Chapter 3
Fully Extending the Learning Ecosystem Analogy

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ABSTRACT

The biological ecosystem is a common conceptual model used to describe the organization and interplay of elements in many systems, including learning systems. However, the analogy is rarely fully extended to all components of the original biological model. This chapter fully extends the ecosystem analogy for use in describing a modern learning ecosystem, including those parallels most often left absent. It also provides examples as to how extending these analogies can aid learning engineers and scholars to better understand, diagnose, and design effective learning models. Throughout, this modern learning ecosystem analogy will be applied to an online public school learning model.

INTRODUCTION

The biological ecosystem is a common conceptual model used to describe the organization and interplay of elements in many systems, including learning systems. However, the analogy is rarely fully extended to all components of the original biological model. This chapter fully extends the ecosystem analogy for use in describing a modern learning ecosystem, including those parallels most often left absent. It also provides examples as to how extending these analogies can aide learning engineers and scholars to better understand, diagnose, and design effective learning models. Throughout, this modern learning ecosystem analogy will be applied to an online public school learning model.

BACKGROUND

In 1935, English botanist Sir Arther G. Tansley recognized the complex interactions and integration of the life forms of all types (the biotic) and the nonliving components of the physical environment (the abiotic) as an "ecosystem" (Schowalter, 2011, 257). Six years later, Raymond Lindeman introduced the

idea that energy and matter is exchanged between these biotic and abiotic elements (Lindeman, 1042, 399). Ecosystems are characterized by their structure (how they are organized), and function (how energy and matter are exchanged). In short, an ecosystem embodies all biotic and abiotic elements in an environment, as well as the interactions between and amongst those elements (Knapp, 2020).

While the concept of an ecosystem has its birth in the biological sciences, it is often used as a framework in other fields. In economy-related literature, there is much discussion about the business ecosystem, entrepreneurship ecosystem, and digital business ecosystems. The first use of the ecosystem analogy in economics was from Rothschild (Rothschild, 1990). As far back as 1982, Zmud described technology ecosystems to explain the influence of centralization and formalization of software practices (Zmud, 1982).

The field of education is also no stranger to the use of the ecosystem analogy. In 1976, Cremin formally proposed "educational ecology" as the study between education and the surrounding ecological environment (Cremin, 1976). In 1978, Hobbs called for the design of an educational ecosystem that involved families and schools in the context of the larger community (Hobbs, 1978, 764). In 1998, Cronin referenced an educational ecosystem in relation to the development of electronic academies (Cronin, 1998). A 2000 Manno, Fin, and Vanourek article described charter schools as a "new institutional species in the education ecosystem". Most recently, Walcutt, J.J. and Schatz, S. (Eds.) and more than 85 contributors (2019) describe how to modernize learning through the development of a future learning ecosystem.

Challenges With Learning Ecosystem Models to Date

To date, learning ecosystem models fail to fully take advantage of the analogies to their biological counterparts, including:

- **Extending the analogy to include organizational elements** such as biome and migration
- **Considering the human (biotic) elements** in learning ecosystem models
- **Detailing the commodity transfer and transformation processes** (Regents of the University of Michigan, 2017) and the **connections** where transfer occurs
- **Analyzing the effect and impact of abiotic elements** on the system commodity
- **Applying the concepts of biome and migration**
- **Utilizing the concept of catalysts** as key to the use of the systems' commodity (Regents of the University of Michigan, 2017)

Foundations of Biological Ecosystems

Before continuing, it may help to clarify the structure and detail of the model upon which the modern learning ecosystem is based: the biological ecosystem.

Components

An ecosystem consists of a living community and the physical and chemical factors that make up its non-living, or **abiotic**, environment. Processes that link the living, or **biotic**, components to the non-living, or abiotic, components are key to the study of an ecosystem. The abiotic factors of an ecosystem can affect the sustainability and growth of an ecosystem. (Thorsteinson & Love, 2016). The geological

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