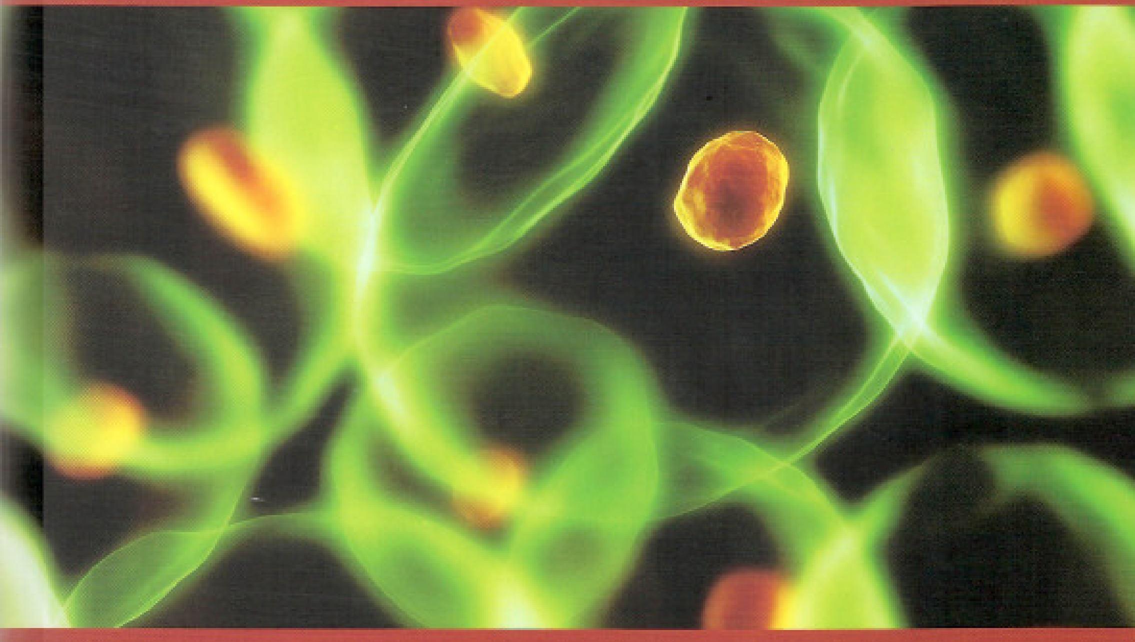
Communicating Science

New Agendas in Communication



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college of communication
THE UNIVERSITY OF TEXAS AT AUSTIN

ROUTLEDGE

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Routledge
Taylor & Francis Group
NEW YORK AND LONDON

Chapter 10

An Interdisciplinary Approach to Science Communication Education

A Case Study

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In January 2007, Alan Leshner, chief executive officer of *Science* magazine issued a call for increased communication training for graduate students of science. Only two months later, the U.S. House of Representatives considered the Scientific Communications Act (HR 1453), a bill to request funding from the National Science Foundation to support communication training for future scientists (GovTrack.us, 2007). Although HR 1453 did not pass, these calls to action underscore recognition of the need for more serious attention to science communication education.

Academic programs that focus on science communication do exist at the university level; a directory published by the University of Wisconsin, home to one of the oldest science communications programs in the United States, lists 47 universities nationwide that offer programs and/or courses for students interested in science communication (University of Wisconsin, n.d.). However, only five of those universities offer communication courses that are housed within or explicitly affiliated with science programs. The programs offered at the remaining 42 universities are typically housed within communications or journalism departments and programs, although a sampling of course offerings and scholarship can also be found across a range of other disciplines. For example, technical writing might be taught in engineering or English departments, science writing might be taught in journalism or political science departments, and so forth. The program tree presented in Figure 10.1 reflects the taxonomy of science communication programs listed on the University of Wisconsin–Madison *Directory of Science Communication Courses and Programs*.

