



Application Information (Application ID# 11703991)

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Application Type

[[edit this section](#)]

U.S. or P.R.

Yes

Institutional Environment

[[edit this section](#)]

1. Technology vision

Albion College is committed to integrating technology with teaching and learning methodology because technology is a fundamental part of daily life, influencing not only academic achievement, but also business effectiveness, social interaction, and recreational activities.

In 2007, to address the challenge of increasing student comprehension of physics in introductory courses that employed traditional "lecture" pedagogy, Dr. Aaron Miller developed and implemented a combination of Tablet PC, web-based, and personal response system technology into his instructional methodology. The successful integration of this pedagogical model drew the interest of other science faculty and resulted in collaboration between Chemistry and Physics faculty to expand the model, with the hope of driving campus-wide adoption of innovative mobile-computing instruction, which is reflected in our current strategic planning process.

Today, the shared vision of the Physics and Chemistry Departments is to increase success of science, pre-engineering, and pre-medical students through the deliberate application of technology-based pedagogy.

Project Details

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2. Project title

Mobile Technology-Enhanced Teaching and Learning for Science, Pre-engineering, and Pre-medical Students in a Liberal Arts Environment

3. Project executive summary

We propose to increase student competence, confidence, and enthusiasm in the physical sciences by creating a Tablet PC-based interactive learning atmosphere involving individualized student exploration.

Traditional lecture-based pedagogy employed in physics and chemistry courses has not changed much in the past 80 years, despite revolutionary advances in computing power and increases in student comfort and proficiency with technology. The majority of today's students are technologically adept and excited about new modes of instruction. In the Physics and Chemistry departments, we have begun to leverage this student competence in technology by piloting Tablet PC lecturing in three courses and "clicker"-based multiple-choice polling in one course with encouraging results and positive student feedback.

This grant will enable the Physics and Chemistry departments to implement significant pedagogical reform into their introductory courses which will impact most physics, chemistry, pre-engineering, and pre-medical students. Using interactive Tablet PC software in both classroom and lab, students will connect with the professor and each other to solve graphically intensive problems and to engage in interactive computer simulations of traditionally "static" material. We believe that interest in this new paradigm of technology-enhanced learning will provide impetus for college-wide adoption of a Tablet PC initiative for all science majors.

4. Teaching and learning issues

Building a strong base of understanding of the conceptually rich material in physics and chemistry is extremely important to the future success of scientists, medical professionals, and engineers. Our past assessments have revealed that student performance in physics and chemistry courses suffers for three reasons. First, students do not make connections between the analytically rich lecture material and the hands-on, physical, and "intuitive" lab-based scientific experience. Second, student participation in traditional lectures and laboratory is often dominated by a few talkative individuals that, intentionally or unintentionally, alienate the struggling, under-confident, or shy student. Third, students underperform because of lack of competence or confidence in analytical abilities.

Through the introduction of a unified Tablet PC-based interactive course structure for lecture and lab components, students will be better equipped to make connections between analytically rich but abstract material with immediate instructor assessment of student learning. The new technology and teaching methods will unify pedagogy in introductory calculus-based Physics and Organic Chemistry lecture and laboratory course components. For example, students will use the Tablet PC platform for note-taking, interactive demonstrations, collaborative problem solving, and data acquisition and analysis. This unification will significantly enhance student-directed

learning for science, pre-engineering, and pre-medical students. We desire to implement similar course redesigns in larger courses (e.g., pre-med physics, general chemistry, astronomy) in the future.

This project is of high value to students who will gain increased competence, confidence, and enthusiasm by participating in a learning atmosphere designed around interactive, student-driven exploration of the physical sciences. The Tablet PC, as a unified hardware platform, will facilitate learning and provide real-time, in-class feedback to enable teachers to dynamically adjust material (“just-in-time teaching”) to properly address immediate needs that would be missed using traditional methods.

