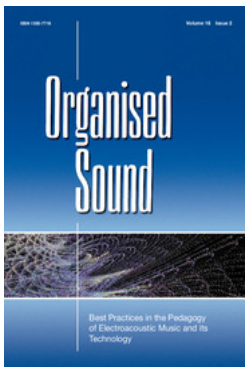

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Consilient Spheres of Influence in a Land Grant Setting

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At Penn State, music technology is something of a stranger in a strange land. As a programme, it began in the early twenty-first century, when the necessity of the moment was an anticipated revision to the guidelines from the National Association of Schools of Music (NASM), the North American accrediting body. Music schools were charged with ensuring that music majors were exposed to 'relevant technologies'. It was left largely to individual institutions to interpret what this meant. At Penn State, a course was created to address this guideline, and it generated interest among students. This course then spawned a series of related courses. These courses eventually created enough of a curricular presence to warrant creating an undergraduate minor. We now expect that the minor will spawn an undergraduate major. The music technology programme's locus lies not solely within the School of Music; rather, it overlaps as an interdisciplinary area with a variety of programmes throughout the university's offerings. These overlaps are a unique feature of the programme. It is an unusual arrangement, but it is a product of its time and place. Three populations of students have coalesced, and the pedagogical challenge has been to create a curriculum that can serve all of them. The programme might be thought of as series of concentric spheres; each is centred around the same general concept structure, but with expanding breadth for different levels of student involvement.

1. SETTING THE SCENE

1.1. Curriculum and culture

Educational expectations vary from place to place. On the day this is being typed, the *New York Times* is running a debate about whether United States secondary educational standards and funding should vary by state (Lehman, Darder, Cargill, Hess, McCluskey, Bush, Williams, Holliday, Biddle and Noguera 2012). And we, the authors, are probably not the only instructors who found we had to make a variety of adjustments when we transitioned from teaching as graduate students in one institution to teaching as faculty members in another. Expectations and approaches that work in the culture of one academic institution may seem foreign and strange in another.

The music technology programme at Penn State is a product of its time and place. The particular challenge of creating course offerings was to create a curriculum that fit into this culture. While we have availed ourselves of certain contemporary teaching approaches – utilising online resources, for example – the primary focus of our energies has been on designing a sequence of appropriate courses. The courses themselves are fairly straightforward and workman-like: students are shown tools and expected to use them. Students' success is the result of their own initiative, rather than the result of novel pedagogy. What follows is an overview of the local culture and the justifications for the curriculum that has come into being. As we shall show, what initially seemed like a disadvantageous position within the larger university has turned out to have unexpected benefits.

Our context is North American. Penn State is one of the original land grant universities, which were a mid-nineteenth-century creation whereby federally controlled land was ceded to the states to create colleges. The purpose of these schools was to provide practical education to the growing middle class of the industrial revolution, typically focusing on science, agriculture and engineering, along with some exposure to the classics. Penn State's original mission was to provide scientific approaches to farming. As is the case with many land grant schools, its main campus is located in the rural geographic center of the state. Pittsburgh is a 3-hour drive in one direction, Philadelphia a 3-hour drive in the other. As the joke has gone since 1855, the location is 'equally inconvenient for everyone'.

While the initial impetus for land grant colleges was to provide an alternative to the traditional and elite liberal arts education, over time the various schools have moulded into their own particular forms. At Penn State, a classically based framework has been folded into the practical nature of its offerings in the form of a general education component that is common to all undergraduate degree programmes. Courses are typically three credits, and students must take a total of 45 credits of introductory courses, usually of their own choosing, in categories that include humanities, natural sciences, arts, social and behavioral sciences, maths, writing and speaking, and health and physical activity. With degree

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programmes typically requiring 120–130 credits for graduation, general education is a larger proportion of general studies than what is required at many universities. The idea is to expose all undergraduates to the methods of all major spheres of knowledge enquiry, with the chance that, in so doing, many of them come across a new subject for which they develop an unexpected passion.

Penn State's School of Music lacks the benefits of some conservatory-modelled university music programmes. Many of these programmes began with large endowments that were made a century or so ago, but such an event never occurred at Penn State. The local musical culture of central Pennsylvania secondary schools is typically focused on choirs and marching bands, rather than on solo classical performance or chamber music. Not being situated in an urban center, there is not the same access to guest performers and adjunct instructors as can be found in urban universities. Thus, the musical culture of the university and the surrounding area is not historically one of high-level concert performance. The School of Music's resources, particularly in scholarship aid, are not quite on par with other large universities' music programmes. Until the 1980s, the School of Music was considered little more than the marching band and glee club to most Penn Staters, a campus service unit with some supporting courses. Since then, the School has grown dramatically. Its training and degree programmes are based on benchmarks set by the National Association of Schools of Music (NASM), the American accrediting organisation, and the School now offers instruction on all orchestral instruments, with a broad array of ensembles.

