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Attracting Students to Engineering Technology Through Effective Use of Laboratory Demonstrations

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ABSTRACT

Many college and university technology schools and departments are faced with the challenge of locating and recruiting students for their programs. In some cases, this situation is caused by potential students being unfamiliar with either technology in general and/or the specific programs that are available. One solution to this problem is to educate potential students about technology areas and programs through the use of effective laboratory demonstrations. This paper reviews demonstrations that have been utilized at Purdue University's Statewide Technology Program in Richmond, Indiana, to expose potential students to the Mechanical Engineering Technology and Technical Graphics fields. Other possibilities for effective demonstrations in technology, and future developments for effective demonstrations are also discussed.

Introduction

Purdue University's Statewide Technology program is tasked with providing technology education to local industries and communities throughout the state of Indiana. The Statewide Technology location in Richmond is one of ten locations involved in this program (Figure 1). Currently there are more than 1600 students enrolled in the programs at the various locations, working toward associate and bachelor's degrees in eight programs of study. Students also have the option of continuing their study towards bachelor's degrees at the West Lafayette campus either before or after completing an associate degree at the Statewide location. While many of the technology programs are

well known and are experiencing heavy enrollments on the West Lafayette campus, many of the Statewide locations are focused on growth and encouraging increased enrollment. Recruiting new students plays an important role in this process.

The need to attract students is not unique to Purdue Statewide Technology. Many college and university engineering technology schools and departments are faced on a regular basis with the challenge of bringing more students into their programs. Many possible causes exist for this situation, such as fewer students graduating high school, fewer high school graduates choosing to

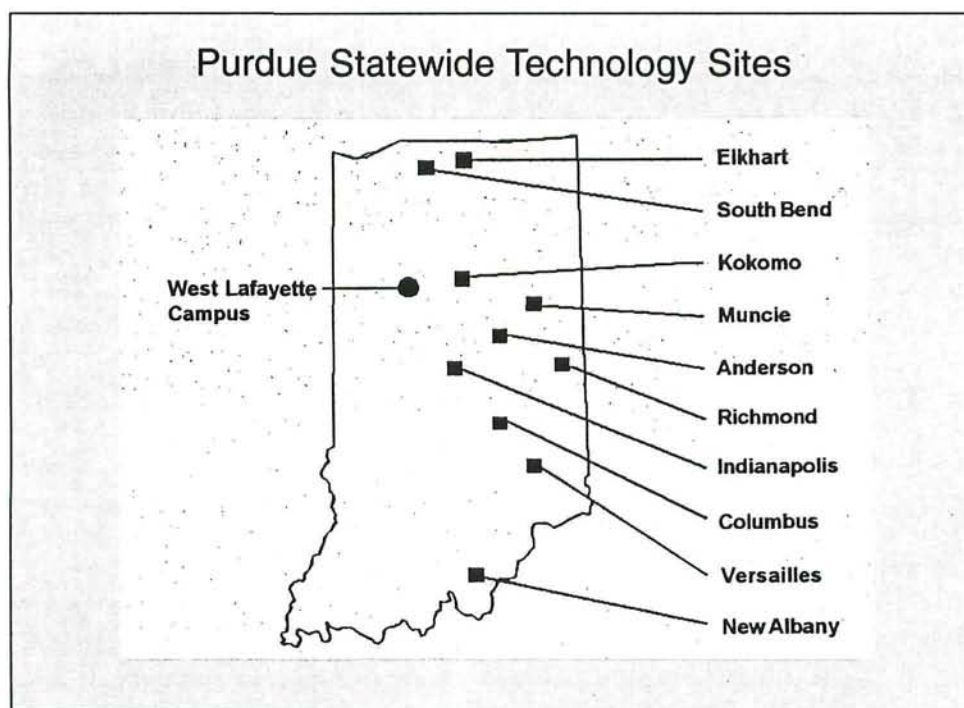


Figure 1 - Purdue Statewide Technology locations.

pursue college degrees, the steadily increasing cost of higher education, etc. (Hutzel et al., 1997) (Garcia and Honchell, 1995). Another common cause for this need to attract students to technology arises from the fact that many potential technology students, either at the college or high school level, have minimal exposure to technology programs, or no knowledge of what engineering technology involves. As Garcia and Honchell (1995) state, "Many of these students also experience a great deal of confusion about the fundamental differences between technology and engineering programs, and how this relates to their career objectives."

There are several ways to attack this problem of unfamiliarity with technology and technology programs, including advertising using various media, visits to area high schools, networking, etc. One effective solution is to educate potential students about technology through the use of effective lab-

oratory demonstrations to show engineering technology "in action." Opportunities to provide demonstrations of this sort occur during school open house programs, on-campus tours, and other times when potential students are visiting campus facilities.

Demonstration Principles

To be effective, demonstrations should have several key ingredients: they need to be interesting to the audience (students), relevant to the subject at hand, succinct enough to hold attention and fit into the allotted time period, and fit within the constraints of equipment availability and material expense. Additionally, the best demonstrations have at least two more important ingredients: they work as planned (or nearly so), and they are fun for both the presenter and the receiver.