To meet the demand for science communication education, some science programs—like the program at Arkansas State University, Jonesboro—have begun to develop communications curricula within their own courses and departments. Yet, offering communication education under the auspices of a science program can be a formidable challenge. For example, scientists who venture out of the classroom, laboratory or field to work with the media (or who become employed by media outlets) may lack sufficient media training to understand the adversarial role of the free press (Cooke,

Figure 10.1 Taxonomy of Science Communication Programs Listed on the University of Wisconsin–Madison *Directory of Science Communication Courses and Programs.*

2007). They may also lack an understanding of the responsibility of the media to the public and the media's function as "watchdog" via criticism and oversight of major institutions (Benn, 1979). And they may have a limited understanding of what makes a story newsworthy. As a result, science writers trained in a science program may face unanticipated consequences and reactions to their work.

At the same time, however, science communication courses offered by traditional journalism departments may fail to meet the exacting and varied technical demands of the scientific community. Although some flagship institutions like the University of Wisconsin may be able to offer a broad set of courses and programs that allow for specialization ranging from risk management for financial managers to training in the hard sciences for journalists, science communication courses and programs nested in journalism departments at smaller academic institutions face challenges posed by the constraints of more limited course offerings and budgetary confines. Given those constraints, it can be difficult to offer students a broad array of communication training that prepares them to meet the demands of the scientific community.

In this chapter, an argument is made for the creation of more interdisciplinary science communication programs. Such programs allow for a pooling of resources, and can draw from the expertise of both trained science and journalism/communication educators. The result, it is argued here, is an educational model that is accessible to upstart science communication programs at smaller universities and that better poises educators to help students overcome the aforementioned challenges that surface when training occurs within the confines of only one discipline. A case study illustrating a science communication curriculum taught at Arkansas State University, Jonesboro is presented, along with reflections on how this curriculum can serve as a model for developing and delivering interdisciplinary science communication courses at other universities.

The Paradigm Problem

In science communication, the need for effective communication strategies is particularly crucial. The communicator, whether scientist or journalist, often must translate highly technical information to language that a less-specialized audience can understand. However, when a communicator alters specific terminology to produce understandable content for a general audience, the changes may not accurately convey the original information. And yet, if that information is presented using the exact terminology of the scientists, the message may be so nuanced and complex that it cannot be understood or appreciated by the general audience; general audience members often lack an understanding of terms commonly found in scientific or academic research. This creates a delicate balancing act for the communicator who, in order to be effective, must be true to the science, but also write for optimum reader accessibility.

The task of communicating science is made more difficult because, as alluded to above (and as covered in several of the earlier chapters in this book), journalists and scientists tend to approach science communication from different perspectives. For example, journalism practitioners place a high priority on developing stories that are newsworthy and that meet the needs and tastes of an often diverse mass audience (Russell, 2008). Thus, journalists may freely question, criticize, rewrite, and reinterpret scientific research programs or studies. They also may question or criticize the motives, backgrounds, or funding sources of scientists whose work they are covering.

Scientists, on the other hand, may regard science communication in terms of public relations (Russ-Mohl, 2007) or public education (Bhattacharjee, 2006; Gropp, 2006). In terms of public relations, scientists might perceive the media as a tool for bolstering public support for their institutions or their personal research agendas. Or they may attempt to influence public opinion on policy issues that impact their research agendas, such as intelligent design or embryonic stem-cell research. Public education, on the other hand, may have persuasive elements but tends to focus more on building public knowledge—and the media are often the chosen conduit for this task. Yet a scientist without formal training in journalism may think that all scientific work is of interest to the public simply because it is of interest to science. This is not necessarily the case. Proper training in communication can help scientists better understand how to overcome potential obstacles to media and public interest.

In addition to the challenges inherent with balancing the needs of communicators and scientists, each situation and each institution has its unique issues, opportunities, and challenges. Indeed, the challenge of developing curriculum to prepare future scientists to communicate effectively with a range of different audiences is further complicated by the inherent differences among institutions of higher education: public versus private; postgraduate education versus 4-year baccalaureate institutions; primarily educational versus research-intensive institutions, etc. According to Sharon Dunwoody, who has taught science communication at the University of Wisconsin for more than 20 years, when it comes to developing science communication courses and programs, "there is no one-size-fits-all model out there … There are many different needs" (personal communication, October 24, 2007). In other words, no one science communication course can meet the varied list of challenges outlined above. However, any attempt to develop an effective science communication course that meets even a handful of those challenges will certainly be more effective when different perspectives and disciplines are recognized.

