2008 NCTI *Technology in the Works* Abstract:
Exploring Accessible Computer Algebra System for Secondary Students with a Learning Disability or Visual Impairment

Through the project, *Exploring Accessible Computer Algebra System for Secondary Students with a Learning Disability or Visual Impairment*, Dr. Emily Bouck, Dr. Waseem Sheikh, and Dave Schleppenbach propose to study the effectiveness of a new assistive technology: an Accessible Computer Algebra System (ACAS) for secondary students with a disability. The project will target middle-to-high school students with a disability, particularly a learning disability or visual impairment, and will explore on how this innovative device can improve students' performance in mathematics. Dr. Bouck is an assistant professor and researcher at Purdue University. Dr. Sheikh, a research software engineer, and Mr. Schleppenbach, President, of GH LLC, a leading company in developing technology that makes information more accessible to individuals who have a disability.

The new technology, ACAS, will include multiple features geared towards assisting students with a disability (i.e., learning disabilities, visual impairment) in improving their performance in higher-level mathematics. The features will be built around the paradigm that there should be multiple ways of providing input and output to/from ACAS. Input to ACAS will come from a mouse, keyboard or voice, whereas output will be provided via voice and visual display. MathSpeak, a formal language developed by GH LLC to speak mathematics unambiguously, will be used for providing speech input and output. Some of the other features that this devise is developed to do include: inputting algebraic expressions in MathSpeak; solving equations; displaying/voicing the intermediate results in the simplification of expressions; outputting answers, visually as well as through audio; synchronized highlighting with text-to-speech for mathematical expressions; various levels of navigating through mathematical expressions (sequential as well as tree-traversal based); a graphing feature with zoom and contrast change; standard display with zoom and contrast change; feedback to verify the mathematical numbers or grammatical correctness of expressions entered; shortcuts to entering certain commonly used functions; ability to convert MathSpeak to MathML for visual rendering as well as the ability to convert MathML to MathSpeak for voicing mathematical expressions; and saving/printing/editing mathematical expressions entered.

The research plan will involve a mixed methodology approach to exploring the effectiveness of this piece of technology (ACAS). First, a single subject design will be conducted in late summer/early fall to investigate the effectiveness of the accessible computer algebra system for secondary students with learning disabilities or visual impairment. This work will investigate students' ability to use the ACAS device, their performance when using the ACAS device as compared to when not, and the time it takes them to become fluent with this piece of technology. Second, in early-to-late fall, a small-scale intervention study using the ACAS will occur focusing on secondary students with learning disabilities and/or visual impairment. Half of the students in the study will be randomly assigned to use a traditional calculator and the other half the ACAS to help them solve mathematical problems. Students' performance in these two groups will be compared. Finally, all students involved in the research will be interviewed regarding their perception of the ACAS device, if they felt the device helped their learning of mathematics, and if so, which features they thought were particularly helpful and which were not helpful or even provided distractions.