Much has been written on the impact of diverse learning styles/teaching styles on teaching quality and education. Learning style models such as Kolb's, Myers-Briggs,

Felder-Silverman, etc., highlight the fact that individuals prefer to learn, or process information, in significantly different ways (Felder, 1996). These same principles help explain, in part, why demonstrations are an effective means of reaching the greatest possible audience. Research has shown that approximately 70% of all people are more visually oriented than verbally oriented, i.e., they prefer visual cues and images to hearing or reading words. Visual learners get more out of pictures, diagrams, graphs, animations and demonstrations than they do from written or spoken words and formulas (Felder, 1993) (Montgomery, 1995). Furthermore, results of studies also indicate that almost 70% of the general population tend to be "sensors" (prefer facts, observation, real world examples) as opposed to "intuitors" (focus on theory, models, interpretations) (Montgomery, 1995) (Jacob, 1997). Obviously demonstrations would appeal to the more sensing oriented portion of the population. Also, demonstrations sometimes allow for a more "hands-on" active learning approach as a way to get to know the material, as opposed to more passive or reflective methods of learning.

Highly visual, factual, hands-on demonstrations will only be effective if they are relevant, that is, deliver the appropriate information at the appropriate level for the group in question. To this end, it is a good idea to have demonstrations of graduated complexity levels or adaptability to fit the needs of various groups ranging from the junior high school level (or younger) through college level. The same recommendation can be applied to the need of having demonstrations of varying time lengths, to fit opportunities that may span from 10 minutes to two hours or longer.

Demonstrations also need to take into account both the laboratory equipment that can be used and the cost in materials that will be consumed. Several of the examples presented in this paper use expensive, but generally available, laboratory or computer equipment, but there are many demonstrations that can be developed that do not require significant capital outlay for major equipment. There is an additional advantage to demonstrations that require only a minimal outlay for materials used. Fiscally responsible demonstrations can be repeated more often, and thereby reach more audience than demonstrations that price themselves out of reach for regular usage.

Finally, all demonstrations are susceptible to Murphy's Law - "If it can go wrong . . ." Care should be taken prior to the demonstration to ensure that the process can be successfully carried out virtually every time without fail. If there is a lack of confidence in the potential success of the demonstration, it is best to discard it in favor of a different one that has a better chance of succeeding. Additionally, it is strongly recommended to have a backup plan ready in the event of equipment failure, electrical problems, or other facility related issues that don't work out as planned.

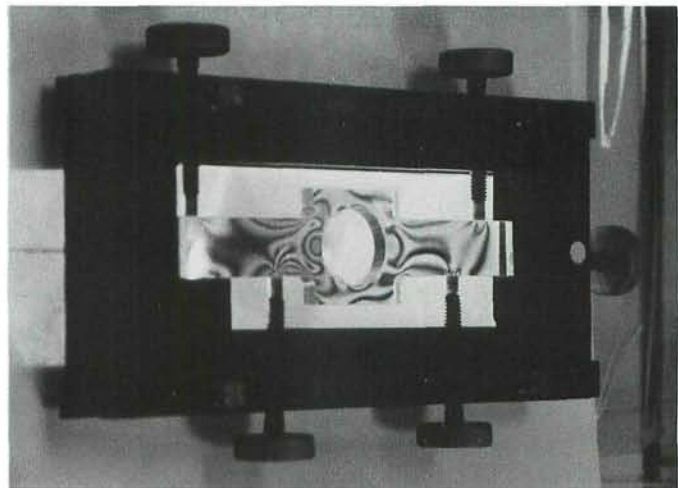


Figure 2 - Vishay Stress-Option device.

Demonstration Examples

At the Purdue Statewide Technology location in Richmond, we have several laboratories that we use to provide demonstrations, including two CAD/computer labs and a Mechanical Engineering Technology laboratory. In the MET area, visitors have responded well to several demonstrations using a Vishay Stress-Opticon device, a heat pipe, and a Tinius Olsen Universal Testing Machine.

The Stress-Opticon (*Figure 2*) is used to demonstrate basic principles of stress analysis, materials, and stress distribution. By using several different structural model shapes, and adjusting the loading modes, it is very easy to provide a colorful visual example of beam loading and similar applications. One advantage of this device for demonstrations is its portability - it can be taken to schools or other locations conveniently. Other advantages are that it can be projected on an overhead device for easy visibility in large groups, and it requires no outside power source, complicated machinery, or support equipment.

The heat pipe (*Figure 3*) is another simple demonstration that we have used successfully, and one that allows for audience participation. Generally we recruit two volunteers to each grasp the upper end of two bars, with the other end of each bar immersed in a heated liquid. Unknown to the

two recruits, one of the bars is a solid piece of copper bar stock and the other is a copper heat pipe device. The heat pipe becomes too warm to hold much faster than the solid bar, which allows for a great teaching moment and discussion of principles involved in heat transfer and materials. The demonstration is especially effective when the recruit who



Figure 3 - Heat pipe.