1.2. Standards

The Penn State School of Music grants four undergraduate degrees: two professional degrees, one liberal arts-based degree and one interdisciplinary degree.

According to NASM standards, professional degree programmes emphasise the development of a high level of proficiency in the student's major area of interest and generally require at least 65% music content. A liberal arts degree programme combines a liberal arts education with broad coverage of music, rather than a heavy concentration in any one area in music. Liberal arts music programmes normally involve 30–45% music content, with lower expectations in performance ability and ensemble participation than for students in professional degrees.

At Penn State, the two professional undergraduate music degrees are the Bachelor of Music (in performance or composition) and the Bachelor of Music Education (which is the degree pursued by over half of the School's undergraduate students). The liberal arts-based degree is a Bachelor of Arts in Music, and the Bachelor of Musical Arts is an interdisciplinary programme that pairs performance-level music study with advanced study in another field.

Prior to 2000, the extent of the School of Music's offerings in music technology was an electronic composition course meant primarily for composition majors. Defining what music technology might mean beyond this proved to be a challenge due to the broad range of assumptions that people associate with the term. As of 2012, this challenge is easier, as NASM have completed a set of music technology standards (NASM 2011–12: addendum, Appendix I.H) that are of great help in clarifying the breadth of the field and identifying areas of focus. The standards identify a variety of areas, including:

- *recording, manipulation, and live performance*: mastery of industry-standard recording studio technology, audio engineering
- *electroacoustic music and live electronics*: use of digital technology to create and perform new compositions
- *audio applications*: sound design and audio production for film, games, video and other multimedia
- *education*: use of digital technology and classroom-based systems for developing pedagogy
- *psychology-based research*: understanding and assessing human behaviour
- *engineering and the creation of technological means*: creation of audio hardware and software.

The expectation is that no one school will offer training in all these areas, but schools can define the areas in which they do offer training, and ensure that in those areas they are within current norms. At Penn State, we touch upon the first four, and provide opportunities for greater depth when students wish to pursue them further.

2. CREATING A PRESENCE

At the turn of the twenty-first century, a necessity of the moment at the School of Music was to ensure minimum technological coverage: a single course needed to be required of all music majors that acquainted them with technological tools relevant to musicians. This was in response to additions to the accrediting standards created by NASM, whereby all music majors were to be exposed to 'relevant technologies'. (It was left largely to individual institutions to interpret what this meant.) While this course was being created in the School of Music, the School of Theatre launched a major in sound design. Both of these separate, initial efforts spawned several courses. The present music technology offerings grew out of these two initiatives, which gradually converged due to the many commonalities between the two areas.

The structure that has resulted in this *ad hoc* fashion is one that provides a telescoping set of requirements to meet the needs of three student populations:

- Basic coverage is provided for all Music students.
- In-depth coverage is provided for students who earn a music technology minor.
- Advanced coverage is provided for majors in three possible degree programmes.

2.1. Level 1: basic coverage for all music majors

As of 2012, NASM standards for technology have softened somewhat, largely due to the ambiguities in the certification requirements. In current versions of their guidelines, various degree programmes typically include a list of competencies, one of which is the 'ability to use the tools of the field, and applicable technologies' (NASM 2011–12). At Penn State, we require all music majors to complete a one-credit online course that is meant to acquaint them with tools based on a digital audio workstation (DAW) that are relevant to music performers and educators. The course gives them exercises in:

- audio editing with Audacity (or equivalent)
- sequencing, processing and mixing audio in a sequencer such as GarageBand
- working with MIDI files and MIDI tracks in a sequencer
- podcasting audio projects
- basic concert recording with handheld device, creating a multi-track audio CD
- preparing arrangements with notation software.

In additional to this DAW course, there is also a general education course in the natural science domain in musical acoustics. All music majors are encouraged to enrol in it, and it is a requirement for students majoring in music education.