Such a collaborative effort is under way at Arkansas State University, Jonesboro, where researchers from three different academic disciplines and diverse backgrounds have worked together over a span of 3 years to design and implement a science communication curriculum using an interdisciplinary approach. The following case study details that effort. However, before presenting the details of the case, the following section reviews the related literature and serves as a framework for the case study.

The Interdisciplinary Approach: A Brief Literature Review

Given the inherently different perspectives underlying many science communication endeavors, any participant—whether teacher, student, scientist, communicator, or audience member—can benefit from an improved understanding of the different points of view he or she encounters. As a result, an interdisciplinary approach involving instruction by multiple faculty across different relevant academic disciplines, including science and journalism, is particularly appropriate to science communication. This approach is underscored by de Semir (2000):

> Since most of public knowledge is derived from mass media, it is easy to see why the general public tends to be poorly informed about scientific issues. The reporting of science news via the mass media is anything but easy, but it is becoming increasingly important. Fortunately, both journalists and researchers are realizing that their fields are becoming increasingly intertwined, and are exploring new ways to work together. The evolution of this partnership is likely to be fruitful. (p. 128)

An interdisciplinary approach is especially important in the development of education policy and curriculum related to scientific issues that cross several subject areas. Saito and colleagues (2007) summarized the results of a conference dedicated to developing multidisciplinary approaches to studying and teaching aquatic ecology models. They reported that there is a consensus among scientists and educators that "the solution to environmental problems require interdisciplinary approaches" (2007, p. 48). For example, when addressing related issues in hydrology, it is necessary to draw upon chemistry, physics, geology, and even the social sciences, and to consider perspectives and information from all those areas. Yet, as indicated earlier in the chapter, no existing science communication courses or programs appear to explicitly use such an interdisciplinary approach. This limitation is illustrated in Saito et al.'s closing, which says that although there is a need for interdisciplinary collaboration, "environmental scientists are often still trained in a disciplinary fashion" (2007, p. 48).

In support of the interdisciplinary approach to education more generally, McClure (2007) notes, "Interdisciplinary studies, the thinking goes, will better equip students to solve problems creatively and to deal with increasing complexity" (p. 70). Drake and Burns (2004) concur that an interdisciplinary approach facilitates creative teaching and the time is right for integrating curricula.

While there is an increasing demand for science communication education, the field of communication itself is going through rapid change—and traditional approaches to communication education are changing as well. In *The Scientist*, Nisbet and Scheufele (2007) challenge traditional science communication. They state that for too long, scientists have embraced the media-centric "popular science model," which puts the news media in charge of educating the public about science that is controversial such as embryonic stem-cell research. Nisbet and Scheufele (2007) argue that in the world of MySpace and YouTube, audiences eschew traditional media and seek their own sources of information.

If audiences seek varied new media sources for their information, science communication educators must also address those trends within their courses. Ways must be found to incorporate new teaching material into existing courses, while balancing the need to continue to teach more traditional material as well. Science journalism may be found on the Web on blogs, multimedia presentations and even as YouTube videos. Science communicators—or any professionals dealing with modern media—need to be conversant with multiple technologies while maintaining a grounding in critical thinking, concise writing, and journalism laws and ethics.

As the media undergo rapid change, the inherent flexibility of the interdisciplinary approach can be a good way to address science communication across an array of channels, including online, broadcast, speech, print, and other forms of message delivery. Faculty from the sciences bring their background and knowledge of their subject to the seminar table, and communications faculty bring their familiarity with the ever-changing media. Faculty members with both scientific and media expertise are rare at best, but most universities may achieve the necessary expertise to address the needs of science communication by using several faculty members. Moreover, the different perspectives offered by different faculty members can only bring more information and ideas to a class than the knowledge base of individual faculty members. Further, students need help finding and developing their own voice and interaction with different faculty through interdisciplinary teaching provides them with concurrent exposure to varied communication styles on the same subject matter.

However, use of an interdisciplinary approach is not free from challenges. In an economic climate of declining financial resources for universities, supporters of the interdisciplinary approach may face increasing political opposition to instructional methodology that requires a more intensive commitment of time and personnel than a standard laboratory-lecture teaching method. There are also pedagogical consequences, including potential disagreements between science and communication educators over structural issues like course content, assignments, the nature and format of faculty and student presentations, grading, and other issues.

