



Post baccalaureate professional development in noise control engineering

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ABSTRACT

Professional development opportunities for practicing engineers are an important element of noise control engineering education. An effective and efficient approach to providing these opportunities involves leveraging development and delivery of formal professional master's programs, graduate certificates, formal coursework, and non-credit workshops and short courses. Typical audiences for these offerings include practicing engineers with substantial undergraduate background in noise control engineering, practicing engineers who lack fundamental background in noise control engineering, and other professionals who need background information on noise control engineering because of their related work in consulting, government, or management roles. Courses and other programmatic elements can be developed to utilize educational technology, simulations, and distance delivery via the internet to a variety of audiences including on-campus students, off-campus students, and students who receive materials via multiple modes. Leveraging the development of various elements enables efficient and cost effective delivery of educational programs to the often small and specialized interest audiences

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1. INTRODUCTION

Undergraduate engineering education in specialized disciplines such as noise control engineering varies widely across universities in the United States with very few comprehensive educational programs that provide bachelor's degree graduates with the broad background that is necessary to begin a successful career as a noise control engineer. A typical bachelor's level graduate with strong interest in noise control engineering will often have taken at most three or four courses that are specifically noise control engineering, acoustics, signal processing, and/or mechanical vibrations. A larger number of graduates will have taken one or two such courses.

At the same time there is demand in industry and consulting firms for engineers with substantial background in noise control engineering. This demand is being met by engineering graduates from a variety of disciplines, as well as physicists and other professionals who then need further professional development in noise control engineering. Such development can take the form of a professional master's degree with substantial noise control engineering content, often (but not always) housed in a Department of Mechanical Engineering, but also may involve only additional coursework or a graduate certificate. For many practicing professionals, their further professional development typically involves courses or programs that are offered at a distance, most frequently via the internet, or a combination of internet delivered and face-to-face courses.

Although there are multiple audiences for post baccalaureate and professional development courses and programs in noise control engineering, at any particular time the number of potential students in any specific audience is often small and may be dispersed geographically. In order to deliver appropriate programming to such audiences in a cost effective manner, it is important to develop and implement approaches that leverage programmatic material among multiple audiences to the extent possible.

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One potential approach to the multiple small, dispersed audiences, issue that has been implemented by Iowa State University to address professional development needs in specialized engineering and technology sub-disciplines is a multi-level approach that combines internet course and program delivery to address the needs of both on- and off-campus audiences. The approach provides advanced undergraduate and master's levels graduate coursework that can be used to address specific topical professional development needs, contribute to undergraduate background in specialized engineering topics, support graduate certificate programs, and support formal graduate degree programs.

This paper describes how Iowa State University has implemented an approach to multi-level engineering and technology education and professional development in specialized engineering sub-disciplines through leveraging of programmatic materials across levels and, when possible, across related sub-disciplines. The description includes implementations that involve engineering and technology sub-disciplines in general and noise control engineering in particular.

2. POTENTIAL AUDIENCES

The potential audiences for post baccalaureate professional development in specialized engineering and technology disciplines, including noise control engineering, are diverse and often dispersed geographically. In order to leverage programmatic development and delivery costs across such audiences it is often advantageous to also consider related audiences such as advanced undergraduate degree seeking students, as well as more traditional on-campus graduate students. It is also important to consider the needs of private sector organizational partners that may be seeking professional development opportunities for employees as part of relatively broad partnership agreements. In addition, bi-lateral, or multi-lateral agreements among educational providers can lead to economies of scale for programmatic development.

The primary audiences for courses, programs, and programmatic materials developed for specialized engineering sub-discipline professional development thus include at least the following.

- Post baccalaureate professional development for individuals
 - Practicing engineers and acousticians with modest to substantial prior formal education in noise control engineering who wish to update knowledge or broaden background in noise control engineering and related areas
 - Practicing engineers who have little or no formal background education in noise control engineering, but who do have background in foundational engineering disciplines such as mechanical engineering, electrical engineering, structural engineering, aerospace engineering, systems engineering, etc.
 - Professionals from technical, but non-engineering backgrounds such as physics, architecture, mathematics, statistics, engineering technology, etc.
 - Practicing professionals in consultant, technical management, and government roles who have modest or no technical educational background
- Partner private or government sector organizations with missions/activities that include noise control engineering elements
 - Automotive, aerospace, agricultural equipment, construction equipment, mining equipment and other industrial enterprises
 - Preferred professional development provider agreements
 - Employee reimbursement for professional development
 - Specific professional development agreements
 - Government and non-profit organization professional development
- Degree seeking students at the undergraduate and graduate levels
 - Advanced undergraduate specialized courses
 - Master's levels courses for both applied and research focused masters degrees
 - Advanced graduate coursework for research focused graduate students

Although the variability of needs across these diverse audiences can be great, there are also good opportunities for leveraging the development and delivery of course materials, simulations, and other programmatic elements. In addition, when possible, the various audience segments often can benefit substantially from mutual interactions that occur as part of course and programmatic element delivery.

3. AN APPROACH TO MULTI-LEVEL SPECIALIZED ENGINEERING EDUCATION AND PROFESSIONAL DEVELOPMENT

3.1 Background

Iowa State University has a long history of offering specialized engineering education in a variety of engineering sub-disciplines including noise and vibration control engineering, engineering acoustics, architectural acoustics, structural dynamics, systems engineering, and quantitative non-destructive evaluation. None of these sub-disciplines are offered as stand-alone undergraduate or graduate degrees or majors, although there are graduate certificates in systems engineering, environmental engineering, and environmental systems that could involve noise control engineering elements.

