Chapter 11
Hubble's Expanding Universe: A Model for Technology Infused Adult Learning

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ABSTRACT

Until Edwin Hubble's discoveries in 1924, astronomers thought that our Milky Way galaxy was the entire universe. Hubble provided a model of a larger universe beyond our galaxy and an expanding universe. Since then, the Hubble telescope has allowed us to view galaxies farther and farther away and introduce ideas beyond our comprehension nearly a century ago. This seems an appropriate model for the expanding universe of learning that is provided by technology. Technology has provided us with an expanding view of our personal and collective adult learning universe. It has provided expanded access to information and increased opportunities for communication. This chapter explores how our learning communities can span our neighborhood, field of interest, and the globe.

INTRODUCTION

While astronomy and education may initially seem like two unrelated disciplines, this chapter will use a model from physics/astronomy to propose a more accurate model for the ever expanding universe of technology infused learning. For decades, this has been described by noting changes introduced by technology. But the experience is more than that. The effect of technology is not changing but expanding possibilities and opportunities in the realm of pedagogy and andragogy and in curriculum and program development in those areas. This chapter will focus on andragogy.

This chapter has two clear objectives: The first objective is to provide a view of technology in education through a different lens. This lens shows technology as infused into education, not just added on. The second objective is to develop a new model for andragogy by exploring parallels between the impact of Hubble's discoveries on astronomers accepted view of the universe and the impact of technology on educators' traditional view of curriculum and program development.

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Theoretical Framework

The theoretical framework for this paper will include theories about our physical universe developed by astronomers and theories about our educational universe developed by educators. The current theories about our universe were developed in the early 1900's through the discoveries of Edwin Hubble while those in education began with adult educators during a similar period and continued with Knowles and others.

Theoretical Framework for Hubble's Universe

Hubble's model of the universe transformed the thinking of centuries of astronomers. Comins and Kaufmann (2012) explain that "cosmology is the study of the large-scale structure and evolution of the universe" (p. 536). Before the early 1900's, people believed in an essentially static and unchanging universe.

Isaac Newton promoted this belief that the universe was infinite and static. Newton's three laws of motion and his universal law of gravitation provided explanations to substantiate this belief. Newton's first law of motion, the law of inertia, is the special case of his second law which relates force to motion. Since force is directly proportional to acceleration, the absence of an unbalanced force results in an object that is either stationary or moving with constant speed in a straight line. This was consistent with his view of a static universe. His law of universal gravitation explained that the force of gravity was directly proportional to the product of the masses of the objects and inversely proportional to the distance between them. This explained Newton's view that each star was held in a fixed position by the influence of a uniform gravitational pull from every other object in the cosmos.

This model was accepted well into the early 1900's. Comins and Kaufmann (2012) note that the beginning of modern cosmology is considered to have begun with Einstein's publication of his theory of general relativity in 1915. His general relativity equations indicated that the universe was not static but was instead either expanding or contracting. This was inconsistent with current thinking. However, the current thinking was so strong that Einstein adjusted his equations by adding a cosmological constant to yield a static, finite cosmos. "After new observations revealed that the universe is expanding, Einstein said that adding the cosmological constant was the biggest blunder of his life" (p. 536).

These new observations began with the work of the astronomer Henrietta Leavitt who published a key paper in 1912 on the period-luminosity relation of variable stars. Her work was key to Hubble's calculations of the distance of M31, the Andromeda Galaxy. The calculations showed that Andromeda was 2.2 million light years beyond the Milky Way Galaxy and therefore was not part of the Milky Way as previously thought. These results showed a model in which the universe was recognized to be larger and populated with far bigger objects than most astronomers had imagined.

This significant finding was only the beginning of an even more profound expansion of the model of the universe. Pais (1982) noted that the announcement by Edwin Powell Hubble in December 1924 "of an experimental result which settled a debate that had been going on for well over a century: the first incontrovertible evidence for the existence of an extragalactic object, Messier 31, the Andromeda nebula. Theoretical studies of cosmological models received even more important stimulus and direction from Hubble's great discovery of 1929 that the universe is expanding: nebulas are receding with a velocity proportional to their distance" (p. 268). Solar systems, galaxies, and clusters of galaxies are held together by gravity but clusters of galaxies are moving away from each other in Hubble's expanding space.

Hawking (1988) noted that "in less than half a century, man's view of the universe, formed over millennia has been transformed. Hubble's