Additional caveats are offered by documentation of attempts at integrating interdisciplinary work in the K–12 curriculum, experiences nonetheless relevant at institutions of higher learning. For instance, implementing integrated curriculum takes time as instructors choose their content, gather resources, discuss course assignments, consider student learning needs, and coordinate their schedules (Lake, 1994). Considerations should also be made by involved faculty to avoid the potential pitfalls of introducing inappropriate or ineffective interdisciplinary approaches (McClure, 2007). Although many of these problems can be overcome with ample planning, integration should not be forced if the mix of disciplines results in irrelevant course activities and inappropriate content delivery (Lonning & DeFranco, 1997).

Complicating the demands even further, as Nisbet and Scheufele (2007) argue, there is an increasing need in science communication to partner with audiences (also see Brossard & Lewenstein, Chapter 1, and Nisbet, Chapter 2, this volume). Fuller (2002) makes a similar assertion, arguing that journalists, scientists, and the general public should work together to create a forum for feedback and to enter into dialogue. Fuller (2002) takes the argument one step further, asserting that the field of science communication should build trust and rapport with people so that people not only become more involved in the issues, but also begin to see science as an accessible, viable career path.

Given these varied perspectives, an interdisciplinary approach to teaching science communication was deemed appealing to and beneficial for Arkansas State University, Jonesboro students—particularly students who were involved in two or more disciplines combining natural sciences, social sciences, and/or the humanities. At the same time, it was reasoned that the resulting course projects (such as packaged news stories), if properly publicized via media outlets, could create opportunities for the university to educate various audiences, stimulate interest in science, encourage dialogue on science issues among the general public, and make the public more familiar with the work being done at the university.

A Brief History of Interdisciplinary Science Communication at Arkansas State University

Established in 1909 as a state agricultural school, today Arkansas State University (ASU) in Jonesboro is characterized as a quality regional institution of higher education and is recognized for offering special services to the people of the Arkansas Delta, an area of the state that is characterized as agricultural and poverty stricken. Enrollment at the university is approximately 10,000 undergraduate and 1,500 graduate students in programs at the doctoral, specialist, master's, bachelor's, and associate degree levels.

As a result of the Tobacco Settlement Proceeds Act of 2000, ASU, as well as an additional four Arkansas campuses and a medical school, received substantial funding to plan and build major bioscience facilities throughout the state; the result is the collaborative Arkansas Biosciences Institute (ABI). The ASU–ABI provided the catalyst for unprecedented research initiatives in agriculture, bioengineering, tobacco-related illnesses, nutrition, and complementary fields. A major research facility was constructed on the ASU campus and a national and international call for scientists attracted diverse and skilled researchers, professors, and graduate students to this region of Northeast Arkansas.

Two of the authors, John B. Zibluk, an associate professor of journalism, and Amy R. Pearce, an associate professor of psychology conducting research at ABI who also had graduate training in science communication, began developing a communication course. The third author, Aldemaro Romero, then chair of the ASU Department of Biological Sciences, later became a participant as a frequent guest speaker.

The intent of the course was to inspire students from various disciplines to explore the possibilities of new research initiatives and to communicate ABI and other university research outcomes with a wider, more general audience. At the time, problems not uncommon to many small colleges and state campuses arose. Little support was offered for team-teaching throughout the university and seemingly insurmountable issues arose about exactly how to handle faculty compensation and teaching loads that were shared between colleges and departments. For these reasons, the journalism faculty member was the teacher of record and the course was not cross-listed among other academic fields. The course was offered in the fall semester of 2005 and incorporated a fairly standard model of a science communication course, inspired by a similar course taught at Johns Hopkins University (course details follow).

This undergraduate course, "JOUR: Science Communication," was offered through the Honors College and the Department of Journalism in order to attract qualified students as well as expose the students to a field of prospective graduate study. The course attracted 10 students, mostly from the social sciences. The honors course featured a general overview of various media and required students to "translate" information from scientific journals and other sources into scripts and stories suitable for media presentations. As a final project, students were required to present a media plan, which included identifying audiences, budgets and facilities considerations, and developing appropriate media presentations tailored to various audiences.

