Susan Rowland · Louise Kuchel *Editors*

Teaching Science Students to Communicate: A Practical Guide

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An Introduction to Science Students and Communication in the Workplace

1

Louise Kuchel and Susan Rowland

Abstract

A science degree *can* lead to a career in science but, for the majority of science graduates, their pathway lies elsewhere. Although we do not know exactly where our graduates will work, we do know communication plays an important role in the work and personal lives of graduates. In this chapter, we will discuss where science graduates are employed, how communication capabilities contribute to employability, and what meaningful teaching of communication in science programs looks like. We aim to set the scene for the rest of this book so you, as an educator, can understand the importance of helping science students learn to communicate, and we provide you with an overview of how to use this book in your teaching.

1.1 Why Do Science Graduates Need to Learn to Communicate?

A science degree *can* lead to a career in science but, for the majority of science graduates, their pathway lies elsewhere (OCS report, 2020). As we educate science students, it is important for us to remember this. We are educating future scientists, but we are also educating many people who will never work in a lab or conduct a

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research study (McInnes et al. 2000; Leuze 2011; Logan et al. 2016; Palmer et al. 2018).

Although we do not know exactly where our graduates will work, we do know something about their futures. They will seek employment, and during this process, they will need to articulate who they are, what they can offer, and why their scientific training is valuable. They will also enter society as science-informed citizens and ambassadors for the scientific way of approaching decisions and debate (Harris 2012). To achieve these things, our graduates need to know how to communicate.

In this chapter, we will discuss where science graduates are employed, how communication capabilities contribute to employability, and what meaningful teaching of communication in science programs looks like. We aim to set the scene for the rest of this book so you, as an educator, can understand the importance of helping science students learn to communicate.

1.2 Where Are Science Graduates Employed?

Often as academic educators, we fall into the trap of thinking we are primarily educating more of "us"—more scientific researchers and academics. While scientific research and academia are both important and fulfilling careers, they do not constitute the limits of gainful science employment. The Science Council (2021) provides valuable resources that define both science and scientists. They also discuss the multiple different types of scientists our graduates can become—business, developer, entrepreneur, explorer, investigator, policy, regulator, teacher, technician, and communicator—and provide a self-test that students can take to get a sense of where they would like to go in science.

These options assume that science graduates are working in science, but our science graduates also have a lot of other career options. Recent Australian studies show that more than 50% of science graduates do not work in science (Leigh et al. 2020). The non-science career destinations for science graduates are extraordinarily diverse. They include management, finance, marketing, health, education, IT, professional work, and construction (Palmer et al. 2018). Some of these careers eventuate because graduates cannot find work in their area of disciplinary expertise, but many others are deliberately chosen by graduates.

Indeed, many of our students enter their science training with the goal of working beyond science once they complete their education. A large study in the UK found that only around half of STEM graduates "definitely" wanted a career in their study area (Mellors-Bourne et al. 2011). Students who complete a research degree are also not wedded to the idea of continuing in science. Studies of science PhD students in the US suggest that at least 50% are interested in non-academic careers (Fuhrmann et al. 2011; Roach and Sauermann 2017), and of these only a tiny minority of PhD graduates (between 2 and 5%) actually end up obtaining a stable academic position (Rowland 2016).

This information about science graduate outcomes reminds us that science graduates will need to make choices about their work options and compete for

employment (Boden and Nedeva 2010; Office for National Statistics 2012a; Siefert 2011). The modern work landscape is complex and changeable; not surprisingly, universities are under pressure to develop graduates who can navigate this landscape successfully. In this context, graduate employability has become a significant focus in a number of western countries and higher education institutions, and communication abilities are a key contributor to employability.

1.3 Communication As an Employability Literacy

Employability can be conceptualised in several ways, but perhaps the best-accepted definition comes from Mantz Yorke (2006). He describes employability as "a set of achievements—skills, understandings and personal attributes—that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy" (Yorke 2006, p. 7). Clearly, the ability to communicate would fall under this umbrella. Dawn Bennett also describes a set of Literacies for Life that prepare students to thrive in the workplace. Bennett (2017) classes "communicating and interacting with other people" as a Basic Literacy.

