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Accademia Musicale Studio Musica
Michele Della Ventura, *editor*

2020

Proceedings of the
International Conference on

New Music Concepts Inspired Education and New Computer Science Generation

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Accademia Musicale Studio Musica

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Accademia Musicale Studio Musica
Michele Della Ventura
Editor

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Preface

This volume of proceedings from the conference provides an opportunity for readers to engage with a selection of refereed papers that were presented during the International Conference on New Music Concepts, Inspired Education and New Computer Science Generation. The reader will sample here reports of research on topics ranging from a diverse set of disciplines, including mathematical models in music, computer science, learning and conceptual change; teaching strategies, e-learning and innovative learning, neuroscience, engineering and machine learning.

This conference intended to provide a platform for those researchers in music, education, computer science and educational technology to share experiences of effectively applying cutting-edge technologies to learning and to further spark brightening prospects. It is hoped that the findings of each work presented at the conference have enlightened relevant researchers or education practitioners to create more effective learning environments.
This year we received 57 papers from 19 countries worldwide. After a rigorous review process, 24 paper were accepted for presentation or poster display at the conference, yelling an acceptance rate of 42%. All the submissions were reviewed on the basis of their significance, novelty, technical quality, and practical impact.

The Conferece featured three keynote speakers: Prof. **Giuditta Alessandrini** (Università degli Studi Roma TRE, Italy), Prof. **Renee Timmers** (The University of Sheffield, UK) and Prof. **Axel Roebel** (IRCAM Paris, France).
I would like to thank the Organizing Committee for their efforts and time spent to ensure the success of the conference. I would also like to express my gratitude to the program Committee members for their timely and helpful reviews. Last but not least, I would like to thank all the authors for they contribution in maintaining a high-quality conference and I hope in your continued support in playing a significant role in the Innovative Technologies and Learning community in the future.

March 2020

Michele Della Ventura

Conference Chair

Michele Della Ventura, Accademia Musicale Studio Musica, Treviso, Italy

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Learning Tools
Learning Technologies
Learning Practicies

Educational Design of Music and Technology Programs

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Abstract. Educational designers around the world have developed music and technology degrees of various types over the past 15 years; students have many options when selecting where and what to study. This is an outcome of strong industry interest in graduates trained in engineering and the arts, a growth in science/technology/engineering/arts/mathematics (STEAM) mindset, and student interest. Within this global ecosystem, music and technology programs have developed in different educational jurisdictions in an ad hoc fashion. The system is largely uncoordinated. There is ample room for collaboration and synergy to generate new opportunities for students. This paper surveys programs in music and technology at the undergraduate level to determine whether there are underlying commonalities among learning outcomes, and to identify future directions in programming. The first aim is to describe the learning outcomes associated with these degrees, then to compare them across different institutions. The results give educational and curriculum designers a broader context for designing new programs in music and technology and updating existing programs to stay current and relevant to students and industry.

Keywords. Educational design, learning outcomes, quality assurance, undergraduate degree, music and technology

1 Introduction

Educational designers around the world have developed music and technology degrees of various types over the past 15 years; students have many options when selecting where and what to study. This is an outcome of strong industry interest in graduates trained with skills in engineering and the arts, a growth in STEAM mindset, and strong interest from students who want to be industry ready upon graduation. Governments have responded with specialized funding, digital superclusters, and similar programs to support innovation in university education in arts and technology.

Within this global ecosystem, music and technology programs have developed in different educational jurisdictions in an ad hoc fashion. The system is largely uncoordinated. There is no single professional society or body that accredits the programs. There is great variety in web content promoting the programs, ranging from listings of courses,

testimonials from alumni, brief descriptions of programs, to more full-scale statements of learning outcomes and goals. There is ample room for collaboration and synergy to generate new opportunities for students.

The purpose of this paper is to survey programs in music and technology at the undergraduate level to determine whether there are underlying commonalities among learning outcomes, and to identify future directions in programming. The first aim is to describe the learning outcomes associated with these degrees, then to compare them across different institutions. The results of such research will give educational and curriculum designers a broader context for designing new programs in music and technology and updating existing programs to stay current and relevant to students and industry.

