Bringing it All Back Home: Some Implications of Recent Science and Technology Studies for the Classroom Science Teacher

Shelley Costa, Thomas B. Hughes, and Trevor Pinch
Cornell University

Abstract

In this paper, we support the validity of drawing from science studies to reshape science education. While true educational reform must involve alternative curricular structures, we stress that we do not propose here either a comprehensive curricular framework or a report on a pilot classroom project, as our research perspective comes from science studies rather than from education. Instead this paper is intended to encourage educators to draw from methodologies used in science studies to further their goals in education research and in classroom teaching. First, we examine theoretical connections and divergences between science studies and theories of education. Secondly, we discuss the benefits of teaching science as a social process and offer some suggestions that can be introduced by classroom teachers into pre-existing science curricula.

Teaching science as a social process has unique potential to enrich students’ understandings of the practice of science and the knowledge generated by that practice. Happily, we are far from alone in making this assertion. There has been significant interest in recent years among various educators in utilising the ideas of recent history, philosophy and sociology of science in science teaching. Matthews (1992) published an extensive review of “the use of, and arguments for, the history and philosophy of science in school science courses” (p. 11) which indicated widespread interest in this phenomenon, and the trend seems to have gained momentum and shape in the five years since that review was published—incorporating, for example, more references to sociology of science. The methods advocated by these writers take a variety of forms. Some authors discuss the benefits of including perspectives from science studies (the history, philosophy, politics and sociology of science) when designing general science curriculum (Allchin, 1995; Kelly, Cunningham, & Carlsen, 1993; Magnusson & Templin, 1995; Milne & Taylor, 1995; Solomon & Aikenhead, 1994; Sutton, 1989). Others report on specific science lessons attempted in secondary schools (Allchin, 1997) or newly designed science courses at the college level (Flannery, 1995; Flower 1995; Kumar & Brown, 1995). Still others address the difficult but essential issue of encouraging appreciation of science studies in science teachers (Bombaugh, Ralston, Sounder, & Shiner, 1995; Cunningham, 1995; McComas, 1995; Nott & Wellington, 1995). An interesting twist is to advocate new educational research methodologies modelled on those profitably used in science studies (Roth & McGinn, 1997).

Our aim in this paper is to support the validity of drawing from science studies to reshape science education. While true educational reform must involve alternative curricular structures such as those advocated by authors mentioned above, we would like to stress that we do not propose here either a comprehensive curricular framework or a report on a pilot classroom project, as our research perspective comes from science studies rather than from education. Instead, this paper is intended to encourage educators to draw from methodologies used in science studies to further their goals in education research and in classroom teaching. First, we examine theoretical connections and divergences between science studies and theories of education. Secondly, we
discuss the benefits of teaching science as a social process and offer some suggestions that can be introduced by classroom teachers into pre-existing science curricula.

Specifically, in order to unpack the meanings implied by similar terminology, we explore in the first section of the paper the compatibility between separate research paradigms which share the name constructivism: that which has guided the twentieth-century educational research tradition (Piaget, 1970; von Glasersfeld, 1984, 1989, 1995; Eisenhart, Finkel, & Marion, 1996) and that which has arisen in science studies—specifically, in the sociology of scientific knowledge, or SSK. We then proceed in the second section to offer some suggestions for using SSK in the science classroom. Because science studies is a large and growing field encompassing a variety of approaches and theoretical stances, we have narrowed our focus to two subcategories of this research—explorations of scientific controversy and work on the role of writing in scientific process. Our suggestions for the classroom thus come under two categories: activities which study scientific controversy and assignments which encourage students to explore and critique scientific process through writing.

Two Constructivisms: Points of Affinity and Divergence

Constructivism in the sociology of science can be traced back to Berger and Luckmann's (1966) *The Social Construction of Reality*. Although what is meant by constructivism in science varies somewhat (e.g., Sismondo, 1993) most authors share the view that science is socially constructed in the sense that to some degree or other the technical contents and practices of the sciences can be treated as social constructs. This means that scientists' social groups are treated as actively constructing their knowledge and practices. In short, what gets to count as valid scientific knowledge and practice is settled within the confines of social groups. This means that sociologists of science adopt a methodological principle of symmetry (Bloor, 1976) whereby the same social explanations are used for knowledge and practices that come to be deemed "true" as for those that come to be deemed "false." This does not mean that "anything goes" or that scientists will accept anything to be "true." It just means that the ways that knowledge claims and practices are warranted within science are irredeemably community processes.

There is another, separate theoretical framework called constructivism in the field of education. This framework has been extremely important in informing—indeed, dominating—research in mathematics and science education for several years. Inspired by the widespread influence of Piaget's model of child psychology in the mid-twentieth century, educational constructivism holds that learners actively construct their own understandings of the world around them rather than simply "receiving" information from another person. Like constructivism in the sociology of scientific knowledge, educational constructivism does not deny a reality outside the knower. Rather, it holds that attempting to describe such a reality in an "objective" fashion in order to transmit it to learners' minds (much as one fills empty vessels) is a pointless task. What is central for the educational constructivist is that each learner builds all personal knowledge, including knowledge introduced in the classroom, through an active and individual process.

There are several versions of educational constructivism. In this paper we mention two principal varieties: radical constructivism and sociohistorical constructivism. The version that has been termed radical constructivism promotes a relationship between knowledge and truth similar to that promoted in SSK. Von Glaserfeld (1995), the principal spokesperson of radical constructivism, writes that "it is logically impossible to establish the 'truth' of any particular piece of knowledge" or to know absolute reality. So what does it mean to know something from a constructivist stance? We quote von Glaserfeld at length: