Chapter 3
Knowledge Framework for Online Learning:
Implications for Cybsersecurity and Programming Education

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ABSTRACT

While online education continues to grow, virtual instructors face certain asynchronous uncertainties when it comes to knowledge exchange with students. These challenges are especially prevalent in the cybersecurity and programming domains. To counteract such uncertainties and minimize teaching deficiencies expected to occur in asynchronous learning environments, this chapter assesses knowledge factors that impact virtual knowledge transfer and absorption processes. Synchronicity framework is proposed to integrate knowledge-seeking behavior, knowledge properties, knowledge domains, knowledge types, knowledge tools, and technology synchronicity. A real-life case is provided to integrate the framework in practice.

INTRODUCTION

A key component of distance learning platforms is an asynchronous learning environment, which promises to allow both students and their instructors to engage in learning at their own pace and schedule, without having to adhere to a fixed meeting time or location (Moller, 1998; Swan, 2001). Asynchronous learning can be effective for tasks where steps and outcomes are well-defined, such as an assignment to review academic literature to participate in a discussion forum (Loncar, Barrett & Liu, 2014; Nandi, Hamilton & Harland, 2012); however, in tasks where the steps are not well-defined or outcomes are not known in advance, a student may struggle when questions or uncertainties arise and there is no guidance on how to proceed (e.g. software engineering tasks)(Arkorful & Abaidoo, 2015; Dowling, Godfrey & Gyles, 2003).

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Two domains that are particularly challenging for online students are cybersecurity and programming. For example, Hoffman, Burley and Toregas (2012) argued that universities are slow to respond to the cybersecurity needs of the industry due to their academic silos and challenges in meeting the institution's mission through online programs. Furthermore, these challenges are compounded since universities' online learning systems are often compromised by cyber-attacks and hindered by inefficient IT policies and procedures (Bandara, Ioras & Maher, 2014).

Research has identified numerous techniques for addressing these deficiencies in asynchronous learning (Chen & Wang, 2004; Johnson & Altowairiki, 2016; Underdown & Martin, 2016; Cleveland & Block, 2017); however, many of the approaches require some form of synchronous intervention (cognitive apprenticeships) (Jonaseen et al., 1995), or are limited to addressing finite problems that can be anticipated in advance (scaffolding)(Sims, Dobbs & Hand, 2002). These approaches do not improve a student's own problem solving skills for indeterminate problems without resorting to synchronous interactions, thus representing a challenge for online programs that offer 'self-paced' competency-based degrees with minimum intervention by instructors. As a result, the research question for this study is: how can knowledge be organized to minimize teaching deficiencies expected to occur in asynchronous learning environments?

In this paper, the authors present an asynchronous knowledge technology synchronicity framework that integrates knowledge form, types, dimensions, and technology synchronicity required for completing knowledge exchange in a virtual classroom. An example is provided to illustrate a deficiency in knowledge transfer and to integrate the framework.

The rest of the paper is structured as follows. First, an examination of knowledge exchange in the virtual classroom is performed and a set of building blocks is analyzed in detail. Next, a framework to organize the knowledge exchange properties are proposed. The paper concludes with a summary and a call for further research.

KNOWLEDGE EXCHANGE IN ONLINE ENVIRONMENT

In this study, the authors define asynchronous learning as the process of acquiring and converting knowledge within an online environment that is independent of space and time. The process, which was made possible by advancements in the technology for computer-mediated communication (CMC), has revolutionized the education industry. It has bridged the interaction between students and educators through virtual classrooms hosted within online learning systems (OLS).

The modern virtual classroom is a space where students interact with one another and with the instructor through forums, simulations, and collaborative assignments. Such interaction has been found effective in increasing the motivation to learn, mastery of course material, and greater quality of educational experience (Hiltz and Wellman, 1997). The interaction between instructor and students consists of complex processes that involve the seeking, acquisition, conversion, and integration of knowledge between parties. In the following section, we examine specific behaviors, knowledge properties, knowledge domains, and knowledge tools that will be used to formulate the proposed framework.