

# **AC 2010-948: HELPING ENGINEERING AND SCIENCE STUDENTS FIND THEIR VOICE: RADIO PRODUCTION AS A WAY TO ENHANCE STUDENTS' COMMUNICATION SKILLS AND THEIR COMPETENCE AT PLACING ENGINEERING AND SCIENCE IN A BROADER SOCIETAL CONTEXT**

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# **Helping engineering and science students find their voice: Radio production as a way to enhance students' communication skills and their competence at placing engineering and science in a broader societal context**

## **Abstract**

Terrascope Radio is a class offered to second-semester freshmen at the Massachusetts Institute of Technology. The subject satisfies one of their freshman humanities requirements, and also one “communication-intensive” requirement. Through intensive critical listening sessions and writing assignments, students develop a deep understanding of radio as a medium for the communication and expression of ideas. They explore radio-specific techniques—such as the use of sound to evoke a physical setting and the effective interweaving of interviews and ambient sound—as well as techniques common to a variety of media, such as the use and development of story arcs and pacing. At the same time, in laboratory and field sessions they develop proficiency in the technical aspects of radio production, such as gathering high-quality sound, audio editing and digital audio effects. The class culminates in a major team project, in which students develop and produce a radio documentary on the social, economic, political and technical aspects of a complex environmental issue. The documentary is aired on the MIT radio station and then distributed and licensed for broadcast on other community and public radio stations nationwide.

Student and faculty feedback on the class has been extremely positive, both in informal forums and in formal assessments. Students report (and show) strong learning gains both in oral communication, as one might expect, and also in written communication and the ability to explore in detail the broader societal context of their technical studies. Many students have used their work in the class as a jumping-off point, from which they have continued their exploration of radio/audio. For example, one group of former Terrascope Radio students created and now produces its own weekly radio program on environmental and social issues. Others work as mentors in Terrascope Youth Radio, an outreach program in which local urban high-school students create radio programs on environmental topics.

In this paper we describe the class in detail, paying particular attention to the aspects we believe are responsible for its success and lessons learned from its development. We also examine evaluation and assessment data, and we give examples of students' work.

## **Introduction**

In this paper we describe a class designed to address questions faced by engineering and science faculty at many institutions: how to give students the skills necessary to communicate their ideas to diverse audiences, and how to help them develop the ability to see the broader societal context of their work. The class, called Terrascope Radio, is a component of one of MIT's freshman learning communities, but it would be possible to develop similar classes independent of such a community. Students who have taken the class report not only that it has improved their communication skills and broadened their outlook, but also that it has enhanced their ability to function in teams, to approach unfamiliar settings with confidence and to absorb and process

technical information provided in lectures and presentations. Here we give an overview of the class itself, and we discuss its outcomes for students.

Terrascopes Radio, which has been offered since the 2004-5 academic year, is an optional class for second-semester freshmen in MIT's Terrascopes learning community. The class satisfies part of MIT students' humanities requirement and part of a separate communication requirement. Terrascopes has been described in detail elsewhere,<sup>1,2</sup> but a brief description here will help to place Terrascopes Radio in context. Terrascopes is a voluntary learning community, in which roughly 5 percent of MIT freshmen participate in some way. At the core of the program are a number of special classes, but Terrascopes students also are assigned academic advisors drawn from faculty and staff affiliated with the program, participate in regular lunches and other events, and have exclusive access to a classroom/lounge/kitchen space. They also have the opportunity to participate in an optional field experience during spring break. Upperclassmen continue to be part of the Terrascopes community, both formally (by serving as teaching fellows for the classes and on the field trip) and informally (by continuing to use the Terrascopes facilities and to attend events).

In the fall Terrascopes class, Solving Complex Problems (also known as Mission 20xx, where "20xx" changes annually to reflect the students' expected graduation year), the students are presented with a real-world problem, one that involves not only scientific and technical issues, but also social, economic and political considerations. They are given one semester to come up with a detailed solution to the problem; at the end of the semester they present and defend that solution for a panel of experts. The problem generally involves environmental or Earth-system issues, although it is not exclusively devoted to them. Previous problems have included: developing a plan to provide adequate fresh water for western North America for the next century and beyond; creating a legal, regulatory and scientific framework to preserve the viability of global fisheries; and deciding how (and whether) to rebuild New Orleans in the aftermath of Hurricane Katrina. Students are given broad latitude in structuring their approach to the problem, and they have great freedom in organizing themselves and their solution to address the problem as they see fit.

