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The Diffusionist Model of Adoption of Digital Learning

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Introduction

In the contemporary network society, human learning is dialectically intertwined with digital technologies. Instead of talking about adopting computers in education (and formal educational systems, in particular) therefore, theorists of the early twenty-first century are increasingly using the integral perspective of digital culture which provides "a richer engagement with the ways education is shaped and practiced with and through the digital" (Knox 2015, pp. 1–2). Yet, as newer versions of technologies continuously replace their older counterparts, and as conceptually new kinds of gadgets (such as tablet computers or smartphones) and web products (such as various sharing platforms) enter the scene, it is still important to understand the dynamics of digital innovation within educational systems. Historically, the first digital technologies have been invented within institutions of education and research – for instance, the first e-mail in history was exchanged between computers at UCLA and Stanford. Immediately after their public release, however, digital technologies have been taken up by the marketplace and then returned to educational institutions as vehicles of progress. It is within this dialectic that schools and universities have become recipients of digital technologies, including but not limited to specialized products developed for teaching and learning.

The adoption of digital technologies within educational systems can be described by several models and theories including the Gartner Hype Cycle, the Technology Acceptance Model, domestication theory, etc. Arguably, however, the oldest and the most influential model is the theory of diffusion of innovations developed in early 1960s by Everett Rogers (1986, 1962/1995). Based on Rogers's theory, Zemsky and Massy developed the e-learning adoption cycle (2004, pp. 9–12), which has quickly been taken up by worldwide educational community (Duan et al. 2010; Zhang et al. 2010; Soffer et al. 2010). This article consists of three main parts. In the first part, it uses the diffusionist model developed by Zemsky and Massy to describe the history of adoption of digital learning into educational systems. In order to account for complexity and diversity of the relationships between digital technologies and human learning, it replaces the term e-learning originally used by Zemsky and Massy with the broader concept of digital learning (in the Encyclopaedia of Educational Philosophy and Theory, Hayes (2015) analyzes these differences in more depth). The second part of the article analyzes theoretical issues associated with the diffusionist model of adoption of digital

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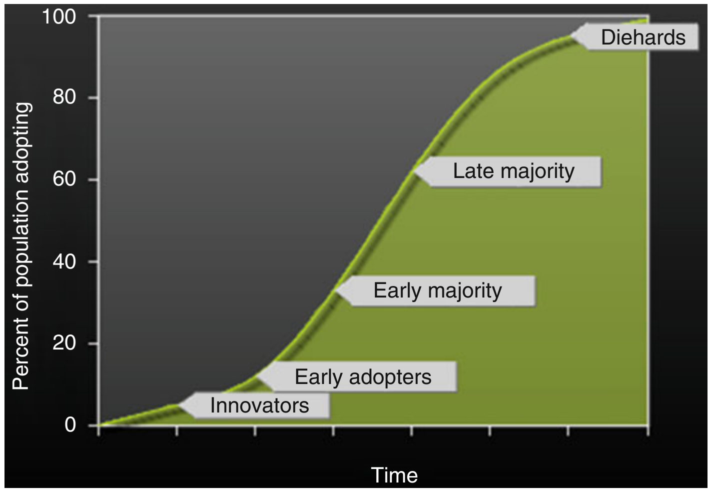

The Diffusionist Model of Adoption of Digital Learning, Fig. 1 Adoption of digital learning according to cumulative percentage of population (based on Zemsky and Massy 2004, p. 9)

learning, and the third part of the article analyzes its practical applications.

The Diffusionist Model of Adoption of Digital Learning

Zemsky and Massy's cycle of adoption of digital learning statistically distributes populations according to the Gauss curve into the following categories: innovators, early adopters, early majority, late majority, and diehards (2004, pp. 9–12). Figure 1 represents the cycle of adoption of digital learning according to cumulative percentage of population, while Fig. 2 represents the cycle of adoption of digital learning according to relative percentage of population. This section applies Zemsky and Massy's model to the history of development of digital learning in formal educational systems such as schools and universities.

