Running Head Right-hand: Designing Vocational Training

Running Head Left-hand: Duncan Williams

12

Designing Vocational Training for Audio Engineers at a Distance

Challenges, Reflections, and Recommendations

Duncan Williams

Introduction

This chapter addresses the design of a full credit remote access module as part of an undergraduate degree course in music technology with a particular focus on sound recording technology at a public university in Texas.[1] Although the audiovisual industries, and to a certain extent the corresponding educational sector, have traditionally regarded music technology as a vocational skill, and as such, one that must be learned in practice, the client university required that all content be delivered, facilitated, and assessed entirely electronically—a challenge that necessitated a number of particular pedagogical approaches. Distance learning allows students to study technical content at any time, and at their own pace.

The method of practical assessment used would be appropriate to many other creative sections of the audio-visual engineering sector where technical knowledge and achievement of professional standards is an overarching mark of skill, and thereby an indicator of successful learning. A combination of multiple-choice assessment and virtual face-to-face reinforcement can be leveraged to maximize academic differentiation and contextualization of course content. This chapter will focus on appropriate curriculum selection and design for distance learning, illustrating the advantages and disadvantages of such a system with technical and vocational content delivery in practice, and includes an analysis of the difficulties inherent in teaching and assessing such topics remotely as well as examples of the curriculum content to give a context for assessment.

With the age of the personal computer it is no surprise to see distance learning techniques adapted to delivery electronically, often using an "in-house" *Virtual Learning Environment* (VLE) that facilitates browser-based display of reference and interactive material. A review of literature addressing this electronic mode of distance learning exists (Philips and Merisotis 1999). It is often stated that distance learning is "no new thing"—in the United Kingdom. For example, the Open University has offered distance learning courses for adults up to doctoral level for many decades, and teachers offering material for remote study via postal services can be traced back much further than this (Holmberg 2005). In fact, the application of the Edison Phonograph to music education, predicted by the inventor himself (Edison 1878), as a means for musicians to not only hear example performances from their instructors at a distance, but also, by return, submit recordings of their own performances for assessment using the postal service, is an early example of music technology informing and supporting distance learning practice, though the curriculum was not usually tailored to the delivery format *per se* (Kelleher 2012).

The pedagogical success of distance learning strategies is often judged by comparative analysis with traditional teaching (Ni 2013). In the case of a student enrolled on a vocationally based course—by which for the purposes of this chapter we mean a full undergraduate degree program which includes practical training in music technology (or indeed namesakes such as sound engineering, audio technology, recording, etc.)—traditional teaching would most likely be delivered face-to-face in classrooms, laboratories, workshops, and studio suites. Exam performance is a common method for the summative assessment of theoretical content, whereas students' practical skills are typically developed, and assessed, by a combination of formative observation and summative coursework submission.

"Value Added" data (a UK-specific term referring to a government statistic) can also be used as a tertiary metric—indicating student progress against their academic profile on entry to the program. Student satisfaction, or even "attitude" toward the content and style of program delivery are also occasionally monitored as further benchmark measures with which to compare the success of distance learning with face-to-face teaching. "Blended" learning, a system combining distance learning and traditional methods, has gained some popularity amongst the Further and Higher Education sector ("Scenarios, Strategies, Guidelines and Tools", 2012). In the UK, further education refers to study below undergraduate degree level, but beyond compulsory school-age (secondary) study.

A challenge with providing degree level programs in music technology, at least when combined with a vocational focus, is the lack of an industry standard qualification level. Anecdotally, it appears that many sound engineers working at the highest level in industry have learned their trade via unpaid internships, apprenticeships, or autodidactically. However, the advent of manufacturer certification for particular software packages does address a benchmark skill set in some respects, as does the efforts of accrediting bodies to standardize with industry (in the UK this falls under the aegis of the government funded *Creative Industries' Sector Skills Council*). It is difficult to ascertain from the job market whether or not such accreditation has become a criterion for subsequent entry to the workplace. Nonetheless, full degree programs with a focus on developing vocational skills in music technology, as well as broader, more generalized academic skills, have become part of the repertoire of many universities (both publicly funded and specialized institutions).