The adoption of required courses is both a blessing and a curse. While there is a decided sense of validation for a faculty member who designs courses that are valued by colleagues and adopted as requirements, the downside is a statistical certainty of some level of failure. Students who take courses only because they are requirements are like water: some percentage will seep into any leak or loophole in a course's policies; they will often seemingly demonstrate far more initiative in trying to avoid meeting requirements than it would take simply to do the coursework. An instructor's energy is often disproportionately consumed with responding the conniving and the unwilling. While this has always been true to some degree, educators often point out that the situation has intensified in recent years, and is the outgrowth of a society that is increasingly consumer-oriented. Millennial students are 'digital natives' who expect service on demand, are accustomed to being able to shop or view entertainment online at any time, and who shape what is available for consumption by participating in various related forms of social media. A degree is often seemingly something that is to be purchased rather than earned, and courses that do not fit students' notions of the product they wish to purchase are often treated with open disdain. An instructor is often forced to create rigid enforcements to course policies, with the unfortunate side effect that the overall course environment becomes something like martial law. Inevitably, this alienates some students from the subject as a whole, thus undermining the original goal for the class. One can, at best, please most of the people most of the time.

2.2. Level 2: in-depth coverage with a music technology minor

At Penn State, a minor is defined as an academic programme of 18–21 credits that supplements a major. A minor programme may consist of course work in a single area or from several disciplines, with at least six, but ordinarily not more than half, of the credits at the upper division level. As courses applied to a minor may double-count with courses for a major, students may use the minor as a complement to their major field of study without increasing their graduation credit requirement.

The ability to pursue minors in a broad variety of fields is one of the selling points for a large university. The uncertain unemployment market students face upon graduation compels them to try to add to their list of credentials whenever possible. Effective pairing of a major and a minor can lead to different types of resumes. For psychology majors, for example, their degree coupled with a minor in early child development looks very different on a resume from a psychology major with a minor in accounting or statistics. Thus, while a minor may mean little in isolation, when applied properly it can legitimately enhance a programme of study.

The music technology minor groups five courses from music and theatre into a basic core curriculum; in addition to this core, two additional elective courses allow students to define an area of particular focus:

- Music rudiments: a general education arts course in introductory musicianship; (students often refer to it with the nickname 'clapping for credit'). This requirement is often waived for students who have some musical training in their backgrounds.
- Science of music: the same natural science general education course required for music education majors, described above.
- An expanded version of the DAW workstation fundamentals course that is offered for music

majors, described above. The expanded version of the course is three credits, with the same general types of lessons, but with assignments that are more in-depth and completed with a professional level sequencer, such as Logic Pro; this is a general education arts course.
- Introduction to theatre sound design: the role of audio in dramatic productions (theatre, film, television).
- Audio recording: how to record projects in a professional studio.
- Two approved elective courses.

The theatre presence in the minor weighs the learning outcomes towards a general concept of sound design, rather than towards formal musical training. While those with musical training have an easier time of it in the courses, there is ultimately no way to enforce musicality. This naturally calls into question whether the word 'music' belongs in the title of the minor. We feel that it does, with the justification that the minor's core courses provide groundwork in both means-of-production and means-of-perception regarding musical audio technology. The music rudiments requirement ensures that students attain at least some basic music literacy. But, being a minor, it is not meant to be a complete programme of study, but rather a set of foundational principles that should give students a head start if they do decide to seek more comprehensive training.

A theme uniting the core courses is an emphasis on a form of ear training. The musical acoustics course introduces students to spectra and sound types (simple tones, noise, complex tones, instrumental families, and the role of reverberation in performance venues). In the DAW course, one of the capstone projects involves creating a sound collage consisting of audio clips lasting no longer than two seconds. Those who succeed at this assignment are those who can identify interesting features of a sound and combine them with other sounds in a way that creates a convincing sound world. The theatre sound design course takes the creation of a sound world further by considering the effect sound has in a production along with other design elements, and the role of sound in establishing an enveloping virtual environment for audience members. Finally, the studio recording course fine-tunes students' appreciation of different microphone choices and stereophonic patterns.

These core courses are meant to provide a solid set of fundamental skills. Effective instruction in fundamentals seems not always to be a given. For example, we have had electrical engineering majors tell us that the Fourier transform only started making sense when they took our courses – we don't immerse them in maths, but just give them the 'view from 10,000 feet', which seems to get overlooked in the engineering courses. The fact that music technology at Penn State has taken hold from the ground up, rather than the top down, means that we started by developing introductory courses, which had to be accessible to the general student population. As a result, one of the minor's strengths is its core courses' presentation of fundamentals.

