How the Shining Star Project improved Mathematics and Science Learning with the inclusion of Data-loggers and Teacher Professional Development in Greater Clark Schools.

James E. Hollenbeck, Ph.D.
Assoc. Professor of Education
School of Education
Indiana University Southeast

Marianne Fisher, Ed. D.
Director of Curriculum
Greater Clark County Schools Corporation
Utica, Indiana
Presented to Science of the South, Southern Illinois University, Carbondale, Ill.
January 28, 2011, Paper completed on January 25, 2011.

Science is often remembered as the class in which students learn how to use various instruments and measuring devices, manipulating numbers into graphs and then trying to write the whole experience into a written report. Science is regarded as the key to the nation's economic future in information, technology and our continued standard of living. It is where the knowledge and skills gained in language arts and mathematics form a single discipline of observing and applying natural phenomenal into applications. Science is vital to the nation and the concern by the public in demanding: high stakes testing of students and teachers, greater teacher accountability, and legislative mandates like No Child Left Behind and now the proposed, Race to the Top, never have schools been under such pressure to demonstrate student learning and mastery of science concepts. Schools must show student success in learning in mathematics and science as never before. This revolution is taking the traditional science teaching and learning methodology and is examining and incorporating new technology.

Indiana University Southeast received the opportunity to act on the challenge to positively influence student learning in science, and mathematics by funding from the Indiana STEM network, a partnership was formed with Clarksville Community Schools, and Greater Clark Schools Corporation and Fourier-Systems to enhance science learning. This initiative promoted science, technology, and literacy in the middle schools and Jeffersonville High School in the Clarksville and Greater Clark School Corporations. The Shining Star project reaches over 5000 students. Shining Star promoted science and mathematics learning, application, and appreciation with the assistance of trained science educators using the Fourier Nova 5000, a student data-logger.

Teacher participants that participated in this project followed the listed guidelines:

- Complete a one-week training workshop at IUS entitled “Integrating Technology in the Science Classroom.”
- Attend a Fourier-Systems in-service session prior to the start of the school year and throughout the school year.
- Submit tri-weekly reports to the ISTEM-IUS program director, about the use and application of the Nova 5000 system in their classes.
- Cooperate with all assessments related to using the Nova 5000.
- Teachers had technical support provided by Fourier-Systems and Fourier-Systems provided academic support for teachers using existing curriculum.

The new approach to learning science is the application of microcomputer-based-laboratory (MBL) applications such as the data logger. This new, powerful, and inexpensive learning tool allows students to take out to the learning sites a hand-held computer with electronic probes, interfacing boxes, and software that can measure and collect data (Hollenbeck, 2003; Krajcik, J.S. and Layman, J.W. 2003). The hand-held device, Nova 5000, a data logger with the capability of mini PC, with the probe ware advantage, a student can measure temperature, motion, force, pH, sound, light, and many other science phenomena with relative ease.

The Nova 5000 used by the science teachers in this project is a portable scientific laboratory that empowers students to actively engage themselves in learning science by doing real science as described in the constructivist learning model by Yeager (1991).Unlike most education reform programs, Shining Star did not require teachers to change their curriculum. The Shining Star program incorporated the existing curriculum and academic standards. The teachers used the data loggers in their regular class activities where appropriate. Teachers would guide the students by leading them in initial experiences accompanied with careful question scaffolding and discussion. Teachers would demonstrate observing and practicing the modeled learning behavior, as a result of this teachers reported that students asked important and meaningful questions about their lab activities (Hollenbeck, 2003; Novak, A. M., Gleason, C., Mahoney, J. and Krajcik, J.S. 2002). As the teachers introduce the data logger experience, they encourage the transition from teacher centered to student-centered learning and encourage the students to ask sub-set questions that they can research, design and conduct their own investigations incorporating their technology tools. The National Science Education Standards (NRC, 1996), American Association for the Advancement of Sciences benchmarks (1993) and the Indiana Academic Standards for Science (2002) all support the use of data-loggers in learning science.

Students are able to use the data loggers to gather real time information, and teachers can take the students where the science activity is occurring. The data-loggers are used in various settings: in the classroom, the laboratory or outdoors to solve problems or investigate questions. As the students gather the data, they develop a greater appreciation of how science solves problems. They develop a more in depth understanding of science concepts, process skills, and experience using technology.

An even greater skill that was realized by the use of the data loggers was addressed was that of graphing and analyzing data (Krajcik, J.S. and Layman, J.W. 2003).Graphing is a difficult skill for many younger students to master. The data storage ability of the MLB allows the students to focus on analyzing the graph and the concepts represented by the graph. Students understand the information better, because they must construct the conditions of the graph as data is collected. Bassell (1987) and Krajcik, J.S. and Layman, J.W. (2003) and Linn, M., Layman, J.W., and Nachmias, R. (1987) report that the longer the delay in the graph production, the less the student will understand of the graph and concepts that should have been learned. Allowing students access to real time graphing allows the students to modify their initial experiment enabling them to see how their experiment may be changed or the how variables can be changed to modify their experiment.

The teacher plays a pivotal role in creating an atmosphere that allows students to investigate nature with MBLs. Research by Hollenbeck (2003) Krajcik, J.S., and Layman, J.W. (2003) determined that the effectiveness of teaching with data-loggers is determined by the teachers comfort level and understanding of how the data-loggers are integrated into existing curriculum. Teacher training is important if these devices will be embraced in the classroom. This portable technology offers the student:

Enhanced inquiry based learning as embraced by the national and state standards.

- The ability for students to work as “real scientists.”
- Experience real science situations.

- Engagement in problem-solving activities.
- Improvement of graphing and data analysis skills. (Hollenbeck, 2003; Novak, A. M., Gleason, C., Mahoney, J. and Krajcik, J.S. 2002).

Schools that have used the data-loggers in their curriculum have reported success as shown in several reports and on manufacturer's websites. The success of the data-loggers in the classroom depends on the willingness of teachers to use them, support by the school administration, teacher training, and on the manufacturer's providing teacher training, support, and affordability to all school districts.

Cited References

American Association for the Advancement of Sciences. (1993). *Benchmarks for scientific literacy.* New York, New York. Oxford University Press.

Brasell, H. (1987). The effect of real-time laboratory graphing on learning graphic representation of distance and velocity. *Journal of Research in Science Teaching*. 24(2), 385-395

Indiana Department of Education. (2002). *Indiana Academic Standards for Science*. Indianapolis, IN.

Hollenbeck, James, "*The New Portable Technology Wave; Using the Microcomputer-Based-Computer (MBL) in the Curriculum"* The Indiana Mathematics Teacher*. Volume18/No.2 Fall/Winter 2003*

Krajcik, J.S. and Layman, J.W. (2003). Microcomputer-Based Laboratories in the classroom. *Journal of Research in Science Teaching*, The NARST Journal. January 2003.

Layman, J.W. (2003) and Linn, M., Layman, J.W., and Nachmias, R. (1987). Cognitive consequences of microcomputer-based laboratories: Graphing skills development. *Contemporary Education Psychology*, 12(3) 244-253.

National Research Council. (1996) *The National Science Education Standards.* Washington D.C. National Academy Press.

Novak, A. M., Gleason, C., Mahoney, J. and Krajcik, J.S. (2002). Inquiry though Portable Technology. *Science Scope*. November/December 2002, p.18-22.

Yager, R.E. (1991) The constructivist-learning model. *Science Teacher*. 58(6), 52-57.