5. Goals, objectives and outcomes

This proposal has three distinct goals common to Physics and Chemistry courses:

1) Increase connections between analytical and experimental material across the lecture/lab boundary.

While laboratory activities are an essential part of building physics intuition, our evaluations show a disconnect between the hands-on labs and the analytically rich lecture material. Our objective is to unify the learning experience between lecture and lab and promote interaction in both environments. The impact of this technology on the unification of lecture and lab experiences will be assessed by comparing pre-tablet and post-tablet exam performance.

2) Increase in-class participation of students.

The introduction of in-class, interactive, Tablet PC-based exercises will improve the participation of all students in the redesigned Chemistry and Physics courses. This will particularly benefit students who feel uncomfortable participating in class, are unsure of their abilities, or dislike public discussion of their ideas. We estimate our current participation rate to be about one student in five. Our objective is to increase student in-class participation to 100% through the use of Tablet PC interactive polling. The hardware and software provided by this grant will enable us to assess participation by quantitatively tracking student activities and will allow for comparison to non-Tablet PC-enhanced courses.

3) Increase student competence and confidence through increased understanding of course material.

Our objective in Physics courses is to improve the integration of physical concepts, mathematical models and quantitative analyses, and experiential observations encountered in physics education. Our redesigned Physics courses will be improved by exploiting technology-enhanced teaching methods and by incorporating interactive physical simulation software. Similarly, Organic Chemistry, often the most visual and spatially challenging chemistry course for students, will be improved through real-time diagrammatic exchange, note-taking, and the introduction of a fully digital notebook environment. Assessment of student competence and confidence will be accomplished through the use of local and nationally recognized standardized exams in each discipline (e.g., American Chemical Society Organic Exam, Force Concepts Inventory, Conceptual Survey in Electricity and Magnetism)

overlaid with Gardner-Medwin's Combined Assessment of Accuracy and Confidence tool (ALT-J, 3, 80-85, 1995) and will be compared to student performance in previous years. We will also track student retention rates to determine if increased confidence correlates with retention.

During the first year of this project we will introduce this technology into one of three concurrently offered lecture sections of Organic Chemistry. We will pilot Tablet PC pedagogy in this section, assigning one Tablet PC for every two students. This will allow side-by-side comparison with the other sections that do not use technology enhancements. Because of lower enrollment, the Physics Department does not offer multiple concurrent lecture sections; therefore, the first year of classes will be the control group for subsequent years. During this year, we will develop enhanced physics course material. Full implementation of the technology-enhanced learning environment in both Physics and Chemistry lecture and labs will occur in the second year of the project. Each year we will perform pre- and post-course assessment of student perceptions, course content, and course expectations.

Project Details (continued)

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6. Technology integration

Implementation of this technology will significantly change our current course structure and methodology. By integrating the lecture and lab under a common technology platform, students will use software pre-labs, real-time simulations, lecture-demos, and interactive assessment to build stronger connections between the laboratory and lecture material.

With the Tablet PC inking capability, multiple interactive polling questions that require free-form graphical response will be posed to students. Through the use of interactive lecture/polling software (e.g., DyKnow, UW Classroom Presenter, SynchronEyes), student submissions will be reviewed in real-time by the instructor and students will engage in collaborative exercises. Additionally, the ability to manipulate objects in three-dimensional space is critical to understanding key concepts in both Chemistry and Physics. Individual modeling software installed on the Tablet PCs will allow students, with guidance from the instructor, to manipulate objects in their own virtual 3-D spaces, be they organic molecules or falling masses. The instructor can choose to share student responses with the class without revealing student identity. This will result in 1) an increase in student confidence in their work and 2) a reduction in student perception of negative peer pressure or stigmas associated with verbal classroom interaction. Furthermore, real-time class interactions will provide students with a personalized learning experience which will improve their intuition and ability to put the course material into practice.

