Chapter 15
Constructivism in Education: Interpretations and Criticisms from Science Education

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ABSTRACT

Constructivism has been widely adopted as a referent for research, curriculum development and recommended pedagogy in education. This chapter considers key issues relating to the adoption of constructivist thinking in education which have arisen within the field of science education. Constructivism has been mooted as a dominant paradigm in science education, where it has informed a major research programme over some decades. However, the application of constructivist ideas in science education has also been subject to a range of critiques. This chapter gives an outline of the developing influence of constructivism in science education, and the common understandings of the term in relation to science teaching and learning; it reports on the main areas where the influence of constructivist thinking has been heavily criticised, and discusses how these criticisms are countered within the research programme; it considers some major directions for research within the research programme; and it evaluates the level of influence of constructivism in contemporary science education practice.

INTRODUCTION

Constructivism is a term that is commonly met in educational and wider social science discourse, although it is used with a range of different meanings and associations relating variously to educational philosophy, research epistemology, cognitive development, learning theory, and approaches to pedagogy (see Figure 1). Constructivism has - or, perhaps more accurately, 'constructivisms' have - been especially influential in science and mathematics education, although the mantra ‘we are all constructivists now’ (Wheeler, 1987, p. 57) has been propagated (Brubaker, 2009; Donmoyer, 2012) - and challenged (Bader, 2001; Lesh & Sriraman, 2010) - much more widely. Constructivism is sometimes associated with philosophical and sociological stances that have questioned traditional views of the nature of public knowledge and its ‘production’. So a naive notion of the nature and production of scientific knowledge

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has not only been challenged through scholarship in the philosophy of science (e.g., see Taber, 2009a), but through the increasing importance of the sociology of knowledge with its focus on the social construction of (what is taken in particular cultural contexts as) reality (Berger & Luckmann, 1991), and which has drawn attention to the social and institutional aspects of knowledge production (Gilbert & Mulkay, 1984; Latour & Woolgar, 1986).

Whilst these debates about the nature of canonical knowledge and how it is acquired are potentially important for fundamental educational questions relating to the purposes of schooling and the structuring and selection of curriculum, the form of constructivism which has arguably had the most impact on classrooms around the world is constructivism as a perspective on learning that has consequences for how to teach canonical knowledge. Constructivist learning theory is certainly not divorced from wider epistemological considerations, but can inform teaching practice without requiring commitment to the more contentious forms of constructivism. This chapter will argue that this is already a common situation in science classes around the world where constructivist thinking on pedagogy has been widely influential. Although the chapter draws upon the specifics of science education - where constructivist influence has been both widespread and often vigorously debated - the ‘hard core’ premises of the constructivist research programme in science education (as detailed below) would seem to be equally applicable to any area of the curriculum that is concerned with teaching a body of canonical public knowledge (Sjøberg, 2010).

The chapter discusses then how constructivism has been understood and adopted as a referent in science education. Constructivism has been a key idea underpinning much research, curriculum innovation, and teacher development in science education since the 1970s. However, constructivism has been understood in different ways, and the ‘flavour’ of constructivism widely adopted within science education has been of a kind sometimes called pedagogic constructivism or psychological constructivism (see Figure 1), which is not completely aligned with some forms of constructivism that have been influential in other areas of scholarship (for example the use of the term constructivism as a label associated with a particular epistemological stance adopted in some educational research and evaluation). This is discussed further later in this chapter.

Perhaps due at least in part to a lack of a consensual understanding around what being a ‘constructivist’ in science education entails, the constructivist movement in science education has been subjected to a range of critiques from both within and beyond the field. These critiques have concerned the underpinning commitments of constructivism, and the desirability of its perceived aims, as well as its value in informing effective science teaching. Despite the diversity of presentations of constructivism in the science education literature, and - in particular - the lack of consistency in nomenclature in the field, it is possible to identify a canon of seminal literature which offers a basically consistent representation of what can be considered the ‘hard core’ of a constructivist research programme - in the sense that the philosopher of science Imre Lakatos (1970) described scientific or ‘progressive’ research programmes. Consequently, an analysis of constructivism in science education as a Lakatosian research programme can provide a basis for exploring the relative merits and limitations of the common critiques of constructivism in science education (Taber, 2006b) as well as offering guidance on productive directions for further work in this area (Taber, 2009a).

This chapter will:

- Offer an account of the nature and influence of constructivist ideas in science education;
- Summarise how this area of work can be understood as a scientific research programme;
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