Motivation

There are at least two distinct advantages over traditional (face-to-face) teaching for an institution delivering a program via distance learning (Oblinger 2000). First, the field of potential student applications is no longer constrained by geographical location—a student can apply, and potentially study remotely, from anywhere. Similarly, the university human resources committee can "cherry pick" subject specialist staff to deliver the content, regardless of their location. A university or college based in an area with limited audiovisual industry might employ instructors from more prolific industry areas—London, Nashville, Los Angeles, or New York, for example—selecting instructors with firsthand industrial experience and an ongoing professional practice. This selection of adjunct faculty from industry (whom often continue to work in industry outside of their teaching duties) gives reassurances to students (and potential applicants) that relevant and current industry practice is being taught (though the technical element of the program might need to be supervised by a local technician, or by a video demonstration in the case of some content). Both of these motivating factors have an additional advantage for students enrolled in a distance learning program.

First, if the course content has been designed with care and appropriate pace, students should be able to navigate the content at their own speed, allowing for technically complex material to be covered. Practicable formats for delivery of technically complex material depend on the context—for example, DAW techniques might be feasibly delivered remotely by screen capture video sequencing, or fundamentals of sound by more traditional reading and interactive exercises. Physical audio engineering related to signal flow is more difficult to recreate virtually or remotely without appropriate setups at both ends of delivery—e.g. a duplicate patch-bay and outboard equipment (although some virtual instruments, such as the Reason platform, offer virtual simulations of patch-bays with similar signal flow). This is particularly relevant to the field of music technology, where both an aesthetic and technical understanding is vital to the overall curriculum, and will be discussed further later in the chapter.

If technically complex or "dense" material was all delivered face-to-face, students would have to ensure they kept up with the speed of delivery in the classroom (or indeed, workshop, or studio), which can mean keeping pace with (or conversely, waiting for) others in the student body (Otondo 2016). Second, the practice of *active listening* or *critical listening* (Walzer 2015) can "eat" into face-to-face teaching time, similarly active practice (Digolo et al. 2011; Seddon and Biasutti 2009). Developing a critical ear is a standard part of most music technology curricula, and hence giving the students an unconstrained amount of focused listening time, and space free from classroom distractions, for example, can be a strong advantage to be exploited by distance learning. Although the technical accuracy of a home monitoring environment can be compromising, high-quality open back headphones are reasonably affordable and the previous bandwidth limitations involved in delivering audio content online are less restrictive with current internet provision.

Existing Strategies

Currently, the delivery of distance learning in the music technology field can be broadly divided into one of three “camps”, based on their general pedagogic approach (Booth et al. 2003):

1. Vocational programs without formal assessment (“hobbyist” courses)
2. Blended learning, content designed to support formative assessment on higher level programs (for example, to support degree-level study at university)
3. Full online delivery, including summative assessment, of higher level programs

A fourth approach, using totally virtualized environments, for example modeled using 3-D technology (Dickey 2005) (Halvorson et al. 2011), social media platforms (Salavuo 2008), or VR/AR/XR approaches (Jordan et al. 2016), where XR is a relatively new term for *extended reality*, were at the time of developing this material considered beyond the scope of this work, though they each offer the possibility of providing interesting tools to overcome limitations such as access to specific studio equipment, and indeed some research from the broadcast audio industry is considering these techniques for use in novel production paradigms (Pike et al. 2016). However, this work focuses on material that can be used within traditional (existing) distance learning technology, with a view to wider dissemination and the focus on both broader academic and vocational skills.

Virtual and distance learning technology has now become relatively standardized—many institutions use the same, or similar, technology, and hence this chapter focuses on the broader pedagogical issues of such an approach with specific reference to the vocational training and assessment of sound engineers and music technologists. Two papers presented at conventions of the Audio Engineering Society have evaluated specific technology and selection of appropriate material (Papanikolaou et al. 2000) using database/web interfacing technology (Kalliris et al. 2001), with a third paper outlining the initial stages of design and development of this module (Williams 2012). Beyond the Audio Engineering Society community however, there has been recent scholarship on the use of e-learning particularly for music education, and to some extent in music technology, for example the interested reader may wish to see the work of Himonides (2018), Ruokonen and Ruismäki (2016) or Crawford (2017) in these contexts.