Human learning has had a prominent position in works of the early innovators of the computer industry (the so-called "digerati") such as Sherry Turkle, Howard Rheingold, Stewart Brand, Kevin Kelly, John Markoff, Jaron Lanier, Richard Stallman, and others. However, following fast penetration of broadband Internet in western homes during 1990s, the convergence between digital technologies and learning had been rapidly gaining importance in wide formal educational settings. The cycle of adoption of digital learning starts with *innovators*. In worldwide schools and universities, typical innovators were computer experts and enthusiasts who simultaneously developed and used digital technologies for learning. The stage of innovators is abundant with fresh ideas and small individual projects started mostly in technical schools, research laboratories, and private enterprises. Larger-scale projects for development of digital learning had mostly been conducted in computer laboratories of a few elite research institutions such as MIT and Stanford. Following such lack of institutional opportunities, worldwide innovators adopted "the lone-ranger approach" (Anderson and Elloumi 2004). The community of practitioners of digital learning was in its infancy, and research results were (if at all) published on the fringes of conferences and journals oriented to traditional research areas. Consequently, the stage of innovators is marked by significant overlapping between various development projects. For instance, during the early 1990s, almost every progressive educational institution had been developing its own virtual learning environment. For all those reasons, early research in digital learning was predominantly focused on technologies.

Moving on to the stage of *early adopters*, the population of digital learning practitioners had slowly shifted from technology experts toward teachers with special interest in information and communication technologies. Development had

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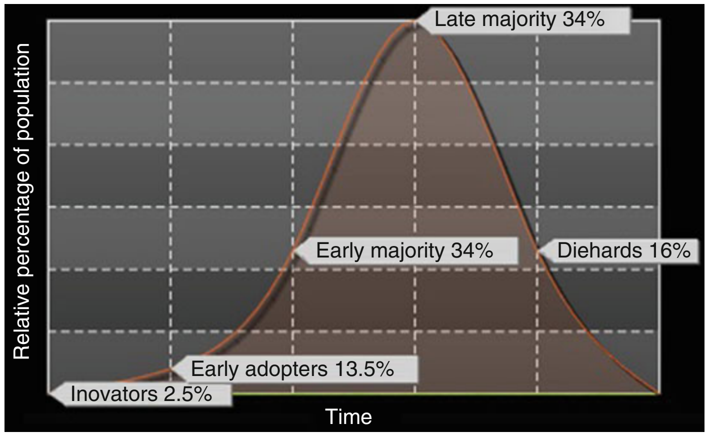

Fig. 2 Adoption of digital learning according to relative percentage of population (based on Rogers 1962/1995, p. 262)

still been strongly technologically oriented. However, specialist licensed and open source tools for digital learning had slowly but surely flooded the technology marketplace. Classroom implementations of digital technologies had increased in size and scope. Research focus slowly had shifted from technology toward pedagogy, thus creating a widening gap between technology-oriented and pedagogy-oriented communities. Development and maintenance of learning technologies had still been dominated by the lone-ranger approach. However, there had been an increasing number of larger interdisciplinary collaborative projects between individuals and institutions in specialized fields such as pedagogy and technology.

The stage of *early majority* had strongly reinforced these trends. The gap between technology and pedagogy had become deeper and wider. Specialized software companies and open source projects had rapidly grown in number and size, causing professionalization of technological development and support. Consequently, most educational institutions had discontinued their own production of learning technologies and switched to ready-made market products. Teachers and institutions had rapidly embraced digital learning: near the end of the phase of early majority, total penetration of digital learning in traditional educational systems had reached 50 %. Development of digital learning had switched from small lone-ranger projects to large(r) collaborative projects. Consequently, the scope and extent of the supporting activities had exponentially increased. In order to fulfil the growing demands for labor, educational institutions had created new types of jobs such as e-learning managers, administrators of e-learning systems, and learning technologists. The new positions require specialist skills and knowledge: in order to satisfy the increasing demand for experts, educational institutions had introduced appropriate degrees.

