Music Engineering Technology: 
An Undergraduate Curriculum

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When one receives a degree in music theory, the terminal competencies are relatively standardized. Except for particular philosophical approaches e.g., Schenkerian, Real or Forte, the agreement on course content and acquired musicianship skills is fairly universal. One of the problems in music technology education is that there is an abundance of degree types, course and collateral experiences. These may be focused in electronic composition, music technology, music engineerng, audio and/or recording engineering, and multimedia. The purpose of this paper is to describe the Music Engineering Technology (MET) program at Ball State University, to define a music engineer, and to present a curriculum review based on research begun in 1993.

My sabbatical in 1993 took me to a selected group of institutions, manufacturers, and independent artists in the United States, Canada, and Europe, dedicated to research and education in music technology. From a curricular point of view, my research revealed no generalized agreement on curricular patterning, course content, or programmatic planning. Commonality that do exist are usually related to operating systems, applications, or hardware resources. The variations in course offerings in music technology, science, and mathematics are remarkable. In most instances, there are no unified degree patterns; instead we find a range of offerings from diversified courses in music technology to hybrid degree patterns that support other more traditional formats. There are a few institutions with degree patterns that have combined traditional music requirements with new courses that have been developed to meet the needs of music technology. In almost every case the music components are still driven by very traditional expectations, and the music technology components separate into two categories: technological experiences that are more practical or vocational, and coursework involving definite scientific disciplines and preparations.

Most programmatic attempts at the organization of the curriculum have been ad hoc—borrowing this course, taking those sources, modifying that course. The patchy nature of these experiences reveal a weakening of the integrity and continuity of the curriculum. In light of this, there is a definite need for curricular evaluation and program design. As an example, the adoption of traditional musicianship training is not adequate for students in music technology. These courses need to be redesigned to include a much more thorough and detailed exposition of psychoacoustics and music perception skills. John Chowning reflects that it is "very important to know how the ear works [and] where the mysteries are in pitch perception." There are materials being developed to address this problem e.g., David Mounton’s "Music Ears" CD. This is a significant step toward revising and enhancing ear training pedagogy. Here again, these resources are being implemented as add-ons, rather than completely redesigning the way in which ear training and musicianship courses are taught. Bruce Pennycook states: "If we’re trying to do it make the next generation of developers of good music tools, they need to know as much about how music works as possible . . . the theory and analysis part is indispensable, as is ear training and basic musicianship skills." (Pennycook, B.) Because of the almost universal agreement that people in music technology need a thorough formal music training we must think about revisiting courses that are more efficient in enhancing cognitive development and that accelerate the acquisition of music skills. This will require a different kind of teaching, learning, and guidance. It demands the use of the technology in the educational process at all levels. The integration of technology throughout the curriculum will offer the advantage of more unique and indescribable learning experiences while, at the same time, increasing the temporal efficiency of the process.

One of the basic problems in educational systems is the administrative tendency to structure temporal components of the system to their advantage. We do not use time efficiently. All courses are not necessarily a full semester long. Maybe we ought to reorient the wheel once again. We need to get outside the administrative convenience and look at what it is we really do in terms of teaching, and see if we cannot
build a system that would be more open and flexible.

The Music Engineering Technology (MET) program at Ball State University has been in development for over twenty years. It began with the establishment of an electro-acoustic music studio in 1969, and its curriculum has been closely related to developments in music technology and in how this technology is used in both the performance and the making of music. The MET degree was originally an outgrowth of the Bachelor of Music in Music Composition. Fundamental courses in electronic music were added to the B.Mus. in the early 1970s: introductory electronic studio techniques, advanced electronic music composition, and electronic sound literature. In the late 1970s, two more courses were added: introductory and advanced recording technology. The first degree in MET was approved in 1983 as Option C of the B.Mus. in Music Composition.

Several early decisions have had long-range effects on the program's development; the program was to be compositionally based, technology was to be strictly 'Munch's Handmade' (Bowles, E.) the science behind the technology must be a part of the students' experience, and the technology studied must itself be used to teach the curriculum. By involving science, the program became interdisciplinary and extramural. This has had a broadening effect on the students and the faculty involved in the program. The decision to build the program around the student's creative involvement was a formative one, for it changed the learning experience from passive to active, from impersonal to personal. The program rejects the conservatory approach in favor of the exploratory.

James Beauchamp reviewed the program in 1987 and found it to be "unique in Indiana and rare in the United States." (Beauchamp, J.) The uniqueness of the program is directly related to its mission to prepare a musician with musical and technical competencies appropriate to the demands of contemporary music making. Its curriculum represents a significant departure from the traditionally accepted patterns of music education. The program requires music and science are designed to produce an individual with a well-balanced ratio of art to science in both theoretical and practical capabilities.

This combination of art and science is similar to the European 'tonemaster' tradition. One literal translation of tonemaster is "sound master," someone who is skilled in the arts of sound recording, transmission, and production. The complexity and special insight of the tone-honed sound studio profession is that it calls for a strange mixture of artistic flair and technical knowledge (Gorweck, J.) In Europe, however, the tendency is to make artistic and scientific education parallel; the MET program program proposes to use science in the service of art. The program is designed to prepare a musician to meet accepted standards of musical competence and to develop expertise in disciplines that have heretofore been a part of science curricula and are, just now, emerging as requisite in areas where music is the principal product; but science and technology provide the basis tools for the media.

The evolution of the MET program has been shaped by the development of new tools dedicated to the making, processing, and saving of musical information. Because of this, special emphasis is placed upon incorporating these technologies into the curriculum and upon presenting these technologies from both the experimental (practical/demonstrating activity) and theoretical (abstract/problematizing activity) points of view.

