

**Using Electronic Data Collection to Enhance Student Learning and Laboratory Data
Collection Skills**

Faculty Mini-Grant Proposal

Southeast Ohio Center for Excellence in Math and Science
(SEOCEMS)
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Submitted by:

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Purpose and Rationale:

There are several ways students can fall behind and not achieve optimal success in a laboratory setting: they may improperly record their findings; a delay in analyzing their findings can lead to misinterpretation of results; and a delay in analysis can lead to misplacing their findings and losing crucial data. Since hands-on learning is a major component of being successful in college level science courses, it is important that students understand data analysis, collection, and interpretation and how it coincides with the material they are learning in lecture. With technological assistance, such as Vernier's LabQuest, students would have a device to collect and store their findings, increasing the probability that a student will be able to correctly understand all data and/or findings from their laboratory course. A device such as this would give them site-wide access to their data, allowing more time to analyze and interpret trends in their results. All of these benefits combined will help further students' understanding of the data and the scientific theories behind the experiment. The hand-held LabQuest devices will allow the students to input the information directly into a computer via the accompanying probes. Using Logger Pro 3 software will allow them to analyze data and make appropriate graphs, tables, and charts more easily, giving them time to organize and adequately present data and leading to a more fulfilling laboratory experience for each student. Using this type of device allows for a more dynamic and interactive learning experience and enhances their understanding of the subject matter (Aziz, 2007). This equipment is highly versatile and can be used for multiple disciplines within the school of science, so they would be a benefit to many courses in the curriculum. This type of 'mobile instructional laboratory' will help enhance their practical experience and understanding (Robila, 2008)

Since laboratory experiments present a hands-on learning experience that is crucial to understanding biological sciences, it would be very beneficial for students to have a method of collecting, organizing, and analyzing data at the experiment site, be it in a laboratory or in the field. Vernier LabQuest presents this opportunity through a hand-held that can be used as a stand-alone apparatus or as a computer interface. By using this technology, students will be able to instantaneously collect data, will be able to incorporate it into a graphical representation of the experiment, and will be able to observe data trends more rapidly than if they were to wait for an available computer. If the students have laboratory access to a computer, the device can be used with the supplementary computer program, Logger Pro 3. With LabQuest Emulator Software

(included in the package), the hand-held is capable of connecting to an overhead projector so students can learn how to navigate the device by watching the screen of the instructor's device. This user-friendly device can help students understand the results of experiments in real-time, avoiding time-gaps that can allow students to forget important details of their experiment that may be crucial to data analysis.

Investigative Processes:

To evaluate the benefits of using the LabQuest hand-held, students enrolled in the same lecture course will be divided into two different lab sections that will act as a control group and a test group. With the exception of the utilization of the Vernier equipment, everything in the two sections will be identical, including the laboratory experiments. Three separate experiments will be used to analyze the students' performance with and without the supplemental hand-held. Since a laboratory curriculum is available through Vernier upon purchasing of this product, their curriculum will be used in the test classes. The control classes will perform modified versions of the same experiments; the difference being they will not have access to the LabQuest. The control group will have to record their data on paper, input the data into their own graphs, and analyze the data when they are able to have computer access. The test group will have access to the LabQuest hand-held and will be able to have all of their data collected, integrated into a graph, and analyzed via the hand-held.

This same experimental model could be used in different classes to access improvement in learning. The LabQuest hand-held devices, with their variety of probes and accompanying laboratory experiments, can be transferred to many different classes to help elucidate the value of these devices.

Description of Activities with Timeline:

May 10, 2010

- Purchase and install Vernier software
- Develop tests and assessments
- Develop a set of instructions for the use of Vernier WebQuest laboratory assignments

June 1, 2010

- Collect students GPA and ACT scores
- Administer Pre-/post- tests
- Demonstrate the instructions for the WebQuest assignments
- Data collection begins

July 1, 2010

- Data analysis of students' performance on pre-test, post-test, and attendance
- Written summary will be submitted for review by the and Chair and Dean of Math and Science
- Assess and summarize data for publication and/or conference presentation
- Submit written summary to SEOCEMS for posting on the website

Proposed Laboratory Experiments for Study:

- Osmosis/Diffusion Lab
 - Using the probes to study the rate of osmosis/diffusion
- Heart rate/Blood Pressure Lab
 - Using the sensors to examine the rate of exercise of blood pressure and heart rate
- Cellular Respiration Lab
 - Using collected data to determine whether germinating peas and non-germinating peas respire.

Project Effectiveness Assessment and Dissemination of Findings:

The project's effectiveness will be determined by utilizing a pre-/post-testing method. A pre-test will be administered prior to lecture presentation to establish a baseline of students' understanding of the topic prior to the course. Upon covering the material in class, an identical post-test will be given to calibrate inquiry-based learning. The data will then be analyzed using a multivariable statistical analysis of variance to test for significant difference between the control group and test group with respect to the pre-/post-test and attendance. The percentage of students attending class can be monitored on a weekly basis and analyzed for comparison. By utilizing the proposed investigation, we should be able to make a determination of the effectiveness of the LabQuest in improving student learning and to determine if devising more laboratory experiments using the devices is warranted.

Budget with Explanation and Justification of Funds:

The reasoning behind budgeting for 5 LabQuests is that most of our labs hold 24 students. When they are broken into groups, there needs to be at least five of the devices so the students can work within the time constraints of the class without rushing. Too many students using one device can lead to only one or two students doing the actual work and the others not benefiting at all by not participating.

LabQuest Biology Starter Package

One Starter Package	\$809.00
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<u>Items</u>		<u>Total Price</u>
Set of Five Hand-Held Starter Package (LQ-BIO-ST)		4,045.00
Human Physiology Lab Book (HP-A)		48.00
EKG Sensor (EKG-BTA)	Two	294.00
O2 Gas Sensor (O2-BTA)		188.00
BioChamber 250 (BC-250)	Two	12.00
Logger Pro 3 CD / Stacy		00.00
	SubTotal	<u>4,587.00</u>
	Shipping (Quote)	57.34
	Total	<u>4,644.34</u>

Bibliography

Aziz, El-Sayed S.; Esche, Sven K.; Chassapis, Constantin, **Content-rich interactive online laboratory systems**, *Computer Applications in Engineering Education*, Vol. 17, Issue: 1, March 2009. pp. 61 - 79

Robila, Stefan A.; Wachsmuth, Bert G.; Scharff, Christelle ; Popyack, Jeffrey L., **Mobile instructional laboratory environments and their use in computing sciences**, *Journal of Computing Sciences in Colleges*, Vol. 23, Issue: 3, January 1, 2008. pp. 114-118