Design and Assessment

This section outlines the design and rationale behind assessment of the remote access module (MUT360, Commercial Recording and Composition) for the Sound Recording Technology program at a public university in Texas. The module was designed in conjunction with technologists and learning specialists at the university, as well as faculty from the Sound Recording Technology program.

Course Design

Research on the definition of the discipline of music technology in the UK concluded that there is no definitive job description for a music technologist (Boehm 2005). As a descriptor, music technology traverses many fields and specializations, but some might take issue with the label of music technologists (Boehm 2007). Nevertheless, designing any course for music technologists requires an immediate and encompassing consideration of technical provision. There are many possible tasks which might be deemed teaching in the delivery of this provision—and the task of course design can be discrete or integrated with the teaching (in other words, may be carried out by the same person, though not necessarily). Teaching might include technical demonstration, moderation of discussion threads, delivering video lectures or seminars, and so on.

In this case, a particular demand on the teaching aspect of the delivery is the emphasis on "hands-on" experience, without which a student would reasonably be expected to struggle in industry as many entry level positions will provide little time for practice, and in any case, without technical experience it would be difficult to contextualize much of the material involved in this type of sound recording course—a course aimed at practical production with some theoretical knowledge. In this case, the fundamental question posed must be: *can students access the technology they require to complete industry standard work remotely?*

However, distance learning is not as disadvantaged as it might initially seem when compared to face-to-face methods in this regard—real industry work often requires the engineer to be "in field" (perhaps carrying out a recording of Foley, cues, or dialogue, for example), and contemporary composers or sound designers working on commercial music seldom work in large teams in the recording studio (with notable exceptions in the world of high-budget gaming or film soundtracks).

Therefore, basing assessment briefs on such examples of industry practice fulfills both the requirement to train students for the real world of work, and negates the need for a centralized equipment "hub" in a school, college, or university (recording studio suites, workshop laboratory or the like) which might have traditionally provided "face-to-face" students with access to hardware technology. However, by the same token, the implication is that the development of interpersonal skills and teamwork are two elements of traditional teaching that are extremely difficult to replicate or promote via distance learning, particularly with this "solo" approach.

Fostering collaboration and interaction between students is a useful approach for many elements of the study of music technology, and while an online forum allows for some interaction and discussion amongst the student body, the technology in many traditional VLE systems is not currently advanced enough to readily allow for true distance collaboration on practical projects in real time. Although increasingly social media style platforms (Salavuo 2008), synchronous group video calling (Abdalrahman et al. 2018) and other cloud computing platforms (Kim et al. 2018) might address these challenges, in this case the course content was nevertheless designed with the need to foster such skills in other ways.

The below levels treated as H3

Course Content

The curriculum was designed with the development of two streams of skills in mind: holistic (transferable, broader educational) skills and specific vocational skills, though as might be expected there is a degree of crossover and reinforcement between the two.

Table 12.1 Example holistic and vocational skill set streams targeted by curriculum design

Holistic	**Vocational**
Collaboration	Sound
Analysis (written)	Processing
Critical listening	Sequencing

The below content treated as TSN

Source: For more detail on holistic approaches to distance education the interested reader may wish to see (Bozkurt 2019) and for the influence of model on vocational training (Suartini 2019).

The course we describe here is aimed at third-year students majoring in sound recording technology. Each cohort contains up to 30 students, with a broad range of backgrounds. The course has run successfully each spring semester since 2012, most recently at the time of writing in 2019. The interplay between the skill set elements presented in Table 12.1 is important. An understanding of the fundamentals of sound from acoustic principles can inform the students own practice of critical listening, which we might consider as a development of aural analysis (not unlike the aural analysis a musicologist might require in their field, but rather, focused on the elements of recorded sound, thereby core to music technology).

