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EXPANDING AUDIO EDUCATION PEDAGOGY: LINKING CREATIVE PRACTICE WITH AUDIO PRODUCTION EDUCATION.

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ABSTRACT

Since the inception of audio production programs, a schism has existed between creative practice (*e.g.* composers) and technical roles (*e.g.* audio engineering). However, as the democratization of technology has been integrated into modern audio production workflows, contemporary audio professionals and students are increasingly seeking ways to combine music creation and recording, editing, and mixing. As a result, there is a demand for audio production programs to develop curricula that links creative practice with commercial audio production education. This paper (a) identifies the ambiguity when defining contemporary audio production programs, (b) describes the educational goals of current audio production students to prepare themselves for employment in the contemporary music industry, and details the five phases of creative practice for the development of critical thinking skills, troubleshooting, and the ability to work under the authority of a mentor. In addition, this paper describes a Basic Creative Recording Project (BCRP), which balances technical learning objectives while incorporating the acquisition of creative practice skills. The BCRP project schedule is detailed with examples for meetings and assignment turn-ins. A process-based assessment is described and includes detailed session documentation, recursive feedback loops, and verbal presentations. Infusing the creative process within an audio production project can help to engage students already involved in the creative process.

Introduction

As early as the 1940s, Arnold Schoenberg, an influential experimental composer of the twentieth century, identified the need for what he called a *tonmeister* [1]. Schoenberg described an audio recording professional as a person who is trained in music, acoustics, physics, and mechanics, and has the ability to control and improve the sonority of recordings, radio broadcasts, and sound films [2]. Schoenberg identified this training as essential not only for recording, but for the creation and execution of future creative works. Unfortunately, many

educational institutions did not embrace the *tonmeister* educational ideal. In fact, as music education progressed throughout the 20th century, audio production programs separated recording from creative practice and specialized in technical, scientific, and competency based educational models [3, 4, 5, 6, 7]. Nevertheless, contemporary audio production professionals often find themselves in roles that require them to be both content creators and content editors [8]. These modern audio workflows and work environments mirror the deep and cross-disciplinary training described by Schoenberg almost 100 years ago.

Many contemporary educational institutions segregate learning of students wanting to train as content creators (e.g. composers) or as content editors (e.g. recording engineers and audio production) [9]. This delineation of majors was effective for previous generations of students, who entered technical programs to engage with and have access to expensive and sophisticated technology [10, 11, 12]. However, the democratization of technology has enabled students to gain experience with software, recording, and music creation prior to enrollment in an audio educational institution [13, 14]. Moreover, most students matriculating in audio production programs already engage in creative practice [15, 16]. Specifically, students use laptops and simple production software to create musical works ranging from four-bar loops to sophisticated orchestrations.

This experience with home recording has influenced student's expectation of audio production education threefold. First, many students view their audio production education as a method to refine their existing creative practices [15]. Traditional composition programs often require a high-level of musical aptitude for performance and sight-reading, which may not be required for a student's personal creative pursuits [9]. Second, many students are not interested in earning a degree in solely traditional

composition at a rigorous or conservatory level, but rather are combining audio production with other majors, such as music industry or electrical engineering [15]. Third, students are not interested in learning skills that are not directly connected to a job in an audio production studio or the music industry [14, 15, 16].

To reflect the modern student, some institutions have created Music Technology programs, which are a blending of traditional composition programs and audio production programs mediated through technology [9]. However, little to no research exists on these relatively new programs, and thus their efficacy and ability to train students to work in the audio production and music industries is unknown.

This paper provides best practices in linking creative practice within commercial audio production education. This paper will (a) identify the ambiguity when defining contemporary audio production programs, (b) describe the educational goals of current audio production students, and (c) detail the five phases of creative practice. In addition, this paper describes a Basic Creative Recording Project (BCRP), which balances technical learning objectives while incorporating the acquisition of creative practice skills. The BCRP project schedule is detailed