While the course was generally successful, it failed to attract the interest of science students. Originally, the instructors intended to require students to take their own research and prepare it for media presentation, but since the majority of the class members were not involved in any research, much less their own, the students did not have a great personal stake in this work.

Meanwhile, over a few years ABI had grown and many affiliated research faculty and their graduate students were developing connections in the region. The ASU central administration asked constituencies to focus efforts and resources in order to cooperate with new campus-wide science research and other interdisciplinary projects.

The Department of Biological Sciences began exploring ways to work with the media in order to bolster public understanding of projects under way at ABI as well as some projects of the department's own initiative. The department began encouraging students and faculty to write for newspapers. They did so intermittently, and in order to better organize outreach efforts, the department in 2005 entered into an agreement with the local newspaper, the *Jonesboro Sun*, to publish weekly articles produced by faculty and students. The challenge was to tailor these scientific messages into newsworthy and educational stories that were suitable for a general lay audience. To address this need, in 2006 Pearce and Romero extended the science communication curriculum further by offering a half-day science communication training workshop for both faculty and graduate students in the sciences. The workshop focused on two components: (a) an overview of the need for science communication in the community and (b) advice on the practice of science communication.

Products of the workshop were a series of print articles written by participants that focused on the science that was being produced at the university. With the help of the workshop, participants conveyed their own research (or research in their fields) in a format and language suitable for the general public and ready for publication in the local newspaper. Upon review of the workshop evaluations and informal oral feedback, the venture was deemed a success. Graduate students and faculty in the sciences soon requested that a formal course on writing for the general public and for public presentations be offered.

The following year, the biology department launched a radio show, "Science in the Natural State," produced in cooperation with the school's National Public Radio outlet. Each week, the radio show presented a short documentary on projects and issues involving ASU faculty and staff. At about the same time, Romero began producing short videos promoting the department's effort that were presented on two local television stations (ASU-TV and KAIT), and posted on the department's website and YouTube representing the majority of the university's viral video presence. An archive of articles, radio shows, and TV shows are posted on the website of the Department of Biological Sciences at http://biology.astate.edu/Outreach/outreach.htm and continue to be distributed for free by the ASU Public Relations Office to about 50 media outlets nationwide.

The need for professionalizing the approach was soon realized. With established outlets for their work, current faculty and students saw the opportunity to immediately see their broadcasting and writing efforts in print, on the air, and online. Yet, scientists, or those in training, were not always the best of communicators. It became apparent that an additional means was needed to generate stories to meet the practical need of providing stories to the media outlets as well as providing contributors the opportunity of controlled media exposure while continuing to generate sustained interest in the overall endeavor.

Given the infrastructure of established media outlets, and given the interest and need for scientists and science students to be able to navigate the media environment, the biology department was well suited to carry out a more formal science communication initiative.

In the spring of 2007, Romero revisited the recommendation to offer a semester-long science communication course, this time with focus on graduate students in the sciences. Romero teamed up with Pearce and Zibluk, and also consulted with the chair of the graduate program in environmental sciences, to develop a science communication course cross-listed through biology and environmental sciences (Romero, Pearce, & Zibluk, 2007). In addition to training scientists to better communicate with the public and the media, the course sought to fulfill three additional objectives: (1) to publicize the activities of the faculty and students in the host department—the Department of Biological Sciences, (2) to increase the profile of the department and thus enhance student recruitment and extramural funding efforts, and (3) to improve the morale of faculty and students within the department to enhance the working environment.

Romero submitted a graduate course proposal for "Science Communication for Scientists." To offer a variety of perspectives, Pearce and Zibluk would co-teach the course with him. Pearce offered expertise as a neuroscientist, science workshop organizer for educators, youth, and the lay public, and former producer of a science radio show, and Zibluk, a former National Geographic magazine faculty fellow, offered print journalism background as well as a grounding in general journalism philosophies and practices as well as insights into legal and ethical issues. (The course syllabus can be read at: www.clt.astate.edu/aromero/new_page_173.htm.)