By the spring semester, Terrascopes students have thus developed a deep interest, and some level of expertise, in a specific complex problem. Terrascopes Radio, an optional class open to those who have participated in Mission, builds on that interest and expertise by presenting students with a challenge of a different sort: by the end of the semester, they must collectively produce a half-hour radio program, intended for a general audience, that covers some aspect or aspects of the problem they have been studying. The students' fall-semester work thus provides an intellectual focus for the class, but it would certainly be possible to develop similar classes that derive their central focus in other ways.

### **Class Structure and Curriculum**

Terrascopes Radio was developed in a collaborative effort by the Terrascopes program and the MIT Program in Comparative Media Studies (CMS). Terrascopes staff began developing the class, as a way of expanding the variety of communication experiences open to Terrascopes students and engaging them more deeply in the social and humanistic aspects of their work, and

turned to CMS for assistance. Two CMS graduate students who had extensive experience in public radio worked closely with a Terrascope instructor who has expertise in project-based, team-oriented learning and some additional media experience to create the class and teach it for the first time. In subsequent years other CMS students and affiliates have participated in teaching the class; a number of upperclass alumni of the subject have also participated as teaching fellows. Input from students has played a key role in shaping the class over time.

Students in Terrascope Radio develop a deep understanding of radio as a medium for the communication and expression of ideas. As with many other media, in order to truly understand how radio works, and what makes good radio so effective, students must understand radio as producers, not simply as consumers. Along the way they must develop several distinct sets of skills: They must learn how to operate professional-quality recording equipment and audio-editing software, and they must come to understand what it takes to tell a story effectively using only sound. (The latter is generally the most challenging aspect for most students, since very few of them will have spent much time listening to audio-only pieces, and almost certainly none of them will have done any critical analysis of such pieces.) The class thus initially proceeds down two tracks: hands-on “laboratory” sessions in which students use audio gear and software to gather, edit and structure sound; and intensive group listening sessions, in which the class as a whole listens to a wide variety of audio pieces, analyzing them closely in order to understand what makes them effective (or not). Individual writing assignments complement this work, giving students the opportunity to focus on particular aspects of radio production and storytelling.

At the beginning of the semester students need first to develop their ability to listen carefully, so the first class exercise is a “sound walk,” in which students are blindfolded and led around campus, focusing on the sounds they hear and what those sounds tell them about their environment. Many students are amazed from the start, as they walk down the hallway outside the classroom; the acoustic environment at one end of the hallway (classrooms and offices, most with closed doors) is completely different from that at the other end (an open space, with elevators, exterior doors and vending machines) but usually none of the students have noticed that before. During the rest of the sound walk, students focus on trying to identify the size and type of spaces they pass through, separating “foreground” from “background” sounds, kneeling or squatting in order to listen for differences in sound at different heights, hearing transitions from one space to another, and so on. The blindfolded sound walk is followed immediately, in the same class period, by a sound walk on which students carry microphones and recording equipment, and listen only through their headphones. The goal of this exercise is to help students understand how different the microphone is from the human ear, and how using a microphone makes it easier to pick up very faint sounds but harder to distinguish individual sounds or to separate them spatially.

For the rest of the semester, periods are divided into “class” sessions (mostly devoted to critical listening and analysis) and “lab” sessions (mostly devoted to hands-on recording and production). Each listening session covers a specific topic, element or technique in radio production. For each session, the lead instructor and teaching fellow create a list of roughly twenty or more possible listening samples. Not all of the samples will be played during a given session, but it is important to have a wide variety available, in order to emphasize or address

points that come up during class discussion. The class listens to one sample at a time, over the classroom audio system, and discusses each sample in detail before moving on to the next (which is chosen in response to the ongoing conversation). The discussions can be quite lively, with students often building on or contradicting one another's points of view. Topics covered over the course of the semester include:

- Radio's strengths and weaknesses as a medium
- The variety of sound, both natural and artificial, available to radio producers
- Using sound to evoke a sense of place or time
- The theory and practice of conducting interviews
- Stages in development of a radio piece or program
- The role of story arcs in shaping a piece
- Shaping a piece with music and incidental sound
- Writing for radio
- Voicing
- Field reporting
- Commentary writing and writing in the first person
- Scriptwriting
- Pulling together all the elements into a coherent whole.

Listening sessions are concentrated in the first half to two-thirds of the semester. Then the focus gradually shifts to intensive production work, as students put their knowledge into action in the development of their final project.