Audio Production Degree	Fields of Rigor	Program Titles
Bachelor of Music (BM)	Music Theory, Ear training, History, and Applied instrument, Ensemble	<ul style="list-style-type: none"> • Media Music • Sound Recording Tech. • Music Tech. • Recording Arts & Sciences
Bachelor of Fine Arts (BFA)	Music Theory, Ear training, History, and Applied instrument, Ensemble	<ul style="list-style-type: none"> • Audio Recording & Sound Design • Music & Audio Tech. • Audio Engineering
Bachelor of Arts (BA)	Breadth Across Disciplines (Liberal Arts Educational Philosophy)	<ul style="list-style-type: none"> • Audio Production • Computer Music & Multimedia • Recording Industry & Music Industry • Commercial Music & Music Tech. • Sound Recording Tech.
Bachelor of Science (BS)	Science, Computer Programming, Engineering, Electronics, Acoustics, Manufacturing	<ul style="list-style-type: none"> • Audio Tech. • Music Industry • Music Media Production & Industry

Table 1. Types of audio production degree, field of rigor and program titles for four-year degrees [3].

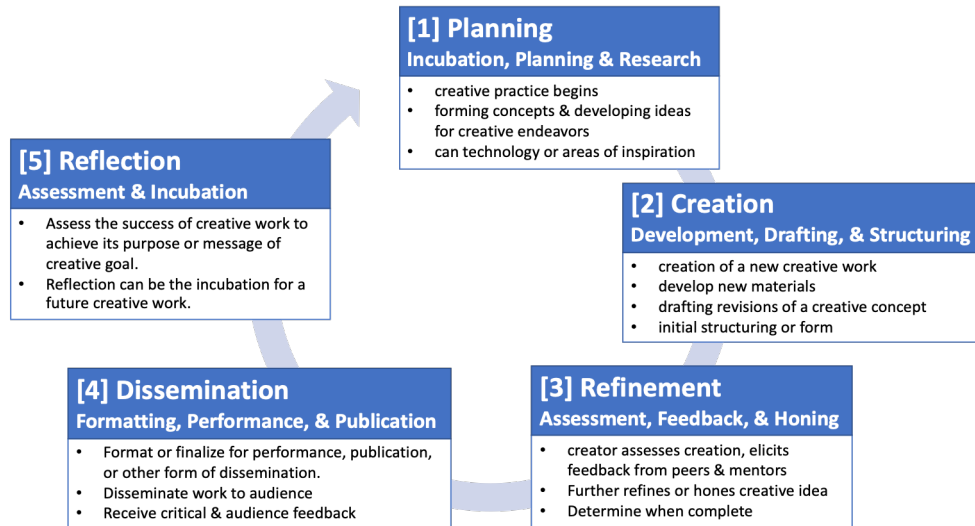


Figure 1 – Five phases and sub-steps of the creative process

with examples for meetings and assignment turn-ins. A process-based assessment is described and includes detailed session documentation, recursive feedback loops, and verbal presentations.

Audio Production Education

Formal Audio Production Programs have become commonplace to train future sound recording technicians (*e.g.* recording and mix engineers) for work in the audio production industry [3, 6, 10, 4, 7, 16, 11, 5, 14, 12]. Audio education students can select educational institutions ranging from short certification programs to four-year tonmeister programs. These audio educational programs vary in awarded degree, length of matriculation, area of focus, and educational setting (*e.g.* university department or within a business) [9]. As a result, there is currently no one definition for formal audio production education, which causes confusion about what skills students have acquired based on education type [17, 18, 19]. When looking at just four-year bachelors level degrees, the focus of rigor is commonly influenced by where the education is taking place (see Table 1). More specifically, music and fine art degrees focus more on musical training while the Bachelor of Sciences focus is more on computer programming, engineering, and acoustics.

Surprisingly, however, this is not always the case. When reviewing course requirements and objectives of several major US audio production programs, many include a large number of elective courses in both music and sciences and allow for minoring in related technical fields [20, 21]. In addition, there is a lack of consistency in program titles across all audio production programs in the US [9]. There are several program titles that have the same name, but occur in different colleges/departments, which is surprising because previous research suggests that these programs have different areas of rigor [9, 10, 11, 12]. It is unclear whether this ambiguity in focus of rigor hinders student as they seek employment after completing training.

After graduation from a formal audio production program, many students seek employment in the audio production industry [15, 19, 18, 8, 16, 13]. A common role is a sound recording technician as identified by the U.S. Bureau of Labor statistics [22]. A sound recording technician role includes: (a) operation and application of equipment to record, (b) synchronization, mixing, or reproduction of music, voices, or sound effects in movie and video production, (c) television production, and (d) music production for major and independent labels [22, 23]. Unfortunately, there is little research on how each type of the aforementioned formal audio production

training prepares students for careers in the audio production industry. Furthermore, the impact of constantly evolving technologies and workflows is not documented.