2 Educational Design and Undergraduate Music and Technology Degree Programs

Adapted from the fields of engineering, architecture, and computer science, the design process for educational programs includes planning, development, implementation, and evaluation [1]. My paper takes as an assumption the need for music and technology programs (which yields the planning and development phase of educational design) and focuses on the implementation and evaluation of existing programs.

Music and technology degrees are offered under a range of titles. For the purpose of this study, I searched degree programs using the keywords: music and technology, music and computer science, music production, and music industry. The Audio Engineering Society (AES) maintains an online directory of educational institutions worldwide, yielding the most comprehensive inventory of programs and courses in music and technology. The online inventory is searchable by geographic region and program type, within seven categories: courses (that do not yield an accredited qualification or certificate), courses that yield an accredited qualification or certificate, associate degree courses, bachelors degree courses (e.g. Bachelor of Science [BSci], Bachelor of Arts [BA], Bachelor of Music [BMus]), masters degree courses (Master of Science [Msci], Master of Arts [MA], Master of Engineering [MEng]), research courses (e.g. Master of Philosophy [MPhil], Doctorate of Philosophy [PhD]), and other. While comprehensive, the inventory relies on entries generated (and updated) by institutions; many entries date back to 2011 without further update. Each entry includes basic information on location, program type, tuition, facilities, key contacts,
and a link to the institution's web content.

As my own research has expanded from historical analysis of music to program design and development, there are three critical questions that should be asked of any new program: How will the program set up students for the future? (2) How will the new program leverage the department's research and creative practice? and (3) Will this program build in high impact, hands-on, minds-on learning opportunities for students? Music and technology programs have developed across the higher education system with little attention given to cross-system coordination and collaboration. This is surprising,

given the global market for music and technology. A goal of this study is to identify the potential for collaboration and system coordination at the undergraduate level so that students have more opportunities for learning in the global music and technology environment. To achieve this, I focused on bachelor degrees (type 4) and surveyed the inventory in the United States and the United Kingdom. From this survey, I isolated sixteen institutions (eleven in the United States and five in the United Kingdom); these institutions were selected for the more robust goal statements and learning outcomes (a requirement of programme specification in the United Kingdom) [2] and the longer history of programs. An environmental scan of all undergraduate music and technology degrees in North America, the United Kingdom, and Europe informed my understanding of overall programming trends.

3 Survey of Music and Technology Programs in North America and United Kingdom

Appendix A, Overview of Features and Learning Outcomes for Undergraduate Degrees in Music and Technology [3, 4] consists of a concise summary of sixteen undergraduate degree programs in music and technology with information on the institution, goals of the program, learning outcomes, and special features.

There are three commonalities in programming that can be isolated among the degree programs at the sixteen institutions: (1) an emphasis on professional training and career readiness; (2) a focus on experiential, hands-on learning in the course delivery; and (3) collaboration among departments to offer the degree.

Websites geared to student recruitment emphasize the professional training and career preparation that students will get from the program. This is supported by course offerings in the business of music (noted at Oberlin Conservatory and New York University, Tisch) and learning opportunities such as capstone courses that connect students to industry leaders. The focus on training in a professional setting is stronger in music and technology programs than in other university-based degree offerings and may be linked to the presence of industry-engaged faculty members and instructors in these areas.

Experiential learning is a method and movement that is firmly established as a desirable and essential component of university education. Definitions of experiential learning are plentiful. They all incorporate some notion of hands-on or real-world learning (learning outside the classroom), a form of formal assessment, and an opportunity for students to reflect on their experiences. The Association for Experiential Education defines experiential learning as follows: “a philosophy that informs many methodologies in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people’s capacity to contribute to their communities” [5]. For music and technology degrees, experiential learning takes the form of studio-based training, work with practitioners, and the production of recordings. Some programs feature specialized types of experiential learning opportunities such as internships or an Industrial Placement Year

(Goldsmith) and study abroad (featured at Keele University and the University of Liverpool).

