Chapter XXIII
Structural Coupling as a Foundation for Instructional Design

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ABSTRACT

In this chapter, we describe an alternative to the cognitive and neo-behavioral views of learning that currently dominate the field of instructional design and development. Founded in the work of Chilean biologists Humberto Maturana and Francisco Varela, this view questions the fundamental notions that the environment can actually be "instructive" and that instruction can be prescribed to change learners in predictable ways. Instead we offer a proscriptive model of instructional design, one that embeds the process in the basic foundation that learners are organizationally closed, structurally determined, and coupled with their environment. Instead of threatening the field of instructional design, as some writers have expressed, we argue that this approach actually "sets it free"!

INTRODUCTION

A hallmark of traditional models of learning and cognition is that they assume that culture, in general, and knowledge, in particular, is external to the learner and can be objectively specified (e.g., by task analyses, schema, semantic networks, production systems, etc.). That is, they rely on the existence of information "objects" that can be passed through mental structures by cognitive mechanisms in an analogous way that a message flows through a telephone wire. The process of learning becomes one of mapping this external knowledge into some form of internal representa-

tion that more or less approximates the external "objects." To see if the transmission process has been successful, we check the match between the student's cognitive representation and the knowledge as previously defined. The learner learns by acquiring or being directed by the culture to behave in new ways. Thus one may say that the interactions between the learner and the environment are instructional: The environment instructs the learner. Most self-described constructivists hold the position that while knowledge is constructed, information is still received from the environment in this manner. This places those constructivists well within this same tradition.

In this chapter, we will explore the consequences of a position that takes quite a different point of view of the teaching-learning process, one that questions the very notion that culture/environment can be "instructive" in any real sense of that word. We will draw upon the writings of the Chilean biologists, Humberto Maturana and Francisco Varela. Our purpose is not simply to reject other positions, but mainly to assess the implications of this view for existing and possible new instructional systems. In other words, would instructional design and the use of technology look different based upon Maturana's notion of autopoiesis? In what way can we design instruction that is synomorphic[1] with this process? But first, a few words about Maturana.

BACKGROUND

Two Questions: What is a Living System? How Does Perception Work?

At this point the reader must be warned that terminology plays an important role in the story we will tell. For example, most scientists, biologists included, use the terms organization and structure interchangeably. However, Maturana found that he had to make a logical distinction between the two in order to solve the problem of what makes a living system a living system. Maturana has always been very conscious of the terminology he uses because any given language limits what may be said. Terminology will be discussed in a later section of this chapter.

As an instructor of biology interested primarily in perception, Maturana found that he was constantly faced with some variant on the following question from his students: "What is proper to living systems that had its origin when they originated, and has remained invariant since then in the succession of their generations?" (Maturana, 1980, p. xii). This was turned into his initial driving question: "What is the organization of the living?" (p. xii). There are, of course, lists of the characteristics of living systems, and we can recognize whether a system is living, but this is different from saying that we *know* what a living system is; that we can identify the invariant feature of living systems around which natural selection operates (Maturana, 1980). After years of research and thought, Maturana concluded that the single most important characteristic that distinguishes the living from the non-living, in regard to their unitary character, is *autopoiesis* (a term he coined to differentiate what he was saying from the more general term, autonomy). In brief, a living unity is self-producing; it produces within itself all its own components, everything it needs to stay alive. This is his answer to the first question. The prototypical example is the cell. Self-production means that the living system does not depend upon an external environment for any of its components. The boundaries of the living system separate it from its medium, it does not import any necessary components; it produces them all, including its boundaries. The living system has no function or purpose other than to keep itself alive.

Following his own particular interests, Maturana's second driving question became "What takes place in the phenomenon of perception?" The two questions began as parallel interests, but