Creative Practice in Audio Production

Creative practice refers to the intentional practice of creating by learning, mastering and using the skills (*i.e.* craft, technical, artistic, intellectual, and creative) that are required for making creative work [24]. Creative practice encompasses the act of making art as well as incubation of thought and ideas. The creative process includes five major phases as shown in Figure 1. Each phase in creative practice has several sub-steps and is essential for the overall success of the creative process [25].

Understanding and engaging with the creative process helps students as they undertake creative activities within a discipline [26]. The creative process is more commonly integrated into courses in the field of humanities and social sciences as compared to education and engineering. Courses in the field of arts, humanities, and social sciences are typically considered by students to be more impactful than courses in education and engineering and highly influential in the development of their own creative process [27].

The practical outcomes of engaging in creative practice includes interdisciplinary application and formation of a repertoire of creative works, or portfolio, that benefits from refinement and revisions based on feedback from mentors and peers [28]. Open-ended projects, practice on exercises, and instructor feedback are common elements of creative practice and are closely related to the highly effaceable practices of self-directed and problem-based learning, experiential learning, and use of recursive feedback [16, 29, 30, 31]. Therefore, the integration of the creative process within education and engineering field can assist in the development of creativity in students.

Infusing the creative process within an audio production project can help to engage students already involved in the creative process [16]. The creative process benefits students by developing skills such as critical thinking, troubleshooting, and working under the authority of a mentor. The

development of these skills were indicated by employers, educators and students, as highly desirable skills for sound recording technicians work in the audio production industry [17, 18, 13]. Infusing the creative process into a traditional recording project requires some restructuring of project learning objectives and requires a process-based assessment.

Basic Creative Recording Project

The proposed basic creative recording project (BCRP) requires students to work in small production teams to complete a final mix for a single song or composition. Tasks will include songwriting/composing, demo recording, full tracking session, additional orchestration and arrangement, and multiple mix revisions. Production teams will consist of composers, arrangers, producers (*i.e.* advanced students), and tracking engineers. Production teams will need to identify an artist to record and can be a composer or artist from within the group. Production team members are required to conduct several recording sessions and be available during project benchmark meetings. The BCRP will enable students to complete one cycle of the creative process with a creative outcome defined by the production team.

The BCRP's learning objectives are (a) completing an audio production and engineering project, (b) applying technical skills in project completion, (c) identifying and meeting important benchmarks and deadlines, (d) communicating effectively with artists, musicians, and team members (e) addressing and interpreting feedback, (f) publishing the final production for dissemination and feedback, and (g) apply skills for creative practice. These goals reflect the important aspects of a successful recording production and creative process. Students will be required to engage technically and creatively to complete the project.

In the BCRP, having specific project phases is important for the coordination and assessment of project progress. For each project phase, Table 2 shows the meetings, presentations, recording tasks, and creative practice phases.

BCRP Phase	Presentation	Recording Task	Creative Practice Phase
Preplanning	Artist Review	none	1
Preproduction	Demo Review	Demo Session	1 & 2
Recording	Tracking Review	Tracking Session	2
Postproduction	Mix Review	Initial & Revised Mixes	3
	none	Final Redbook Pre-master	3
Distribution	none	File, Meta Data, Art upload	4 & 5

Table 2. Course project summary, deliverables, recording tasks, and remote recording modalities

During the Preplanning Phase, production teams will conduct a group meeting and create a brief presentation of their proposed artist. This presentation, the Artist Review, will contain (a) biographical and contact information of the artist, (b) musical samples/examples of the artist from current or previous work, and (c) an outline of goals for the rest of the project. This first phase requires students to use the first phase of creative practice by incubating an idea, planning, and research. Note, this creative phase may be completed prior to the course project by a group member who has already created an idea.

The Artist Review will be presented during a class meeting that will enable the coordination of all production teams, including producers and engineers, artists, musicians, and additional stakeholders. Also, the production meeting requires production teams to confirm their artist and production approach. The production teams will receive feedback from the professor and peers to further refine their approach and project goals. After the presentation, clarifying questions can be asked and answered to assist in further refining the project plan. Production teams will receive feedback from the professor and peers, and will be documented.

