

Learning Analytics and Deep Learning: New Quantification for STEM Instruction

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ABSTRACT

The quantification of results, analysis of efficacy and enhancement of live instructional teaching techniques is now being enabled by advances in emerging technologies, *e.g.* Learning Analytics, Deep Learning, Neural Net Training, and Meta-Disciplinary approaches to the evaluation, selection, and preparation of instructional personnel. For millennia, sages, teachers, and mentors have been sought to help prepare people for productive lives. Most of that search has been based on subjective and un-quantified impressions. The obfuscatory intercession of human emotions has masked even the modest ability people had to evaluate effectiveness. Data is adduced to show how this conflation of personal attractiveness and teacher productivity has predestined early attempts to evaluate teacher skills to disappointment. The authors have participated in DoD-Sponsored research in the use of virtual human conversational interfaces and that surfaced a number of issues concerning teacher evaluation. Concomitantly, many researchers in computer aided education have made significant strides in Learning Analytics that suggest the Artificial Intelligence community may have insights that could be transferred back to studies of live-instruction environments. Those studies are surveyed and reported. Also, several emerging capabilities in the computational sciences have showed both results and promises for additional advances. These new technologies are outlined and reviewed. Then the paper lays out work that posits the ability of machine learning and learning analytics to produce improved evaluation of human teachers. All of these issues are then synthesized to produce a supportable path to a new set of psycho-metric tools for a better regimen of pre-selection evaluation, tailored education, and final competency assessment of instructional personnel in primary, secondary and tertiary education, an especially pressing current concern of the authors. The conclusory remarks present the potential, the risks, the benefits, and the costs of a few paths to more optimal STEM education and training.

ABOUT THE AUTHORS

Dan M. Davis is a research staff member at Catholic Polytechnic University and is active as 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.

Jerome C. Placido serves on the Advisory Board for Catholic Polytechnic University in the San Gabriel Valley, California. He also is the Director of Software Application Development at Workday, Inc. in the Bay Area. With over a decade of experience in higher education technology and his primary research interests are in organizational effectiveness and concrete applications for combinatorial optimization in student success scenarios. He has also held leadership and technology positions at Envisions in Irvine California and while serving on the board for YCP Silicon Valley. His continuing professional interests are in developing an integrative understanding of the human/machine interfaces in application to service delivery. Jerome received a B.S. degree in Computer Science from the University of California Riverside and an M.S. degree in Psychology from Divine Mercy University..

John J. Tran is the Chairman of the Computer Science Department of the Catholic Polytechnic University and he is a Major in the California Air National Guard. He has worked at ISI, USC, the Stanford Linear Accelerator Center, Safetopia, and Intel Corporation. At USC, he focused on Object-oriented software engineering, large-scale software system design and implementation, and high performance parallel and scientific computing. Air Force tours

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Frederica J. Stassi is a Science Education Analyst, working 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.