Vernier

Measure. Analyze. Learn.™

PROBEWARE IN SCIENCE

DEEMED EFFECTIVE BY RESEARCHERS, NECESSARY BY NATIONAL GROUPS

"Technology is needed…not just to give students exposure to the technology or to satisfy parents; technology greatly improves learning and supports science education standards that are difficult to teach without using technology."[1]

INTRODUCTION

National organizations including NSTA, ISTE, and ASTE and IB call for the regular incorporation of technology, including probeware, in the science classrooms. "The National Education Technology Standards specifically recommends the use of scientific probeware with students when conducting real-time investigations of natural scientific phenomena. The use of this technology supports the shift from conventional teacher/student dialogue and teacher-centered instruction to a learning environment that is student-centered and inquiry-based (NRC, 1996; ISTE, 1998; Zuga, 1991)".[2] According to a position paper by NSTA, technology "should be used to permit students to collect and analyze data as scientists do, and perform observations over long periods of time enabling experiments that otherwise would be impractical".[3] This position is based on evidence that the use of such equipment has a positive impact on student learning and achievement from elementary grades through college across all science disciplines.

THE DATA

National and international studies show that the use of probeware can increase student understanding of concepts in many science disciplines and across grade levels. The 2000 NAEP study shows students, at Grade 8, whose teachers used computers for data analysis scored higher than students whose teachers did not indicate doing so.[4]

Grade 12 students who reported using computers to collect data, download data, or analyze data had higher scores than students who reported never doing so. More frequent use (1-2 times per month) of computers to collect data or to analyze data was also associated with higher scores than less frequent use (less than once a month).[5]

According to Thornton, student understanding of concepts, including force, acceleration, and velocity, is drastically improved with the use of teaching