Music and Technology degrees are offered as a collaboration by multiple departments: a school or department of music and a department in engineering. In larger arts-specific institutions, the collaboration may take shape across different areas of the same departmental structure. Combined programs leverage the research and creative practice of faculty members and introduce students to a wider spectrum of research than they might encounter in a single-unit degree program.

4 Conclusions and Future Directions

Music and technology is a growing industry with global reach. The survey and analysis of undergraduate programs in music and technology indicates that there are many quality programs with strong industry ties, a critical feature for programs geared to professional training and careers for graduates. As these programs get redesigned and updated in light of industry and educational innovations, there is benefit to greater cross-fertilization and collaboration across the system. This could take many forms, including increase in study abroad and student exchange programs and an increase in industry placements during the degree. As these forms of experiential learning are already embedded in individual degree offerings, this may entail an expansion of existing offerings alongside an effort to coordinate and communicate offerings across the system.

References

[1] "Introduction to Educational Design in Higher Education," UNSW Sydney, https://www.futurelearn.com/courses/educational-design/0/steps/26415 (accessed December 30, 2019)

[2] For an overview of the system in the United Kingdom, see the Association of European Conservatories, https://www.aec-music.eu/services/nationalhttps://www.aec-music.eu/services/national-overviews/united-kingdomoverviews/united-kingdom (accessed December 20, 2019)

[3] I would like to thank and acknowledge the research of Dr. Maris Oss-Cech in the preparation of Appendix A, Overview of Features and Learning Outcomes for Undergraduate Degrees in Music and Technology.

[4] Information for Appendix A, Overview of Features and Learning Outcomes for Undergraduate Degrees in Music and Technology is drawn from websites maintained by host institutions. URLs are provided directly in the entry for each institution.

[5] The Association for Experiential Education, as quoted by Queen's University, Canada, https://www.queensu.ca/experientiallearning-hub/about/whathttps://www.queensu.ca/experientiallearninghub/about/what-experiential-learningexperiential-learning (accessed January 4, 2020)

Appendix A

Overview of Features and Learning Outcomes for Undergraduate Degrees in Music and Technology

Institution	**Berklee College of Music** https://www.berklee.edu/mpe/bachelor-of-music-in-music-production-and https://www.berklee.edu/mpe/bachelor-of-music-in-music-production-and-engineeringengineering
Degree offered	Bachelor of Music in Music Production and Engineering
Summary goal of program	The music production and engineering program prepares students to enter the current music production field as an effective professional in any number of roles within a land- scape of rapidly evolving tools and techniques.
Learning/Program Outcomes	Through in-studio classroom experience, hands-on project work, and exposure to resident and visiting industry professionals, students will: • Develop an informed and critical aesthetic vision; • Gain a thorough knowledge and understanding of complex technical systems; • Learn to collaborate effectively with others in numerous musical settings through participation as an engineer and producer; • Learn to define quality using both musical and technical criteria, and to apply those criteria to your work and to the work of others; • Refine your communication and time-management skills in the context of multidisciplinary productions.
Special Features	Highly regarded program with an illustrious alumni, https://www.berklee.edu/notable-alumni-in-musichttps://www.berklee.edu/notable-alumni-in-music-production-engineering-fieldproduction-engineering-field

Institution	**Carnegie Mellon University** https://www.cmu.edu/cfa/music/programs/undergraduate-programs/undergrad-music-technology.html
Degree offered	Bachelor of Science in Music and Technology

Summary goal of program	The goal of the core coursework in music and technology is to provide a comprehensive undergraduate understanding of all three areas of study: music, computer science and electrical engineering. Designed for students who want to pursue music technology as a career.
Learning/Program Outcomes	Broadly: "Regardless of the entry point - an interest in computer science, electrical engineering, or music - the coursework prescribed will allow each student to gain the requisite knowledge and experience in all three areas."
Special Features	• Joint project between three of the schools: The School of Music, School of Computer Science, and the Department of Electrical and Computer Engineering. • Students will work closely with advisors and will be guided in both course selection and capstone projects.

