Annual Report for Period: 09/2003 - 09/2004
Submitted on: 08/11/2004
Principal Investigator: Hawke, Scott D.
Award ID: 0309546
Organization: Willamette University
Title:
Investigative Process & Technology in Introductory Physiology

Project Participants

Senior Personnel

Name: Hawke, Scott
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Tallman, John
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Stavrianeas, Stasinos
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:

The primary thrusts of the project are to introduce computerized data acquisition and investigative inquiry-based learning in Physiological Dynamics in Animals and Plants (PDAP). PDAP is a required sophomore-level introductory core course in biology. It is expected this program will increase student participation in physiology, i.e., enrollment in other physiology courses, and a greater number of senior research theses focused on physiological studies.

In September 2003, we (Hawke, Tallman, Stavrianeas) were awarded a NSF grant (#0309546) to accomplish the objectives stated above. During the Fall semester 2003, we ordered and received Biopac instrumentation to accomodate students at eight laboratory work stations. Also, we developed assessment tools to qualitatively and quantitatively measure the impact of the laboratory program design and new technology on learning in physiology. During the Spring semester of 2004 the Biopac system was introduced to students in PDAP and Human Physiology (HP) and limited assessments were made. Our experience with Biopac foreshadows a much more comprehensive assessment of the technology

on student learning to be made in Fall semester 2004. It is during the Fall semester that one of us will visit Harvey Mudd College to learn how well a similar technology program is working in their biology program.
A visit by an outside consultant (Dr. Mary Williams, Harvey Mudd) during the third year of the grant will provide evaluation of how well the program is operating for us. The consultant will make recommendations that can be implemented before the grant period expires in 2007.

Findings:

A quantitative assessment of Biopac use and the ability to use the newly acquired technology to interpret physiological studies was implemented at week 12 for students enrolled in Human Physiology (HP) during Spring semester 2004. The evaluation used contains five Student Learning Objectives (SLOs), some with more than one goal. The SLOs can be viewed at our Web site (http://www.willamette.edu/cla/biology/biol244/index.htm) as noted in the dissemination section of this report.

The overall mean response of students to the SLOs in HP was clearly below the mid point (2.50) of our four point scale ranging from 1.12 for the student has learned computerized data acquisition skills to 3.53 for the student can recognize limitations in experimental designs and methods. The less than satisfactory scoring level to all but one of the SLOs was surprising considering this evaluation was conducted during the last quarter of the course. There is no easy explanation other than it may take more than one semester of computerized data acquisition use and immersion in scientific problem solving. The students appear to be relatively naive in their ability to comprehend the scientific process using Biopac as a tool to achieve this objective.

The assessment plan for Fall semester 2004 is to implement the SLOs for two other physiolgy courses, PDAP and Animal Physiology (AP). Additionally, there will be multiple evaluations, i.e., self evaluation at weeks 1 and 15, peer evaluation at week 15, and faculty evaluation at week 15. It is hoped these additional evaluations from several different coherts will provide a clearer explanation of how well our Biopac instrumentation is translating in our physiology courses.

In the Spring of 2004 16 students in PDAP and HP responded to a qualitative assessment of Biopac by accessing the Web site (http://www.willamette.edu/~stas/nsfevaluation.htm). The salient conclusions were:

-the majority of students had not previously used digital data acquisition systems;

-the students all indicated they gained confidence in use of the Biopac system in their investigative class projects, although only a minority of the respondents actually did;

-the availability and ease of use of Biopac did not appear to influence their choice of investigative projects suggesting the student choices were driven by personal interests that transcend electronic recording;

-students, with one exception, acknowledged Biopac provided reliable data outputs and laboratory instructions were easy to comprehend

A concerted effort will be made next semester (Fall 2004) to have the majority, if not all, students respond to the Web-based evaluation. Only 16 of 43 students responded to the evaluation. A greater number
of respondents reporting will give us a clearer picture of the impact of the Biopac system on our undergraduates in physiology courses.