The award of this grant will supply a sufficient number of Tablet PCs for use in introductory Physics and Organic Chemistry. Through College matching funds, 20 additional Tablet PCs will be acquired which will provide a Tablet PC for each student (instead of pairs of students sharing a single tablet) in Organic Chemistry lecture. In the future, we hope to expand the use of this technology to include the algebra-based physics courses (Pre-Medical Physics) with an enrollment of more than 65 students each semester.

We will use the provided multimedia projector as a second screen in our lecture/lab rooms to allow multiple slides of material to be visible simultaneously. The digital camera will be used to acquire images for course presentations and for documentation of the progress of this grant, dissemination of grant outcomes to larger academic communities, and presentations at national forums of teaching with technology. Students will use the large-format printer for several group-oriented laboratory exercises that will require the creation and presentation of research-like posters during the lab period.

7. Project timeline

Summer 2008

- * Evaluate supporting software
- * Install hardware infrastructure
- * Test software and hardware configurations
- * Create equipment management policy
- * Develop evaluation/assessment instruments
- * Obtain Institutional Review Board approval
- * Begin development of student exercises
- * Begin development of a public web page to describe the project
- * Milestone: Internal evaluation of Tablet PC techniques

Fall 2008

- * Administer pre-class student perception survey
- * Pilot Organic Chemistry and develop course redesign in Physics
- * Administer post-class student survey
- * Milestone: Evaluate pilot testing and survey usefulness

Spring 2009

- * Administer pre-class student perception survey
- * Continue pilot of redesigned courses in chemistry
- * Administer post-class student survey
- * Milestone: Report at HP Conference

Summer 2009

- * First year outcome assessment
- * Possible course modification based on outcome assessments
- * Milestone: Report to administration regarding success of project

Fall 2009

- * Full implementation of Physics course redesign
- * Expand Organic Chemistry pilot to full implementation
- * Train additional science faculty in Tablet PC techniques
- * Milestone: Plan additional course offerings

Spring - Summer 2010

- * Pursue expansion to other courses inside and outside the sciences
- * End-of-project celebration
- * Milestone: Second Year Assessment

8. Course impacted Courses that will be immediately affected by the award of this grant include our introductory, calculus-based Physics courses (Phys 167, Analytical Physics I and Phys 168, Analytical Physics II) and their associated labs (Phys 167L and Phys 168L). Additionally, the Organic Chemistry courses (Chem 211, Organic Chemistry: Structure, Stability and Mechanism and Chem 212, Organic Chemistry: Mechanism and Synthesis, with their associated labs (Chem 211L, and, Chem 212L) will be equally impacted by this award. These courses are taught by faculty in our Physics and Chemistry Departments.

9. Course redesign Course redesign in Physics is already underway. Currently incorporated is multiple-choice class polling using an audience response system and instruction using a Tablet PC to replace chalkboard lectures. The award of this grant will expand interactivity to include real-time, free-form graphical responses, and interactive simulations unified with collaborative labs that employ "paperless" data acquisition and analysis.

Organic Chemistry lecture involves the drawing and manipulating of structures in space. Molecular modeling software installed on each Tablet PC will enable each student to dynamically explore the spatial nature of organic structures. Students will find this interactive capability to be highly engaging and empowering. In the laboratory, students will access prepared video, interactive software content, the Internet, and E-Notebook software. The electronic nature of this technology allows for instantaneous sharing of information between group members during and after the lab and will allow students in different lab sections to work together on the same project. Students will dialog and cooperate in new ways on joint research projects.

10. Course discipline Science

Other course discipline

11. Faculty Three Faculty: Dr. Aaron Miller, Dr. Andrew French, and Dr. David Seely will be involved directly in this project.

12. Students We anticipate impacting 40 students in Physics lecture and lab and up to 120 students in Organic Chemistry lecture and lab (separate enrollment for each)

13. Extra Consideration

Extra Consideration Description

14. Project visibility

Internal Visibility:

We will develop on-campus presentations and workshops for faculty and students. We will provide demonstrations at faculty meetings and events to highlight the project on campus. Instructional Technology will act as liaison and advocate between Project Investigators and other academic departments to promote collaboration, creativity and awareness. Internal campus communications (e.g. Albion websites, digital signage, print, and electronic publications) will bring visibility to the project.