Of the eight students who signed up for the course, one was an undergraduate and three were international graduate students representing Japan, India, and Costa Rica. When asked their reasons for taking the course, American students expressed an interest in developing their communication skills and working with various media formats. Conversations with the international students revealed their desire to improve their ability to communicate their own research in English as well as a desire to develop rapport with their research colleagues in the United States and to use any new communication skills to benefit the general public in their home countries.

The course was offered for the first time in the fall semester of 2007. The approach to the course was mostly in the form of introductory lectures or skill-development sessions followed by hands-on exercises. Students were taught the basics of science communication aimed at the general public via different media including basic techniques of radio and TV production such as recording, videotaping and editing. The textbook adopted was *A Scientist's Guide to Talking with the Media: Tips and Tools Scientists Can Use to Communicate Complex Research to a Media Audience* by Hayes and Grossman (2006). Harrower's *Inside Reporting*, (2007), a comprehensive journalism textbook, was also used extensively. After the introduction to techniques, students were then required to take their own research and present it in the various formats. They wrote news stories and press releases and developed radio and television scripts and storyboards. Each student also produced a radio program on his or her subject and created a 30-second video suitable for airing on the university and local television stations, as well as on YouTube. The students also were taught how to make presentations about their research to the general public. To that end they were asked to give the same presentation at the start and at the conclusion of the course, in order to compare their evolution as public presenters. Their presentations were videotaped and their performance was reviewed for strengths and weaknesses in areas ranging from clarity of content to body language.

The students' performance in the course was also evaluated using faculty consensus based on the quality of the products generated by the students. In addition, the instructors individually critiqued each project, with each instructor paying particular attention to student work in his or her own area of expertise. To engage the students in the critiquing process, constructive peer evaluation was practiced regularly during class discussions.

The expected student-related outcomes for this course were that students would become better communicators in terms of relaying their research to external audiences and the media, and that they would know how to approach different media formats and how to take on the role of science advocate in the media and community. Anecdotal comments early in the semester suggested that students were very excited about the skills they were learning. As the course progressed, students were impressed by the fact that their articles and radio and TV shows were being published and/or broadcast while the course was still being offered. Formal end-of-course evaluations revealed students believed the approach had increased their motivation to engage in science communication and had expanded their knowledge of and interest in the field. Students also considered the material and techniques intellectually challenging and useful. Suggestions to improve the course included using a website to facilitate course instruction and to better coordinate instructor feedback. While students did not rate the required text and readings as particularly helpful in relation to course activities, all eight students gave the highest rating to the evaluation statement "overall this was a great course." Based on the anecdotal comments and quantitative and written evaluations, it was agreed that the science communication students had a new-found appreciation for the media and for their own previously untapped abilities to influence people's understanding of science through the media.

The science communication course and related media products have been commended by university faculty and the administration. Responses from readers, listeners, and viewers have been unprecedented. This multifaceted approach worked for ASU and particularly for its host department in Biological Sciences not only as a science communication strategy, but also as a national recruiting tool. Such promotional and educational efforts publicized current courses and research projects in which faculty and students were engaged. According to Romero, student recruitment in both undergraduate and graduate programs increased and results from recent surveys suggested that many new students decided to attend ASU after watching the Biology videos on YouTube. Additionally, because all products were freely available on the Internet, feedback has come from audiences as far away as The Netherlands. To date, a steady stream of faculty and students volunteer to write articles for the newspaper, give radio interviews, and produce videos, and science-related community outreach activities have increased. Support for the ASU Science Communication initiative currently under development is strong.

The Arkansas State University Model of Science Communication

Our experiences with team-taught interdisciplinary science communication courses, related training workshops, and continuing public outreach initiatives have been overwhelmingly positive. In 2008 our concerted efforts were recognized by the Coalition for the Public Understanding of Science (COPUS). COPUS is a national grassroots coalition intended to promote public understanding of the nature and societal value of science. The coalition links major universities, scientific societies including the American Institute of Biological Sciences, science centers and museums, government agencies including the National Science Foundation, advocacy groups, media, educators, and industry (Coalition for the Public Understanding of Science, n.d.). COPUS cited the publication of weekly articles by ASU science faculty members as exemplary outreach activity.

After 3 years of examining various programs, discussions with journalists and scientists, and the trial-and-error experience undertaken at ASU, the following tenets for developing science communication education are recommended (also see Table 10.1). These tenets are particularly relevant to universities or programs that are starting a science communication emphasis from scratch.

