

Teaching Accomplishments and Philosophy, Alfred Hübler, 2010

A skillful and committed teacher, Hubler has also creatively applied the principles of nonlinear resonance to develop an intuitive and interactive Web-based software package. “Cyberprof” is used to teach a variety of science courses at the University of Illinois. The software analyzes student homework problems in real time and provides meaningful and individualized feedback. He has also invested in an educational project focused on strengthening the reasoning skills of students with computer assisted reasoning software. His educational outreach efforts on this project have led to one of the top 3% most downloaded papers of all AIP journals (G. Gintautas, A. Hubler, Phys. Educ. 44, 488-491 (2009)).

(1) Resonances in the student-computer interaction

Context: Hubler designed the innovative web-based tutoring software, “Cyberprof”, based on the idea that the student’s attention to a virtual tutor would be particularly high if the response time and the preferences of the virtual tutor match those of the student. (Hübler & Assad, *CyberProf: An Intelligent Human-Computer Interface for Asynchronous Wide Area Training and Teaching*, World Wide Web Journal 4, 231(1996); Raineri, Hübler & Mertens, *CyberprofTM: An Intelligent Human-Computer Interface for Interactive Instruction on the World Wide Web*, JALN 1, 20 (1997)).

Most significant recent work: A. Hübler, C. Martinez, *A Complex System Perspective to Computer-Assisted Learning*, Proc. of ICCE'98, 1, 5-12 (1998).

Web technology has made it possible for the Internet to become increasingly incorporated into American society. The educational sector has lagged behind the progress curve, however. This lag in the application of technology in education is due to financial limitations and because education, unlike other internet services, is more than information delivery and simulation. To teach a student via the Web, at least two components are required: a human computer interface that resonates with the student and artificial intelligence that understands specific areas of knowledge and applies appropriate responses. In this context, CyberprofTM is an asynchronous learning environment, which can apply several fundamental complex systems paradigms to human computer interaction: nonlinear resonances applied in a Digital Mirror, dynamical reconstruction applied in a Field-Specific Tutor and control of chaos applied in a Five Senses Human Computer Interface. Hübler also incorporated Differential Concept Analysis (DCA) to monitor student's actions step by step, determine which concepts the students are using, in which sequence the concepts are used, and if the students are able to substitute and alter the sequence of the applied concepts.

Current and future work: DCA data will be used to collect feedback from a large student population in introductory University courses. The effectiveness of the student-computer interaction will also be tested in collaboration with the UIUC College of Education. Future work will also incorporate an English language parser into CyberprofTM so that the virtual tutor can evaluate student input to free response questions and answer questions by the students.

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(2) Computer Assisted Reasoning Software

Context: Hübler was one of the first researchers to specify a precise definition of a concept (Durak & Hübler, *Scaling of Knowledge in Random Conceptual Networks*, Lecture Notes in Computer Science **2074**, 976-985 (2001)). He used this definition to systematically conceptualize courseware in Science and Mathematics. Once the courseware is conceptualized the courseware and student input can be parsed by educational software. This allows computer assisted tutoring on a high level of abstraction.

Most significant recent work: A. Hübler, A. Vlastic, E. Stiegler, L. Bievenue, D. Raineri, *Interactive Middle School Courseware on Abstract Reasoning Skills*, preprint 2006, <http://server10.how-why.com/publications/2006/Site.pdf>

Quantitative reasoning skills are a fundamental tool in many fields, from mathematics to business. However, quantitative reasoning is almost never taught as a course except in the context of other disciplines, such as mathematics or physics. This paper introduces basic elements of a course in reasoning, such as the definition of a concept and the definition of a strategy and studies the response of the students. These definitions are applied to algebraic proofing. Algebraic concepts are conceptualized along with strategies for proofing, i.e. each concept is named, its range of applicability is specified and each concept is illustrated with typical examples. The paper indicates that a diverse population of female middle school students readily accepts this approach and achieves proofing skills on a level which is comparable to university freshmen.

Current and future work: The courseware covered by the computer assisted reasoning software will be expanded and tested both with middle school students and university students. The computer assisted reasoning software will be used to collect data about the reasoning strategies of the students. These strategies will be modeled, published, and used to improve the computer assisted reasoning software.

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Hubler is consistently ranked on the UIUC list of excellent teachers by his students. For many years, all of his graduate students who were eligible for ranking were listed as excellent or outstanding teachers. Several of his students have received the Scott Anderson Award for teaching excellence.

Hubler's teaching accomplishments and philosophy are featured in an article by C. Pacey (Pacey, *Defining the Art of Teaching*, Physics Illinois News (2), 9 (2005), <http://www.physics.uiuc.edu/alumni/PIN-2005-No2.pdf>).