Institution	**Indiana University – Jacobs School of Music** https://music.indiana.edu/departments/academic/audio-engineering-and-sound-production/
Degree offered	Bachelor of Science Associate of Science from the Audio Engineering and Sound Production Department established in 1982.
Summary goal of program	Intended for the student who wishes to pursue a career in music recording, radio, audio post-production for visual media, live sound, technical support, and Information Technology applications in audio. • Over four years, students will spend over 1000 hours working in the studios. • Courses and lab project draw resources from the Jacobs School of Music
Learning/Program Outcomes	Broadly: • Students will have studio experience. • Students will get to record. They will experience from basic analog production to advanced DAW technique. • Some students will have the opportunity to collaborate with world-class faculty/producers and engineers.
Special Features	The School's record label IU Music has released over 50 discs.

Institution	**New York University – Steinhardt School** https://steinhardt.nyu.edu/degree/bm-music-technology
Degree offered	Bachelor of Music in Music and Technology
Summary goal of program	Receive a solid foundation in music, music technology, and the liberal arts as you prepare for a career in fields like sound engineering, post-production, electronic music, software development, and multimedia.
Learning/Program Outcomes	Broadly: "Upon graduation, students will be prepared for careers in fields like sound engineering, post-production, electronic music, software development, and multimedia. Thanks to an intensive education and important experiences working directly in the industry, you'll be well positioned within a substantial network to take on a variety of roles, or pursue an advanced degree."
Special Features	Students "will have the opportunity to intern at major New York City recording studios, media companies, and performance venues such as Sony Music, Radio City Music Hall, Birdland, and the Metropolitan Opera. Internships have often led to permanent employment opportunities."

Institution	**University of Michigan at Ann Arbor – School of Music, Theatre & Dance** https://smtd.umich.edu/departments/performing-arts-technology/
Degree offered	• Bachelor of Fine Arts in Performing Arts Technology • Bachelor of Music in Music & Technology • Bachelor of Science in Sound Engineering
Summary goal of program	• The Bachelor of Fine Arts in Performing Arts Technology prepares students for careers in music production, recording, composition, and performance; studio and live sound engineering; interactive multimedia design; and music and sound for film, television or video games. • The Bachelor of Music in Music & Technology prepares students for careers involving the creative use of music technology—performance, production, recording, composition, studio and live sound engineering, and

	music and sound for film, television or video games. • The Bachelor of Science in Sound Engineering prepares students for engineering careers in the music technology industry—designing, developing, and testing audio hardware and software—as well as careers in acoustical engineering, sound recording, and studio production.
Learning/Program Outcomes	Not stated
Special Features	• The programs integrate the study of music, engineering, and allied arts, the department features accomplished faculty comprising renowned scholars, teachers, artists and practitioners. Students collaborate with highly talented peers across campus—from performing artists of every genre to next-generation audio technologists at the College of Engineering. • A recent $29.5 million facilities renovation has created state-of-the-art studios for mastering a spectrum of technological skills.

Institution	**Keele University, UK** https://www.keele.ac.uk/study/undergraduate/undergraduatecourses/computerscienceandmusictechnology/
Degree offered	Bachelor of Science (Honours) 3years/4years with International Yearv Combined Honours from School of Computing and Mathematics and Music and Technology
Summary goal of program	It offers students the opportunity to study in two distinctive disciplines but also to benefit from the synergies between these two contemporary and cutting-edge subjects, both of which equip you for careers in our digital, media-rich world.
Learning/Program Outcomes	Broadly: • Students will learn about the theories which underpin software, hardware and computing techniques, and how to apply them to the real world. • Students will use technology to create new theories and problem solving.

	• Students will learn about artificial intelligence, computer game development, human-computer interaction and cyber security. • Students will learn the underpinning theories of sound, history of audio technology and the culture of music. • Students will access modules from the Music programme to create their own programme. Programme specifications for the Music Technology (combined honours), https://www.keele.ac.uk/media/keeleuniversity/sas/qa/ugprogrammespecifications/2020https://www.keele.ac.uk/media/keeleuniversity/sas/qa/ugprogrammespecifications/2020-21/Programme-Specification-Music-Technology-Combined-Honours-2020-21.pdf21/Programme-Specification-Music-Technology-Combined-Honours-2020-21.pdf Programme specifications for the Music Technology (single honours), https://www.keele.ac.uk/media/keeleuniversity/sas/qa/ugprogrammespecifications/202021/Programme-Specification-Music-Technology-Single-Honours-2020-21.pdf
Special Features	Keele's School has many EU partners and students can take advantage of the Erasmus + grant

