

Psychometric Assessment of Pedagogical Aptitude: Evolutionary Computing and Data Visualization

Jennifer H. Nolan, Dan M. Davis & Frederica J. Stassi
Catholic Polytechnic University
Los Angeles, California
{jnolan, ddavis & fstassi}@catholicpolytechnic.org

E. Philip Amburn
University of Arizona
Tucson, Arizona
phil.amburn@gmail.com

ABSTRACT

There is a need for an effective instrument to assess didactic skills and there are promising paths to conceiving and developing such a valuable tool. Computational assets and algorithmic approaches now exist that provide a new opportunity to augment existing methods. This paper reviews the current status of teacher selection, analyzes the points of potential improvement, discusses various approaches and advances several emerging technologies that should significantly improve professor selection. The millennia of teaching are briefly surveyed with a eye toward the evaluative processes at various historical periods, culminating with a review of today's approaches. The needs for improvement, especially at the tertiary education level, are presented. The issues with which the authors were confronted in retaining university faculty are laid out and characterized. One set of issues that is covered in some depth is the use of other psychometric instruments to assess teacher aptitudes and skills, as well as the short-comings of those methods. The paper then identifies several new capabilities in the computational science that may permit new and paradigm-shifting results. These would include using Evolutionary Computing to isolate hitherto unidentified markers of pedagogical capability and advanced Data Visualization techniques to recognize undiscovered correlations. A prototype instrument is discussed with accompanying projected data. Early efforts at planning the optimal use of these new assets are described and data is presented indicating the potential utility of such approaches. The potential risks are also enumerated and characterized. Based on anecdotal and statistical data, the paper considers what impact an improvement of teaching aptitudes might have on the individual teacher, the teaching community, the students/trainees, and the society at large. Where longitudinal studies are going to be required, the paper sets forth issues to be considered and parameters to be included. The conclusions are recorded, along with several potential research paths.

ABOUT THE AUTHORS

Jennifer Nolan, PhD, is the President of Catholic Polytechnic University and Professor of Psychology in their College of Arts and Sciences. Her earlier work specialized in memory, dementias, stroke and insulin resistance. She is a brain plasticity specialist and certified Cogmed provider. Previously, she was the C.O.O. and co-founder of a stroke and brain injury rehabilitation center. Dr. Nolan has taught university courses at UC Irvine, Loyola Marymount University, and Glendale Community College. She has conducted local and nationwide clinical trials, and published in both scientific journals and popular magazines. She received a BA in Psychology from Loyola Marymount and a Ph.D. in Psychology from the Dept. of Cognitive Science at the University of California, Irvine,

Dan M. Davis, CDR. USN, Ret. is a Research Associate Professor at Catholic Polytechnic University and a consultant at the Institute for Creative Technologies, University of Southern California (USC), focusing on large-scale DoD simulations and avatar uses. Prior to retirement, he was the Director of the JESPP project at USC for a decade. As the Assistant Director of Advanced Computing Research at Caltech, he ran Synthetic Forces Express, bringing HPC to DoD simulations. He also served as a Director at the Maui High Performance Computing Center and in computer research roles at the Jet Propulsion Laboratory and Martin Marietta. He was 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. While in the Marine Corps, he saw duty in Vietnam as a Cryptologist and retired in 2002 as a Commander, U.S.N. He received B.A. and J.D. degrees from the University of Colorado in Boulder.

Frederica J. Stassi, Ed.D. is a Science Education Consultant and an Adjunct Assistant Professor at the Catholic Polytechnic University. She is located in the Central Coast of California. Her background includes research for the National Science Foundation in which she was funded to study pedagogies and efficacies in U.S. Science museums.

This research involved museums from the East Coast to O'ahu in Hawai'i. Her doctoral research was conducted under the guidance of Professor William McComas and focused on the development of science standards for the State of California. She received a B.A. degree from Tabor college in Hillsboro, Kansas as well as an M.A. Degree in music performance and an Ed.D., both from the University of Southern California in Los Angeles.

LtCol E. Philip Amburn, Ph.D., is an Adjunct Lecturer in the Computer Science Department of the University of Arizona. Earlier, he was a Research Assistant Professor at Mississippi State University and also was an Adjunct Faculty member at the Air Force Institute of Technology (AFIT). After retiring from the Air Force as Lieutenant Colonel, he was the SAIC Forces Modeling and Simulation on-site advisor for the High Performance Computing Modernization Program. His research interests are constructive and virtual simulation, interactive 3D graphics, and visualization. He has taught Computer Science in the classroom for decades. Dr. Amburn received a BS degree in Physics from Emporia State University, (formerly Kansas State Teachers College), his MS in Computer Science from AFIT, and his Ph.D. in Computer Science from the University of North Carolina, Chapel Hill.