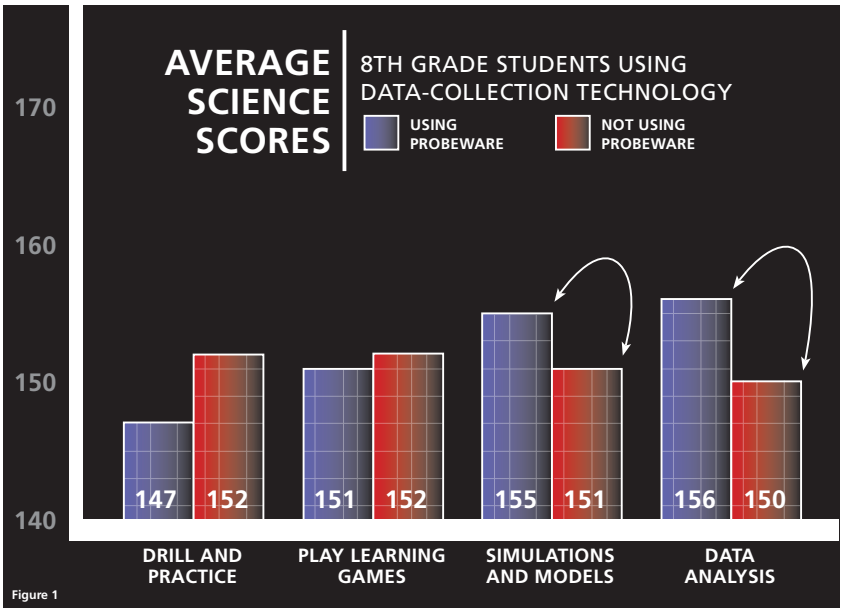


Figure 1

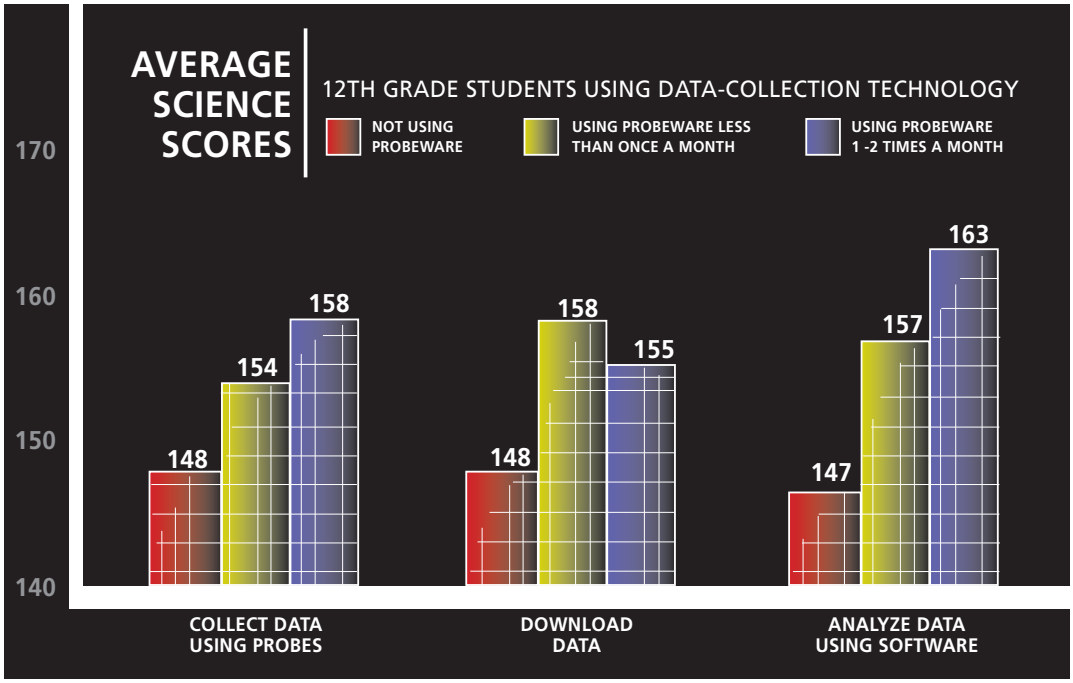


Figure 1: From the 2000 NAEP Science Assessment.

Source: The 2000 NAEP Science Assessment. This study of 49,000 U.S. students shows that students who used probeware to collect and analyze data scored significantly higher on tests than those who did not.

techniques which include the use of probeware and inquiry-based lessons.[6] In particular, evidence from a number of countries (Italy, Germany, UK, USA, Russia) show that real-time Microcomputer-Based Laboratory tools in appropriate learning environments results in successful student learning of physics concepts.[7]

The TEEMSS Project investigated the feasibility of the use of probeware in the middle school classroom and the impact of its use on student understanding and performance. The table below shows student performance on pre/post tests on the Transfer of Energy.

Other data from the same project also show increased student performance on Motion and Forces concepts after the use of data-collection technology.

As can be seen from the variety of research presented, the use of data collection technology in classrooms has a positive impact on student understanding of science concepts — across the science disciplines, in cross-curricular settings, and from elementary through college classes.

SUMMARY

"Technology greatly improves learning and supports science education standards that are difficult to teach without using technology…. As one teacher said, "It's wonderful to see the spontaneous position-time graphs and speed-time graphs. I see a huge difference in their understanding - in past years, their understanding of the shape of graphs correlated with motion was iffy at best, but this year it's much more on, there are many more students who are getting it." Teachers also observed that their students had developed a deeper understanding of the content areas, and more skill in reading graphs." [8]

For over 25 years, Vernier Software & Technology has been committed to developing data collection technology that supports this outcome in elementary, middle school, high school and college science classrooms. By providing educators durable, inexpensive, and easy to use data collection technology and software, each science classroom can provide students hands-on learning to lead to greater student achievement.