Institution	**Kingston University (London), UK** https://www.kingston.ac.uk/undergraduate/courses/music-technology/
Degree offered	Bachelor of Music in Music Technology (Honours) 3 years full time or 6 years part time
Summary goal of program	Hands-on approach to learning and researching music technology.
Learning/Program Outcomes	Broadly: • Students will produce and record music in our unique facilities which include recording studios, rehearsal rooms, Pro Tools and Logic-based MIDI/editing suites, a synthesis/sampling lab - and our analogue/digital hybrid Visconti Studio. • Students can collaborate across the university on interdisciplinary projects in areas like music journalism, broadcasting, composition,

	post production and sound design for film, TV and games. • Students will work with digital, analogue and hybrid music technology tools to create high quality sound and music productions. • From record production to software programming, sonic art and performance, students will develop technical and artistic skills across a range of musical styles and contexts. Programme specifications for the Music Technology (BA) https://progspec.kingston.ac.uk/docs/?l=m&y=19
Special Features	In partnership with world-famous record producer Tony Visconti, the British Library and Science Museum, the Visconti Studio comprises of a 300m² octagonal live room stocked with rare and vintage recording equipment. Students can access this studio to develop skills in analogue sound engineering and tape-based record production.

Institution	**University of Liverpool, UK** https://www.liverpool.ac.uk/study/undergraduate/courses/music-and-technology-ba-hons/overview/
Degree offered	Bachelor of Arts in Music and Technology (Honours)
Summary goal of program	For students who wish to specialise in the vocational areas of recording and production, electronic music, sound design and composition for film and video gaming. The programme focuses on technical areas such as recording and music production but also provide opportunities for creative and experimental applications of music technology.
Learning/Program Outcomes	Broadly: Students will underpin technology practice with specialist theoretical, historical and contextual modules, and will have the option to develop their performance skills in either popular or classical music. For programme specifications, see https://www.liverpool.ac.uk/aqsd/programme-specifications/

Special Features	• Can be combined with another subject (30 subjects and over 200 subject combinations) • Offers study abroad opportunities

Institution	**University of Portsmouth, UK** https://www.port.ac.uk/study/courses/bsc-hons-music-and https://www.port.ac.uk/study/courses/bsc-hons-music-and-sound-technologysound-technology
Degree offered	Bachelor of Science (Honours) 3 years full time-4 years sandwiched with work
Summary goal of program	Learn to manage complex recording sessions and perform and compose music for media such as film and video games. The program will set students for a career in a variety of roles, from producing music to working as a studio engineer.
Learning/Program Outcomes	In this technology degree students will: • Learn the professional and practical skills you need to work effectively in the music industry; • Tackle topics like games audio, composition, sound design, and studio recording and production; • Be taught by a team of lecturers who have diverse musical interests and experience in areas such as sonic art, digital and analogue recording, popular music performance, composition and songwriting; • Be able to manage complex recording sessions and generate music, sounds and effects for everything from films to art installations; • Get the chance to take an optional Protools certification unit as part of your degree; and • Have the opportunity to further supplement your musical talents by joining the University's orchestra, choir, wind band or big band. Students with get practical experience with: • A valve 32 channel TL audio mixing desk; • An SSL Matrix 2 console with 10 Neve 1074 preamps and 16 channels of Neve and SSL dynamics and EQ; • A 7.1 surround studio (Genelec) including a Slate Raven multi-touch console for multi-channel work and spatial audio projects;

	• A Buchla System 7 synthesizer (one of only two in the UK and the only one in a European university); • 4 Oakley Modular synthesizers; and • iMac Dual i7 computers running Logic Pro X, Pro Tools, Ableton Live, Max/MSP (including Max for Live), Native Instruments Komplete (including Reaktor), Pure Data and Game engine software. Full details on learning outcomes, https://www.port.ac.uk/study/courses/bsc-hons-musictechnology
Special Features	Accredited by Joint Audio Media Education Support (JAMES). JAMES is a group of industry professionals that represent Association of Professional Recording Services (APRS) and The Music Producers Guild (MPG).