When we contemplate teaching our students to communicate, we should keep this idea in mind—communication is not just about transferring science content from one person or organisation to another. Communication is also about making connections, interacting for mutual benefit, and problem solving. Communication is about asking for input, valuing the ideas of others, and making informed decisions.

Teaching students to communicate is not easy. It can be difficult for students to understand the relevance of communication-related learnings to their curriculum and their goals. It can also be difficult for science educators to teach communication in a way that they think is discipline-appropriate. In response, we and others have addressed communication teaching and learning using the lenses of work and study (Rowland et al. 2018 (www.clips.edu.au); Bennett 2017, (employability toolkit and educator website). This employment and assessment-linked approach is something that students appreciate and can use as a driver for improving their practice. This idea—that teaching communication should be linked to students' real-world needs—is the genesis for this book.

1.4 Teaching Meaningful Communication in Science Programs

We are all, as academic educators in science, familiar with teaching and assessing traditional forms of science communication—written scientific reports, conference-style presentations and project proposals (Stevens et al. 2019). We value these genres because they are authentic ways for students to learn and demonstrate their understanding of many aspects of scientific inquiry. But in the context of modern scientific practices and in developing students' employability, they are severely limited.

Consider all the reasons why science-trained graduates need to communicate—to solve problems, to suggest solutions, to negotiate, to ask for input, to be part of the conversation, to collaborate, to share data, to shape policy, to discuss their ideas. The list is almost endless. The lab report, the poster, the risk assessment, and the conference-style presentation are not enough for these graduates.

Meaningful teaching of communication focuses on foundational ideas in communication and a variety of core skills and practices that will serve students beyond university. We can think of teaching communication in a science degree as analogous to the challenge of teaching science in a journalism degree. Journalism academics will not prepare their students to be specialist scientists, and in science we are not aiming to develop professional communicators. We are, however, working to provide a foundation from which students can become agile and extend.

For example, developing habits of mind where we ask "who?" "what?" "when?" "how?" (Wack et al. 2021; Bean 2011) and practising the principles of the rhetorical triangle are among important foundations for meaningful teaching of communication. Core communication skills such as taking notes, working in teams, and active listening are also meaningful learnings that students benefit from in the short term and can build upon beyond university. Ways to teach all of these practices are addressed in this book.

Meaningful teaching of communication does not detract from learning science—it improves it. Quality educational practices often involve foundational communication ideas and practices. For example, articulating our knowledge and thoughts in different ways to different audiences sharpens and clarifies our thinking. Asking students to do this helps instructors identify learning trouble-spots. The acts of writing and speaking improve our working memory's ability to connect new information to past knowledge and experiences. Asking students to speak and write helps their working memory process information. Critical thinking and argumentation skills improve as we review and reorganise our thoughts to build a presentation (e.g., Bean 2011); asking students to present material helps them learn to be discerning and organised consumers and conveyors of information. We also know that engaging students in active discussion and interpersonal interaction is more effective than traditional, passive teaching modes in helping students learn science (Wieman 2014).

Teaching foundational communication ideas and skills need not be time-consuming nor difficult. It can be incorporated into existing teaching by academic science educators to enhance student learning. This book brings practical communication-learning tools to science educators so we can all get started!

1.5 Using This Book in Your Teaching

This book was born from our collective experience working with our teaching and research faculty colleagues, with employers of science graduates, and with science students who struggled to communicate. The section titles for practice chapters reflect common, desirable attributes we hear discussed by employers and see

described in job advertisements for science graduates. The teaching activities outlined are exciting and practical ways in which these attributes can be taught in the science curriculum.

We recognise that academic science educators often feel ill equipped to teach communication. Many of us have learned our communication practice tacitly or during a research apprenticeship. Many of us are also faced with a crowded curriculum in which content is king! In some cases, our students also struggle to understand why learning to communicate is important. In response, this book provides enough detail to give educators a grounding in communication, and in the pedagogy needed to teach it in a way that relates to the science curriculum. Importantly the book is *not* a manual to help people teach the discipline of science communication. It is focused, instead, on helping scientists teach their science students to communicate.

The chapters are built to help unpack the practice and pedagogy of communication learning. The theory chapters explain key concepts in communication to give instructors some background as they teach communication in their class. These chapters will be useful when students ask why communication learning is relevant to their futures.