The MET program has always been viewed as an extension of composition composition, in turn, has always been considered an activity that is different from other educational activities in that it requires the interaction of sonic images—the imagining of aural information—and the creative organization of these images, first in imaginary patterns; then, by the structuring of these patterns, into formal components. Composition is the central integrating activity that focuses all aspects of the program.

In addition, the program's emphasis upon composition allows students to develop their unique personalities and to discover their special attributes and individual qualities. There is an ardent attempt to encourage individuality and a personal view. Roger Lagacé observes that "we must have people with impeccable knowledge, but there will be no progress unless they are people with strange ideas. Digital audio started that way." (Lagacé, R.)

The twin demands of excellence and individuality required a completely new direction for curricular
development. Educational thought in the twentieth century can be summarized as an angle between quantifying and qualifying. Most curricular design originates in an abstract-scientific epistemological point of view. "Scientific assumptions have not only set theoretical coordinates on the field [of curricular development] by prescribing the acceptable criteria for knowledge about educational problems, but they have also defined the parameters within which these problems can be posed. Problems that do not lend themselves to measurement or scientific solution have been intellectually ill-conceived." (Kner, E.) The problem is obvious: measurement/quantification has too often been substituted for real evaluation. The MET curriculum tries to balance empirical knowledge and scientific abstraction. Both quantification and qualification become part of personal judgment and evaluation.

In general, curricular planning has been preoccupied with predictable goals and with control. Little time has been spent developing an educational paradigm that integrates the student in any role other than as a passive receiver of information. However, the MET curriculum replaces the usual four-year sequence of "running hurdles" with a four-year sequence of processing through gaining experience that fosters the acquisition of skills and knowledge by involving individual participation and feedback. It is based upon an action-judgment paradigm modeled on a solid-state physics device called an operational amplifier, a system provided with a controlled feedback loop to select and amplify segregated information.

The MET course sequence is linear, but course activities, projects, and assignments are supported by many non-linear, individual interactions. These activities are designed to encourage the personal development of a concept and its correlate in the real world. Problem-solving is at the root of every activity, and solutions are typically executed as creative endeavors. It is the ratio of theoretical knowledge to applied action that makes an experience that is creatively potent. Evaluations are the feedback component; it is these personal judgments concerning quality and value that contribute to the building of a special kind of person. The intention is to use abstraction as a basis for investigation, thereby energizing the imagination while fashioning an artifact that becomes a sharable creation.

The Music Engineering Technology curriculum has undergone two revisions since 1983 and is under advisement for a third revision for next year. The 1983 revision dealt with developing courses within the School of Music that would support a major in Music Engineering. These courses were designed to broaden the composition-based pattern and to include introductory experiences in sound synthesis and computer applications, as well as a composition materials course that covered twentieth-century experimental and electroacoustic music. In 1987 the program was reviewed externally which resulted in a curriculum revision in 1989. This revision added advanced courses in sound synthesis and computer applications, a production experience, a course in music acoustics, and a minor in applied physics--electronics.

The current curriculum requires a music major in Music Engineering Technology, a minor in Applied Physics--Electronics, junior standing in music performance, and a final composition recital in the senior year. The MET components are: Music Acoustics, Introduction to Electronic Studio, Composition Materials of Electroacoustic Music, Music Perception, Sound Synthesis I, Introduction to Computer Applications in Music, Sound Synthesis II, Advanced Computer Applications in Music, Introduction to Recording Technology, Advanced Recording Technology, Recording Workshop, Production Workshop, and Electronic Music Composition. The general music components are: 6 semesters of Music Theory, 9 semesters of Music History, 6 semesters of Large Ensemble, and 4 semesters of acoustic composition. The Applied Physics minor includes: 2 semesters of calculus, 2 semesters of general physics, and 2 semesters of electronic physics. In addition to these requirements, there are approximately 35 semester hours of general education requirements.

The curriculum revision committee for the MET program has proposed a combination of music acoustics and perception and the introduction to electronic studio course and the materials of electronic music course in order to add more composition. They have also suggested breaking up the technology courses into smaller modules and developing media tools to teach these modules on a more independent basis. Course assignments seem to be more project oriented and the student portfolio review is to be expanded. A request has also been made to include some expansion of the DSP components in the physics minor.
The music engineer is a hybrid of the interdisciplinary artist and the scientifically competent engineer. The
technological growth in the late twentieth century is unprecedented. At no time in our history has the
thinker, the maker, or the poet been faced with such a communicational and representational convergence.
Technologies flourish today that were inconceivable a few months ago. This has had a tremendous impact on
the kind and quality of our musical tools. Competition is becoming an engineering activity.
The role of the music engineer is similar to that of an architect; one who designs music, plans and creates
environments for music and creates and maintains systems for the production, reproduction, transmission
and storage of music and the allied arts.

The requirement that the music engineer should become a composer produces a person with very special
insights. These insights are applicable to many careers: recording production, broadcast, sales engineering,
telecommunications, and the technologically-dependent performing arts. The point, then, is not that all
MET graduates remain composers, but that the special insights offered younger composers through the study
of technology-assisted composition provide learning models that can be translated into the kind of effective
operational skills that are required to manage a complex technology system.

It should be apparent that the MET program is quite different from audio engineering and recording
engineering programs. The audio and recording aspects of the program are important in the sense that they
define how certain technologies are used, but they are only component parts of a larger curricular question:
how can we use these technologies musically? These questions must remain paramount amidst the
complications that arise from merging many technologies, as highlighted by Stephen St. Croix: "we see too
much technology today that we are often immersed in 20 or more basic technologies at the same time." (St.
Croix, S.). The key word here is “basic”, and that forms the cornerstone of the MET experience: learning a
basic scientific and artistic foundation for the marriage between art and science.

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