Chapter 14

FCM–Based Modeling of LMS Users’ Quality of Interaction

ABSTRACT

Part III is concluded with this chapter that proposes a Fuzzy Cognitive Map (FCM)-based modeling of the Quality of Interaction (QoI) of the Learning Management System (LMS) users within a blended (b)-learning context, namely FCM-QoI model. Two training/testing scenarios were conducted and explored here, i.e., time-dependent and time-independent, using as pre-validated QoI data the ones presented in chapter 13. Moreover, a FCM-Viewer application that facilitates the visualization of the FCM-QoI model structure is also presented. The experimental results show that the proposed FCM-QoI model can provide concepts interconnection and causal dependencies representation of LMS users’ interaction behavior. With this chapter, the circle around the basic fuzzy logic topics discussed in Part II, i.e., FIS, ANFIS, IFIS and FCM, injected into the educational context is fulfilled. Based on the models discussed so far, prospective hybrid modeling approaches are envisioned in the final section of the book (Part IV) that follows.

INTRODUCTION

In the previous chapter (chapter 13), a thorough analysis and discussion upon the fuzzy logic-based modeling of the users’ Quality of Interaction (QoI), when interacting with a Learning Management System (LMS), especially Modular Object-Oriented Dynamic Learning Environment (MOODLE), based on the concept of the FuzzyQoI model introduced in (Dias & Diniz, 2013), was presented. Considering that LMS Moodle is one of the most commonly used free LMS in online learning environments (OLEs), enabling the creation of powerful, flexible and engaging online courses and experiences (Rice, 2006), it accumulates a vast amount of information that is very valuable for analyzing users’ (professors/students) behavior, establishing a valuable source of educational data. In the LMS database, all the system information, such as personal information about the users (profile), academic results and users’ interaction data are archived on a daily basis; hence, manual management of these data becomes a challenging task, especially when there is an abundant number of LMS users (Dringus & Ellis, 2005). Combining this with the Higher Education Institutions (HEIs) need for constant monitoring of users’
interaction with LMS, so they could identify key areas for potential improvement, it is apparent that efforts, such as modeling of LMS users’ interactions and estimation of their relevant QoI within a blended (b)-learning environment, could offer important information to HEIs for optimizing their educational policy. Moreover, at the user level, the provision of quantitative QoI estimates in a dynamic way could provide valuable information to him/her, in analogy to the one examined in chapters 10-12, referring to the user’s information about his/her Quality of Collaboration (QoC), provoking metacognitive processes and intentions for change and improvement.

In the FuzzyQoI model presented in chapter 13, the knowledge of the experts in the field was translated into fuzzy constructs, and, through five nested Fuzzy Inference Systems (FISs), an estimation of the QoI was achieved (Dias & Diniz, 2013; Dias et al., 2014). As it was shown in chapter 13, the input of the FuzzyQoI model is based on users’ LMS metrics (110 initial reduced down to 12 categories plus two direct metrics). The mapping between the inputs and the output (normalized index of users’ QoI) of the FuzzyQoI model was integrated into a system as a quantitative map. This, internally, it can be considered as a set of qualitative linguistic rules (see chapter 8) that could be used to model the type of uncertain systems that are difficult to handle using conventional crisp logic (Tsoukalas & Uhrig, 1996).

Stemming from the fuzzy logic (FL) concept proposed in FuzzyQoI model (Dias & Diniz, 2013), an alternative approach, yet within the field of FL, is proposed here, exploiting the potentiality of the Fuzzy Cognitive Map (FCM) (Kosko, 1986; chapter 8), to be used as a structural element of a new modeling scheme, namely FCM-QoI (Dias et al., 2015a; Dias et al., 2015b), for effectively estimating the users’ QoI with LMS within a b-learning context. The research effort regarding the use of FCM in the educational context have already analytically presented and discussed in chapter 9. To this end, here, the rationale behind the FCM use in the structure of the FCM-QoI model is only presented in the following section.

THE RATIONALE BEHIND THE FCM-QOI MODEL

In general, FCMs can model causal relationships in complex systems that evolve with time (see chapters 8 and 9). From this line, several studies have shown how FCMs can provide an understanding of problematic domains or systems and/or knowledge for strategic purposes in terms of maximization of benefits, minimization of risks and management issues (e.g., Sharif & Irani, 2006; Rodriguez-Repiso et al., 2007; Glykas, 2013; Jetter & Sperry, 2013). Similarly, here, the use of FCMs in modeling the QoI of the LMS users within b-learning environment can provide a “strategic mapping” to better understand the particular domain of higher education in an interconnected way of thinking.

In fact, the theory of FCM is mainly concerned with modeling factors and their interrelationships within complex domains/systems. Knowing that the adoption of LMSs in HEIs represents a complex domain with multiple influencing aspects, FCMs are suitable to model this particular domain; simultaneously, considering that FCMs have the ability to model dynamic systems (Kosko, 1992), they are ideal to capture the (internal/external) dynamic aspect of the LMSs (see chapter 9 for thorough literature review).

The main motivations for basing the FCM-QoI model upon the use of FCM approach can be summarized below, as FCM is:

- Easy to use, create, visualize and parameterize,
- Flexible in representation/visualization,
- Understandable for nontechnical experts and for different stakeholders groups,
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