At the undergraduate level the current approach to virtually all of these and other engineering sub-disciplines is for students in engineering programs such as mechanical engineering, aerospace engineering, electrical engineering, civil engineering, agricultural engineering, or industrial and manufacturing systems engineering to select one to three elective courses in the sub-discipline. Many of these courses are also courses that are appropriate as beginning master's level coursework or professional development course work for practicing engineers and other professionals.

A sustaining influence supporting many of the engineering sub-disciplines listed above are long-stand partnerships with industrial and governmental organizations. The partnerships have long fostered specialty engineering professional development course offerings, professional master's degree offerings for practicing engineers, non-credit workshops, graduate certificates, and in a few cases, broad-based preferred provider arrangements for a variety of professional development products to an entire industrial organization or consortium of organizations.

3.2 Leveraged Multi-audience Educational Products

Educational technology has evolved rapidly in recent years and continues to do so. The substantial majority of distance education course and program offerings in engineering by Iowa State University, and many other universities, are via online technology that may be synchronous or asynchronous. In addition, online technology is increasingly an integral component of on-campus educational programs. In fact, during the 2012-2013 academic year, there were just under 10,000 enrollments by on-campus ISU students in online courses as compared to slightly more than 8,000 off-campus student enrollments in credit courses.

Clearly online/distance technology is already being leveraged quite heavily in conventional undergraduate and graduate education, as courses are simultaneously being made available to on- and off-campus audiences. Since in many instances professional development courses and educational programs for practicing noise control professionals are also likely to be delivered via online technology, it is evident that such courses and programs can easily be made available to multiple audiences including interested advanced undergraduates, master's level graduate students, and working professionals seeking new knowledge or additional credentials.

At Iowa State, as well as elsewhere, this has led to the development of credit courses that support undergraduate sub-disciplinary specializations, graduate certificates, professional master's degrees, and professional development products. This multi-audience approach has enabled the continued offering of courses in noise control engineering and supporting disciplines that would have been otherwise difficult to sustain in the face of substantial enrollment growth in undergraduate engineering programs.

In addition, the multi-audience approach has allowed Iowa State University to develop and offer specialized graduate certificates, available fully to distance or on-campus audiences in 14 engineering and technology based sub-disciplines. The certificates typically involve approximately 15 semester credits of coursework at an advanced undergraduate or graduate level related to the specific sub-discipline. Examples include environmental systems, power systems, systems engineering, and computational fluid dynamics. Ten professional master's degrees are also fully available via distance education technology to off-campus, as well as on-campus audiences.

3.3 Specialized Program Development

Successful specialized program development requires an initial educational product (typically a number of core specialty and supporting courses), an initial audience (sometimes, but not always, a group of potentially interested on-campus students), and reasonable faculty interest and support

infrastructure – particularly if distance/online technology is to be employed. When initial conditions are sufficiently established to support or encourage further program development, the identification and cultivation of new audiences is a critical next step.

A typical progression is the development of core advanced undergraduate and beginning graduate courses in the sub-discipline that is often in support of faculty and industry research or product development interests. Expansion to off-campus audiences usually involves existing stakeholder relationships with industrial partners and practicing professionals which are gradually expanded into related new sub-disciplines of interest to the corporate or individual stakeholders.

As the off-campus and accompanying online/distance technology components of the program grow, it is also important to provide faculty members who are involved with appropriate distance technology, production, and student services support. Such support is usually best provided through central or engineering college level support infrastructure. At Iowa State we provide “production and delivery” support infrastructure at the engineering college level through a collaborative college-level distance education unit. This unit also collaborates with central distance education student services units to provide a variety of support services to distance students. A central online learning hub has also been established to provide professional development opportunities and support for faculty members who are engaged in developing and implementing educational technology approaches in their on-campus and/or off-campus courses and programs.

4. CONCLUSIONS

Specialized engineering sub-disciplines such as noise control engineering have substantial demand for post baccalaureate professional development in a variety of forms including formal coursework, graduate certificates, graduate degrees, and workshops. This is largely a result of the demand for expertise in such disciplines exceeding the typically small number of bachelor’s graduates who develop an adequate background in the sub-discipline as part of their undergraduate education. In addition, there is substantial post baccalaureate professional education demand in sub-disciplines such as noise control engineering from professionals with backgrounds from outside engineering.

Although demand for post baccalaureate education in engineering sub-disciplines such as noise control engineering is important, it can be modest, geographically dispersed, and varying in the rigor and quantity desired. As a result, a coordinated, multi-audience, multi-level approach is advantageous in terms of efficiency and cost effectiveness of delivery. The growing utilization of similar educational technology for both on-campus and distance education delivery of educational products allows for significant leverage in meeting the multi-dimensional professional development needs of engineering sub-disciplines such as noise control engineering. It is however, important to recognize that appropriate technical and support infrastructure are important to the delivery of high-quality, technology-based, engineering educational products. Multi-audience, multi-level educational product leverage can enable relatively small and specialized engineering sub-disciplines, such as noise control engineering, to flourish in an environment of substantial growth for traditional disciplinary based engineering educational programs.