Incorporating Cognitive Apprenticeship in Multi-Media

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Remote learning solutions should account for important yet neglected aspects of contemporary learning environments, such as the activities that occur during mentor relationships, or the affect of community on cognition. It may be possible to partially replace the learning and motivation ordinarily provided by mentors and community through the marriage of a constructivist cognitive teaching model and contemporary delivery platforms, such as cognitive apprenticeship and multimedia. This approach is used in Convection Initiation, a multimedia training course designed to help weather forecasters interpret Doppler radar. The course is discussed in this paper to illustrate how cognitive apprenticeship can be used as a framework for designs that address the needs of a distributed learning environment.

Issues facing designers of instructional multimedia are numerous and profound: an audience that is often not part of a community-of-practice (Brown, & Duguid, 1991) where learning occurs in a communal environment of discussion, analysis, and reflection; a diverse audience having varying levels of subject-matter expertise, metacognitive skills, machine interface skills, and motivation; an ill-structured subject matter; and problematic learning environments. This paper discusses the application of a cognitive teaching model that addresses these issues. The discussion remains centered on a specific application of cognitive apprenticeship to multimedia that was developed by The Cooperative Program for Operational Meteorology, Education and Training (COMET) at the University Corporation for Atmospheric Research, Boulder, CO, which develops training materials for meteorologists (Wilson, Heckman, & Wang, 1991). An introduction to the situation includes a discussion about the subject matter, prior knowledge, and the environment.

The Subject-Matter. Weather forecasting is a complex, difficult task. The environment on which the forecast is based is prone to rapid changes that are often difficult to anticipate. Accurate forecasts increase in difficulty as they become localized or farther out in time. A relatively new technology, Doppler radar, has the capability of conveying the conditions leading to adverse climatic change by accurately measuring and displaying, as color changes and movement in radar imagery, the velocity and density of small air-borne particles, such as dust and insects. Doppler radar helps forecasters identify familiar pat-
terns typically known to lead to common climatic conditions, combine that knowledge with other information from a cadre of traditional forecasting tools, and make forecasts for everything from calm, clear skies to floods, tornadoes, and snowstorms. There are, however, several difficulties in learning how to use Doppler radar imagery to forecast the weather: recognizing patterns in imagery that represent known climatic concepts and conditions, understanding and predicting the movement and interaction of various familiar concepts and conditions represented in the imagery, correctly identifying and interpreting small, often indiscernible nuance and variance in the imagery, and making accurate forecasts. Also, there is the problem of relearning how certain conditions are represented in Doppler as opposed to more traditional tools, such as satellite imagery.

Weather forecasting is an ill-structured task. The make-up and definition of ill-structured subject matter may change from case to case: the way it is approached may vary the way it is perceived, and strict theoretical principles and methodologies break down in real “messy” cases (Spiro, Feltovich, Jacobson & Coulson, 1991). Problems and issues in ill-structured subject matter are not best solved by applying canned principles, methodologies or hierarchies of learning. Learners must often develop an imaginative understanding of problems and their resolutions. Learners must have the capacity for cognitive flexibility, that is, “the ability to adaptively re-assemble diverse elements of knowledge to fit the particular needs of a given understanding or problem-solving situation” (Spiro & Jehng, 1990). This imaginative understanding and capability to assemble, disassemble, and re-assemble schema requires the learner to go beyond the information given and develop a plan, based on experience and recent learnings, that has the greatest likelihood for success, realizing that even the best rationalized approach could fall simply owing to the instability of the subject matter. The classic objectivist approach is steeped in hierarchies of learning and precisely stated algorithms that attempt to describe the nature of and best way to acquire and apply expertise. It is clinically rigid in its disregard for ill-structured subject matter and the influence the community and thinking organism have on learning and knowing. The task hierarchy breaks down when applied to ill-defined subject matter that is complex, unstable, and difficult to predict. The cost in time and effort in developing a task hierarchy might be better spent in designing an interface that allows for rapid access to and assimilation of new knowledge. It is for the these reasons that this paper and the courseware presented have as their foundation a primarily constructivist or experiential view of the world.

Prior Knowledge varies substantially with students of Doppler radar: some learners may have a master's degree and 20 years' on-the-job experience and, having automatized many concepts and procedures, are able to articulate at more finite and descriptive levels. These experienced learners, capable of maintaining an accurate gestalt, access expository knowledge in a more random-access nature moving both horizontally and vertically through the subject matter. Other learners may have as little as one year's technical training, where every Doppler feature encountered presents numerous underlying gaps in understanding. These learners have no choice but to complete the instruction in a more linear, sometimes remedial manner in order to gain full comprehension of the fundamentals of Doppler radar and weather forecasting.

The Environment. The training platform, a PC with laserdisc, is located within the forecaster's regular workstation which includes an array of monitors and computers. Some learners must conform to a training regimen where advancement is tied to the number of training hours completed. Motivation for others is primarily intrinsic where learners engage the instruction to increase professional knowledge and skills. Usage varies. Some sessions last one to two uninterrupted hours at a set time every day. Other sessions are highly fragmented, lasting 10 to 20 minutes and occurring any time during the learner's regular shift, resulting in sessions frequently interrupted by regular job