinking is crucial for students as it enables students to self-reflect and it provides the tool for them to navigate in the society when facing inescapable dissension from others. (Lau and Chan, "Improve our Thinking Skills")

ii. Sense of Responsibility

Another important lesson learnt from understanding scientific development is the human manipulation of nature and the responsibility of science. In *Silent Spring*, Carson discussed the "giddy sense of power" (Carson 147) from humans as they could manipulate the nature in their favors without harming the environment presumably. However, this could not be further away from the truth: the abusive use of herbicide disrupted the web of life as the habitats and food resources of the wildlife were eradicated. (146) The mindless spraying of herbicides also affected the quantity and quality of livestock (154) and was proven to be hazardous to human body. (153) This provides an opportunity for students to reflect the position of human in nature. While celebrating the improvement of our quality of life brought by scientific advancement, we should also bear the responsibility to be conscious and mindful in preserving our environment. The deeds we established were not just for maintaining our sustainable environment for the next generation, but rather because of recognizing that humans are among equal when comparing to other organisms residing on the plant. Especially given the ever-growing understanding on scientific

knowledge, we should do better when we know better. By this way, it could be a genuine showcase of the power as we can attain our desires without compromising the environment instead of a giddy illusion.

As critical thinking and sense of responsibility both are desirable values to be imparted to the students, understanding scientific development fits the worthwhileness of the criteria of education.

IV. Specific Trait to Science—Logical Thinking

The appreciation of logical thinking is constantly reoccurring in understanding scientific development. Being evident-based is particularly stressed as it carries logical thinking applying beyond the mathematical field, which one would perceive to be limited to. For example, in order to introduce his idea of theory of evolution, Darwin gathered abundance of morphological evidence from different species to illustrate his theory, the most prominent example would be the adaptive features of finches according to their individual habitats. The importance of being evidence-based is that it can eliminate subjectivity. By inculcating the students with logical thinking, they would be equipped with the tool to differentiate between belief and truth. Especially during the formative years, we need to ensure students possess the ability to filter information in order to develop them into sensible individuals. We need to stress the importance of logical thinking that it cannot be overlooked even in occasion when it is self-evident. The fact that the sum of any two lengths of a triangle would be greater than the remaining is “blatantly obvious” (Dunham 271) but Euclid still put forward an effort to prove as dismissing sense-perception is crucial in developing knowledge as it provides the foundation and the rigidity of the entire theory.

Another trait of logical thinking is the elaboration of the steps arriving to the conclusion. In *The Principia* and the *Elements*, they both share a sensible proving system. They both firstly lay down definitions of important concepts to confine the premise for the following discussion. After the mathematical proof, they concluded the laws or statement and developed based on those findings. The proving processes give the students an opportunity to understanding the process of arriving to the conclusions that what we now conceive as innate. Hence by exposing the students to comprehend the underlying principle of the knowledge, understanding scientific development fulfills the cognitiveness of the criteria of education.

V. Distinction between Learning Scientific Theory and Scientific Development

One may argue the scientific knowledge itself can train students' intellectual capability especially logical thinking, understanding scientific development would be irrelevant and unnecessary. However, they would have omitted the last criteria of education—voluntariness. It would not be peculiar to hear students ask why they would need to study as it is inapplicable to their daily life and they lack a justification for studying other than passing exams. Understanding scientific development can build the bridge for the hard knowledge from textbooks to reality as it contextualizes the knowledge. For example, the discovery of DNA structure is groundbreaking in treating genetic diseases and the theory of evolution heavily influences the agricultural and pharmaceutical industries. By reconnecting the science knowledge to real life scenarios, we can reinvigorate the students' interest and curiosity for science. Hence understanding scientific development

is necessary for all students as it unmistakably fulfils the trinity of education criteria.

VI. Conclusion

As Carl Sagan once said: "We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology". Even though not all students would devote themselves into scientific fields in their future, but there is no dispute over how our world is shaped by science and would continue to be. In order for us not to be the ignorant prisoners described in the "Allegory of the Cave", (Lindberg 13) it is our duty and responsibility to be science-literate.

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Teacher's comment:

Beginning 2012–13, CUHK introduced the General Education Foundation Programme (GEF) as a common core for all undergraduates, which "In Dialogue with Nature" (UGFN) is one of the two compulsory

courses. “Are there any justifications in making it a core subject?” Yau Tin systemically evaluated the values of the course by putting it into a framework of three criteria of education, namely worthwhileness, cognitiveness and voluntariness. Yau Tin impressed me with his careful examination of the contexts of the course and fitting it into an accessible framework based on his learning experience. The intellectual journey of UGFN was shown to be more than the learning of scientific knowledge, which scientific endeavors, critical thinking and proving something “blatantly obvious” were appreciated. Remarkably, the expected learning outcomes of the course, including the societal implications of scientific explorations, the relation to contemporary human condition, and the corresponding social responsibility were clearly presented. As a teacher, I find his arguments both encouraging and convincing! (Lam To Kam Cherry)