By the beginning of 2016, arguably, the majority of educational institutions in the First World have entered the stage of *late majority*. In this stage, trends identified in the stage of early majority have stabilized. Digital learning has a firm position in educational administration, teaching, and research. There are specialized conferences, journals, schools, departments, and communities of practitioners and researchers. The fields of learning technology and digital pedagogy have become highly developed. Research in digital learning has grown beyond issues related to school settings – at the beginning of 2016, new research frontiers are in the fields of digital cultures, critical theory, epistemology, and social studies of technology. According to Knox, these developments have brought about two main developments: “the diversity, nuance, and strangeness of culture, as opposed to the rational universalism of education, combined with useful perspectives from the philosophy and theory of technology, which are able to account for more complex notions of our relationships with the digital” (Knox 2015, p. 1).

The last population in the diffusionist model of adoption of digital learning are *diehards* (sometimes also pejoratively called *laggards*). For one reason or another, diehards will never adopt digital learning in their practice or will adopt the necessary minimum for normal functioning in the workplace. While Zemsky, Massy, and other early theorists of development of digital learning have sported slightly negative attitudes toward diehards, the perspective of digital cultures offers a more cautious approach. In saturated digital environments, it is the balance between the offline and online that matters, and diehards do have an important contribution to achieving that balance.

Theoretical Issues

The diffusionist model is overly simplified in several important ways. Firstly, the diffusionist model was developed in mid-twentieth century for analyzing the introduction of relatively simple agricultural techniques into farming (Rogers 1986, p. 117). In the context of digital cultures, however, digital learning is much more complex than any particular (agricultural) technique. Secondly, people and institutions may belong to different categories in the context of two or more innovations. For instance, an innovator who took up using e-mails decades ago might be a diehard in the context of virtual learning environments – either by his or her orientation to technology or because of technological affordances or because of any combination of these factors. Thirdly, the diffusionist model does not recognize the objective obstacles to adoption of digital learning such as the Digital Divide.

The diffusionist model classifies past and present events. It places human adoption of digital learning into a proverbial Gauss curve, thus reapproving the universality of simple abstract mathematical laws in the context of various human activities. However, the diffusionist model is unable to predict whether yesterday's and today's trends will remain for the future. While it is easy enough, and often seducing, to extrapolate abstract mathematical curves, such extrapolations do not have theoretical grounding and result in mere speculations. Furthermore, it is impossible to predict the viable extent of digital learning in the future. In spite of continuous efforts, learning in areas such as painting, dancing, or music has proved more resistant to digitalization than fields such as languages and sciences.

Information and communication technologies constantly evolve. Today's computers bear little resemblance to dishwasher-sized machines of the 1970s or simple home entertainment tools of the 1980s. However, such mutations are not included in the diffusionist model. Recent history is full of examples where more advanced technologies, such as virtual learning environments, disrupted development of less advanced technologies, such as CD-ROM-based courses. However, the diffusionist model does not include disruptive technologies within an adoption cycle. In later works, Rogers tried to resolve the first problem by describing technology development using several diffusion curves and the latter by connecting several successive adoption curves (Rogers 1986, pp. 116–125). Such remedies improve accuracy of the diffusionist model, yet the inherent tension between evolutionary and diffusionist models remains.

Ontologically, the concept of diffusion implies penetration of one medium into another (in biology and physical sciences, it usually refers to penetration of denser into less dense liquids during the process of osmosis). Therefore, the main prerequisite for diffusion is the ability to make a clear distinction between the two media, which, in the process of osmosis, is represented by a semipermeable membrane. In the age of digital cultures, however, it is impossible to divorce predigital learning from its digital counterpart. At the ontological level, therefore, the diffusionist model does not correspond to the reality.

