

**Associated Colleges of the South
Teaching with Technology Fellowship Program Proposal
Summer 2004**

**Environmental noise and architectural acoustics:
Field studies with a Tablet PC**

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in collaboration with

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1. Background

The Davidson College community and the surrounding town face many of the same issues related to environmental noise and architectural acoustics that are in common with citizens and community leaders throughout the country. Students complain about too much sound transmission through the walls in a new dormitory. HVAC noise masks speech in new classrooms. HVAC noise coupled with long reverberation time greatly limits the usefulness of a sports arena as an entertainment venue. Increased road traffic and an emphasis on residential and commercial in-fill by town planners and developers force awareness and review of noise ordinances. In what ways can a student understand and positively contribute to these issues?

Liberal arts curricula provide many opportunities for developing disciplined, observant, creative and socially conscious minds. Core requirements within the curriculum are designed to expose students to areas outside of their major track of study. The curricular material that will be developed in this project is to be used in non-science major courses, currently being offered by the physics department, which satisfy a core requirement in the sciences. These courses challenge students to become directly involved in scientific study and seek to demonstrate the importance of scientifically literate leaders and members of society. A formal laboratory period is not associated with these courses and so conceptual discovery and experimentation must take place outside of the classroom. The emerging technology of Tablet PC's overcomes many problems of mobile data acquisition and analysis that have made field studies in the past an awkward and cumbersome activity. The work proposed here will integrate Tablet PC's in several field exercises investigating environmental noise and architectural acoustics.

2. Description

The proposed curricular material will help non-science major students explore concepts in much the same way that a scientist does. As with most scientific studies, the greatest challenge is finding obvious occurrences of a real-world phenomenon that are not clouded by competing effects or ones in which simplifying assumptions can be realistically made. The need for clear examples is even more important when the students are using an unfamiliar technology.

In the physics building, several architectural acoustic phenomena that fit the above criteria have been identified. The reverberation time in our seminar room is around 0.5 seconds whereas, in the stairwells, it is nearly 5 seconds. Strong echoes in the basement hallway may be heard and, at two places along the hallway, flutter echoes can be made. The stairwells also exhibit very strong resonances.

In a typical exercise, the class of 30 students will be divided into ~10 groups of 2-4 students. Each group will be supplied with a Tablet PC and equipment. The exercises assigned to the groups will be organized in three parts. The first will help familiarize the students with the Tablet PC and the sound recording and analysis software. The focus for this part will be on architectural acoustics. The second part will use the sound level meter and Tablet PC to measure integrated noise levels in different locations. The third part will be a project of each group's design addressing an issue of either environmental noise or architectural acoustics. Each group will submit a proposal to be approved by the professor. The work of the group will be submitted in poster format to be used in a class poster presentation.

Much of the effort for this coming summer will be to write clear descriptions of these acoustical phenomena as well as procedures for making and analyzing accurate measurements so that definitive conclusions can be drawn. Examples outdoors and in other buildings must also be found in order to detach the place of learning from the physics building. Through such well-developed exercises, the students should gain confidence in their ability to recognize and test real-world phenomena. Consequently, they are more likely to design well-formulated projects for themselves. Also this summer, a list of viable group projects will be compiled should some groups need direction in choosing a project.

3. Timeline

The proposed work will be accomplished in the period from mid-May through August 2004. First full use of the new curricular material will be in the Musical Technology (Physics 115) course to be taught in the spring of 2005. Portions may be used in Physics of the Environment (Physics 103) or in The Physics Around You (Physics 110) during the fall of 2004.

4 & 5. Technology and Other Support

The proposed work will be carried out in collaboration with Mur Muchane, Davidson's Director of Instructional Technology. Davidson's Instructional Technology Group has recently acquired 15 new Fujitsu Stylistic Tablet PCs as part of a pilot project to explore their possible uses in educational computing. These units are equipped with most of the quality features of a desktop PC including an onboard soundcard, microphone, speaker, and jacks for external microphones and speakers. With pen-based input and robust handwriting recognition, Tablet PCs represent a promising new frontier in educational computing. USB-2 ports provide connectivity to numerous external devices including a variety of digital transducers (e.g., sound level meters) from PASCO. Davidson College is supporting this work by providing the investigator with the necessary equipment (Tablet P's, microphone, sound level meter) and software.

6. Learning Outcomes

According to recent physics education research, active engagement with course material outside of the classroom or laboratory provides a powerful learning process that is often overlooked. The nature of the proposed curricular material is for the student to be guided through the processes that a scientist uses. In this case, the work includes the use of an exciting, new, and enabling technology. The student then is responsible for applying course material to an issue that is pertinent to his or her life.

7. Curriculum

The proposed curricular material will be used the next time Musical Technology (Physics 115) will be taught, which is in the spring of 2005. In addition, the material developed through this fellowship would be applicable in Physics of the Environment (Physics 103) and in The Physics Around You (Physics 110).

8. Assessment

The first two parts will be assigned and graded in a manner similar to end-of-chapter homework sets. Group projects will be presented during a class poster session, a valuable communication device widely used in scientific meetings. The grade for this portion will depend upon written and oral criteria.

In order for the project as a whole to be evaluated by the students, a section of the end-of-course student evaluation form will be dedicated to the new material. Feedback from presentations at professional research and education meetings (see #9 below) will be gathered as well.

9. Dissemination

At the local level, the results of this work will be shared with the Davidson College community via the Instructional Technology seminar series sponsored by the

Instructional Technology Group. Additionally, Boye and Muchane will present their findings at the ACS IT workshop. In the fall of 2004, the Davidson College Physics Department will host the North Carolina Section meeting of the American Association of Physics Teachers. This venue is an ideal place to pass along the results of this work to many ACS colleagues and other educators (high school, 2-year and 4-year college and graduate faculty) in physics throughout the state in the form of a talk and/or a workshop. In order to have the broadest impact with the curricular materials, a webpage will be created for the free distribution of this material to faculty at Davidson, to ACS colleagues, and to higher educators in general. In addition, the new material will be presented at an upcoming meeting of the Acoustical Society of America.