



Professor of the week: Neil Heffernan



Exploring frontiers of education with cutting edge technology

By **Funmi Adebayo**
Newsstaff

From elementary schools to institutions of higher learning, educators of all levels have historically been faced with the challenge of teaching effectively. Given that education is such an important part of our society, why does it seem to be afforded such little scientific attention? Professor Neil Heffernan, Associate Professor of the Department of Computer Science and Co-Director of the Learning Sciences and Technology Graduate Program at WPI, has made education his lifelong passion and endeavors to use applications of computer science to contribute to the science of learning.

As a result of his experiences while participating in Teach for America as an eighth-grade algebra teacher in Baltimore, MD, Professor Heffernan wanted to precisely evaluate his students' learning. Heffernan was quickly able to identify many fundamental gaps in his students' knowledge and began to institute a systematic approach to teaching every concept in the curriculum.

"I was trying to do right by my kids," Heffernan elaborated when questioned about the topic. This vested interest in his students propelled him to seek and develop more advanced educational tools to this end. While completing his PhD at Carnegie Mellon University, Professor Heffernan persevered to develop a tutoring software application that harnesses computer

intelligence to automate the approach he has described as "mastery learning."

Since his arrival to WPI in 2002, Professor Heffernan's early

vast range of subjects in over thirty school districts throughout Massachusetts and Maine.

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day," Heffernan said. "We're sending gobs of kids home with textbooks with no answers and cognitive scientists know that immediate feedback is very important."

Furthermore, the system learns over time exactly what type of feedback on difficult questions is most effective to help the student learn. In this way, the system prizes the concept of individualized learning.

As Heffernan said, "The only way you're going to be able to personalize learning is to know what's going to work for whom."

The ASSISTments team maintains continued contact with teachers using the system. These teachers value the system's ability to describe student learning with meaningful metrics without the need for laborious bookkeeping. Indeed, teachers report that they save enormous amounts of time in their classes that may instead be spent instructing.

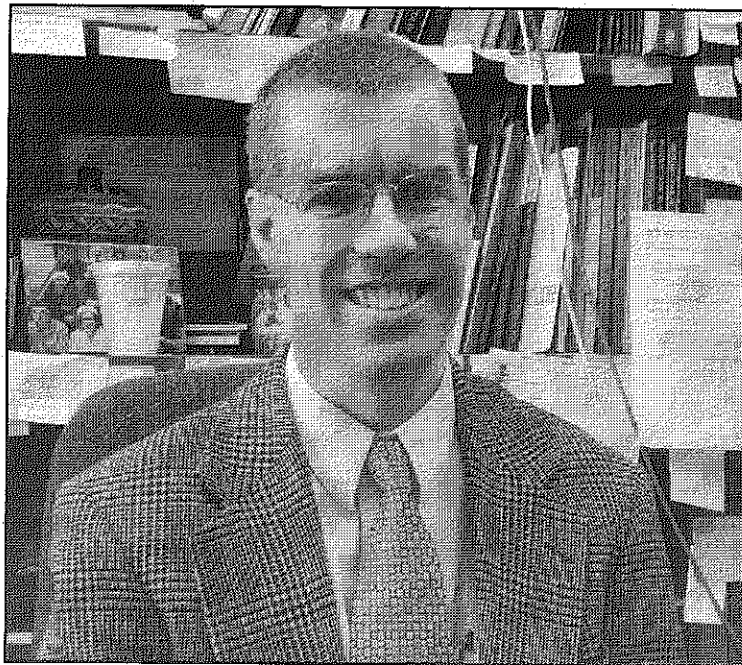
Their gratitude complements the telling evidence in support of ASSISTments from numerous scientific studies and demonstrated increases in standardized test scores. Students who use the software learn more, and its effect is great enough to have attracted the attention of state and national officials. In addition to garnering over 10 million dollars of support, in part from both the US Department of Education and the National Science Foundation, Massachusetts state officials are currently giving serious consideration to the adoption of ASSISTments statewide.

By virtue of keeping ASSISTments strictly nonprofit, Professor Heffernan hopes that it will continue to serve as an unconstrained research tool to advance learning science.

With the acclaim surrounding ASSISTments, it comes as no surprise that usage of the software has doubled annually for the last five years. Today, over 7,000 students use the system which has processed over 20 million questions. To maintain and further develop this project, Professor Heffernan has drawn upon an army of undergraduate and graduate students who have demonstrated their interest in the project through work study, IQPs, MQPs and graduate research involvement. By his reckoning, over 100 WPI students have spent over a year of their time in support of the project's various components.

"This project would be nothing without all of them," acknowledged Heffernan. Considering the degree of involvement by its members, the progress made through this project ought to be a great source of pride for the WPI community. The project exemplifies the great achievements possible through faculty and student cooperation. Indeed, Professor Heffernan encourages students to involve themselves in faculty research and learn more about the current projects at WPI.

"We're always excited to help other students learn about it, but also, you guys actually help get it all done," he said.



Professor Heffernan happily talked with us in his office which is located in Fuller Labs.

Photo by Skyler Whorton

project has blossomed over time into a robust and incredibly versatile educational tool. The product is an advanced piece of software combining areas of research in computer science such as artificial intelligence, data mining and Bayesian networks. The software, known as ASSISTments, is a "web-based intelligent tutoring system" that is currently being used by grade school teachers of a

wide range of subjects in over thirty school districts throughout Massachusetts and Maine. Inseparable, and at the core of the system, are the ideas of assistance and assessment. The software assists students with immediate feedback about correct and incorrect answers and can even provide detailed hints to guide the student to the correct answer. This is one of the most important aspects of the system and represents a concept that Professor Heffernan finds to be in a widespread deficit.

"We in this nation are committing educational malpractice every