Implementing Innovative Constructivism: An Architected Approach to Enhancing STEM Education

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ABSTRACT

Constructivism in education is a well recognized approach to teaching science, but often fails to achieve its goals, especially among students who have not been inculcated with cultural norms emphasizing aggressive inquiry and challenge of existing dogma. The primary author has developed and implemented an approach, founded in constructivist theory, which provides a carefully architected framework in which the students can learn by engaging in scientific inquiry, rather than memorizing facts in a didactic environment. The need for and benefits of the architected framework are laid out. The applicability of this approach to DoD education, ranging all the way from the DoD Education Activity up to the Staff Colleges, is discussed and justified. The initial instantiation of the method was conducted in Biology classes in a school district in the Los Angeles basin, whose student population was extremely diverse, in both ethnicity and socio-economic status. The authors present the basic method implemented, discuss its development, adduce data on its impact on students and comment on its maintenance over time. Further, they discuss the extensibility to other sciences, to other educational levels and to DoD education. A short review of current parallel efforts to improve science education is presented, with analyses as to the compatibility of this approach with others. The issue of the potential requirement of a "hero teacher" for success of various approaches is considered. Acknowledging the move toward serious games and on-line instruction, the authors present their experience in distributed simulations and the utility of them in educational contexts. The implementation of this approach in either the serious game or on-line education environment is explored. On-going and future research is outlined and various options are analyzed.

ABOUT THE AUTHORS

Erik C. Elstad is a member of the Board of Directors at Share Science and a practicing classroom instructor of biology at the Bellflower Unified School District in the Los Angeles basin of Southern California. His research interests are in innovative ways to radically alter the way science in taught at the secondary level. His master thesis and research addressed constructivism in science education. As part of his out of the box thinking, Erik has developed a way of using conceptual building blocks to enable students to manipulate or to create their own models. To support his formal education, Erik has practical experience working for the Department of Fish and Game and a Marine Biological Consulting firm. Erik Elstad is passionate about making positive contributions to the educational community. His received a BS in Biology and a Teaching Credential from California State University, Long Beach and an MEd from Concordia University, Irvine California.

Dan M. Davis is a consultant for the Information Sciences Institute, University of Southern California, focusing on large-scale distributed DoD simulations, including being the Director of the JESPP project for a decade before he semi-retired from USC, where he now consults. Prior to that, he was the Assistant Director of the Center for Advanced Computing Research at Caltech, where he managed Synthetic Forces Express, bringing HPC to DoD simulations. Dan also served as a Director at the Maui High Performance Computing Center and as a Software Engineer at the Jet Propulsion Laboratory and Martin Marietta. He was selected as the Chairman of the Coalition of Academic Supercomputing Centers and has taught at the undergraduate and graduate levels. As early as 1971, Dan was writing programs in FORTRAN on one of Seymour Cray's CDC 6500's. He saw duty in Vietnam as a USMC Cryptologist and retired as a Commander, Cryptologic Specialty, U.S.N.R. He received B.A. and J.D. degrees from the University of Colorado in Boulder.