

Unfurling Audience

**In Science Communication
Research & Education**

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Abstract

When we talk about ‘audience’ in Science Communication what do we mean? ‘Audience’ is central to Science Communication. However, despite - and perhaps because of - ‘audience’s’ centrality to the field, concepts of ‘audience’ are often implicit rather than explicitly communicated. This Honours Thesis unravels these often implicit conceptions of ‘audience’ through investigating 1360 Science Communication research articles and surveying 45 Science Communication tertiary level educators.

I found that overwhelmingly our conceptions of ‘audience’ are plural, rich, and cover a wide array of conceptual categories. This indicates that there are many ways in Science Communication to frame our thoughts of audience. Building beyond conceptions of a ‘general’ audience, I found there are clear yet entwining conceptual categories of ‘audience’ across both Science Communication researchers and educators. This thesis further divides these conceptual categories in groups. One group includes categories that singularly describe ‘audience’ in Science Communication such as demographic, embodied, interaction based, knowledge, and values. The other group contains categories that span multiple conceptual ideas of audiences such as diverse, dynamic, future, and multiple. Together these two groups of conceptual categories highlight the complexities, abundance, and varieties of understandings of ‘audience’ used by Science Communicators.

This study unfurls ‘audience’ so that Science Communicators may use and hold a more rich, robust, and explicit understanding of ‘audience’.

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In acknowledgment and recognition of the first scientists, artists, lawmakers, and leaders of this country. I live, work, and study on the beautiful lands of The Ngunnawal and Ngambri peoples, I grew up on the stunning country of the Kulin Nation, and I submitted my thesis on the lovely lands of the Larrakia peoples. I pay my respects to the First Nations peoples and their elders past, present, emerging, and future, I acknowledge their ongoing custodianship of country where sovereignty was never ceded.

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Finally, thank you to the audience of this thesis. I hope you each get something from reading my work. I hope you feel that this work is for you, because it is. I hope your understanding of areas of audience conceptions are widened and solidified. I hope whoever you are that your demographics, your diversity, your dynamism, your embodied self, your held knowledge, your values, your potential, and your multiplicities feel acknowledged through the exploration of these conceptions. I hope you feel seen far beyond the general. I hope you feel important and valued in your role as an audience member. Thank you for reading.

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Chapter 1.

Introduction

My Introduction to Audience

At the culmination of my undergraduate studies, I found that there was still a lot I wanted to understand better. I am sure this is not a new or unique experience amongst academics. The area I found myself with the most questions in was my area of specialisation: Science Communication. More specifically, I had questions about the concept of ‘audience’ in Science Communication. What do we mean when we use the term? Why does everyone seem to communicate this concept slightly differently?

In my personal experience of learning, reading, and starting to create early research in the field of Science Communication, there is a distinct gap in communication of our understandings of audience within the field. For example, throughout my Science Communication major in my undergraduate degree, ‘audience’ was consistently re-iterated to me as a crucial element in the field of Science Communication. This emphasis on ‘audience’ can be seen in one of my handwritten course notebooks from 7 of my classes in Science Communication, where I wrote notes from key points made by my lecturers, resulting in ‘audience’ appearing 50 times across 110 pages. Yet despite mentioning ‘audience’ almost once for every 2 pages of notes, I was still uncertain about the term. I never encountered an academic article that solidified the

conceptualisations of audience, though many articles reinforced ‘audience’ as a foundational element in Science Communication. It felt like there was so much about ‘audience’ that I didn’t understand, like there was a ‘gap’ between how we understand ‘audience’ in the Science Communication community and how we communicate this understanding. Understanding key concepts is important as communication becomes both more meaningful and efficient when involved parties have a shared understanding of the language and concepts used. To investigate this gap I experienced, I designed a research study that would first expand on where this gap may be in literature, before exploring how audience is taught across Science Communication tertiary educators, and then comparing the two results. But before diving into my own research and results within this Thesis, it is important to first establish why audience is so important and to unpack conceptions of ‘audience’ from other Science Communicators. Therefore, [Chapter 2: Background](#) first will give context to where key concepts such as ‘audience’ are currently positioned within the academic field of Science Communication, and then explore how unfurling our conceptions of ‘audience’ as a field can enhance the conversations we have about ‘audience’.