Practical Applications

In spite of theoretical limitations, the diffusionist model of adoption of digital learning has many successful practical applications. In order to illustrate the main bases for such success, this section shows three applications of the diffusionist model of adoption of digital learning and analyzes reasons for their success. In the first study, Duan et al. (2010) successfully utilize an innovation adoption perspective in order to examine Chinese students' intention of taking up e-learning degrees at UK institutions. In the second study, Zhang et al. (2010) investigate "people's perceptions and attitudes toward adopting e-learning to explore the key factors affecting the e-learning adoption behavior in China. Based on Rogers' innovation adoption theory," they identify 33 factors of the perceived innovative attributes of e-learning and analyze them using advanced statistical methods. In the third study, Soffer et al. (2010) look deeper into the past and explore "long-term web-supported learning diffusion among lecturers at Tel Aviv University (TAU), from an organizational point of view" within the period of 8 years.

Duan et al. (2010) focus on the very specific group of Chinese students who consider taking up online degrees provided by UK universities. Zhang et al. (2010) ignore the temporal dimension and horizontally investigate 33 factors relevant for the adoption of e-learning here and now. On the opposite side of the spectrum, Soffer et al. (2010) investigate the few factors relevant for the adoption of digital learning through the period of 8 years. These studies have been designed to minimize the impact of theoretical restrictions. For instance, it is reasonable to expect that students who seriously consider taking up an expensive overseas online degree possess elementary access to computer and the Internet – thus, in their research, Duan et al. (2010) could safely eliminate concerns related to the Digital Divide. Similarly, Zhang et al. (2010) can safely hedge the model's inability to make predictions, because their research question is firmly situated in the present. Applied to narrow questions, where theoretical restrictions have minor impact to studied phenomena, the diffusionist model of adoption of digital learning provides useful results. More generally, the usefulness of the diffusionist model of adoption of digital learning decreases in inverse proportion with size and complexity of the researched phenomenon.

The diffusionist model is phenomenological and unable to provide prediction of the future. However, formal educational institutions are traditionally inert. Therefore, as can easily be seen from Soffer, Nachmias, and Ram's analysis of 8 years of e-learning at Tel Aviv University (2010), the diffusionist model of adoption of digital learning enables sound short-term and mid-term educated guesses. A similar line of argument can be applied to the remaining theoretical restrictions, such as the model's failure to account for technological evolution and, more specifically, to account for disruptive technologies. Information and communication technologies do not evolve overnight; even the most disruptive technologies take few years for a complete market takeover. For instance, long after virtual learning environments powered by broadband Internet have disrupted their adoption curve, CD-ROM-based courses could still be found in various educational institutions. Theoretically, accuracy of the diffusionist model of adoption of digital learning decreases in inverse proportion with timescale. In practice, however, there is a fairly long "safe period" where the model provides accurate or near-accurate results. Therefore, the diffusionist model of adoption of digital learning has proved instrumental in short-term to mid-term strategic and managerial decisions (Zemsky and Massy 2004; Bates 2000; Anderson and Elloumi 2004).

Conclusion

The diffusionist model of adoption of digital learning is instrumental in describing small-scale and time-restricted phenomena such as the implementation of this or that technology to a school or university. Theoretically unable to make predictions, the model does offer fairly accurate small-scale and mid-scale educated guesses. Therefore, the diffusionist model of adoption of digital learning is widely used in technology-related change management in worldwide educational institutions. However, the model does not offer an insight into the evolution of digital learning and the emotional work of teachers in adopting digital tools in their practices. It cannot explain why people take up one technology and abandon another; it does not provide a window into the future. The diffusionist model of adoption of digital learning is based on a simple statistical method – the Gauss curve – which merely distributes populations according to certain criteria. For as long as the research problem is framed in ways that avoid the main theoretical restrictions, and for as long as results returned by the model are interpreted phenomenologically, the diffusionist model will yield accurate and useful results. The praxis of education equally consists of everyday practical improvements and grand theoretical achievements. Firmly situated in the first domain, the diffusionist model of adoption of digital learning provides an important tool for managing technological change in educational institutions.

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