

Using Virtual Agents and Interactive Media to Create an ElectronixTutor for the Office of Naval Research

Whitney O. Baer, Qinyu Cheng, Yan Gong, Zhiqiang Cai, Arthur C. Graesser

University of Memphis, 365 Innovation Drive, Institute for Intelligent Systems, University of
Memphis, Memphis, TN, 38152

whitney.baer@gmail.com, qinyucheng711@gmail.com,
ygong2@memphis.edu, zhiqiang.cai@gmail.com,
art.graesser@gmail.com

Abstract. The focus of ElectronixTutor is to build an intelligent tutoring system technology for Navy-relevant applications in training. The goal is to have an ITS for Apprentice Technician Training (ATT) courses in electronics for naval trainees who have completed boot camp and are in the process of A-school training under the Navy Educational Training Command and to supplement the human instruction with this advanced learning environment that can help sailors achieve the instructional objective.

1 System's Purpose

ElectronixTutor integrates many of the ITS technologies that were developed and completed among the four contracts funded on the ONR Stem Challenge initiative. These included: **AutoTutor** (conversational agents to promote verbal reasoning, question answering, conceptual understanding, and natural language interaction), **Dragoon** (simulation and metal model construction environments with associated assessments), **LearnForm** (electronics content and assessment materials), and **ASSISTments** (platform for learning technologies and assessment materials delivered on the web).

ElectronixTutor incorporates the most current, advanced, ITS technologies in a single learning environment on the web. ElectronixTutor (ET) will help Navy trainees in Apprentice Technician Training (ATT) courses in basic electricity and electronics (BEE). Prior to using the program, the trainees would have completed boot camp and would be in the process of A-school training under the Navy Educational Training Command (NETC). ET supplements the human

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instruction with advanced learning environments that can help sailors achieve their instructional objectives.

2 Significance of the Approach Implemented

Multiple training methods are important in order to have the ITS adapt to the profiles of individual trainees and also to facilitate transfer of training to new situations. The main instructional modules developed in ET for the selected subset of BEE topics are reading, answering multiple choice questions, answering deep reasoning questions in natural language, answering knowledge check questions in natural language, asking questions and receiving answers through Point & Query, exploring circuits in a simulation environment, constructing mental models of circuits in a simulation environment.

In ET, AutoTutor constructs a system which consists of questions from two agents (one peer and one teacher) and allows for many possible responses from learners. These questions can be extensive deep reasoning questions with multiple expectations, or shorter knowledge check questions, which are answered in natural language conversation (Graesser, 2011; Graesser, et al., 2012). Actual learner responses are followed by corresponding feedback, hints, prompts, or pumps by agents. If the response is not an expected answer, or an expected misconception, the system delivers a hint that may help after analysis of the given answer. If the learner answers correctly, the conversation ends positively. Agents will assist learners several times in a loop, but eventually an intelligent agent will assert the expected answer. Another feature of AutoTutor in ET is the Point and Query learning aid. In the AutoTutor system, the trainee clicks on a hot spot, a menu of questions appear, the trainee selects a question from the menu and the answer is presented. Computers cannot answer any question a student asks so this has proven to be a reasonable option. Students ask a remarkably small number of questions and a narrow distribution of questions in most learning environments (Graesser & Person, 1994), but the nature of the questions asked are diagnostic of student understanding (Graesser & Olde, 2003). Point & Query increases the frequency and diversity of questions.

Performance measures are collected on each instructional module, such as time on task, percent correct, match scores between trainee behavior (physical actions or verbal) and expectations, and so on. Associated with each topic is a set of knowledge components that are tracked throughout the interaction by the above learning modules (except for reading). These performance measures are stored in data repositories that update the student model. A very important pedagogical consideration lies in making decisions on what a particular trainee does in a lesson. The ET team developed mechanisms for determining what will happen. The first is simply the topics in the curriculum established by the instructors of A-school. That is, when the trainees arrive on a particular day, the human instructor has one or more topics to cover in the curriculum. ET assigns this topic to the trainee. The topic consists of a bundle of learning resources (e.g., readings, AutoTutor questions, Dragoon modules, as listed above). Second, the ASSISTments system developed at WPI has an If-Then-Else facility that decides what learning resource to present next among a bundle of learning resources associated with a BEE topic. The selection of learning resources depends on the performance of the trainee. For example, if the trainee performs well on an AutoTutor reasoning question, then the trainee is assigned a Dragoon item; otherwise the trainee receives another AutoTutor question. If the trainee still performs poorly on the topic then the trainee would be asked to read a document or receive some skill building exercises. Third, there is a recommender system that makes suggestions on what the trainee might do next, based on the rich profile of data stored in the student model. For example, if the trainee is making frequent mathematical errors that reflect a misunderstanding of the Ohm's law formula, then some skill savings exercises on Ohm's law would be recommended. A small number of recommendations (2 or 3) are made at any point during the ET training. Fourth, the trainee would have access to the entire ATT curriculum and would be free to choose any topic to review for refresher training. They would make their selections in a self-regulated manner.

3 Outline of Demonstration

At the beginning of this conference, the ET team will have at least 14 topic bundles associated with the ATT curriculum. An attendee would be able to access the ET homepage and could select a topic from the curriculum. The attendee could try the adaptive problem set and follow the path that the student model recommends.

For anyone with additional interest, we are working on an interface which allows instructors to try one of our lessons at random, or to create a class for themselves using our development tool and established content. We can demo this interface as a work-in-progress at the conference.

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