Chapter 2.

Background

Audience is central to Science Communication

‘Audience’ is a central concept in Science Communication. As leading Science Communicator scholars have argued, Science Communicators need to understand their audience to communicate effectively (Stocklymayer 2001; Longnecker & Gondwe 2014). This need to understand their audience is applicable to a long list of communication outputs including sharing vital public health information, delivering a science education speech, or writing a digest of recent research discoveries. Understanding ‘audience’ is important as who the audience is of any given piece of Science Communication changes the communication strategy (Szymanski 2016; Dudo et al. 2021). Furthermore, placing ‘audience’ in the centre of a Science Communication approach is seen as being of high ‘quality’ (Olesk et al. 2021) highlighting the importance for this Thesis to explore understandings of ‘audience’ and share this exploration with the field.

As a central topic, ‘audience’ has recently attracted attention in the global Science Communication community. Survey results from recent Science Communication research literature found that:

“If audiences don’t pay attention to something, it kind of doesn’t exist” (Fährnrich et al. 2023).

This sentiment primes ‘audience’ as crucially entwined with the work of Science Communication, particularly that of Science Journalism (Fährnrich et al. 2023). Through this

work ‘audience’ is placed as a universally significant priority both within the research literature and its surrounding Science Communication contexts; inclusive of Science Communication practise, writing, teaching, events, performance, and more. Recently, the International Science Council has “challenged the systemic under-conceptualisation of ‘audiences’ and ‘public’s’” through their Talk Back Better Webinar Series as part of their Public Value of Science programme, in partnership with the International Year of Science Engagement initiative (2022). Additional evidence for ‘audience’ asserted as central in Science Communication comes from Mercer-Mapston & Kuchel’s core skill list, used for training scientists in Science Communication skills. 7 of the 12 core skills for effective science communication listed by Mercer-Mapstone & Kuchel are audience-centered skills (2017), positioning ‘audience’ as essential to effectiveness of science communication practice. Through Mercer-Mapstone & Kuchel’s work we see ‘audience’ as a key concept being positioned as significant through non-traditional research outputs inclusive of webinars, workshops for Science Communication skills, and digital media communication. As well as rising in prominence in global non-traditional research outputs, ‘audience’ is also a hot spot in traditional Science Communication research.

Problem driven fields, such as Science Communication, often need to interrogate and investigate their key concepts as these are critical to working in these specific fields day-to-day (Hesse-Biber & Johnson, 2016). ‘Audience’ is a key Science Communication concept, and as such there is a multitude of studies that draw and build on audience as a key concept. Recent audience focused research for Science Communication has looked into audience segmentation as a way to reach a nuanced understanding of shared attitudes, views, and values (Hine et al. 2014; Metag &

Schafer, 2018; Klinger et al. 2022). These contexts highlight the prioritisation and importance of unfurling ‘audience’ in both public and academic Science Communication contexts.

Unfurling the concept of audience is helpful beyond understanding who our ‘audience’ is in Science Communication, it can also tell us who our ‘audience isn’t’. Indeed, in understanding how we think of those we include in our ‘audience’ we can also better understand those people we often leave out. Previous research has highlighted the importance of questioning what audiences are **not** being reached through science communication (Dawson, 2018; Humm et al. 2020), and how we may be able to best reach them. Inclusion is highlighted as highly relevant by The Royal Society, as “science communication is an important prerequisite for participation in modern society” (The Royal Society, 1985, p.10). Additionally, there is work being done in areas of Science Communication practice to aid in training scientists to reach out to new and underserved audiences (Weber et al. 2021). To address inclusion this study will unfurl the conceptualisations of ‘audience’ and unpack the richness of this central idea, which will aid in deciphering what the understanding of this term can bring the field of Science Communication in terms of inclusivity.

In Search of Understanding Audience

Other Science Communicators have noted an absence of a shared robust definition of ‘audience’ within the community of Science Communication. When introducing the concept of audience in their handbook, established Science Communicators Bucchi and Trench write the following:

“Audience conceptions in science communication are often under-defined and remain[ing] implicit rather than explicit, but also audience conceptions vary considerably” (Bucchi & Trench 2021, pp.291).