During the Preproduction Phase, production teams will conduct a demo session and create a Demo Review presentation. The demo session will consist of vocals and at least one instrument, or at the bare minimum a recording that documents the form, lyrics, and foundational material of the proposed song or composition. This phase enables the production team to use Phase 1 and 2 of creative practice by allowing a group member to create the initial song or composition.

The Demo Review Presentation will occur during a class meeting that allows students to present their demo session and receive feedback. The presentation will include (a) all session documentation, (b) the DAW Session files, and (c) goals for the tracking session including additional instruments and recording production. Production teams will receive feedback from the professor and peers, and feedback will be documented. This feedback will focus less on the technical aspects of recording a demo and focus rather on the song and the creative process.

During the Recording Phase, production teams will conduct several tracking sessions in which all musical elements of the project will be recorded: percussion, bass, harmony components, and lead and backup vocals. The Tracking Review will be presented during a class meeting that allows students to present a tracking session and receive feedback. The presentation will include (a) all session documentation, (b) DAW Session files, (c) goals for additional tracking, and (d) elicit feedback from artist, classmates, and professor, on additional tracking production needed before mixing can commence. Production teams will receive feedback from the professor and peers, and will be documented. This feedback will focus on the technical aspects of the recording process including mic choice and placement, evaluation of performance, consideration for additional instruments, and arrangement components.

During the Postproduction Phase, production teams will create an initial mix of their project including several revisions based on feedback from the professor and peers. This phase will allow students to work in the fourth phase of creative practice as they may be required to create additional instrument parts or add to the musical arrangement. The Mix Review presentation will occur during a class meeting where

production teams will present the initial mix of their artist. The presentation will include (a) all session documentation, (b) DAW session files, (c) goals for additional mixing, and (d) elicit feedback from artist, classmates, and professor on changes to be made on the mix. Furthermore, conducting several of these mix review sessions during class meetings is highly suggested as developing engineers often need several drafts and revisions to meet client and course goals. The Listening Party will occur during a class meeting where each production team's final Redbook pre-master will be played allowing artists, classmates, and professor to provide any final feedback or summative reflections. Also, an optional phase to the BCRP is to include basic finalizing or mastering benchmarks to prepare the mixes for digital release.

During the Distribution Phase, production teams will digitally distribute the final production for dissemination and outside feedback. Figure 2 shows an example of a digital release of a similar project.



Figure 2 Northeastern's Recording Minor Release: Field Recordings Vol 2 (2020)

There are several music distributions services that will allow for the upload, meta data creation (including IRC codes), and distribution of the final output of each production team. In fact, some music distributions services offer free licensing, royalty collection, and dissemination on the major music streaming applications and services. Often music distributions services allow for uploaders to create an institutional or 'Label Account,' which allows for the upload of multiple compilation albums. Depending on time and experience of students, the professor or

facilitator may conduct uploading and formatting. This final Distribution is important for Phases 4 and 5 of the creative process which requires students to engage in dissemination and reflection.

Process-Based Assessment

A process-based assessment approach borrows from the cognitive apprenticeship model, which suggests that future engineers need strong procedural knowledge of technology [29]. This strong foundation in audio practice and production is especially needed in the audio for game industry because employees are typically from disparate audio backgrounds and specializations [30, 32]. Furthermore, research shows that some educators feel a multi-disciplinary approach to audio education helps students obtain an understanding of their own workflow and how it applies to other roles in the creative fields of film and media [8]. Furthermore, this process will assist in the development of each student's personal creative process [28, 31]. Traditional outcome-based projects should be graded via process-based assessment [30, 33]. For example, grading the output or artistic quality of a novice or basic-level project is not purposeful. Such a project may require students to hook up an audio interface and record via a microphone. Therefore, credit/points should focus on the process, both the technical, creative, and social skills pertinent to the assignment.