- Assess the individual needs of the program, including student needs and the nature of the market. For example, if a given department or university is engaged in a health-oriented initiative, tailor your program to that need.
- Assess the available personnel and faculty. Engage faculty from various departments in discussions about course development and adjust the curriculum to match the expertise of the faculty involved in the program.
- Consult the pedagogical literature for theoretical guidance and consider ways to incorporate some of the most accepted communication theories into the program.
- Keep administration (at the department level and higher) abreast of your efforts and aware of deliverables that will serve the university and the larger community.

Table 10.1 Recommendations and Considerations for Offering an Interdisciplinary Science Communication Course

1.	Examine what others are doing and find a model that works for your students, faculty and university.
2.	Involve people from multiple disciplines across your college, university, or community in both the planning and execution stages.*
3.	Decide early on what your course goals are and any products that should result from the course. Is this course specifically for training future science communicators? A graduate recruiting tool?
4.	Negotiate course content, teaching styles, course schedules, activities, and assignments with the participating faculty and appoint one person as the primary course facilitator.
5.	Determine what resources are available for use. These include both personnel and equipment resources. Examine your budget and consider ways to offset costs of expensive items such as cameras or software.
6.	Know your target audience for the course, are they students in the sciences, communication or journalism majors, graduate or undergraduate students, or a mixture.
7.	Arrange to visit media outlets such as radio stations, television stations, and newspaper headquarters. Invite reporters, producers, announcers to visit the classroom as well.*
8.	Gain hands-on experience by writing news releases, articles, radio shows, video segments, webpages, giving oral presentations, or creating science blogs.*
9.	Direct students to a wide-ranging body of resources from which to explore. Provide both exemplary and nonexemplary samples. (We used many sites from NPR, New York Times, YouTube and local radio, television and news outlets.)
10.	Develop a supportive relationship with media outlets. Are they willing to support a special student series?
11.	Allow regular opportunities in the classroom for constructive feedback from both the instructors and student peers.
12.	Embrace different perspectives brought to the experience by the journalists and scientists.
13.	Evaluate your course, the effectiveness of course products, student perceptions, and the understanding and appreciation of your efforts by the general public.
14.	Remain flexible and have fun.

Note

* We were already practicing such when we discovered Warren, Weiss, Wolfe, Friedlander, and Lewenstein, (2007).

- Involve the university's public outreach and public relations personnel.
- Engage students in work in which they are already involved. Require them to take their own work to different audiences and different media. If students are discussing their own work, they are more likely to be engaged and enthusiastic.
- Take the same projects across several media outlets. The repetition of material increases the understanding of the similarities of basic media outlets and keeps students focused.
- Have students present their work to the class and faculty. Encourage faculty and students to discuss and critique. The seminar approach encourages participation and decreases anxiety as students discover they are all facing similar issues.
- Ensure students actually produce products—articles, videos, scripts—that can be presented in media outlets. Local media outlets continually search for local material to present and students tend to be motivated when they know their work is taken seriously and professionally.
- Coordinate course assignments and exams through one instructor to limit variability in assessment criteria and to help provide consistent expectations for students.
- Participating instructors should remain in regular contact with one another to discuss challenges, criteria for course assignments, and how the integrations of differing perspectives can be managed to avoid personal conflict among students and faculty.

The interdisciplinary approach implemented at ASU is flexible and it encourages participation of students and faculty, while also providing practical experience for students. The different academic programs involved in the class benefit from increased exposure to students as well as the general public. The interdisciplinary approach followed at ASU allowed individual faculty members to concentrate on their personal strengths and afforded them the opportunity to defer to colleagues if they needed to miss an occasional class due to other obligations at the university, such as the demands of field research, etc. Benefits to co-teaching also included offering broad perspectives and varied expertise. Furthermore, the synergies experienced via this interdisciplinary approach (and the external praise it garnered) offered an enticing framework for campus-wide consideration of integrative teaching and learning initiatives. The tangible contributions in the form of publicized course products raised the profile of students, faculty, and university programs within the community and the state, and provided evidence for garnering future external funding.