Bucchi and Trench describe how audience conceptions in Science Communication “vary considerably” (2021, pp.291), an argument that foregrounds their later recommendation that there should be efforts made “to describe such audiences further” (pp.300) in their plurality. This ‘gap’ posited by Bucchi and Trench (2021) in shared use of ‘audience’ as a Science Communication community connects with the misalignment I encountered within my undergraduate studies. Having an abundance of conceptions is not necessarily unhelpful, but the frequently implicit and under-defined nature of our practice as the community of Science Communication muddies this conceptual water. In Science Communication there is a large emphasis on ‘audience’, particularly on understanding the audience (Longnecker & Gondwe 2014), tailoring your communications to your audience (Stocklmayer 2001), and scholarly analyses of ‘audiences’ (Bucchi & Trench, 2021). Often enough communicators do not think about their audience and ‘fail’ in their communication intention, purposes, and messaging (Stocklmayer, 2001). ‘Audience’ here is posited not only as a central pillar to Science Communication as a field, but also as an underserved idea in practice. This opinion of ‘audience’ being an underserved central idea in Science Communication is also shared by Bucchi & Trench (2021) and Dudo et al. (2021), highlighting a “gap” or “gaps” within the field. This thesis aims to provide some clarity on the ways in which we conceive of ‘audience’ in the Science Communication field by classifying academic papers based on the most abundant conceptual categories that arise during coding, and furthermore discussing these with contexts of audience from tertiary Science Communicator educators.

‘Audience’ as a concept, from my own experience, could be more robustly explained in Science Communication teaching and literature. There is a wealth of literature on defining other terms in Science Communication such as ‘Science Communication’, ‘engagement’, ‘scientific literacy’, ‘public’, ‘participation, and ‘participatory’, that richly communicates our understanding of these terms through either precisely explaining terminology or descriptively discussing key concepts (Burns et al. 2003; Johnston & Taylor, 2018; Dascal et al. 2019; Weingart et al. 2021; Metcalfe et al. 2022). Key concepts such as those above as well as ‘audience’ function as a linguistic tool for the organisation of knowledge in the scientific domain. Communicating our current understanding of each of these terms, and now too the term ‘audience’, benefits the international exchange of ideas in Science Communication. This understanding does not have to be a succinct singular definition, as though there is merit to singular definitions, polysemous terms such as ‘audience’ can be conceptually narrowed by this lack of “diversity of forms” (Dascal et al. 2019, pp. 183). Consequently, ‘audience’ as a polysemantic key concept in Science Communication should be conceptually explored, mapped, and discussed.

Research Questions

Therefore, the Research Questions I aim to answer within this thesis are:

Q1. How do we conceive of audience in Science Communication?

Q2. How do we communicate concepts of audience in Science Communication teaching and research literature?

Q3. Is there a disconnect in our conceptions of audience and our explicit communications of audience as a Science Communication community?

In answering these three research questions, this thesis will explore the ways we consider, engage with, and teach conceptions of ‘audience’ as a Science Communication community.

To answer these research questions, two different methods will be employed. The first will be a systematic search in literature to distinguish the number of articles in Science Communication journals explicitly talk about audience and explore the implicit and explicit categories that audience conceptions fall into. The second methods will involve survey responses from tertiary Science Communication (and related studies) educators and explores the ways in which audience as a conceptual topic is defined and taught in this environment. The data from those two datasets in this study will be communicated through two different results chapters which will lead into a discussion taking into account all data points, before finally heading into conclusion. The

following chapters will ultimately give further richness, breadth, and clarity around ‘audience’ in the Science Communication community.

Chapter 3.

Methods 1: Systematic Review of the Literature

The first component of this study is a systematic review of the Science Communication literature on audience.