In the proposed BCRP, the process-based assessment will quantify the technical and musical outputs of the project and will focus on student's ability to manage, apply, and navigate the creative process. The use of documentation, recursive feedback loops, and verbal presentation with critique

Grading Criteria	Ratings			Score
	Excel (5 pts) Complete	Satisfactory (2.5 pts) Missing Elements	Novice (0 pts) Incomplete	
Pre-plan	Student coordinates with musician & creates a pre-plan	Student fails to either record musician or coordinate with musician & create a pre-plan	Student Fails to complete category	
Session	Student performs recording of all instruments/components for final production	Student struggles to perform recording of all required instruments & components needed for final production	Student Fails to complete category	
Documentation/ Turn-ins	Student includes all session doc on Canvas & uploads to folder in RCP cloud storage. Student uploads entire Pro Tools session & all docs to cloud storage & shares link via Canvas	Student fails to include all session doc on Canvas & uploads to folder in RCP cloud storage. Or student fails to upload entire Pro Tools session & all doc to cloud storage & shares link via Canvas	Student Fails to complete category	
Discussion	Student shares link to Redbook bounce of demo & includes: a) all session doc, b) Pro Tools session, c) goals for add tracking, d) elicits feedback from artist, classmates & professor on add tracking	Student is missing components when sharing Redbook bounce of demo or a) all session doc, b) Pro Tools session, c) goals for add tracking, d) elicits feedback from artist, classmate & professor on add tracking	Student Fails to complete category	
Total Score (20 Pts)				

Table 3 Example Grading Rubric for Tracking Draft

will enable assessment at the completion of each phase. The requirement for session documentation at each phase of the BCRP will allow the professor to evaluate the project progress and the students to reflect on the pre-session planning, organization of musicians, and reservation of resources. Implementation of a recursive feedback loop fosters the ability of students to work under a mentor [16, 34]. A recursive feedback loop requires students to submit projects/course work, receive feedback from instructors, and then make alterations in response. Potentially, students could re-work a specific project several times until they have reconciled all feedback to the professor's satisfaction. This recursive feedback loop integrates one-on-one or mentor/mentee opportunities within the classroom and hones a student's ability to communicate with clients/co-workers and respond to feedback [16, 34]. During this feedback process, it is important for the professor to determine both the number of iterations and appropriate grading scheme to create incentive/meaning for each feedback round. Within the BCRP, each recording tasks requires a draft submission followed by a final submission. The rubrics for both the draft and final submission include categories for preplanning, creative outcomes, and documentation. However, the draft rubric focuses on the collection of feedback, whereas the final rubric focuses on the application of the collected feedback.

The Tracking Draft Grading Rubric is shown in Table 3.

Students are required to obtain feedback, suggestions, and client input via synchronous class events and asynchronous course discussion boards. The Tracking Final Grading Rubric is shown in Table 4 and requires students to make revisions based on received feedback. Therefore, documenting feedback is important in project assessment as well as achieving musical outcomes.

Often in listening sessions or production meetings there is a focus on the outcome, or what the client, producer, or label is hearing. This requires an engineer to reflect on how the production techniques and processes used are affecting these musical outcomes. In a process-based assessment, reflection on tools used to obtain a musical outcome is evaluated.

In the BCRP, verbal presentations allow students to review and reflect on each completed recording and creative task. When students are presenting a specific task, they are reflecting and summarizing not only the musical or artistic outcomes, but are also detailing their process. Refining this process, based on client (and in this case professor and peer) feedback is

Grading Criteria	Ratings			Score
	Excel (5 pts) Complete	Satisfactory (2.5 pts) Missing Elements	Novice (0 pts) Incomplete	
Pre-plan	Student coordinates with musician & creates preplan	Student fails to coordinate with musician & create preplan	Student fails to complete	
Session	Student records all instruments/ components needed final production	Student struggles to record all required instruments/ comps. for final production	Student Fails to complete category	
Documentation/ Turn-ins	Student includes all UPDATED session doc on Canvas & uploads to RCP cloud storage. Student uploads entire Pro Tools session & all session doc to cloud storage & shares link via Canvas	Student fails to include all UPDATED session doc on Canvas & uploads to RCP cloud storage. Or student fails to upload entire Pro Tools session & all session doc to cloud storage & shares link via Canvas	Student Fails to complete category	
Feedback	Based on in-class feedback & feedback provided on Canvas Discussion Board, student makes changes to original recording	N/A	Student Fails to complete category	
				Total Score (20 Pts)

Table 4 Example Grading Rubric for Tracking Final

deemed essential by employers in the industry [17, 18] and will enable students to refine their creative process.