The practice chapters offer classroom-ready activities to teach important aspects of communication; each chapter explicitly articulates what communication skills and concepts students learn and explains how to teach the class. The activities offer high-value learning, but they are also pragmatically short (taking between 15 min and 3 h to implement)! The practice chapters include a run sheet for the class, questions to facilitate discussions, and links to useful resources. All practice chapters use active approaches to teaching, with tips and tricks provided by the author to support instructors unfamiliar with this style of teaching.

As such, this book offers a plug-and-play approach to incorporating communication in science programs. The activities have been tried and tested with science students by the authors, most of whom are academic science educators. The activities can enrich existing communication pedagogies or introduce a new approach where such pedagogies are absent. Importantly, the activities are transportable and complementary. Instructors can adopt one or many activities in an individual class, in a unit of study, or across entire programs.

In this book, we recognise communication as something more than presenting a written or spoken piece. Drawing from how communication is taught in language studies (e.g., American Council for Teaching of Foreign Languages; Sandrock et al. 2012), we recognise that foundational communication skills involve listening, reading, interpreting and interpersonal interactions, and that in science, communication involves working with numbers and code as well as with words.

Learning to communicate can help students identify their interests and strengths and inspire them to move into areas that are challenging and unknown. Learning to communicate can also help science graduates help others and spread the gifts of science to society.

We are deeply grateful to the educators and science communicators who have authored chapters and shared their practice through this book. Thank you for your

wisdom and your collegiality! We hope that this book is the beginning of a larger movement of sharing practical teaching of broad communication skills to enhance both teaching and learning of science and student employability.

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Part I

Theory Chapters

Rhetoric, Influence, and Persuasion

2

Louise Kuchel and Susan Rowland

Abstract

The art and practice of rhetoric is crucial to human communication. Rhetoric allows people to compel attention, to convey information, and to influence and persuade one another. Applied in different ways it can invite or hinder meaningful conversation, enhance or obscure academic argument, and help resolve intellectual problems. In this chapter, we explain rhetoric, Aristotle's rhetorical triangle, and the rhetorical situation. We also discuss how these shorthand guides (heuristics) for composing an argument can improve the teaching of communication in science.

2.1 Aristotle's Influence

"Rhetoric may be defined as the faculty of observing in any given case the available means of persuasion."—Aristotle (Kennedy 2007)

Although we may not know it by its formal name, rhetoric is something we are all very familiar with. It is the art of persuasion and influence and can be used to understand things from another person's perspective (Burke 1969; Roskelly 2008). It is all around us in advertisements, movies, art, social media, body language,

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everyday conversations, and scientific arguments. Done well, the art and practice of rhetoric leads to a meaningful, two-way dialogue.

Each of us employs the tools of rhetoric daily, but we are usually unconscious of our rhetorical practice. By becoming aware of how rhetoric works we become more discerning of what we see, hear and read. We also become more able to identify how we are persuaded and decide whether arguments are sound and sources are credible. An understanding of rhetoric makes us more effective communicators. This capability is valuable for any science graduate.

Rhetoric was first established as a formal theory by the ancient Greek philosopher Aristotle in the fourth century BC, and it remains central to our practice of persuasion today. His theory arose in the context of dramatic cultural change that brought about the political and legal reform of democracy. As you might imagine, understanding how to influence a broad range of audiences and see issues from different perspectives was key to this shift.

At a time when most people could not read or write, broadcast communication took place mostly through public speaking. Aristotle believed that speakers could observe how best to communicate by considering the interactions between three key elements in what we now know as the rhetorical situation: the speaker, the audience, and the subject (Fig. 2.1). He argued that by using this understanding, orators could develop sound and convincing arguments. To improve the persuasiveness of these arguments, Aristotle and his philosophical descendants identified the three rhetorical appeals: logos (logic), pathos (emotion), and ethos (credibility). Thus, Aristotle's rhetorical triangle (Fig. 2.3) forms an underlying framework for all communication (Roskelly 2008). We discuss the specifics of the rhetorical situation and rhetorical triangle in later sections of this chapter.

