Performance Assessment and Diagnosis in a Complex Domain

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Introduction

Instructors may use assessment and diagnostic information to intervene in the learning process in a number of ways. Each of those intervention strategies may require different types of diagnostic information to support instructional decisions. The design of an automated performance assessment and diagnosis (PA&D) tool to support instructor decision making in a complex, dynamic domain may require the application of different methods to generate the diagnostic information necessary to achieve different instructional purposes. Automated assessment and diagnostic information should augment the instructor's intuitive diagnostic skills and facilitate the formation and implementation of instructional decisions. This paper describes one approach for generating automated performance assessment and diagnosis in an applied setting. The context of the described approach is the Shipboard Instructor Training Support (SITS) program.

Assessment and Diagnosis in Scenario-Based Training

The objective for automated PA&D in the SITS program is to consider potential approaches for analyzing Combat Information Center (CIC) operator keystroke data, after completion of a training scenario, to support the instructional activities of the shipboard Combat System Training Team (CSTT). Providing reliable preliminary assessments and diagnoses based on keystroke data will allow shipboard instructors to focus on other operator behaviors, and integrate these with results from keystroke data to make more complete diagnoses of operator strengths and weaknesses. It is important therefore to maximize the information that can be gleaned from keystrokes, with a goal of diagnosing to higher level cognitive operations, information acquisition and integration, and decision making.

In the shipboard CIC training environment, there are a number of training interventions performed by instructors requiring different diagnostic descriptions of the trainee. These interventions include: providing post exercise feedback at a team level, providing more detailed individual level assessment and diagnosis, and making decisions about the content of future training scenarios. While the cycle of assessment-diagnosis-intervention between the training team members and the trainees is ongoing, the emphasis shifts from identifying "what happened," to determining "why it happened," to understanding the underlying deficiency and how to correct it. These considerations lead to a design strategy that will provide assessment and diagnostic information to the CSTT team as needed throughout the training cycle.

Approach

Our approach to the development of the automated PA&D tool reflects Wenger's (1987) three-level scheme for categorizing diagnostic activities according to the information they provide. At the behavioral level, student actions are compared to a model of the expected actions of an expert. Deviations from expected performance provides information about skill level on tasks and sub-tasks. The epistemic level focuses on identifying the knowledge individuals use to guide action. This cognitive level diagnosis is required to infer from observed performance the information cues that may have been missed or the specific task knowledge that may have resulted in a misuse of information. At the individual level, both behavioral and cognitive diagnosis are used to construct a profile of knowledge and skill deficiencies based on scenario performance.

In the automated PA&D system, a trainee's observed performance on the target exercise is compared to the output of an expert model that has been stimulated by the same scenario. Trainee deviations from model performance or from pre-specified performance criteria are calculated. These deviations provide the basis for behavioral performance measures and provide input to the diagnostic analyses. A back tracing process is used to identify the potential causal influences upon critical performance deviations. These influences may involve cognitive factors and the behaviors of other team members. This diagnostic process supports instructor assessment and feedback. Finally, a profile of potential knowledge and skill weaknesses is developed and used to support selection of future training activities.

References

Wenger, E. (1987). *Artificial intelligence and tutoring systems.* Los Altos, CA: Morgan Kaufmann.