Conclusions

A tonmeister is an audio recording professional who is trained in music, acoustics, physics, and mechanics, and has the ability to control and improve the sonority of recordings, radio broadcasts, and sound films. The original intent of this designation was to identify audio professionals trained to assist in audio recording. However, contemporary audio professionals and students could benefit by removing the schism between creative practice (*e.g.* composers) and technical roles (*e.g.* audio engineering). With the democratization of technology, contemporary audio professionals and students are increasingly seeking ways to combine music creation and editing to meet modern audio production workflows.

This paper provided a review of best practices for linking creative practice within commercial audio production education. The paper identified the ambiguity when defining contemporary audio production programs and detailed students' desire to matriculate in formal audio production training to prepare themselves for a career and roles in the contemporary audio production industry. In addition, the paper described five phases of creative practice and its use and efficacy in higher education for the

development skills such as critical thinking, troubleshooting, and the ability to work under the authority of a mentor. The development of these skills were indicated by employers, educators and students, as highly desirable skills for sound recording technicians work in the audio production industry [17, 18, 13].

A Basic Creative Recording Project (BCRP) was described that balanced technical learning objectives while incorporating the acquisition of creative practice skills. The BCRP project schedule was detailed with examples for meetings and assignment turn-ins. A process-based assessment was described and included detailed session documentation, recursive feedback loops, and verbal presentations. Two grading rubrics were presented for execution of a process-based assessment of the BCRP.

More research into creative practice and its infusion into audio production programs is needed. Infusing the creative process within an audio production project can help to engage students already involved in the creative process.

About the Author

Dr. Bielmeier is an Associate Teaching Professor in Audio Recording and Production, at Northeastern University, Department of Music - College of Arts, Media and Design with a doctorate in education and 15 years of experience teaching music, audio

engineering and music technology at the graduate and undergraduate levels. Bielmeier was formerly a freelance engineer in Nashville, TN and has 15 years proven success as a studio and live sound engineer. Dr. Bielmeier's live sound work has included working at the Kennedy Center, In Washington D.C., and sound for Vice President Joe Biden. Dr. Bielmeier was the designer and studio manager of the C.L.E.A.R. Lab recording studio at the Purdue School of Engineering Technology.

Dr. Bielmeier's papers on audio education, circular design, and music proficiency in media programs have been published internationally in the Audio Engineering Society Journal, The Art of Record Production Journal and the Journal for Media Education. As a researcher, Dr. Bielmeier strives to understand what skills and competencies aspiring engineers need to develop to be successful in the audio industry. Dr. Bielmeier explores the relationship between audio education and industry, DIY circuit building for self-directed instructional methods, and high resolution/multichannel recording via the internet.

References

- [1] J. Borwick, "What is a Tonmeister?," *Studio Sound*, vol. 2, p. 2, February 1973.
- [2] J. Borwick, "The Tonmeister Concept," in *Proceedings of the 46th Audio Engineering Society Convention*, New York, 1973.
- [3] R. Gadhoke, "Curriculum in Recording Engineering.," in *60th AES Convention*, Los Angeles, 1978.
- [4] T. Lodge, "A curriculum in music industry arts," *Journal of the Audio Engineer Society*, vol. 15, pp. 7-9, 1978.
- [5] T. G. Stockham, "Records of the Future," *Journal of the Audio Engineering Society*, vol. 15, pp. 892-895, 1977.
- [6] M. R. Gander, "Balancing theory and practice in audio education: experience of a recent graduate.," *Lansing Sound, Inc*, p. 15, 1 January 1978.
- [7] Manquen, "An audio design engineering certificate program for BS students in electrical engineering," *Journal of the Audio Engineer Society*, vol. 15, pp. 17-18, 1978.
- [8] E. S. A. Lankford, "Case Study: An Interdisciplinary Audio Curriculum.," in *Audio Engineering Society Convention 145.*, New York, 2018.
- [9] S. Phillips, *Beyond Sound: The College and Career Guide in Music Technology.*, london: Oxford University Press , 2013.
- [10] J. W. Lightner, *A survey of the professional audio industry in an eight-state region to assess Employers' perceived value of formal audio education and their perceived training needs for entry-level employees.*, Big Rapids, MI: Ferris State University, 1993.
- [11] D. H. Sanders, "The professional preparation of the audio engineers: A survey of studio personnel and recommendations for school curricula design.," *Dissertation Abstracts International (UMI No. 9423006)*, vol. 55, no. 04, p. 797, 1994.
- [12] E. J. Walsh, "Important occupational skills and knowledge needed in the preparation of the recording engineer: A survey of faculty perceptions.," *Dissertation Abstracts International (UMI No. 9705709)*, vol. 57, no. 09, p. 3850, 1996.
- [13] D. Tough, *Developing a Consensus-Driven, Core Competency Model to Shape Future Audio Engineering Technology Curriculum: A Web-Based Modified Delphi Study*, Nashville, TN: Tennessee State University, 2009.
- [14] D. Tough, "Shaping audio engineering curriculum: An expert panel's view of the future.," in *129th Audio Engineering Society Convention*, San Francisco, 2010.
- [15] D. Bielmeier, "Audio Recording Production Students Report Skills Learned or Focused on in Their Programs," in *143rd International Audio Engineer Society Convention*, New York, 2017.