By actively considering rhetoric when we conduct and teach science we can improve the rigor of our work and the effectiveness of our communication. For example, we can use rhetorical analysis as a powerful way to examine the rigor of a scientific argument, theory, or debate. It is helpful here to know that when discussing rhetoric, the term argument refers to the content or subject matter of what is being discussed (e.g., Darwin's theory of natural selection), and the term rhetoric refers to

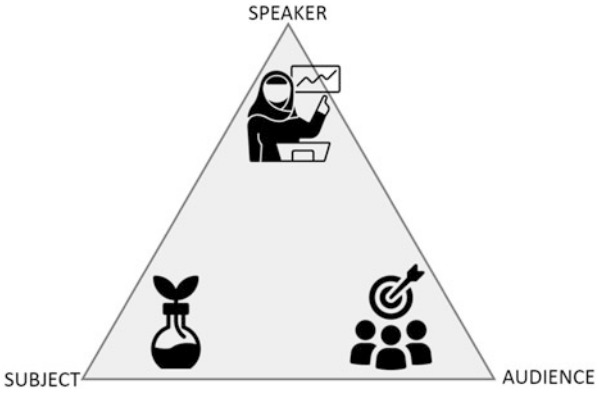

Fig. 2.1 The basics of Aristotle's rhetorical situation: the speaker, the audience, and the subject

"how" that subject matter is conveyed irrespective of the subject matter. So, if we conduct a rhetorical analysis on an argument, we can identify what factors or strategies are being used to persuade the reader or listener about the ideas being discussed. Although scientists strive to be objective by using an evidence-based approach to our work, we are also human and are influenced by the cultural norms, insights, and interpretations of the day. Conducting a rhetorical analysis helps us look objectively at the argument (Longaker and Walker 2011), and reduces the possibility that we will be swayed by pathos or the apparent ethos of the speaker.

Rhetoric is a powerful tool for facilitating an open, two-way exchange of ideas, but it can also be used to confuse and mislead an audience. Rhetorical fallacies are powerful distraction tools that derail the audience's logic process (Lunsford and Ruszkiewicz 2004). For example, emotional fallacies play unfairly on emotional appeals, such as those we see in anti-vaccination campaigns that prey on parent's fear of permanent, severe, vaccine-induced damage to their child, despite overwhelming evidence of vaccine safety. Similarly, ethical fallacies overplay the authority, credibility, or character of the messenger. We can see this in advertisements for cosmetics that use imagery and terminology from science to lend credibility to their (sometimes unproven) claims. Logical fallacies depend on faulty logic; a detective game adults love to play with young children.

The ability to identify rhetorical fallacies helps us understand where and how an argument may be incomplete or twisted (Tindale 2007). This, in turn, helps us explain science to an audience that has been misinformed or misdirected. Through being conscious of rhetoric and by calling out rhetorical fallacies, we are better able to facilitate meaningful and constructive conversations, which of course depend upon an open exchange of ideas.

Adapting the way we talk or write about science to a variety of audiences and purposes is far more effective when rhetoric is considered and rhetorical tools are applied, as we will explore below. Although there is more to the art of persuasion and influence than rhetoric, rhetoric provides an excellent foundation.

2.2 The Rhetorical Situation

To observe how best to communicate, Aristotle considered the situation in which communication takes place, and the interaction between its three elements: the *audience*, the *subject*, and the *speaker* (Rapp 2010). When we think about an orator in ancient Greece, the notion of Aristotle's speaker addressing a crowd of spectators or listeners makes sense. In modern rhetoric 'audience' refers more broadly to any person or group of people receiving communication (e.g., a listener, a reader, a viewer, or a participant in a conversation), and 'speaker' is the person communicating the message (e.g., a writer, speaker, an organization, or visual artist).

Subsequent scholars have elaborated on Aristotle's rhetorical situation by acknowledging that the *context* in which communication takes place and the *conventions* used to communicate in that situation (known as *genre*) also inform best practices in communication (Rapp 2010). These scholars suggest that Aristotle