In recent years there have been many advances in critical reflection on the processes and practices of music production, especially in educational contexts. The interested reader might consider Zagorski-Thomas (2007) or indeed the journal and conferences of the Art of Record Production, who frequently discuss how to develop critical listening in the context of practical music technology, for example interviews with educators (Wells 2012) about teaching content, or technological changes as the industry evolved from analog to digital recording (Bennett 2012). These elements can, once understood in principle and *heard* in practice, be deployed, through the remaining vocational elements. These include signal processing, sequencing, and editing, thereby allowing the student to develop and demonstrate their mastery of the vocational skills required to work with music and technology, which the design team considered important when specifying the course. Thus, student work could, in context, be self-directed and single-handed, but ultimately should require collaboration (developing teamwork and interpersonal skills, juggling deadlines, and negotiating priorities), which involves working in small teams outside of scheduled contact time.

The advantages of group work are somewhat axiomatic based on the author's own praxis, but several pedagogic theories also ground this thinking, both as a dialogic practice (Skidmore and Murakami 2016) and in terms of the so-called *design ladder*, wherein knowledge is developed in response to real circumstances (Wrigley and Straker 2017). If we consider the design ladder as a possible "route" students might take through these skill sets, it becomes clear that the quickest way for the student to learn some of the skills required for work with music technology is not necessarily the most advantageous in terms of creating a more balanced academic profile, in other words a set of transferable academic skills beyond the immediate requirements of the discipline, or indeed the development of material suitable for academic assessment (Barber et al. 2015). If the route the student takes through the material can influence their learning in a dramatic way, the order of curriculum presentation must be considered carefully. Figure 12.1 illustrates an idealized route through this process.

[Insert 15031-3763–012-Figure-001 Here]

Figure 12.1 Possible routes a student might take through this course as an online-only offer in music technology studies.

The below content treated as FgSN

Source: Teamwork and collaboration are difficult to develop in a distance based course but are essential elements of the interpersonal skill set that a music technology program to encourage. Much of the music industry relies on these skills (Bennett 2017; Cain and Cursley 2017).

Content was based on real-world industry experience and fed directly into the design of assessment work. The "yardstick" assessment criteria applied was simple: *is the work submitted at, or close to, professional broadcast standard*. Much of the module content was therefore focused on broadcast practice and deliverables, including written and theoretical examples from professional radio and television, with technical discussion of the necessary associated standards. Publishing briefs and contracts from an anonymized major label were used to provide context as to the type of brief practitioners might expect if engaged in professional work, for student analysis, along with example session files and documentation. A clear advantage of delivering this material online was the ability to "embed" audio and video examples, and include example sessions (generally Pro Tools sessions with stem files) for practical experimentation by students, augmenting the written material. For students without access to Pro Tools alternative sessions (.wav stem files for use in any multitrack DAW) could be provided, but in the case of this course all students are given a license for Pro Tools when they enroll.

[Insert 15031-3763–012-Figure-002 Here]

Figure 12.2 Slide illustrating de-essing technique. Sidebars allow students to audition audio files and session files.

For example, when discussing the use of side-chain filtering and dynamic compression to remove vocal sibilance in a “de-essing” process, students can download and audition “before” and “after” versions of a processed vocal, read a written explanation of the signal flow, click through to further references, or download an example session file to experiment with directly. In this case students are required to complete a spoken word edit for an audio book production (also known as a “cough edit” in UK broadcast circles). The signal processing involved in de-essing has numerous applications throughout commercial recording as it involves an understanding of signal flow, dynamics and equalization processing.

Encouraging students to develop critical listening skills and a skeptical eye for proponents of “Gear Acquisition Syndrome” can, to some extent, future-proof a course like the one presented in this chapter. The design philosophy here was to teach concepts rather than specific pieces of equipment. For example, in the case of de-essing, dynamic range is always dynamic range; even if the controls on a specific unit vary in layout (or tonal characteristic). Similarly, in choice of DAW—underlying concepts are more important than operational, platform-specific details. Industry tradeshows and the popular music technology press have been shown to encourage consumer desire for new products, usually by promising quality closer and closer to professional standards, yet the baseline for professional audio performance in the commercial world has changed very little.

