Philosophy or Science?

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Professor Matthews takes the view that a primary goal of school science education should be to deepen "students' epistemological awareness." He recommends introducing students to the methodology of science by teaching them "how to interpret data and how to appraise its bearing upon claims to knowledge." He promotes the study of the pendulum for exploring such methodological issues, because it was in their investigations of pendulum motion that Galileo and Newton "played a pivotal role in the scientific revolution." Two methodological topics that he recommends placing on the school science curriculum are "the role of idealization in science" and "the distinction between worldly events, data, phenomena, and theory." Matthews's motivation is his conviction that the widespread attention to the narrow methods of science in science courses, "skills in obtaining data, or taking measurements," displaces needed attention to methodological issues, which are fundamentally epistemological by Matthews's reckoning. We shall examine and critique Matthews's treatments of the role of idealization and of the distinction between data and phenomena, and end with a query to him about whether it is philosophy or science that he hopes to teach students by his recommended approaches.

The Role of Idealization

In order to explore the role of idealization in science, Matthews turns to the debates between Galileo and Guidobaldo del Monte over the focus of scientific enquiry. Del Monte believed that scientific descriptions should faithfully describe the real world as it is observed; Galileo built a theory that, by his own acknowledgement, did not correspond to the material world. Actual pendulums do not obey Galileo's mathematically derived rules. Matthews's point is that idealizations as introduced by Galileo are a necessary part of science, even though some idealizations prove with hindsight to be scientifically fruitful while others prove to be in error.

We agree in broad outline with Matthews's philosophical treatment of the role of idealization in science. Any attempt to do science involves abstracting from the world a subset of features on which to focus, and often involves the construction of models that are not intended to mirror nature. Matthews concludes that this philosophical analysis provides an "occasion to introduce a number of core methodological issues to students." These proposed lessons for science students fall within the domain of the history and philosophy of science, and are largely contested within those disciplines. For the vast majority of students who will not become practicing scientists, it is at least one reasonable proposal for providing a perspective on science that might help them deal with science-related social issues.

However, Matthews recommends his methodological approach on other grounds: he claims it is a more effective means than constructivist pedagogy for forming students' scientific views and altering any scientific misconceptions that they might

have. Matthews is quite emphatic that constructivist pedagogy is the wrong approach to teaching science and overcoming students' misconceptions. His reasons for criticizing the constructivist approach and for promoting the methodological one are sparse, and we are convinced neither of his criticism nor of his proposal.

Here are some reasons for our doubt. Many ten-year-olds have false beliefs about pendulums before they study them: such as that the length of the pendulum is not related to the period of swing, and that the weight of the pendulum and the angle of the swing affect the period dramatically. These beliefs can be challenged and replaced relatively straightforwardly. Students are given some string, a number of metal washers, and a ruler. By varying the length of the string and the number of washers, they quickly realize that what they observe disconfirms their original beliefs, and furthermore leads them to formulate broad generalizations compatible with accepted scientific belief. The pedagogy criticized by Matthews does work in this case, but we acknowledge that such pedagogy might not work in all cases.

Even if the constructivist approach did not work, how might the methodological approach recommended by Matthews do the job? First, Matthews's methodological approach might do a reasonable job of teaching lessons *about* science. However, if the goal is not to teach lessons about science, but to teach science itself, then it is not at all clear to us how his methodological approach is supposed to work. If the false beliefs listed above were the ones we wished to change, then how is any lesson on the role of idealization in science going to help? It seems clear that such false beliefs are not a result of a poor understanding of the role of idealization in science, but rather of impoverished experiences and reflection of the relevant sort.

Data and Phenomena

The second methodological issue concerns the distinction between worldly events, data, phenomena, and theory. Phenomena and data occupy most of Matthews's attention and the distinction between these appears to be his most important focus. According to Matthews, the same data can be given different phenomenal interpretations, and different data can be accorded to the same phenomenon. Therefore, phenomena are separate from and not implied by data, although there is an inferential link between them.

We are dissatisfied with the relationship between scientific data and phenomena as described by Matthews. Although he explicitly describes the relationship as passing from data to phenomena, we see the relationship as reciprocal, and, in fact, believe that a reciprocal relationship is implicit in Matthews's discussion. Matthews talks about scientific data as "the raw representations of real objects." We wonder with respect to what the data are raw, given that these data are already "sifted, sorted, and selected" descriptions of observations. Data conceived in this way are highly theoretical. On this point we agree with Matthews. However, it is this theoretical nature that leads us to see the relationship as reciprocal rather than unidirectional. This is so because the considerations that permit the scientist to sift, sort, and select presuppose that the scientist already has some notion of the phenomenon in mind. This view is implicit in Matthews's treatment. For example, in order to "throw away or ignore" some observations and exclude them from the data, then it is necessary

10.47925/2001.214

already to have in mind at least a rough idea of the phenomenon that "comes from" the data.

Concluding Remarks

Our disagreement with Matthews's philosophical position on the relationship between data and phenomena just serves to support his view that philosophy of science is fraught with controversy and that there is a danger of zealous teachers indoctrinating students in particular philosophical views. His aim is to introduce philosophical controversy in science classrooms and to promote discussions about them. We have supported a similar position in our work.[1] Yet, we are reluctant to place upon philosophical discussion the burden of teaching scientific methodology. We cannot imagine learning scientific methodology without having to address the substantive issues that arise in doing science, such as in collecting, analyzing, and interpreting data.

So, we wish to enquire of Matthews what he intends when he wishes to deepen "students" epistemological awareness," so that they come to know "how to interpret a set of data and how to appraise its bearing upon claims to knowledge." Does he intend to teach students philosophy or science? If philosophy of science, then, noting our philosophical disagreements with Matthews and assuming that such disagreement would be part of his teaching, we accept his proposal. However, we would not delude ourselves by thinking that in teaching how to interpret a set of data and how to appraise its bearing upon claims to knowledge from a philosophical perspective we were teaching science. The philosophical treatment can be interesting and even important, but philosophy of science is not science.

If he intends to teach students science, then we must demur, and express our belief that the methodological issues should be treated from a scientific perspective. If the teaching deals with methodology poorly, it is not clear to us that the best guidance is to be found in such philosophical debates as those about the role of idealizations and the distinction between data and phenomena. It is important for science teachers always to be alert to what they are teaching — philosophy or science — to recognize where they complement, where they might be in conflict, and where they might be irrelevant to one another.

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1. Stephen P. Norris and Connie A. Korpan, "Science, Views about Science, and Pluralistic Science Education," in *Improving Science Education: The Contribution of Research*, ed. Robin Millar, John Leach, and Jonathan Osborne (Buckingham, U.K.: Open University Press, 2000), 227-44.

10.47925/2001.214