Inculcating Metacognition and Critical Thinking: Standards for Implementing Virtual Humans

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ABSTRACT

This paper reviews the need of and opportunities for improving metacognition and critical thinking in today's DoD personnel. It identifies some current constraints on effectively addressing those issues, and reports on advances in virtual human interfaces that can enhance efforts to augment current educational approaches. The paper asserts that these new techniques would be beneficial to Warfighters and it presents the case that instantiating these pedagogical approaches would be best served by the use of emerging, but prenascent, proactive conversational computer agents using Natural Language Processing (NLP). The paper opens with a view of the need for both metacognition and critical thinking skills in today's defense environment and a reports on the number of leaders, analysts, and staff who decry the current state of those abilities. The capability and need to begin this educational process early with the Warfighters is advanced. Then, a review of the recognized pedagogical approaches to improving these proficiencies is countered by an explication of the many personal, organizational, and social hurdles to implementing these approaches. The last major section is a description of recent advances in the modeling and simulation community leading to the availability of conversationally facile virtual humans and other computer agent avatars with the capability of counteracting the obstacles currently hampering the education required. Some of the obstacles addressed are classroom scheduling, operational schedule overloads, geographic isolation, and personal characteristics of both educator and student. Recent research outcomes are offered as examples of current capabilities and future research efforts are outlined, offering design concepts and previewing some capabilities of new tools that will soon be available to the professionals in this discipline. These capabilities are described with sufficient detail to allow the reader to see if these programs might be applicable in their own work, either now or in the years to come.

ABOUT THE AUTHORS

Dan M. Davis, CDR, USN, Ret., 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.

Jennifer H. 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 the University of California 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 University, Los Angeles and a Ph.D. in Psychology from the Dept. of Cognitive Science at the University of California, Irvine.

Mark C. Davis, Ph.D. is the Chief Technical Officer at Wood Duck Research, Inc, and is semi retired after careers in the US Navy and as a computer design engineer for both IBM and Lenovo. Rising to the level of Distinguished Engineer at Lenovo, he was responsible for the design of laptop computer cross-disciplinary technology, including PC architecture, embedded systems, open source and virtualization. Previous work was with IBM in the areas of software development and architecture involving security, storage and virtualization. Dr. Davis has been granted well over fifty patents that were filed during his service at both companies. He is a graduate of the Duke University NROTC program and was commissioned as an Ensign, attended nuclear power school, and served as a Submarine Officer for twelve years, including one duty tour as a classroom instructor. He left the active duty as a Lieutenant Commander to pursue a PhD. Mark holds a BSEE degree from Duke University and a PhD in Computer Science from the University of North Carolina, Chapel Hill, where his advisor was Professor Fredrick P. Books.

John J. Tran, Ph.D. is a Lieutenant Colonel in the California Air National Guard. He received both his BS and MS Degrees in Computer Science and Engineering from the University of Notre Dame, where he focused on object-oriented software engineering, large-scale software system design and implementation, and high performance parallel and scientific computing. He has worked at the Information Sciences Institute (ISI), University of Southern California (USC), the Stanford Linear Accelerator Center, Safetopia, and Intel Corporation. His current research centers on Linux cluster engineering, effective control of parallel programs, and communications fabrics for large-scale computation. His tours of duty included the White House Communications Agency and Kirkuk Regional Air Base (Iraq), where he was the Communications Squadron Commander. He received his Ph.D. in Computer Science from the University of Southern California,