In the view of the design team, it was important to discourage this type of thinking amongst the student body, and concentrate on the concepts and principles of sound. In order to achieve this, our course content prioritizes the principles of sound and the necessity for broadcast quality in any deliverables rather than the particular features and function of brands of equipment, software specificities, or the like. As detailed in the curriculum development section of this chapter, the design team felt that the baseline principles of sound and music technology begin with acoustics, sound synthesis, and digital audio recording. Rather than stressing, for example, the learning by rote of keyboard shortcuts which are only applicable to a particular digital audio workstation (reinforcing an inherent bias in the content which might be present either from the instructor, the institution, or market pressure from specific manufacturers), time should be spent developing skills which are common in all such workstations: gain staging, signal-to-noise ratios, appropriate use of dynamic range compression, creative and corrective use of frequency equalization or volume automation, and the like.

As audio educators, we might consider these essential competencies, a concept which in the context of DAW use the interested reader might refer to recent work by Walzer (Walzer 2016), or previous work in the context of digital literacy and how competency across domains is important for student development (Raymond 2008). Skills which might be acquired via distance learning could include, for example, production analysis (which necessitates a combination of critical listening with writing skills). The overarching curriculum selection principle is that these fundamentals will be applicable across the audio industry regardless of platform or role, serving the students in better stead when entering the world of work.

The core curriculum of the course described here can therefore be represented by three overarching themes:

1. Sound: acoustic principles and sound synthesis
2. Signal processing: frequency and dynamic range
3. Sequencing and editing: audio and MIDI, synchronization

Assessment Structure

The assessments were structured to encourage self-directed learning with reinforcement and contextualization of technical material in mind, using reframed material from the module content to achieve this purpose. *Checking* or *reinforcing learning* are techniques which can be a useful focus for the classroom based educator—allowing a reasonably experienced teacher to spot when students are not grasping the material, to potentially reframe the subject or give alternative examples (McKenzie 2003). The virtual environment does not afford much opportunity for students to ask for further detail or clarification, or for the course leader to monitor student progress in an intuitive informal manner. In order to keep challenging students, and provide an opportunity for formative assessment, (Nicol and Macfarlane-Dick 2006; Sadler 1998) multiple-choice "quizzes" were added to the assessment sections of the content. Here, 10% of the final grade was allocated to these multiple-choice tests.

To integrate some of the benefits of this "checking/reinforcing" model, a weekly virtual chat seminar was built into the material, giving the delivery a methodology somewhat akin to a "blended" model (Crawford 2017). In this case 20% of the final grade was allocated to this, in order to encourage students to make use of the time. The remaining assessments were allocated to submitted written work (in traditional research report format), with 20% of the final grade, and submitted practical work based on the industry briefs illustrated in the course content, worth 40% of the final module grade. The grade boundaries awarded were as follows:

- Notional "A": 593–660 Points
- Notional "B": 527–592 Points
- Notional "C": 461–526 Points
- Notional "D": 395–460 Points
- Notional "F": 394 Points and Below

A complete breakdown of the assessment structure and mark allocation is shown in Table 12.2.

Note that some course content did not contribute to the final grade awarded.

Table 12.2 Assessment structure and mark allocation

Assessed content	Mark allocation	Contribution to final grade
Discussions:	133 points	20%
Quizzes:	66 points	10%
Online tutorial attendance:	100 points	15%
Weekly projects:	272 points	40%
Final project:	100 points	15%
Total possible:	931 points	100%

Remote Assessment

Devising and formalizing an assessment structure based on the curriculum content highlighted in section 2 presented its own challenges. It can be difficult to re-create the highly pressurized environment of recording, broadcast, or live sound reinforcement in a classroom or simulated environment, and many established "real-world" programs offer access to studio and concert facilities similar in design and specification to the real world of work for this reason. Music technology by its nature requires access to industry standard facilities (microphones, preamplifiers, and acoustically treated spaces suitable for engaging in critical listening could be considered a bare minimum requirement). This raises questions of accessibility more generally, for example, what if potential students did not have access to the necessary level of facilities? In recent years, access to unprecedented computing power and affordable technology (with the exception of acoustically treated spaces) has made the practicality of a home recording studio more and more viable. Nevertheless, it presents a complication in the case of remote access.