As for the minor's elective requirement, a variety of courses are available. Other courses that we teach include software programming for musicians, history of electroacoustic music (Ballora 2006) and sound synthesis. Often, however, students enquire about the applicability of courses offered by their major areas of study. For example, electrical engineering offers digital signal processing (DSP) courses, communications offers courses in sound production for film and television, and information sciences and technology offers courses in media and the law. We are able to apply these courses to the minor's elective requirement, so that the minor overlaps with their majors.

It has been often noted by veterans in the field (ICMC, 2006) that computer music has broadened and democratised from something available only to a small group of specialists to a medium that is now as ubiquitous as photography, another medium once inaccessible to any but professional experts. The ease with which advanced DSP can now be carried out on consumer-grade laptops has made digital music and audio technology accessible and relevant to a variety of fields. Just as content creators of computer music have broadened, at Penn State the curricular offerings in it have similarly broadened and democratised, so that the presence of music technology is not due to its being an area unto itself, but rather to its playing a significant complementary role for other areas of study.

Apropos to the discussion above about an effective pairing of major and minor, a number of electrical engineering majors who have completed the minor are working at audio companies, designing audio-specific integrated circuits. But students in any major may complete the minor. Students who have completed the minor have majored in music, information sciences and technology, electrical engineering, journalism, pre-med, meteorology and astronomy.

On the downside, for many students, minors are something to collect like merit badges, often quickly, when they find that they have extra credits available during their last few semesters in college. 'Music technology' sounds alluring enough that many are drawn to it based on an immature understanding of what work in it entails. (Colleagues report similar experiences with the photography major, which often seems to attract highly eager applicants who have never taken a picture in their lives.)

Many students are misled by commercial software that is targeted at easy creation of dance tracks: while the democratisation of digital audio is a positive development, it also can delude people into thinking that it is easier to become remarkable than it actually is.

It can be difficult to tell at first whether a student has developed real skills, or is simply using software out of the box and essentially painting by numbers. (We become immediately sceptical when a prospective student says, 'I've got to be in this minor because I spend a lot of time mixing beats!') Thus, a certain percentage of our energies are expended in defining what the minor is not: it is not a 'school for waywards', where weak students who aspire to be DJs can seek an academic haven; and it is not 'music lite for rock and rollers'.

Another result of the school of theatre presence is a certain bootstrapping attitude towards the coursework. In the world of theatre, the show goes on, no matter what. There are no such things as 'do-overs', 'excused absences' or 'deadline extensions'. For students who have been raised in an 'everyone gets a ribbon' culture, this mindset can be quite an awakening.

While the minor is not a complete curriculum, it gives students an opportunity to create a compelling portfolio of work. We often stress to students that it is the portfolio that is important, not the minor, which is simply an extra annotation on a student's transcript. If nothing else, students in the minor come up against the bottom line that truly excellent work remains a meritocracy. Having tools does not make one an artist; digital technology only strengthens abilities one already has.

The existence of the minor at Penn State has been helpful as a stepping stone. It gave a presence to an area that was previously undefined at the university. While remaining an appropriate option for students who are forming an individualised pairing of a major and a minor, it also points towards the establishment of a music technology major as a logical expansion of this presence.

2.3. Level 3: major studies in music technology

With the variety of music technology courses available and the resources of a major university, the creation of an undergraduate degree seems feasible, even inevitable. However, music technology courses are already integral to two existing degree programmes.

2.3.1. Integrative arts

This is a general-purpose degree in the arts, in which students are allowed to create their own curricula with the aid of an adviser. This programme is often suitable for those who do not fit the mould of the traditionally based arts training majors offered in the College of Arts and Architecture at Penn State. A number of students have folded the music technology minor into a broader curriculum through this degree. For example, a number of them been able to train themselves to be professional, touring musicians playing original folk or rock material; the training they set up for themselves consisted of courses in music technology, business and design.

2.3.2. Theatre sound design

This is a professional training programme in sound design and theatre technology, with the goal of having graduates placed as professionals on Broadway, regional theatre, and resorts such as Las Vegas hotels. In addition to taking the music technology core courses described above, students are trained in how to design live sound systems for musical theatre, rock, dance and other types of shows, as well as in the issues of different venue types such as small clubs, outdoor amphitheatres, convention halls or concert halls. They also learn show control – the creation of metasystems of smaller systems that are able to communicate with each other, including lasers, lights, sounds and images.