- [16] J. Merchant, "A Revised Approach To Teaching Audio Mixing Techniques: Applying The Deliberate Practice Model," in *Audio Engineering Society Convention 131*, New York, 2011.
- [17] D. Bielmeier, "Why didn't you learn this at recording school: critical comments by employers," in *AES 50th International Conference*, Murfreesboro, TN, 2013.
- [18] D. Bielmeier, *What Skills New Recording Engineers Have and Where They Learn Them: A Survey of New Recording Engineers' Perceived Skill Sets and Those Observed By their Employers.*, Washington, DC, 2013.
- [19] D. Bielmeier, "Audio Recording and Production Education: Skills new hires have and where they reported learning them," *Journal of the Audio Engineer Society*, vol. 64, pp. 218-228, 2016.
- [20] D. Bielmeier, "Disruptive Creativity: a review of disruptive technologies used by independent music producers," in *Art of Record Production Conference*, Boston, 2019.
- [21] D. Bielmeier, "High School Students: Considering Sound Engineering Technician Programs," in *Boston AES High School Educators Conference*, Boston, 2018.
- [22] U.S. BUREAU OF LABOR STATISTICS, "Occupational Employment and Wage Statistics," [Online]. Available: <https://www.bls.gov/oes/current/oes274014.htm#nat>. [Accessed 05 2021].
- [23] B. o. lab, 2020. [Online]. Available: <https://www.bls.gov/oes/current/oes274014.htm#nat>.
- [24] J. Burton, "Creative intelligence, creative practice: Lowenfeld redux.," *Studies in Art Education*, vol. 50, no. 4, pp. 323-337, 2009.
- [25] H. Smith, *Practice-led research, research-led practice in the creative arts.*, Edinburgh: Edinburgh University Press, 2009.
- [26] R. G. A. Comunian, "Beyond the Creative Campus: Reflections on the evolving relationship between higher education and the creative economy.," King's College London, London, 2015.
- [27] S. M. E. O. S. H.-S. A. S. C. Daly, "College students' views of creative process instruction across disciplines," *Thinking Skills and Creativity.*, vol. 22, pp. 1-13, 2016.
- [28] R. B. Kelly, "Engaging in creative practice: From design thinking to design doing," in *Creative development: Transforming education through design thinking, innovation, and invention*, Brush Education Inc., 2016, pp. 57-68.
- [29] R. Hiemstra, *Self-directed learning.*, 1994.
- [30] C. E. Hmelo-Silver, "Problem-based learning: What and how do students learn?," vol. 16, no. 3, pp. 235-266, 2004.
- [31] D. A. Kolb, *Experiential learning: Experience as the source of learning and development.*, Upper Sadle River, New Jersey: Pearson Education, 2014.
- [32] M. Sarisky, "Integrating 'Audio For Games' into the modern production curriculum.," in *AES 41st International Conference*, London, 2011.
- [33] J. Rodgers, "Partnering Approaches for Teaching Music Technology.," Los Angeles , 2014.
- [34] D. Bielmeier, "Apprenticeship skills in audio education: A comparison of classroom and institutional focus as reported by educators.," in *Audio Engineering Society Convention 137*, 2014.
- [35] C. Boehm, "The discipline that never was: Current developments in music technology in higher education in Britain. ," vol. 1, no. 1, pp. 7-21, 2007.
- [36] Ibisworld, "Audio Production Industry Reports," 2019. [Online]. Available: <http://clients1.ibisworld.com.ezproxy.bu.edu/reports/us/industry/default.aspx?entid=1254>.