

Using Computer Software to Assess the Intellectual Development of Engineering Students

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Abstract – We are currently developing and testing interactive computer software which is designed to measure intellectual development in engineering students as defined by the Perry and Reflective Judgment models. Four open-ended scenarios have been constructed and piloted with 25 subjects including high school and college students and college faculty. Initial results suggest the software is capable of predicting intellectual development to the precision of the traditional interview technique.

Introduction

Most engineering programs expect that their students will mature intellectually in addition to acquiring knowledge and skills in a specific engineering discipline but rarely are supporting data collected and reported. Since conducting and evaluating interviews is time-consuming (about three hours for an interview plus scoring) and expensive (\$100-150 per student), this technique is not consistently used as a program assessment tool. [1]

The success of the interview method relies on the ability of the interviewer to probe for evidence of a student's thought processes and decision-making strategies. No static pencil-and-paper test instrument can search for such evidence, but we believe that neural network and expert system computer technology may be used to develop software capable of duplicating the role of expert interviewer and evaluator. This paper will briefly present the intellectual development models which form the theoretical basic for our work and then describe the status of the software we are developing and testing.

Intellectual Development Measurements

During an interview session, the interviewer queries a subject about his/her views on the nature of knowledge, use of evidence, and open-ended problem-solving. Results are used to place subjects along a multi-stage hierarchical model moving from dualism (“all ideas are right or wrong”) through multiplicity (“all ideas are equally valid”) towards contextual relativism (“some ideas are better than others—evidence is required to decide”). The interview determines how a subject is thinking and why he/she reaches a particular decision about posed questions. In contrast, pencil and paper questionnaires tend to focus on what decision was reached. [1,2]

To be successful, our software must also collect information about the “why” and “how” questions. Features of the software that we believe will allow us to collect valid data include:

- Use of open-ended scenarios similar to those posed in intellectual development interviews with response fields extracted from interview transcripts;
- Webpage features (graphics, audio and video clips, hypermedia) designed to hold student interest;
- Use of neural network technology to analyze complex and “noisy” response patterns.

Project Status

The first version of interactive software has been evaluated by five engineering students using verbal protocol analysis. Based on their feedback about interface design, ease of software usage, and the text of each open-ended scenario, we revised several software features and collected responses from 25 subjects (high school students, CSM students, and CSM faculty presumably spanning the range of intellectual development levels). The “correct” intellectual development level of each subject was also determined using the traditional interview method. These results were subdivided into two data sets to: 1) train the neural network for each open-ended scenario (20 subjects), and 2) verify the predicted results from the trained software (5 subjects). Initial results indicate that trained neural nets can predict intellectual development levels within the precision of the interview method (~ 1/3 of a Perry or RJ stage). Additional results will be presented at the FIE '99 conference.

Acknowledgment

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References Cited

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[2] King, P.M. and K.S. Kitchener, *Developing Reflective Judgment*, Jossey-Bass Publishers, San Francisco, 1994.