2.3.3. Looking forward: liberal arts degree in music technology

We are currently designing a special music technology track for the liberal-arts-based BA in music degree (described above). This would include the current musical core of the BA, which consists of two years of coursework in theory, ear training, music history, piano proficiency and ensemble participation. To create a music technology focus to the BA, our idea is to mandate certain general education courses offered by other degree programmes, so that students receive training in calculus, computer programming and electronics. Other BA in music elective credits could be mandated as well, so that they would include the music technology minor's core courses and the other related courses mentioned above: history of electroacoustic music, sound synthesis, software programming, electronic music composition and recording studio training. Like the BA in music, this degree would culminate in a thesis project.

We are attracted to forming a degree based solidly in music rather than creating a general multimedia degree, which may not be based in any established standards. To be sure, a liberal arts degree such as a BA may lack some of the focus of a professional degree programme in music technology. A professional programme would, at the very least, need to include a series of courses in recording, a series of programming courses, as well as courses in studio maintenance, DSP, law/ethics/digital rights, and some sort of internship placement process.

In contrast, a BA programme might be described as 'one of everything', course-wise. Students get enough exposure in enough areas that they should find themselves easily trainable in a professional direction of their choosing. The BA in music technology that we have in mind can arguably be said to observe many of the essential competencies described by NASM for music technology programmes.

Overall, the advantage of any BA is its liberal arts foundation, a once-proud tradition that increasingly finds itself under popular scrutiny, as degrees in STEM areas (science, technology, engineering, mathematics) are often regarded as being of more tangible value. Yet many also recognise the danger of placing an overly vocational focus on a college education. Employers often report being distressed at the lack of critical thinking and writing skills in many of the college graduates that they hire. The goal of a BA is not to produce specialists, but, rather, generalists who are educated, creative and adaptable. These are qualities that are becoming increasingly valuable in a society that is crippling itself with a primary and secondary educational system based on standardised test preparation, with little training in analytical and creative problem solving. (Hirsch (2011) and Hedges (2011) are two references that just scratch the surface of available material on this topic.)

The acclaimed author and biologist Edward O. Wilson (1998) describes consilience, the unity of fields of knowledge – particularly the linkage between the sciences and the humanities. His thesis is that the fragmentation of knowledge is not inherent in the diversity among fields, but is rather an imposition created by contemporary scholarship. He predicts that unified learning, one of the greatest legacies of the Renaissance and Enlightenment, will rise inevitably again in importance, as the answers to many of the problems vexing humanity lie in integrating social sciences, humanities and natural sciences. According to Wilson, the only way of viewing the world clearly is through an integrated perspective.

Wilson's writing rings true to our context: consilience is at the heart of Penn State's general education credit requirement, and it is at the heart of the music technology programme. Penn State's general education credit load is often difficult for professional degree programmes such as music education, which must also meet ever-shifting state teacher certification mandates. Balancing the university's general education requirements with the requirements of their accrediting bodies can be quite a juggling act, and keeping the total degree credits within manageable numbers can be challenging. However, a strong general education component is entirely appropriate for liberal-arts-based programmes. We hope that it will be a refreshing alternative to offer a music degree that unites technology and the arts, and that embraces the university's general education component as a vital part of it.

3. CONCLUSION

Music technology at Penn State is the result of a kind of grassroots groundswell. Students were attracted to an initial course in sufficient numbers that the need for other courses became quickly self-evident. On the one hand, it has taken some time for it to gain the respectability of its own major. But it has established itself as an area of foundational principles that are relevant to a variety of student populations. This gives it a curricular breadth that is not always found at other universities. Rather than creating a niche programme housed within the school of music, we have had to make a programme that had a university-wide footprint.

We believe that this reflects a societal reality, which is that music technology is not just an approach to music composition or recording, but is, rather, a far-reaching endeavour that produces employable people in a variety of positions – our own classmates are now working in fields such as web development, cellular telephone technology and programming at a variety of companies, as well as working throughout the theatre and audio industries. Since music technology is an area with wide-reaching relevance, our greatest strength lies in our greatest disadvantage: one academic unit, such as the school of music, cannot cover music technology all on its own; rather, music technology can only exist as part of an interconnected network of academic offerings within the larger university.

A professional degree is meant to prepare students for jobs that currently exist. A liberal arts degree is meant to prepare students for jobs that do not exist yet. Each has its place; what is a bug for one student is a feature for another. We look forward to being able to offer a liberal-arts-based music technology degree programme that has as its basis a philosophy of consilience.

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