To research the prevalence, patterns, and spread of conceptions of ‘audience’ in Science Communication, all included research articles were analysed against the coding guide developed in the pilot study. These articles were drawn from 5 key Science Communication journals: *Journal of Science Communication*, *Science Communication*, *Public Understanding of Science*, *Research for All*, *Science and Environmental Communication*. From these 5 Science Communication journals, research articles were selected for from a key word search of ‘audience’ in each of the journal’s online databases¹ for the entire length of time each journal had been active and papers were digitally available. This resulted in a total of 1406 articles being added to Covidence, an online research software for screening and data extraction. From these 1406 articles, papers were then excluded if they didn’t use the term ‘audience’ in the body of their text (typically this mean audience was exclusively used in the keywords, bibliography, abstract, and/or author profile). At this stage duplicates were also removed through Covidence, resulting in a total of 1360 papers included in the study.

¹ Online journal databases: <https://icom.sissa.it/>, <https://journals.sagepub.com/home/scx>, <https://journals.sagepub.com/home/pus>, https://uclpress.scienceopen.com/collection/UCL_RFA, & <https://www.frontiersin.org/journals/communication/sections/science-and-environmental-communication>

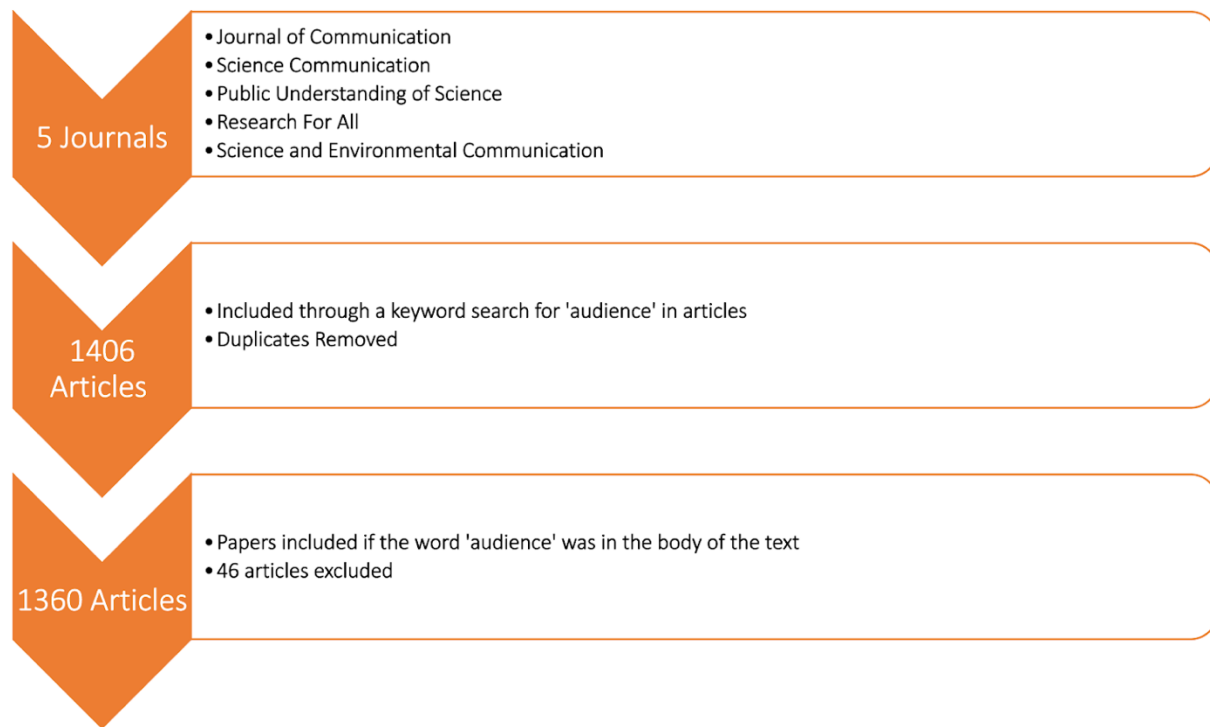


Figure. 1. Visualisation of selection and inclusion criteria of research articles for this research project. Categories include the 5 selected Science Communication Journals (Journal of Communication, Science Communication, Public Understanding of Science, Research For All, Science and Environmental Communication), keyword search of 'audience' for articles in the 5 selected journals, removal of duplicates, and inclusionary criteria of 'audience' appearing in the body of the text.

