Design and Development of the Personalized Curriculum for Interactive Multisensor Analysis Training (PC-IMAT)

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Abstract: The Navy Personnel Research and Development Center (NPRDC) has been tasked by the Office of Naval Research (ONR) to provide empirical evidence of effective instructional strategies for the acquisition of conceptual knowledge under the project name "Personalized Curriculum for Interactive Multisensor Analysis Training" (PC-IMAT). The domain to be investigated and demonstrated includes those concepts required for the successful planning and execution of antisubmarine warfare (ASW), specifically, the conceptual knowledge underlying the prediction of sound transmission paths and detection ranges. Navy-standard ocean models which are used in fleet SONAR prediction systems are available to support the learners' conceptual understanding of the elements of the oceanographic environment which affect acoustic propagation. To date, these models are employed in a microcomputer-based, stand-alone delivery architecture in both a linear interactive courseware (ICW) format and in modules suitable for independent exploratory learning.

BACKGROUND

With changes in the world's political climate, training requirements have increased while available training has decreased. As a result, opportunities for adequate and appropriate practice and refresher training for personnel in both active and reserve ratings are becoming increasingly limited. Tasks in these ratings require extensive analysis, classification, interpretation, decision making, data fusion, and communication skills. These skills all rely on understanding the fundamental concepts and models of how signal sources, sensors, and the environment interact, where understanding is viewed as the acquisition, retention, and appropriate application of an accurate network of concepts and principles (1). As Tennyson and Cocchiarella noted, such conceptual knowledge "is more than just the storage of declarative knowledge; it is also an understanding of a concept's operational structure within itself and between associated concepts." (2)

Traditional methods of platform instruction and standard computer-based training both rely on preprogrammed, systematic presentation of the subject matter, and may not be the best vehicles for fostering the development of conceptual understanding, especially in science-dependent domains such as physics and, by extension, acoustical oceanography. Neither method can, by itself, readily accommodate individual trainee differences in abilities, (mis)conceptions, and experience. Likewise, instruction currently relegated to onboard training (OBT) may only tend to perpetuate any misconceptions of the division supervisor, who is typically the lead chief petty officer (LCPO).

Adaptive tutoring technologies may be the desirable alternative to address and remediate those skill and knowledge deficiencies which result from inaccurate or incomplete conceptual understanding. The promise of adaptive tutoring technology in helping students achieve required levels of mastery far more efficiently than with other approaches (c.f., 3), combined with the strength of interactive simulations (4), may yield an effective training vehicle with which to convey an understanding of this complex, multivariate domain. Thus, several conceptual models were pooled into the architectural confines of PC-IMAT software, including:

Environmental Acoustics. Navy standard acoustic propagation models, using Navy standard environmental databases, enhanced with high-resolution data (up to .5 min of arc) in specific areas of interest.

Magnetic Anomaly Detection (MAD). A MAD model provides predictions of detection range versus geometry and location.

Target Motion Analysis (TMA). A set of TMA exemplars, and a TMA gaming situ7)6spyready to prototyped to display conveyance and then testing of relative motion concepts.
Interactive Courseware (ICW). A set of interactive lessons which cover environmental factors that affect sound propagation, followed by the various propagation paths which sound may take in the water.

There are essentially two concurrent development efforts within PC-IMAT: interfaces for prediction systems such as PE, ASTRAL and MPP, and stand-alone interactive courseware covering acoustical oceanography which uses these models for examples within the lessons on propagation paths and losses.

THE ICW CURRICULUM

Six lessons are currently available in the tutoring portion of PC-IMAT. Learners initially take a pretest to assess prior knowledge of the subject matter. Lessons are divided into segments, each representing a logical grouping of fundamental, related concepts. Within this instruction, examples are provided, many of which directly access propagation models such as MPP and PE where applicable. One or more prescripted examples are available, with the opportunity for the learners to generate their own examples. Following each segment, learners are presented a summary, followed by practice items meant to assess the application of the concepts taught.

Recently there has been an effort to introduce a student modeling capability into the PC-IMAT lessonware which was initially developed at the USAF’s Armstrong Laboratory. This capability provides an “intelligent” component to the instruction, in which intelligence refers to "both diagnosis and remediation, working in concert."(5)

EXPECTATIONS

With regard to the topic area of fundamentals of acoustical oceanography, it is hypothesized that, while training time may vary, there will be minimal variability in post-instructional performance assessment (i.e., in posttest scores) independent of incoming prior knowledge, as well as demonstrated across-the-board significant increases in test scores. The significance is that personnel working within the domain will acquire and retain a common core knowledge of the principles of acoustical oceanography, applicable to a variety of situations. The hypotheses are currently being tested with students at the Colaborative Lab at Lackland AFB, Texas and at the U.S. Naval Academy in Annapolis, Maryland.

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