Chapter V

The Role of Practical Work in Online Science

I hear and I forget. I see and I remember. I do and I understand.

– Confucius (551-479 BC)

There are many educational strategies to achieve learning objectives that prepare students to adapt and survive more effectively in life. Many of these approaches involve, to some degree, practical learning experiences structured to emulate meaningful situations, tasks, and the problem solving required of the real world. In science, educators have long held and place particular importance in the idea that hands-on experiential activities are a fundamental tenet of learning. The portion of scientific instruction devoted to learn by doing is called practical work. In this chapter, we explore the concept of practical work in science instruction, including categories of practical work, the historical basis and development of practical work, its purpose and value, controversies concerning practical work’s utility in science instruction, the importance of practical work in online science instruction, and the design of practical work learning environments. This chapter builds a rationale for the broad value and integral importance of practical work in science education at both the K-12 and university level and, as such, the necessity for its intentional implementation in online science learning environments. In this way, the practical work discussion of Chapter V provides the
underpinnings to later chapters that review current and emerging forms and technologies to support online practical work.

What is Practical Work?

Practical work is suitably characterized as the linking of the domain of ideas with the domain of real objects and observable things, and more specifically, “any teaching or learning activity that involves at some point the student in observing or manipulating real objects and materials” (Millar, 2004, p. 2; Millar, Le Maréchal, & Tiberghien, 1999). Within this definition of practical work, direct representations of objects or materials also constitute practical work (Millar, 1998). Similarly, Hofstein and Lunetta (2003) define a laboratory as, “learning experiences in which students interact with materials and/or with models to observe and understand the natural world” (p. 31). This definition too is inclusive of virtual practical work by its acceptance of models as legitimate lab activities. Finally, in a general review of America’s high school labs, Singer, Hilton, and Schwingeruber (2005) describe laboratory experiences as “opportunities for students to interact directly with the material world (or with data drawn from the material world), using the tools, data collection techniques, models, and theories of science” (p. 4). Thus, under these inclusive definitions of practical work, audio-visual representations, virtual objects, simulations, and other representations in the vein of online laboratories and field trips are legitimate forms and/or instruments of practical work.

There are various explanations of what practical work comprises. For example, Woolnough and Allsop (1985) classified practical tasks into four categories that included: (1) exercises—to corroborate theory or teach procedure, (2) experiences—to improve the perception of science phenomena, (3) investigations—that allow the direct application of scientific reasoning to a theoretical problem, and (4) illustrations—to demonstrate scientific laws and theories. Barton (1998a) further categorized computer-assisted practical work as either illustrative having stepwise instructions or investigative involving observations and predictions.

As regularly construed, practical work in science comprises the laboratory and field work exercises in a course that characterize the style of scientific inquiry itself as well as the modeled activities of that discipline’s science professionals (e.g., chemical experiments, biological sample collection, astronomical observations, geological mapping, etc.). However, practical work is more expansive than just laboratory work and field work. For example, Woolnough and Allsop (1985) categorization also entails aspects of lectures and homework exercises that illustrate theory and procedure. Moreover, the meaning of practical work when applied to science education is, in the main, expansive and not only incorporates scientific techniques of the laboratory or field (what scientists do), but also scientific behaviors (who scientists are). What is more, practical work in science is not just the dominion of nascent scientists and has other levels of purpose. Practical work can support learning in a variety of science dimensions such as those demarcated by Chin, Munby, Hutchinson, Taylor, and Clark (2004) as: (1) bench science—whose purpose is to generate new science, (2) school science—whose purpose is to promote science literacy, and (3) workplace science—whose purpose is to support the goals of the workplace.
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