Training and Development:

The PI/Co-PIs involved in this project were favorably impressed with Biopac instrumentation after one semester of its use in two lower division physiology courses--Physiological Dynamics in Animals and Plants (PDAP) and Human Physiology (HP). We were amazed how well the students adapted their limited laboratory skills to the use of Biopac. The students were not intimidated by using the data acquisition equipment for the first time. The ease of use, i.e., a 'plug and run' approach and easily understood documentation allowed the students to begin operating the equipment independently in a short period of time.
As faculty we were immensely pleased how well the students reacted to this new laboratory experience. All experiments involved use of human subjects. Animal experiments are planned for Fall semester 2004. The animal studies are much more challenging to conduct. It will be of interest to observe how well our students respond to the introduction of animal preparations.

As compelling as Biopac instrumentation is to use, we were somewhat surprised so few students in PDAP wished to use the technology in their investigative studies. This was not true in HP shere the focus was strictly on the human model. Perhaps the absence of animal use in PDAP

limited student enthusiasm for using Biopac. Hopefully, their interest in Biopac will be ignited next semester with the presentation of animal models.

Surveys of our undergraduate teachers using Biopac in the Saturday Explorations in Advanced Science (SEAS) and Willamette Science Outreach Program (WSOP) revealed little change in regard to their interest in teaching public school children. However, they developed a greater understanding of what is involved in teaching students in K-12. Some were discouraged by the amount of work involved in effective instruction or were disappointed by disinterested students. Despite mild discouragment, they were all intrigued by the challenge. The emphasis on investigation over calculation and immediate feedback with Biopac had a positive influence on children's interest in science investigation and encouraged 'future' teachers to pusue the possibility of investigative teaching strategies.

Outreach Activities:

There are two target audiences for the dissemination of our Biopac technology into the wider community of K-12. They are Saturday Explorations in Advanced Science (SEAS) and Willamette Science Outreach Program (WSOP). Both programs utilze biology majors as trained teaching assistants (TAs) for the implementation of the Biopac data acquisition system. The undergraduate TAs design laboratory protocols and direct their use for the SEAS and WSOP students.

This past winter (January-March 2004) on separate Saturdays 75 students in SEAS were introduced to our new Biopac system as one of five different science activities. These students were identified primarily as talented and gifted in grades 5-9. The students were exposed first to a variety of experimental designs from EKG to respiratory cycling. Then the students were given the freedom to modify the experimental schemes and come up with their own hypotheses. The result of their efforts were exciting and meaningful. For the first time these young science minds began to think like scientists by making educated guesses as to findings and 'tweaking' the designs to further refine the outcomes. Of all the science activities in the SEAS agenda, the data acquisition study using Biopac electronics was overwhelmingly the most popular and highly rated. After five Saturdays with students engaged in different science activities, the students evaluated their experiences and selected which of the five science immersions they would like to return to for an extended lesson on the sixth and final Saturday of the program. The Biopac lesson was selected by 34% of the students as a first choice and 22% picked it as their second choice. Evidence is strong, therefore, that the Biopac system significantly piqued the interest of these young students.

In July 2004 and audience of WOSP students (20) in grades ranging from middle through high school were invited to use the Biopac instrumentation. This group of students was primarily of minority ethnicity who indicated a strong perference for learning from the arts to the sciences. Again, with a group of young students more diverse those of SEAS, the use of the Biopac system was an outstanding success. More the half the students considered the science exposure as their most exciting and meaningful experience. I suspect the 'hands on' approach of recording signals from their own bodies is what captured their enthusiasm for electronic recording with Biopac.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

URL(s):

http://www.willamette.edu/cla/biology/biol244/index.htm

Description:

The Web site has a submenu or sidebar titled NSF-CCLI. It describes the purpose of the technology grant to establish computer-based data acquisition in the physiology laboratory. It also highlights the self, peer, and faculty evaluation of student learning. The evaluation forms represent quantitative and qualitative assessments that can be accessed and responded to by students and faculty. NSF is clearly acknowledged for its support.

Other Specific Products

Contributions

Contributions within Discipline:

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Special Requirements

Special reporting requirements: None
Change in Objectives or Scope: None
Unobligated funds: less than 20 percent of current funds
Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Organizational Partners
Any Journal
Any Book
Any Product
Contributions: To Any within Discipline
Contributions: To Any Other Disciplines
Contributions: To Any Human Resource Development
Contributions: To Any Resources for Research and Education
Contributions: To Any Beyond Science and Engineering