Chapter 10
Cognitive Apprenticeship for Teaching Computer Science and Leadership in Virtual Worlds

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ABSTRACT

Cognitive apprenticeship refers to the development of skills under the guidance and tutelage of a domain expert. This chapter covers the theory and highlights 10 years of virtual learning experiences and 52 classes using the cognitive apprenticeship model. It reflects on the impact of presence and explores how learning communities develop as students assume roles and learn by working next to skilled faculty. The examples reinforce the value of deep immersion and identity in situated learning. The software design activities illustrate the benefits experienced when students assume ownership and structure their activities. Through self-reflection, learners illustrated the power of design thinking through group and individual design studios. The chapter concludes with observations from 400 eighth graders and reflections on future work in the design of sustainable learning programs for computer science and leadership education.

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INTRODUCTION

How do students learn? How do they apply the knowledge they acquired to address future problems and tasks? This chapter explores several cognitive theories and the use of cognitive apprenticeship through ten years and 50 classes held in a virtual world. The examples begin with middle school experiences from 8th grade students in Suffern, New York studying in a virtual world and shifts to address every level of higher education in a computer science degree program with a concentration in emerging media as the evolution of Web science. The chapter reflects on how design thinking within the technology strengthened teamwork and leadership skills through deep immersion, and presents recommendations for future work.

BACKGROUND

Learning blends the pedagogy of facts and rules to form cognitive models for how learners think, reason, and respond to apply them in present and future situations. Craik and Lockhart (1972) turned cognitive models of learning upside down by introducing the levels of processing that describe memory recall and the depth of memory processing. Their model featured two categories: shallow processing and deep or semantic processing.

Memories decay under shallow processing and sensory data establishes connections in the mind.

- How an object looks through structural processing
- How something sounds using phonemic processing
- How letters are symbols that when grouped together, become words as graphemic processing
- How the shape of objects appear under orthographic processing

In contrast, the construct of semantic processing through deep immersion provides connections that support applied learning.

- The relationship between objects or experiences
- The deeper meaning of the experience
- The importance of the experience

Craik and Lockhart (1972) researched deep learning and applied semantic processing theory to explain how the exposure to immersive experiences serve as patterns for memories that persist. Computer science education seeks to map the pedagogy related to programming languages and software engineering practices to applied learning activities to give students the tools needed to create and evaluate their products.

Cognitive apprenticeship blends the sensory data experienced in virtual worlds with design thinking practices (Brown, 2008) to form relationships with experts. Students work next to faculty experts, observing the skills and testing them in their early efforts. The practice benefits from the struggle learners experience when the project challenges them to exceed their current capabilities during its design. If the domain expert blends instruction and support with observation, the learner gains the skills, feedback, and support needed during the initial design and later refinement efforts to achieve a sense of accomplishment and mastery that Csíkszentmihályi (2008) described as the mental state of flow.