In this case, the commissioning university made a commitment to provide access to such facilities at a minimal staffing cost (requiring studio technical staff only), generating a saving on Faculty teaching hours. There are legitimate concerns when it comes to cost-cutting efforts in terms of the quality of the learning experience for students. Our intention is that with carefully designed online material, the student experience can be at least maintained or possibly even improved. In other cases, work experience might be used to supplement the online delivery with hands-on training (and indeed, many "traditional" courses award credit for successful completion of work experience or internships) to encourage this practice.

Here, distance learning suffers and by its nature can only localized facilities or expect students to make their own provision for practical experience. However, a suitably equipped student, such as one already serving an apprenticeship or internship, or a working professional seeking an academic qualification to augment their experience, could perfectly reasonably produce the assessment material independently with access to the bare minimum facilities—the assessed content is not targeted at any specific platform or manufacturer and so the equipment used is of significantly less importance than the development of a working understanding of the underlying principles of sound and music, and the skill to produce work of broadcast quality. While this notion does create an intrinsic lack of parity in the equipment being used across the student body in the creation of their portfolio of practical assessment submissions, a similar lack of parity can be seen in the professional arena. It is not uncommon in industry to see successful engineers and facilities operate across a range of differing (or even multiple) platforms.

There is a further consideration in the huge technological advances being made by the open-source software community with regards to music technology. While hardware and commercial software products are undoubtedly widely used in the professional arena, the criteria for delivery of finished material to a broadcast standard can certainly be achieved with alternative resources. In fact, the ability to create multi-tracked arrangements, apply comprehensive editing techniques, and utilize a wide range of synthesis using a DAW gives most students of music technology access to more metaphorical "firepower" than most large-scale recording studios in the 1980s and earlier, where tape-based recording techniques were prohibitive in terms of track count, and physical limitations might restrict the use of numerous outboard processors. The trick, then, is often to discourage the use of too much virtual technology given the hugely expanded range of options faced by newcomers to the field.

Conclusions and Further Work

Distance learning allows students to study technical content at any time, and at their own pace. The method of practical assessment used would be appropriate to many other creative sections of the audio/visual engineering sector where technical knowledge and achievement of professional standards is an overarching mark of skill, and thereby an indicator of successful learning. The combination of multiple choice assessment and virtual face-to-face reinforcement takes advantage of, and answers traditional pedagogical demands for, academic differentiation and contextualization of course content. Theoretically, submitted reports (written work) should be pedagogically “neutral”, i.e. neither advantageous nor disadvantageous if delivered via distance learning when compared to traditional teaching methods.

Current technology has become sufficiently advanced for virtual “chat” seminars to be useful for reinforcing autodidactic learning, creating a shift toward a blended learning model that can be useful for the delivery and assessment of vocational content for the trainee audio engineer. However, assessment of vocational skill in, for example, the sound reinforcement field would not be practical with the technology used here. The need to access appropriate facilities in order to maintain parity with industry for assessment purposes, and to reach a minimum standard for critical listening is in some ways insurmountable with the current technology. Virtual private network access to studio software technology (or simulated, virtualized technology) might, in the future, yield an alternative to access issues, but the requirement for development of interpersonal skills such as teamwork and communication pose more significant obstacles to such delivery. An evaluation of real-time collaborative environments would therefore make for useful further work in order to establish a platform for developing teamwork and cooperation between students undertaking a vocational program in music technology.

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[1] The nomenclature varies between the US and UK. In the UK a module is a component of a course, assigned a certain number of credits. For example, a combination of compulsory and optional modules conveying 120 credits would need to completed per year of a three-year undergraduate program, with 360 credits required on completion of the degree. Similarly, 480 credits for four-year programs—honors degrees generally take three to four years to complete, though the requirement can vary slightly from institution to institution, and at post-graduate study level. The notional equivalent in most US systems is units (academic modules, representing credits toward the course) and subjects (which may contain various units). In either system, modules, courses, or component units may last a single semester or span a longer duration. The term course might mean a complete degree program, or a combination of modules or units in either case, so to avoid potential dichotomy of meaning here, for the purposes of this chapter, we consider module to be interchangeable with unit, and degree to be interchangeable with course.