In parallel with this series of listening sessions is a series of lab sessions and hands-on assignments designed to familiarize students with the practical and technical sides of audio production. Students are loaned audio kits (digital recorder, microphone, headphones, accessories, field bag) and after a few practice sessions they are assigned to produce a "Person/Place" story: a 2-3 minute piece about a person of their choice and a place that is special to that person. The piece must include at least: some scripted narration by the producer; excerpts from interviews with the subject of the piece; and some ambient sound, ideally collected in the subject's special place, if that is practical. Other elements, such as music, may be included but are not required. Students have three weeks to produce the piece, with intermediate milestones (e.g. rough samples of recorded sound, a synopsis or plan for the piece, a script, sound clips selected for use in the final piece) required along the way.

The Person/Place piece serves several purposes. Certainly it gives students a chance to become familiar with the recording equipment and production software, and to overcome the discomfort many of them feel at first when conducting interviews, handling a microphone in public, etc. It also gives them the chance to make errors early in the production process, and to see the consequences of those errors for their later work. For example, many students at first do not

recognize the importance of gathering clean sound, without unwanted background noise. As they attempt to assemble their early recordings into a finished Person/Place piece, they come to see that the poor quality of their sound will have an irreversible effect on the quality of the finished piece, and they begin to recognize how crucial it is to be aware of sound quality at all times while recording. That prepares them well for the sound gathering they will do for their final class project, when the stakes will be much higher. The Person/Place piece also gives students an opportunity to try out some of the techniques they have been discussing during listening sessions.

As the Person/Place pieces near completion, they themselves become the focus of the listening sessions, so that students are hearing and critiquing one another's work, just as they have been critiquing the work of radio professionals. Many of the finished Person/Place pieces are of surprisingly high quality, and several have been licensed for broadcast by public radio stations. A selection of Person/Place pieces can be found at:  
<http://web.mit.edu/terrascope-radio/PersonPlaceSelections/>

As the spring break Terrascope field trip approaches, students begin developing story ideas for their final production. The site of the field trip varies, but it is always relevant to the year's Terrascope problem; it is generally on the field trip that students gather the great majority of the sound they will use for their final project. Because the trip is so brief (a week or less), it is important that the students approach it with a plan in mind, even though that plan is sure to change as they interview people, visit important sites, etc.

The trip itself is generally a very busy time for Terrascope Radio students. The trips are tightly scheduled, and so even those students who are not taking Terrascope Radio find that their days are extremely full. The radio students need to find and interview appropriate subjects (e.g. officials from government or industry, scholars, citizens directly affected by the issues under study, people in the street), gather relevant ambient sound, and communicate closely with one another as new story ideas materialize and old ones become untenable. Most nights during the field trip, radio students gather for "logging parties," at which they listen to the sound they have recorded during the day, log it (i.e. create a text file describing what sound or interview segments they have and where to find them in each sound file), play excerpts for one another and discuss the evolution of their story ideas. Logging parties are also an excellent opportunity for the instructor and teaching fellow to provide advice and give specific guidance on field recording or interviewing techniques and strategies.

On returning from the trip, each student produces an "audio postcard" based on sound he or she has gathered. (Students who did not go on the trip—which is an optional component of the program—produce audio postcards based on their own spring break experiences.) In addition to the practical experience the exercise provides, producing the postcards engages the students immediately in listening to and assessing the sound they have brought back, and it jump-starts the creative process through which they will decide the content and structure of their final program.

Apart from certain targeted listening sessions and writing assignments, the rest of the semester is devoted to the intensive team process of creating the final program. Students divide this task as

they see fit. Usually they decide, as a group, what segments the final show will include and what tone each segment will take, and then the process of finding sound and writing scripts for the segments is divided among teams of students. In some cases certain students will take on special tasks, such as finding, looping and processing music. Even when teams are engaged on separate segments they tend to work in the same space, and so the process is deeply collaborative, both in and out of class time. (It is during this period that the 24-hour availability of the specially designated Terrascope rooms is particularly useful.) The students decide who will provide voicing for each segment, and after several takes of voice tracks are recorded, they select voice cuts for one another and collaborate on final production. The program is then aired on WMBR, the MIT radio station, and is made available for broadcast by community and public radio stations nationwide. All of the final pieces produced in the class have been broadcast by at least a few other stations, and some have been distributed widely. Examples of finished programs can be heard at:

[http://web.mit.edu/terrascope/www/radio\\_archive.html](http://web.mit.edu/terrascope/www/radio_archive.html)

### **Outcomes for Students**

As might be expected, students who have taken Terrascope Radio report that their experience in the class has improved their ability to frame and communicate ideas, but they also describe positive outcomes in a variety of other areas. Some general categories into which student outcomes fall are:

1. Improved communication skills
2. Enhanced ability to see and understand issues from multiple perspectives
3. Strengthened teamwork skills
4. Increased competence in listening and interviewing, outside the radio context
5. Greater self-confidence
6. Discovery of new areas of interest or enthusiasm, which they intend to pursue more deeply

1. Communication Skills: In Terrascope Radio students learn how to communicate their ideas to a lay audience, and to do it in such a way that the audience continues to be interested. They have to learn to be concise and engaging, and to shape their content to suit the needs and interests of the audience. As some students wrote when asked about this topic:

*“One of the main ideas behind radio is that you want to write for a given audience in such a way that they will listen. Radio gives you just a few minutes to say as much as possible, so being able to say a lot with a little becomes very important. In other words, learning radio teaches someone to be concise. How is this useful? MIT students who communicate in the real world will need to be able to get their point across effectively. This goes for e-mail, technical papers, presentations, etc. The skills that learning effective radio imparts (such as concise communication that is appropriate for the audience) are more applicable to many modes of communication than the traditional writing taught in schools.”*

*“In our radio classes we were constantly required to think about how other people would react to radio broadcasts. We had to try to tap into something in people that would enable them to connect with our piece. And we had to try very hard, knowing that in a discipline like this people can just stop listening if you cannot grab their interest right at the beginning and keep it all the way through. I think this ability to hold a random person’s attention is an important skill to learn, since in most of our other work at MIT it is assumed that whoever ends up reading through our proofs and solutions already has a thorough understanding of the subject and an interest in reading all the way through.”*

*“Radio made us think a lot more about communicating these issues effectively. As engineering students we found it easy to understand the technical processes involved in the problem we had studied, but it required a great deal of thought to convey these processes in an easy-to-understand and, above all, interesting way.”*

*“This class required my classmates and me to present our ideas creatively. We were expected not only to explain why the issue of drought in the west was an important topic, but also to persuade the audience to care about the topic as much as we do.”*

Another student, now an editor for the campus newspaper, notes that lessons she learned in Terrascope Radio—the importance of including texture and variety, focus on fine details of word choice, emphasis on the needs and interests of the audience, etc.—have a strong influence on her work as she writes, edits and selects stories.

2. Broadened Perspectives: As students gather sound and conduct interviews, they come to see new aspects of the complex Terrascope problem they have been studying all year. In particular, they come to understand the broader social, economic and political questions more deeply and from a greater variety of perspectives. To quote from “Nerds in New Orleans: No, we’re not here for Mardi Gras,” the program created by Terrascope Radio students in 2006-7:

*“More than anything else, it was the people we met that defined our experience. They came from all walks of life, and they all had their own things to say.... Visiting New Orleans has changed us. By seeing the strength and love these people have for their city, we have stopped looking at New Orleans merely as scientists, and have started to appreciate why it is precious to so many.”*

In the words of a student from a later year:

*“In our case we were studying the water shortage in the Southwest. Radio students had the distinct advantage of being forced to find out first-hand from the people affected what they thought of the issues. On the field trip, the radio students found and interviewed local people, in addition to the officials who gave us tours and presentations. When we played the interviews for each other we learned surprising facts about people’s awareness of the problem.”*

3. Teamwork Skills: The class provides an intense and fruitful teamwork experience, in which students learn how to critique one another's work and to accept criticism as part of the productive process. They divide a complex task among themselves, and they collectively ensure that each part is completed satisfactorily and fits into the whole. The unforgiving nature of the broadcast environment (in which uneven production work is impossible to hide), combined with the reality of broadcast deadlines, unifies the team throughout the process. The process of audio-editing itself encourages teamwork. In the words of one student:

*“We tended to work on a single portion of the overall show, then listen to someone else’s portion and offer comments or editing suggestions. We realized that often, if we listened to the same section over and over, we became deaf to problems with it, so switching off offered us chances to dramatically improve our work.”*

Another student has written:

*“Radio really helped my group-work skills. Editing someone else’s voice/audio work can create a very touchy situation, and it helped me to figure out ways to delicately deal with people and their work, and with disputes.”*

4. Increased Competence in Listening and Interviewing: Students report that they come out of the class much more comfortable with the idea of finding important people and asking them detailed questions, a skill that helps them immediately in school and that will also help them in their professional lives. They also report that they follow talks and presentations more attentively, since they are now trained to listen for the key details:

*“One of the most valuable skills that Terrascope Radio teaches is how to set up and conduct interviews. Going into the class, I felt pretty intimidated by the thought of going to talk to random MIT professors, government officials or people on the street. Radio cures you of that quickly! After a day or two of awkward interviews, I found that I had no fear of going up to anybody with a microphone in hand. You realize that everyone—random people on the street, brilliant professors, wonderful (or corrupt) government officials—are all human, and most of them also really like to talk. So how is this interviewing skill useful? Later in life, MIT students need to go through interviews on the other side of the table—for jobs, for graduate school. Personally, I have found that being interviewed is much easier after spending time giving interviews. I have a much better idea for what kinds of responses are appropriate, and I am much more relaxed about them.”*

*“Once we began conducting radio interviews we were forced to guide conversation on the fly and ask questions that would lead to fuller and more in-depth responses from our interviewees. These skills have trained me in an area that simply writing an essay cannot do. Knowing how to conduct an interview and elicit an interesting dialogue will be invaluable for those of us pursuing jobs where we must regularly interact with others. I listen differently during presentations as well as basic conversations now, grabbing on to the most captivating points and identifying questions that I might ask.”*

5. Greater Self-Confidence: It almost always happens that over the course of the semester some of the quietest and most reserved students find new, bolder selves once they are equipped with microphones and an excuse to approach total strangers and ask questions. As a student who became a teaching fellow for the class observes:

*“I really love watching this transformation. Almost every student starts out nervous and awkward about approaching people for interviews. A few weeks or a month down the line, and I see these students just confidently holding out microphones and conducting interviews.”*

One of the class’s original developers and teaching assistants adds:

*“I found one of the most gratifying elements of teaching the class was watching the students’ confidence and skills emerge over the course of the semester. Students who at the beginning of the term didn’t feel they had a voice to contribute were by May editing each other, displaying unique storytelling styles and, for some students, a real passion for using field sound to provide the connective tissue between concepts.”*

6. New Interests: For some students, Terrascope Radio has sparked a deep interest in communicating ideas via radio. The simplest example of this concerns a group of students who now have their own weekly program, “Terravoice,” on the MIT radio station. The program is in its second year, and regular hosts and producers include students from all three of the most recent years of Terrascope Radio. Some of those students, along with other alumni of the class, also serve as mentors in Terrascope Youth Radio, an outreach program conducted by MIT and Cambridge Youth Programs, in which urban teens create radio on environmental topics. (Terrascope Youth Radio is described in more detail elsewhere.<sup>3</sup>)

For students who have served as Undergraduate Teaching Fellows (UTFs) in the class, the experience has been inspiring. UTFs do day-to-day work assisting students, but they also have strong input into the class structure and curriculum. They participate in redesigning the syllabus year to year, and they also develop assignments and demonstrations. One notes that “Having to communicate about how to communicate added a new layer to my educational experience,” and another says:

*“I find it completely crazy sometimes that I was the UTF for Terrascope Radio my sophomore year, and that one of my students was the UTF the following year. From my side, that’s just extremely exciting, that I now have several generations of students who have all been affected in some way by the work that I did.”*

One international student reports that the class has helped her as she thinks about effecting change in her home country:

*“I have an interest in getting involved in radio broadcasting at home. We have a tricky situation, in which the ruling party controls the public radio. However, over the summer after taking Terrascope Radio I paid much more attention to the local radio broadcasts. This class made me recognize the potential for a new radio program to succeed at home*

*if government control is ever relaxed, since at the moment the quality of the radio there is very poor. I am glad that I now know how to operate recording and sound editing equipment, skills which could come in very handy.”*

## **Summary and Discussion**

Our experience developing and teaching this class has shown us that radio production can be an exciting, engaging and effective way to broaden engineering and science students' communication skills, and to give them insight into the societal context of their technical work. There are a number of factors that have contributed to the class's success so far:

- The fact that most students have never before used this medium gives them the opportunity to reconsider their assumptions about what it means to communicate effectively, and about how to tailor communication to a particular audience.
- There is a relatively low barrier to entry—audio equipment and software are relatively easy to use and learn.
- There is a high threshold for success: Although it is easy to gather and mix sound, it can be very difficult to do so effectively, in ways that live up to the standard of existing work. With effort and application, however, it is possible for college freshmen to achieve a very high level of professionalism and polish.
- The creative and production process is student-driven—students base their work on their own creative instincts and enthusiasm, and their work is motivated by their own desire to produce an excellent product.
- Part of that motivation comes from the very public nature of radio work, particularly in an age of streaming on-line audio: Anyone can tune into the final program, from anywhere in the world—including the students' own peers from their dormitory rooms, their parents and relatives, and complete strangers who happen to listen in.

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