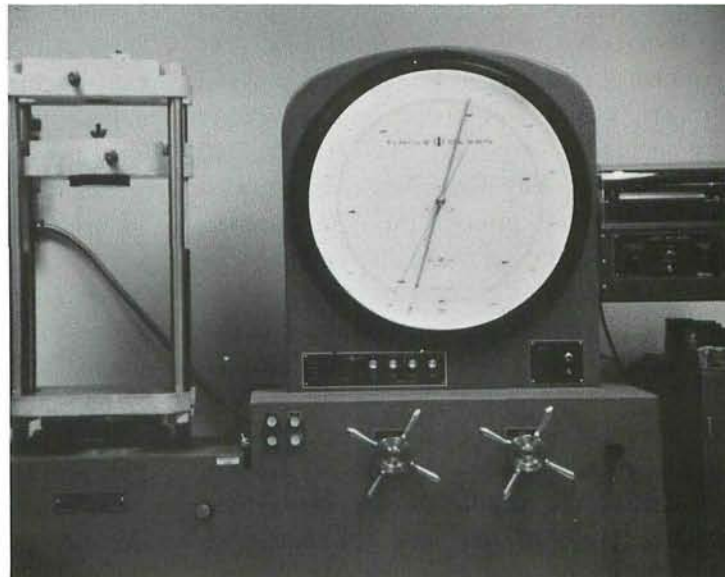


Figure 4 - Tinius Olsen Universal Testing Machine.

tries to hold the heat pipe is much larger in stature than the person holding the solid copper bar. Once the “trick” is explained, many of the students will want to try it themselves to feel the difference.

The Universal Testing Machine (*Figure 4*) is useful for several different demonstrations. One interesting application is using it to display principles of compression and compression testing by crushing soda cans. The students relate well to this, since many have crushed soda cans manually, and they enjoy estimating how much force the can will withstand before failing. An interesting secondary experiment is to do the demonstration again using a can that has a small dent or crease in it, and then discussing the different results.

Another effective use of the Universal Testing Machine has been for tensile testing of various objects. Standard steel and aluminum “dog bones” work well as samples, but we have generated more interest among younger students by using scrap CD’s as the samples to be tested. We have found that if the CD is gripped near the outer edge at the top and bottom, that it will distort and fail rather spectacularly, with shards of CD flying in all directions. Putting Plexiglas sheets around the sample area prior to the demonstration helps ensure the safety of the audience, as well as saving significantly on clean up time. As with all demonstrations of this sort, safety glasses should be worn by all participants.

In our computer labs, we have found that highly visual demonstrations work well in the CAD, page layout and computer graphics areas. Many CAD packages come with numerous demonstration or sample files that can be used in a slide show format for an interesting and informative display. Due to the time investment involved in generating

CAD models and displays, hands-on demonstrations are usually not as effective as “canned” demonstrations for producing exciting images in a short period of time.

We have utilized other computer laboratory equipment in various combinations to achieve successful demonstrations in the page layout/document area. Scanners, digital cameras, and the Internet generate a lot of enthusiasm among today’s students. One of the demonstrations that worked well for us involved the use of a digital camera to photograph the visiting students from a local high school. The photographs were then imported to a template of a wanted poster,

with text stating that the student was “wanted for ditching class to play with computers at Purdue University”. The individual posters were then output to a color printer and given to the students to take back to school. The

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same concept can be used with scanned images or with images downloaded from the Internet. Richard Kopp, a Technical Graphics professor with Purdue University’s New Albany Statewide location, has used the Internet in demonstrations by saving images of the students to a web page. The students were excited to be able to view their own picture on the web, and were exposed to an exciting new field of technology.

Future Directions

Future efforts in demonstration development at the Richmond Statewide location are likely to include the use of hydraulic and pneumatic laboratory equipment located on campus, as well as utilizing the equipment available in the Electrical Engineering Technology laboratory and the Computer Integrated Manufacturing area. However, in the author’s opinion, the greatest potential for effective, highly visual demonstrations that best present technology programs to

potential students at Richmond and other locations, will involve the use of graphics, including further Internet applications, animations, and simulations. Through the use of these media and methods, issues involving expensive, non-portable, or hard to access laboratory equipment can be lessened or eliminated thanks to the virtual nature of these tools. For example, it may be just as effective and more cost efficient to develop an animation of a specific manufacturing process than to actually do the manufacturing process in a demonstration environment. This approach has great potential for demonstrations in all areas, especially those that would involve a high degree of complexity, possible danger, or prohibitive cost.

Conclusion

There are many creative ways to effectively demonstrate technology to potential students. Highly visual, interesting, interactive demonstrations have the greatest chance of making an impact on any audience, and are extremely useful as a method of introducing students to, and recruiting them into, the field of technology. Through careful planning and attention to detail, effective demonstrations can be developed and presented to a wide range of audiences at a reasonable cost in both time and resources.

At Purdue University's Statewide Technology location in Richmond, we have had success utilizing laboratory equipment such as the Universal Testing Machine, computer graphics, and the Internet to provide demonstrations that have been enthusiastically received by audiences of various ages and interests.

Virtual demonstrations, such as animations and simulations, are a promising area for future development that could help alleviate cost issues, facility problems, and other limiting factors that currently hinder demonstration effectiveness.

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