External Visibility:

Principal Investigators and Instructional Technology will showcase the project via presentations, posters, and personal networking with members of peer institutions, organizations, professional society meetings, and consortia. These groups may include National Institute for Technology and Liberal Education (NITLE), Great Lakes Colleges Association (GLCA), Consortium of Liberal Arts Colleges (CLAC), American

Chemical Society National Meetings (Chemical Education Division), Midwest Association of Chemistry Teachers at Liberal Arts Colleges (MACTLAC), March Meeting of the American Physical Society (APS), American Association of Physics Teachers (AAPT), etc. Project team members will promote public awareness through external college publications, press releases, alumni events, and Albion websites, including HP Tablet PC recommendations on Albion's custom CDWG website for personal purchases and print materials. An end-of-project celebration will be held in conjunction with a major campus event.

Principal Investigator (Primary Contact)

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Middle name	J.
Last name	Miller
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Additional Team Members

[[edit this section](#)]

Title	Professor
Salutation	Dr.
First name	Andrew
Middle name	
Last name	French
Role on Project	Preliminary testing of technology, integration of technology and pedagogy into Chemistry courses, and assessment of outcomes in Chemistry
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Title	Professor
Salutation	Dr.
First name	David

Middle name
Last name Seely
Role on Project Evaluation of simulation software, integration of technology and pedagogy into Physics courses, and assessment of outcomes in Physics
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Last name Kraft
Role on Project IT support point contact and technical support for hardware and software
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Role on Project
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Administrative Support and Approval

[[edit this section](#)]

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Administrative

Support and Approval (continued)

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17. Statement of support from key administrator

Albion College has a long standing commitment to providing students with the best technology experiences possible. This project will be led by Dr. Aaron Miller who has completely redesigned his personal pedagogical methods in order to leverage the use of mobile device-aided instruction. His department Chair, Dr. David Seely, is fully supportive of these efforts and will also be contributing to this project. Chemistry professor Dr. Andrew French has also brought technology to the classroom and seeks to build collaboration between the two sciences in order to improve the experience of science students.

The project will be well supported by our IT Department. Chief Information Officer, Scott Stephen, will ensure that this project will have access to Information Technology resources. Instructional Technology Supervisor, Melinda Kraft, will provide instructional support including hardware and software training, classroom technology support, and serve as liaison to the IT Department.

Albion College will support this initiative by acquiring an additional 20 Tablet PCs over the next three years to expand the envisioned project so that every student in organic chemistry lecture can work with their own Tablet PC. In addition, as a member of The National Institute for Technology and Liberal Education, we plan to take advantage of their program opportunities to inform member institutions of our project outcomes.

18. Approval of Terms and Conditions

Yes

19. Privacy Terms & Conditions

Yes

Institutional Information

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Legal name	Albion College
In care of organization	
Address line 1	611 E. Porter St.
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State	MI
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Campus website	www.albion.edu

21. Institution mission statement

Albion College's vision is to lead America's best liberal arts colleges by providing innovative and interdisciplinary programs of study. Our purpose is to embrace the

liberal arts tradition as the foundation for an educated citizen of the world. Teaching and learning are central to our mission and although the classroom is at the heart of our role as educators, we believe that out-of-classroom opportunities, active citizenship, and service, are also valuable components of the liberal arts education we provide.

22. Federal tax payer ID 38-1359081

U.S. & Puerto Rico Institutional Information (continued)

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African American	3
Asian / Pacific Islander	2
Caucasian / White	89
Hispanic	1
Native American	0
Other	5
24. Student financial need	14

Grant Recipient Details - Shipping Instructions

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Title	Director of Instructional Technology
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