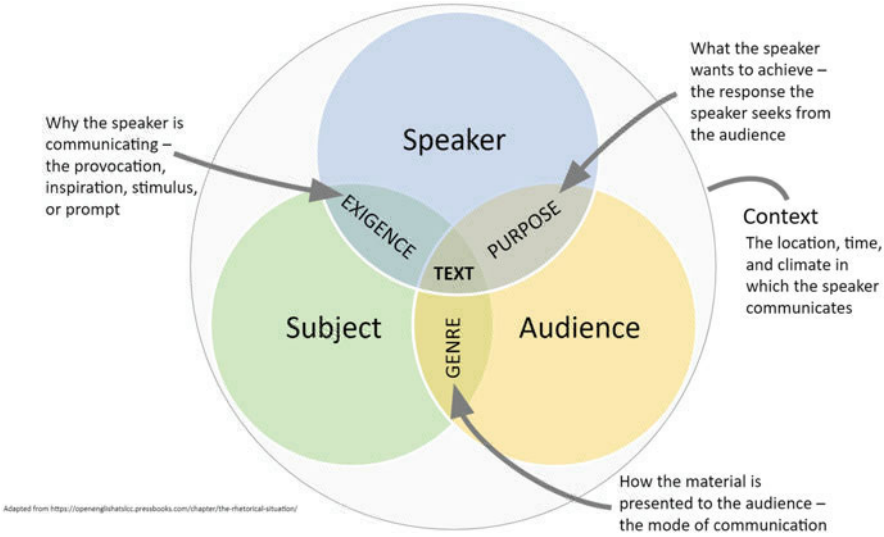

Fig. 2.2 A modern schematic of the rhetorical situation, which expands on Aristotle's three basic elements. Adapted from https://openenglishatslcc.pressbooks.com/chapter/the-rhetorical-situation/

operated in the narrow context of ancient Greece's elite society, so he likely assumed a set context and genre in his model. Other scholars have elaborated even further and modernized some of Aristotle's associated ideas (Fig. 2.2, Rapp 2010); they explain that we should also consider the *purpose* of the communication, *exigence* (the issue, problem, or situation that causes someone to communicate) and *text* (or words in the case of spoken communication). By observing how each element interacts with the others we can fine-tune how to communicate most effectively.

The rhetorical situation is used widely in teaching communication (especially writing in, for example, the Writing Across the Curriculum (WAC) and Writing In the Disciplines (WID) pedagogies; https://wac.colostate.edu/resources/wac/intro). Many of the practice chapters in this book draw explicitly on elements of rhetorical situation theory in their pedagogical design.

2.3 The Rhetorical Triangle (Appeals)

To successfully influence or persuade in a given situation, we need to consider the three appeals that make up the rhetorical triangle; *logos*, *pathos*, and *ethos* (Fig. 2.3). In order to be convincing, we typically use all three appeals but emphasize one more than others depending on our audience, the topic, and our communication goals. Let us take a closer look at each of the appeals.

We begin in the comfort zone for most scientists (and most science student communicators), logos. Logos is the appeal to logic. By conveying a point of view that appeals to the rational thinking and reason of our audience, we are using logos.

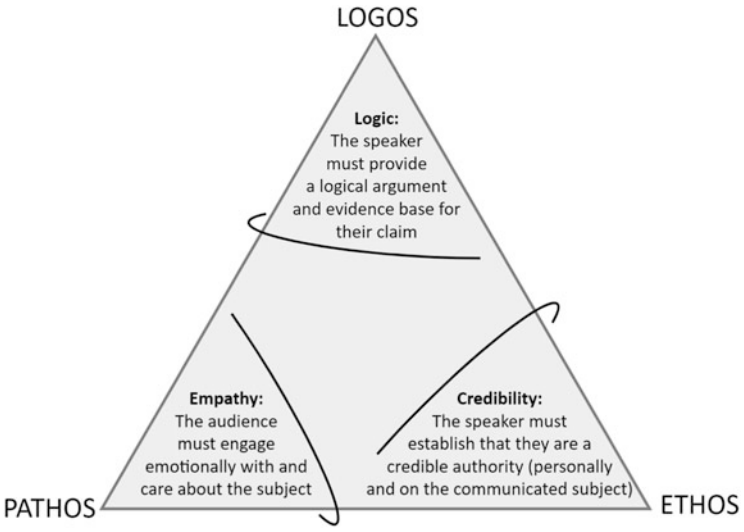

Fig. 2.3 The rhetorical triangle depicting the three appeals: logos, pathos, and ethos

This approach aims for the head, not the heart. We typically apply logos through reasoned discourse and logical argument supported by evidence. So, logos not only includes examples, facts, figures, and statistics as forms of evidence, but also the overall message and structure of the communication, where a claim is supported by evidence.