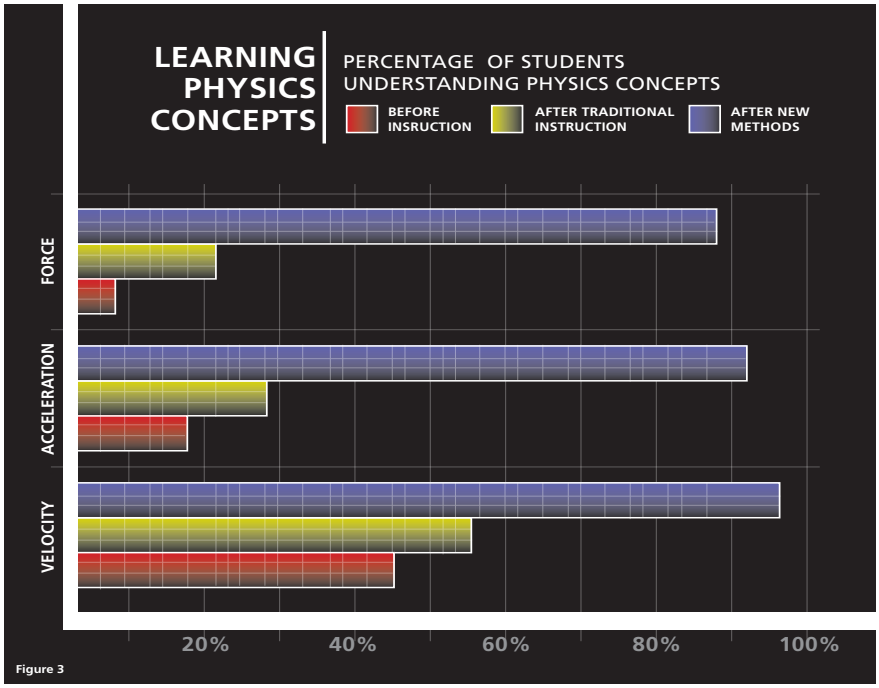
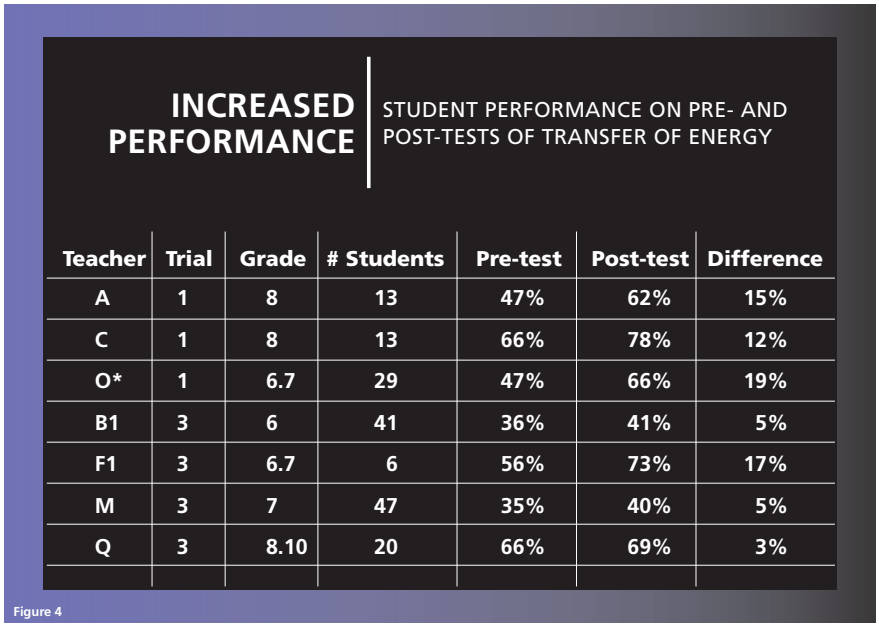


Figure shows an increase of understanding of core science concepts when "new methods" including probeware. *Source:* Thornton, R.K. 1999. *Using the Results of Research in Science Education to Improve Science Learning*. Keynote address to the International Conference on Science Education, Nicosia, Cyprus, Jan. 1999.



Teacher	Trial	Grade	# Students	Pre-test	Post-test	Difference
A	1	8	13	47%	62%	15%
C	1	8	13	66%	78%	12%
O*	1	6.7	29	47%	66%	19%
B1	3	6	41	36%	41%	5%
F1	3	6.7	6	56%	73%	17%
M	3	7	47	35%	40%	5%
Q	3	8.10	20	66%	69%	3%

Figure shows an increase of understanding post-test when using teaching methods that include probeware. *Source:* Metcalf, S. J., & Tinker, R. 2003. *TEEMSS: Technology Enhanced Elementary and Middle School Science*. Annual Meeting of the National Association for Research in Science Teaching, March 23-26, 2003, Philadelphia.

ENDNOTES

[1] Metcalf, S. J., & Tinker, R. 2003. *TEEMSS: Technology Enhanced Elementary and Middle School Science*, Annual Meeting of the National Association for Research in Science Teaching, March 23-26, 2003, Philadelphia.

[2] Wetzell, David R., G. F. Varrella. 1999. *Pre-Service Secondary Science Teachers' Concerns Regarding Use Of Calculator-Based Laboratory Scientific Probeware*. September 26, 2007 Penn State, http://www.ed.psu.edu/CI/Journals/2000AETS/34wetzel_varrella.rtf

[3] National Science Teacher Association Board of Directors. 1999. *NSTA Position Paper: The Use of Computers in Science Education*. NSTA, Jessup, MD.

[4] National Center for Educational Statistics. 2002. *Science Highlights: The Nation's Report Card 2000*. US Department of Education, Jessup, MD. Pp 11.

[5] National Center for Educational Statistics. 2002. *Science Highlights: The Nation's Report Card 2000*. US Department of Education, Jessup, MD. Pp 12.

[6] Thornton, R.K. 1999. *Using the Results of Research in Science Education to Improve Science Learning*. Keynote address to the International Conference on Science Education, Nicosia, Cyprus, Jan., 1999, Pp 1.

[7] Thornton, R.K. 1999. *Using the Results of Research in Science Education to Improve Science Learning*. Keynote address to the International Conference on Science Education, Nicosia, Cyprus, Jan., 1999, Pp 5.

[8] Metcalf, S. J., & R. Tinker. 2003. *TEEMSS: Technology Enhanced Elementary and Middle School Science*, Annual Meeting of the National Association for Research in Science Teaching, March 23-26, 2003, Philadelphia.

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