Book Review / Compte rendu

Ferster, Bill (2014). *Teaching machines: Learning from the intersection of education and technology.* **Baltimore: Johns Hopkins University Press. Pages: 199. Price: $34.95 USD (hardcover and ebook).**

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The boosters of massive open online courses were annoying for their braggadocio, which far exceeded MOOCs' achievements or even rational extrapolations from their achievements. But they were particularly annoying for their ignoring or ignorance of literature in the fields in which they sought to profess. A recent valuable addition to this literature is Tony Bates' (2015) *Teaching in a digital age*. MOOC computer scientists' ignorance of two decades of expertise in the pedagogy of online learning is perhaps understandable though not excusable. But less understandable is MOOC computer scientists' ignoring or ignorance of the history of educational technology, and particularly computing educational technology. This is the gap that Ferster seeks to fill in his *Teaching machines: Learning from the intersection of education and technology*.

*Teaching machine*s is not a rigorous historical review nor a deep theoretical analysis of educational technology but rather an accessible account of "teaching machines" enlivened by the author's personal anecdotes, his reflections and many photographs and illustrations. Ferster defines a teaching machine as "a way to deliver instruction by using technology that marries content and pedagogy into a self-directed experience for a learner and which relies on minimal assistance from a live instructor" (p.17). This excludes graphing calculators and blackboards, for example. But Ferster's definition of "teaching machines" includes programmed instructional textbooks and even hornbooks. Hornbooks were introduced in 1467 (p. 2). A hornbook was a small board with a handle on which was pasted or held a sheet of paper on which was written or printed a primer of basic learning materials such as the alphabet, Lord's prayer or the Roman numerals. The paper was protected by a piece of transparent horn put over it.

Ferster argues that "there has been a long history of people trying to use technology to facilitate education and that those efforts have consistently failed to live up to the promises of their promoters" (p. xi). He examines six aspects of each development: the lives and

personal influences of the developers, their historical context, the theory informing the development, economic and business factors, political factors, and technological factors.

The preface and first chapter introduce the study and set out its main themes. In his second chapter Ferster examines technologies that seek to replicate traditional teaching-learning activities such as lectures and books. He observes the origins of mediated education as correspondence courses, which developed as postal services were expanded by railways in the late 19th century, teaching films in the early 20th century, and, later, videos of lectures posted online. Chapter three examines programmed instruction machines developed in the 1960s by psychologists such as Pressey and Skinner. Ferster notes that USA psychologists established "1960s versions of today's Silicon Valley startups, where companies were formed . . . to address perceived deficits in the educational system" (page xiii). Ferster does not consider these developments fruitful and argues that the entrepreneurial psychologists "probably should have stayed in their laboratories" (p. 80).

In chapter four Ferster examines teaching machines developed by computer scientists, who used digital computing and networks to develop systems such as PLATO (Programmed Logic for Automatic Teaching Operations) (Mayer, 2010, p. 182). PLATO was developed by Donald L Bitzer in 1960 at the University of Illinois (p. 97). It was one of the more successful systems, being run on several thousand terminals on nearly a dozen networked mainframe computers throughout the world by the late 1970s (Bates, 2015, p. 193). The fifth chapter examines the role of the internet in education through such applications as learning management systems, simulations, and the online virtual world known as Second Life, which has sometimes been used for educational purposes.

Ferster argues that "Truly interactive applications that couple the networked nature of the Internet with the power of modern personal computers have a great, but as yet unrealized, potential" (page xiii). However, he has a strong sense of technology's limitations. Thus, he observes of computer based tutoring systems:

> Diagnosing wrong answers turns out to be an exceedingly difficult, time-consuming, and expensive problem to solve; it requires tediously connecting by hand a large number of potential wrong answers with specific remedial instruction. For example, there are over 600 possible misconceptions about early addition and multiplication alone, which has a narrowly defined scope. For more complicated topics such as physics, the number of misconceptions would be completely overwhelming. (p. 120)

Ferster argues that current teaching machines are far less able than tutors to support students' learning:

> Most tools are capable of only a very rough understanding of what the student already knows, mainly through the blunt assessment tools of multiple-choice tests and answers to problem sets. These assessments can tell *if* the student understands the content but not *why*. To identify the why, a teaching machine must have a content map similar to what the tutor has, of how content parts connect with one another, have some notion of what the student already knows, and possess the ability to analyze what content parts are missing from an incorrect response. The system can then offer a new unit of remedial instruction to bridge the student's deficit. (p. 164)

The points made by Ferster, above, have also been elaborated by Diana Laurillard (2002) in her book *Teaching as a design science: Building pedagogical patterns for learning and technology,* wherein she distinguishes between intrinsic feedback that is internal to an action and extrinsic feedback that is external to the action, and which may be a commentary on the action (p. 138).

Ferster looks to the innovation literature for explanations of the different extents to which teaching machines were adopted at various times: the relative advantage conferred by the innovation; the degree to which it can be trialed directly; the extent to which its results can be observed; its compatibility with existing values, needs and previous experiences; and its complexity. While Ferster's discussion is fine as far as it goes, the innovation literature offers at best an incomplete account of the adoption of changes in education, and has led to cul de sacs if not misunderstandings of the process of educational change. This is because it overlooks the requirements for teaching-learning which must be met by any educational change: learners' interaction with learning activities, their need for feedback on their progress, the development of hierarchical knowledge and skills, and the management of learning. A full account of educational change involves the interaction of three factors: financial, technological and physical resources; the nature, structure and level of knowledge; and the methods available for managing knowledge (Moodie, forthcoming).🍁

References

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