Aristotle considered logos to be the most powerful of appeals. It is a staple of academia and the legal system, but it has its limits. Although logos is crucial for communicating science, a logos-only communication event is unlikely to win over an audience. This is because humans are not entirely rational. The anatomy and wiring of our brain dictates that our amygdala, the home of our flight and fight responses, is the first to respond in any rhetorical situation. This means we can use emotions to connect our audience to our subject, and we should pay attention to pathos when we communicate.

Pathos is the appeal to emotion—it aims for the heart, not the head. Emotions are universal, and ancient or core emotions (like fight and flight responses) are relatively easy to elicit. In contrast, rational thought (the logos target) requires significant cognitive work that occurs in the outer cortex of our brain and takes longer to process. The emotional disposition of an audience is important; humans do not interpret and judge communication in the same way when we are angry or happy, annoyed or relaxed. For this reason, it is important to influence an audience's emotions. Because of its universality, pathos is commonly used when the aim is to reach a large number of diverse people (such as in advertising or advocating for a cause).

A communicator tapping into pathos wants the audience to feel something—anger, fear, happiness, joy, pride. Emotions make us feel vulnerable, and pathos can

be used to "open up" an audience and help them be more receptive to a communicator's argument. A short-term appeal to the emotions also helps people activate memory formation by association with previous emotional experiences—as a result emotional (or pathos-associated) information is better remembered than neutral information (Tyng et al. 2017 and references therein). Pathos can be communicated in a multitude of ways, such as through imagery, tone, expressive descriptions, personal stories, and more. Too much pathos, however, can be counterproductive. Heavy-handed use of emotional appeals makes an audience feel manipulated, skeptical, or even cynical, which will reduce their attention to the message.

When using pathos, and logos, a speaker should also convey a sense of 'authority to speak' (or ethos) around their communication topic. If they do not, the audience is unlikely to engage with or believe them. Ethos broadly refers to the credibility and authority of the source of information and/or the communicator, be it an organization, or person. What is considered credible by some people may not be considered credible by others. This credibility gap (or credibility question) is a big challenge in modern communication as societies become larger and more fragmented, and as social media provides us with a vast diversity of speakers. Who and what audiences consider to be credible often relates to their values and beliefs as much as it does to the reputation and authority of a communicator.

Even expert scientists can have difficulty establishing credibility with an audience (especially in this modern age of science denial), but there are multiple ways to go about it. Methods build credibility include establishing common ground with an audience, referencing past achievements, citing affiliations with research bodies, referring to the work of others to contextualize one's own work, explaining personal experiences with the subject, endorsement by well-known public figures, association with reputed organizations, depth of knowledge about a topic, appearance (or "looking the part"), and use of body language. Some of these approaches benefit from the use of pathos as well (for example, a cancer survivor will have ethos and pathos appeals when they talk about the revolutionary treatment that saved their life).

When applied together and in a heuristically tailored mix, ethos, logos, and pathos produce a powerful communication event.

2.4 Linking Rhetoric to Your Science Teaching

In our experience, giving science students even a small amount of training in the elements of rhetoric pays big dividends.

Showing students the rhetorical triangle, for example, helps them understand that they can move beyond dry logos-focused communication, and can inject pathos into their practice. This is exciting for them—usually they *are* passionate about science, but they try to adopt a non-emotional approach to it because they feel a logic-only demeanor is "sciency" behavior! Give them permission and encouragement to engage the emotions of their audience and watch them come alive as communicators.

Ethos can also be difficult for student presenters to establish; students often feel illegitimate as keepers or communicators of knowledge. Establishing expertise, or learning to inhabit the role of expert, takes time and self-confidence. It is important that, as educators, we encourage our students to build their capabilities around projecting ethos and explain that while there may be one 'formal' educator in the room (the instructor) we all learn and teach all the time. Again, giving students explicit permission to project ethos is valuable and exciting, and will improve their communication practice.

Logos relies as much upon structure and composition as it does on evidence. While science students often have a natural tendency to focus on logos, because it sounds sciency, many will not have dissected it to know how to build a logical argument. Focussing explicitly on logos allows us to talk with students about evidence-based reason. We can encourage them to consider the various types of evidence available (e.g., examples, data, qualitative, quantitative, etc.) and the claims (or key messages) they wish to make about each bit of evidence. They can also address their argument the other way—starting with the claims and looking for evidence to support them.