Institution	**University of Southern California** https://music.usc.edu/departments/music-technology/bm https://music.usc.edu/departments/music-technology/bm-music-production/music-production/
Degree offered	Bachelor of Music in Music Production
Summary goal of program	Designed for students wishing to blend music creation (writing and arranging), performance (live studio), recording, engineering/editing and mastering, music synthesis and programming and music business.
Learning/Program Outcomes	Upon completion of the Bachelor of Music program in Music Production, students will: • Demonstrate achievement of professional, entry-level competence in music production, synthesis, recording, editing and mastering; • Demonstrate professional entry-level performance and writing/arranging skills; • Be able to leverage creativity, artistry, industry knowledge and entrepreneurial skills in the creation of performance careers; • Demonstrate practical knowledge of music production, arranging, musical direction, music licensing, music administration and teaching; • Be able to transfer musical skills to non-music related careers;

	• Be able to communicate to professionals and lay persons musical ideas, concepts, and requirements related to the practice of their major field through musical, oral, written and visual means; • Demonstrate an advanced level of musicianship and a broad knowledge of musical elements, structure, repertories, and contexts; • Be able to work as a leader and in collaboration in areas of musical interpretation and performance; and • Have an understanding of the societal impact of music and the ethical responsibility of a professional musician.
Special Features	Culminates with a capstone project that gives students the opportunity to pursue a mentored project to advance their future careers.

Institution	**University of Hartford, College of Engineering, Technology, and Architecture** https://www.hartford.edu/academics/schools-colleges/hartt/academics/music/music-industry/music-production-and-technology.aspx
Degree offered	Bachelor of Science in Audio Engineering Technology
Summary goal of program	The program engages students with electronics, audio production, circuit analysis, recording, mixing, system integration, live sound, equipment maintenance and troubleshooting, music theory, mathematics, technical writing.
Learning/Program Outcomes	https://catalog.hartford.edu/preview_program.php?catoid=23&poid=5054 All graduates in the Audio Engineering Technology program will: • Be competent for successful long-term professional practice in audio engineering technology and related disciplines (broadcast networks, multimedia firms, etc.); and understand the importance of lifelong learning and staying current in the field by participation in professional societies, earning advanced degrees, and receiving additional training or certifications
Special Features	In third year, students join a production team of two or three majors for an assignment that guides them through the learning and application of the tools of the modern recording studio;

	in fourth year, each team produces a full-length recording project. The Hartt Recording Studio (HRS) provides recording services to any Hartt student, staff, or faculty member, as well as outside clients; the studio is staffed by music production and technology majors.

Institution	**Peabody Institute of the Johns Hopkins University** https://peabody.jhu.edu/academics/instruments-areas-of https://peabody.jhu.edu/academics/instruments-areas-of-study/recording-arts/study/recording-arts/
Degree offered	Bachelor of Music in Recording Arts and Sciences
Summary goal of program	Broadly: The program is intended for current audio professionals wishing to obtain certification and students seeking further training to gain employment in the audio industry. Computer Music: • Explores the use of software and hardware technology as creative and interactive tools in the composer's studio and in live performance Music for New Media: • Focuses on virtual reality.
Learning/Program Outcomes	Broadly: • Students with a strong foundation in math and science explore the intersection of audio engineering through music recording and acoustics. • Students will follow a curriculum of conservatory studies in music along with math, science, engineering at Hopkin's Whiting School of Engineering and audio engineering and acoustics at Peabody.
Special Features	• Facilities include four control rooms, Pro Tools, Pyramix, Automated Multi-channel Analog and Digital Consoles • Accreditation by the National Association of Schools of Music (NASM)

Institution	**New York University-Tisch School of the Arts** https://tisch.nyu.edu/clive-davis-institute
Degree offered	Bachelor of Fine Arts in Recorded Music from the Clive Davis Department of Recorded Music
Summary goal of program	The aim is to provide students with necessary skills – business, creative, and intellectual – so that they might emerge as visionary creative entrepreneurs in the evolving music industry. With a special emphasis on experiential education.
Learning/Program Outcomes	Features business courses as they relate to the specialized needs of the contemporary music industry in tandem with a series of production and musicianship courses. Students are expected to become proficient in a range of popular music practices. Concurrently, students explore critical writing and music journalism, delving into the cultural impact of popular music and the history of contemporary musical genres.
Special Features	Students will complete a "Capstone project", a customized music business venture. They will have 5 minutes to present the project to a panel of music industry leaders.