However, the interdisciplinary approach undertaken at ASU is not without some limitations. For example, the broad overview of many media outlets precluded an in-depth exploration of any one outlet. Additionally, the hands-on emphasis does offer challenges for covering theoretical, ethical, and legal units, and also requires a major time commitment of faculty and students. Thus, our pragmatic approach prevented a substantial emphasis on communication theory, coverage of which could have helped ensure that communicators-in-training were able to model their outreach techniques on well-established models for mass communication. Furthermore, while each class needs to be small to be effective, undersized, homogenous classes may exclude more diverse groups of students from other areas of the campus who could add vigor to the course. Finally, when faced with budgetary constraints, low student-teacher ratio may be politically controversial.

The Future of Interdisciplinary Science Communication at ASU

To sustain the science communication efforts at ASU, the support network for the program needs to be expanded. Administrators must be convinced that modern and innovative communication agendas involve science, and that an interdisciplinary model has much to offer all affiliated parties. A better understanding of the benefits derived from an interdisciplinary approach to science communication education will provide stability from which to expand programs and guarantee the necessary opportunities and funding for long-term success.

At ASU, further promotion of science communication will need to include additional undergraduate and graduate courses (including communication theory). A longer-term vision is that these courses will contribute to a minor or degree program eventually to be housed under the auspices of an interdisciplinary Center for Science Communication. In the meantime, the development and enhancement of the interdisciplinary science communication network will be continued and current collaboration with biology, environmental sciences, chemistry, and biosciences will be extended to include other disciplines such as math, psychology, health, and nursing.

The future also includes strengthening regional partnerships among private and academic sectors through volunteer outreach activities, promotional events and media publications. Furthermore, both faculty and students will increase collaborations with other state institutions and established organizations such as the National Association of Science Writers and the American Association for the Advancement Science.

These future directions will provide an exemplary experiential laboratory for students to learn and practice science communication, maintain its interdisciplinary spirit and foster collaborations within and among other learning institutions, all the while raising awareness of important work being conducted at ASU-ABI within the community and beyond.

Conclusions

The interdisciplinary approach to science communication is prudent and reasonable given the interdisciplinary nature of modern science and modern communication. A next essential step in professionalizing this growing field is to assess the effectiveness of individual science communication courses and programs. To date, there is a paucity of published literature in this area.

One recent case study (Markowitz & DuPré, 2007) provided biomedical students with practical teaching and communication skills in an effort to better relate scientific content and improve the students' teaching abilities. The hope for that program is that scientists trained in the theory, principles, and concepts of science education will develop communication skills to employ throughout their careers. Evaluations of the course projects, classroom discussions, online reflections, and written surveys all suggested that the course was effective in improving communication and teaching strategies. A similar case study (Moni, Hryciw, Poronnik, & Moni, 2007) reported improvements in how bioscience students write for the lay public after instruction in the explicit teaching of science concepts. This study's particular strength lay in surveys employed to gauge perceptions of student writing quality among both students and the general public.

Although it remains difficult to evaluate the needs of an ever-changing market, for science communication to truly become professionalized as a field, it is important to know how the public is responding to efforts by scientists to connect and engage potential supporters. Therefore, a broad-based evaluation plan is needed to qualitatively and quantitatively analyze current efforts and provide ideas on improving the dissemination and understanding of scientific advances. Program evaluation can also provide evidence to strengthen solicitation of external funding from sources such as the National Science Foundation, a crucial step for continued support and expansion of programs.

The interdisciplinary approach offers a bridge over these potential problems. If scientists better understand the media and their potential audiences, they can better use the media as partners in reaching their communities and their audiences with newsworthy information that can foster support and understanding of science. At a time when federal agencies and private foundations are encouraging better science communication, it is both pedagogically and practically sound to engage colleagues who have science and communication expertise to help the effort to involve as many constituencies as possible.

Acknowledgments

We thank the ASU Departments of Journalism, Psychology and Counseling, and Biological Sciences, and the Graduate Program in Environmental Sciences for supporting the team-taught, cross-listed course "Science Communication for Scientists." We thank Dr. Sharon Dunwoody for her valuable insights into the teaching of science communication, Drs. LeeAnn Kahlor and Pat Stout for their helpful comments to improve the manuscript and the conference team of New Agendas in Science Communication.

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