To create logical flow, students can ask questions like: What knowledge does my audience already have on this topic? What do they need to know? What new things do I want to convey (the claim/s)? How will I help my audience believe the claim (the logically-linked evidence)? Have I provided reason that connects the old information to the new information I have added?

By breaking down their argument into steps, students can identify the familiar and new information at each stage of the argument and use it to create links between the ideas. Following this pattern helps to identify gaps in logic as well as improve the flow of ideas. Asking students to explain their reasoning to each other can help them clarify their ideas and logic.

Several chapters in this book demonstrate directly how to use rhetorical tools or thinking in teaching communication to science students (e.g., Chapters 20, 38, 60), but here are three simple pedagogical suggestions to get you started:

1. *Provide a rhetorical situation for communication:* In each communication task, you set for students, provide an explicit, specific, targeted rhetorical situation for students to focus on. The more specific and authentic the rhetorical situation, the more tangible the task is for students, and the easier it is for them to make decisions about how best to communicate. Including a specific rhetorical situation also makes for clearer task guidance and easier marking decisions. Advocates of this approach usually recommend specifying audience, purpose, genre, and a reminder for students to reflect on trouble spots in their writing. Two example methodologies are RAFT (Role, Audience, Format, Task; Bean 2011) and PACT (Purpose, Audience, Conventions, Trouble/Translation/Technique; Speakwrite 2011; Bunn 2011).

   Providing a rhetorical situation also opens opportunities to embed authentic situations into course tasks by linking them with workplace scenarios. Some examples of specific rhetorical situations related to the workplace include: a pitch for your idea to your workplace supervisor; explaining the benefits of a new

diagnostic kit to a potential buyer; presenting a negative environmental impact statement to a government department; explaining the science of vaccines to a skeptical family member.

2. *Conduct rhetorical analysis of opinion articles or scientific papers:* In science education, we frequently ask students to distill the essential message of an article or talk ('What is this paper about?'; 'What are the key findings?'). We rarely, however, go further and ask for a rhetorical analysis of the piece. In a rhetorical analysis, we examine how a text, talk, or other communication event persuades us of the speaker's point of view. We can ask: How does the speaker connect to the audience and frame the issue? How do they establish the issue's importance? How do they make and support a claim about the issue? What tools do they use to persuade their audience to accept the claim? Are you, the reader, convinced by the argument and why? This kind of analysis asks students to understand the craft of the communicator, which will likely also help them better understand the content being communicated. For an example task description see Willihnganz (2008).
3. *Make a rhetorical plan for a spoken or written assignment:* This activity requires students to take a stance on an issue, which could range from something simple (e.g., the results of their gel electrophoresis), to something massively complex (e.g., the role of permafrost bacteria in global warming). When students make a rhetorical plan they can use the rhetorical situation diagram and the rhetorical triangle to consider the interlocking aspects of their communication practice. Working through the diagram with a partner is an ideal way to help students get a better grasp of what, why, and how they are communicating. Rhetorical plan production is ideal for helping students construct compelling introductions and discussions in scientific reports. It also, of course, is useful for constructing communication events with political and/or public audiences.

2.5 Conclusion

The art and practice of rhetoric is familiar and intuitive to all of us, from the conversations we have with friends and family, to advertising, and scientific writing. By bringing rhetoric into our consciousness and developing habits of mind around it, we can all improve and sharpen our communication work. An awareness of rhetorical theory and practice enhances our critical thinking capability and is highly valuable both in practising science and in communicating successfully in the workplace. As educators, we can use the rhetorical triangle and rhetorical situation diagrams as powerful tools to help students improve their communication practice.

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Good Science Communication Considers the Audience

3

Nancy Longnecker

Abstract

While those who teach science at university are accustomed to thinking about communication with other scientists, less attention is generally paid to public science communication. Yet it is imperative that scientists are equipped to communicate with diverse audiences. An essential step of planning any communication involves considering the audience. How might an audience engage with and respond to the communication? This can make the difference between communication that is impactful or ineffective. This chapter provides a brief overview to help:

- Identify audience types.
- Consider the most appropriate mode of communication for engaging with particular audiences.
- Consider factors that influence individual reception and use of information.
- Reflect on the appropriate audience level for different communication objectives.
- Appraise the importance of culture and different world views.
- Increase equity and inclusivity.