Institution	**Oberlin Conservatory** https://www.oberlin.edu/conservatory/ divisions/contemporary-music/timara
Degree offered	Bachelor of Fine Arts in Recorded Music
Summary goal of program	The Technology in Music and Related Arts (TIMARA) major is intended for students who desire a career where traditional musical skills and understanding are combined with the exploration of the very latest techniques for musical expression. The Technology in Music major prepares a student for specialized graduate studies in computer music, digital media, and new performance. For those students who go directly into a professional career, the major offers a structured course that stress the application of technology as a resource in composition, new media, and performance.

Learning/Program Outcomes	Broadly: • Students will take business courses related to the music industry in tandem with production and musicianship courses. • Students will become proficient in a range of popular music practices. • Students will explore critical writing and music journalism, delving into the cultural impact of popular music and the history of contemporary musical genres.
Special Features	Each summer, TIMARA faculty sponsor a weeklong Sonic Arts Workshop for high school students interested in performing and composing electroacoustic music.

Institution	**California Institute of the Arts** https://music.calarts.edu/programs-specializations/music-technology
Degree offered	Bachelor of Fine Arts in Music Technology
Summary goal of program	The Music Technology: Interaction, Intelligence & Design (MTIID) Specialization prepares students for careers focusing on electronic composition and performance, sound design and synthesis, web/multimedia design, audio electronics, immersive environment design, recording, software development and interactive audio.
Learning/Program Outcomes	Broadly: • Students on both tracks emerge with a full complement of theoretical and practical methods for creative engineering through artistic expression. • With an emphasis on the sonic arts, students take classes covering subjects like electrical engineering, computer science, physics, acoustics, and mathematics, along with many courses emphasizing the program's core focus in electronic music composition, production, and performance. • Students will collaborate across departments with plenty of performance opportunities in the music school. • Practical opportunities may involve: scoring, animation, building installations with

	the arts & theatres departments and various world music collaborations.
Special Features	Many opportunities for collaboration and performance.

Institution	**Goldsmiths, University of London, UK** https://www.gold.ac.uk/ug/bmus-bsc-electronic-music-computing/
Degree offered	Bachelor of Music or Bachelor of Science in Electronic Music, Computing and Technology 3 years full time/4 years full time with the 3rd year spent on a placement in a relevant industry/institution; 6 years part-time
Summary goal of program	The degree is designed to meet the opportunities, challenges and intellectual demands presented by careers in the arts and creative industries, in music technology and in audio,
Learning/Program Outcomes	Broadly: • Students will develop understanding across broad fields of creative practice, computer science and musical research. • Students will study with a wide range of academics, internationally established composers, performers, writers and computer experts. • Students will study in the departments of Music and Computing. Detailed learning outcomes are provided in the Programme Specification that includes knowledge and understanding, cognitive and thinking skills, subject specific skills and professional behaviours and attitudes, and transferable skills, https://www.gold.ac.uk/media/docs/programme-specifications/bmus-bsc-electronic-music-computing-and-technology.pdf
Special Features	The degree includes an optional Industrial Placement Year between the second and third year of study for students to develop practical skills and real-world experience with the support of a placement tutor, who provides students with guidance and liaises with employers.

This book presents a collection of selected papers that present the current variety of all aspect of the research at a high level, in the fields of music, education and computer science. The book meets the growing demand of practitioners, researchers, scientists, educators and students for a comprehensive introduction to key topics in these fields. The volume focuses on easy-to-understand examples and a guide to additional literature.

Michele Della Ventura, editor

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