Chapter 12
FIS/IFIS Modeling in Professional and Collaborative Learning: A Systemic Approach

ABSTRACT

In this chapter, the capability of the fuzzy inference systems (FISs) to model and provide evaluations in the educational context is further explored through the merits of the intuitionistic fuzzy inference systems (IFISs). The Intuitionistic Fuzzy Logic enables the capture and expression of uncertainty and hesitancy with an IFIS model, thus it extends the fuzzy logic capabilities. In this chapter, the purpose and function of the FIS/IFIS modeling, when embedded in an instructional design (ID), is further examined from Boulding’s systemic perspective. Elaborations of the latter provide a framework for handling the complexity of the above interplay and clarify the aim and the role of the presented modeling approaches. The ID and FIS/IFIS modeling upon experimental data from their materialization in two educational cases in the area of professional learning and computer supported collaborative learning, respectively, serve as the test-bed for the potentiality of the presented explorations.

INTRODUCTION

According to Reigeluth (1997, p. 44), instruction is “anything that is done to help someone learn,” and Instructional Design (ID) aims at offering “guidance for improving the quality of that help.” ID refers to the practice of analysis of the learning needs upon which tools and content are systematically built, in order to facilitate learning. This chapter presents efforts in two levels, to enhance the ID with new insights of the fuzzy logic (FL) modeling.

In the first level, a broad systemic perspective of the ID, based on Boulding’s typology, provides opportunities for its innovative enhancement in a more parsimonious, yet efficient design that enriches its learning ecology (Bronfenbrenner, 1979). Boulding’s typology of system complexity (Boulding,
1956) provides a framework for the realization of the structure and function of any complex system within a hierarchy of nine level subsystems. Checkland’s (1981) elaboration of the typology allowed for a deeper understanding of its function, whereas further elaboration of the typology by Gabriele (1997, 2010) contributed to the realization of the structure and function of all the levels, specifically for school and classroom complex systems. When the tangible and/or intangible artefacts that facilitate learning (Wartofsky, 1979; Engeström, 1999) are reflected to the proposed levels of Boulding’s typology (see chapter 10 for examples of their implementation in computer supported collaborative learning (CSCL)), new insights to their design and function can be realized. This approach entails new interpretations to the FIS models, which serve as artefacts that are integrated in the ID.

In the second level, further elaboration of the Fuzzy Inference System (FIS) modeling is explored, on the basis of the enhancement of modeling the expert knowledge that it functions upon. As it is described in previous chapters (see chapters 8 and 10), the evaluation inferences of a FIS are performed on the basis of modeling the knowledge of the domain expert (e.g., the professor). Moreover, when these evaluations are of formative character, they can facilitate learning by providing intelligent support. However, the vagueness of evaluating the human behavior might provide some hesitance to the expert, while s/he is expressing it. On the basis of the Intuitionistic Fuzzy Logic (IFL), Intuitionistic FIS (IFIS) can model this hesitance and, thus, provide better modeling of the reality, i.e., the expert’s knowledge (see chapter 8).

In this chapter, two cases of ID with FIS/IFIS modeling embedded to them are presented, in order to exemplify the above elaborations, as follows:

**Case #1:** A Professional Learning (PL) ID. PL in education has recently attracted attention as part of a wider concern with ‘knowledge-based society’ and ‘lifelong’ learning. It has also lifted its value, since by understanding its context and occasions, more reliable powerful and effective educational programs and procedures can be designed. However, educational research often lacks insights into the different factors and conditions by which it is affected and can be either supported or hindered (Claxton, 1996; Clarke & Hollingsworth, 2002). Consequently, successful modeling could shed light upon possible dependencies between control parameters and PL and pave the way for enhancing it through restructuring its processes and programs. Over the years, different understandings about the nature of teacher learning lead to different approaches to PL. Hoban’s (2002) taxonomy is the most prevalent in the literature. He identified four theoretical perspectives on learning, each related to one of four models of PL. These are, e.g., for the case of PL of teachers:

- **Traditional training model** (TTM). It consists the most common approach today and it is based on the cognitive perspective in which the unit of analysis or focus for learning is in the mind of the individual. A key assumption of this view is the notion that learning is cumulative in nature. Nothing has meaning or is learned in isolation from prior experience (Shuell, 1986). Under this perspective, teacher learning is then assumed to involve the attendance of workshops to gain knowledge and skills.

- **Learning communities** (LCs). It is related to situated perspective, which emphasizes the importance of the situation or context for learning. Under this approach, the teachers have a sense of managing their own growth. Three conceptual themes are central to the situated perspective; in particular, cognition: (a) is situated in particular physical and social contexts, (b) is social in nature, and (c) is distributed across the individual, other persons and tools (Putnam & Borko, 2002).
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