The chapter concludes with a checklist about audience factors to consider when developing a communication activity or resource.

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3.1 The Importance of Audience

An early step in planning any communication should be to consider how the intended audience might engage with that communication and respond. It is important to remember that one potential and common response to any communication is to ignore it. That is not surprising, given the sheer volume of communication we are faced with each day. Choosing what communication to ignore, engage with, or respond to is part of the human condition. This chapter elaborates on factors that affect audience response. Consideration of audience improves the probability that communication will impact and engage the audience rather than being ignored or relegated to the back burner.

When teaching university science students about communication, the audience that students are tasked to communicate with is often not considered or is implicitly expected to be fellow scientists (Stevens et al. 2019). Explicit designation of the target audience for a written or spoken task can embed consideration of the audience as a valuable part of the learning process. The checklist of audience considerations at the end of this chapter is a useful starter for this purpose. Another useful scaffolding step in a communication assignment is to ask students to consider different potential audiences. Advanced students can be tasked with deciding on their audience, justifying their decision, and tailoring their communication appropriately.

This chapter focuses primarily on communicating with audiences other than scientists, although the principles apply to all audiences of science communication.

3.2 Three Types of Public Audiences

There is no universal "audience," in the same way that there is no single "general public." The appropriate audience, achievable objective, and best way to communicate will vary with the topic, public awareness and knowledge about it, and the objective of the communication. Here, I describe three types of audiences, consider factors affecting communication approach, and illustrate how the most appropriate mode of communication is likely to be different for each.

Each type of audience is composed of individuals whose perceived identity impacts their engagement with information (Longnecker 2016). Identity can be related to demographic factors such as age, ethnicity, and socio-economic factors. More important factors in identity are values, beliefs, awareness, and understanding. Any individual will also experience conditions such as culture, social norms, personal control, and external support that may influence their response to any communication effort.

3.3 Interested, Appreciative Audience

This type of audience is one that will be familiar to scientists who have given conference talks, written scientific papers targeted at other scientists, or taught students who have chosen to study a science course. This type of audience is also

commonly targeted for public science communication. For example, prospective student and science outreach activities often target audiences who have already indicated interest and aptitude in science.

Perhaps one of the easiest, most satisfying, and hence most common activities in science communication with nonspecialists is a traditional public talk, where an expert shares information about their own work with an interested, self-selected, and appreciative audience. This type of one-way public communication falls into a category often called the "deficit model" of science communication (Simis et al. 2016). It is a valid science communication activity in the right circumstances; it can be deeply satisfying to both a curious audience and to an expert whose hard work is appreciated. It may also be a valuable way to practice one's message and style of communication.

For public science communication to be inclusive and wide-reaching, communication efforts should not end with this type of audience. Nor should the deficit model be the default approach to science communication, although it is useful in some circumstances.

3.4 Uninterested Audience

Science communicators may want an audience to engage with something that is of no apparent interest to them. The audience may perceive the subject to have little relevance to their lives (Dawson 2018). This requires the science communicator to consider why they want to communicate with this audience and consider the audience's circumstances and motivations. What might motivate the audience whom you would like to engage? Is the information relevant to them? What are the identities of your potential audience(s)? Consider your audience's relevant values, beliefs, attitudes, awareness, emotional status, level of understanding, skills, and behaviors as discussed below in the section, *Focus on the Individual*. These internal factors affect whether and how an individual will engage with new information (Longnecker 2016).

3.5 Skeptical or Polarized Audience

The biggest challenge in science communication is trying to persuade a skeptical audience to change their attitudes or behavior. You may consider your communication to be useful and important. But will your communication resonate or rankle? Is your intention to persuade or provoke? Factual communication about climate change or vaccination may appear clear-cut but response to information can be different for audiences with different perspectives (Kahan et al. 2010; Manyweathers et al. 2017). Thinking about barriers or perceived barriers that need to be overcome and listening to potentially valid concerns that may not have been considered by experts are important in determining a way forward (Manyweathers et al. 2020; Wynne 1989).

Successful communication aligns with the audience's key values (see Fig. 3.1). This is particularly challenging with mixed audiences where there will likely be a