Pilot Study

The ways in which the contexts surrounding 'audience' from these included papers will be analysed and categorised were developed in a pilot study. In the pilot study a selection of Science Communication papers were analysed, each use of the term 'audience' within these papers was located and then the surrounding sentence was examined for categories of 'audience',

which were then noted. Papers were coded to answer the question “When papers use the term ‘audience’, what do they mean?” The noted conceptions from this pilot study were developed into a coding guide which described each of the categories, as well as examples of how research articles may align with the conceptual categories. At the conclusion of the pilot study the conceptual categories were: demographic, diverse, dynamic, embodied, general, interaction dependant, knowledge dependant, potential and future, value oriented, and multiple conceptions.

Coding Guide for Conceptual Categories

The coding guide gave guidance to code for 10 different categories of ‘audience’ conceptions.

1. Demographic conceptions of audience is a category that records if the paper conceives of audience in terms of relating to structures of population(s) of people, either through using demographic categories in the context of audience, or through conceiving of audience in a way that could be used as a demographic category. An example of a demographic conception of ‘audience’ is use of ‘teachers’ in an audience context, this demonstrates a demographic category of occupation.
2. Diverse conceptions of audience (both specific and non-specific) records if papers conceive of audience in a specific or non-specific diverse way. Non-specific diverse conceptions include if the word ‘diverse’ is used to describe ‘audience’, specific diverse conceptions include if descriptive diverse wording is paired with audience(s). Diverse audience groups are those outside the ‘normal’ for the context presented, for example, Women in STEM are a diverse group in STEM but Spanish speakers are within the ‘normal’ group in Spain.

3. Dynamic conceptions of audience is a category that records if the paper conceives of audience as active, dynamic, and/or changing. An example of a dynamic ‘audience’ conception is “audiences are active in making their own meanings”.
4. Embodied conceptions of audience category is coded for if a paper conceives of their audience in an embodied manner, this is inclusive of both physical considerations and spatial considerations of ‘audience’. An example of an embodied conception of audience is “audiences’ attention and viewing on small screens” as this viewing consideration is taking into account the physicality of the audience.
5. General conceptions of audience are determined by language that describes the conception of audience from a paper in a general or non-specific way. Examples of language that a general conception of audience includes ‘a mixed general audience’, ‘intended audience’, ‘large audience’, and ‘broader audiences’.
6. Interaction dependant conceptions of audience are coded for if the paper presents an understanding of audience defined by the means in which this audience interact with work or social media or a certain platform etc. Examples of interaction dependant audience conceptions include ‘audiences of newspapers’, ‘lay listeners of popular music’, ‘a question asking audience member of a public lecture’.
7. Knowledge dependant conceptions of audience are a category that records if a paper conceives of audience in a way that it specific to the knowledge that they hold or do not hold. Examples of a knowledge dependant conception of ‘audience’ are ‘scientists’, ‘nonspecialist audiences’, ‘medical professionals’, and ‘a non-technical audience’.

8. Potential and future conceptions of audience include where a paper conceives of an audience of occurring/appearing at a further forward point in time, and/or of a hypothetical potential audience. Examples of this conception include phrasing such as ‘the potential audience reach of media’, and ‘a future audience of this workshop’.
9. Value oriented conceptions of audience occur when ‘audience’ is conceived of through values, including those that they hold and/or are thought to hold. Examples of a value based audience conception are ‘people’s values may play a more central role’, ‘audiences each with their own set of beliefs, values, attitudes, and behaviours’, and ‘a science valuing audience’.
10. Conceptions of multiple audiences is a category that records when a paper conceives of more than one audience and/or audiences as a plurality. This conception is commonly noted through use of ‘audiences’ rather than ‘audience’ and includes phrasing such as ‘large audiences’, ‘multiple audiences’, and ‘a wide range of audiences’.

Of these 10 categories, 5 (dynamic, embodied, interaction dependant, knowledge dependant, value oriented) directly describe an audience, 4 (diverse, dynamic, future, multiple) describe conceptualisations of audience based across multiple of the 5 direct description categories, and 1 (general) incorporates multiple conceptions of the multiple categories. A visualisation of these ‘audience’ categories is represented in the below figure, *Figure. 2*.

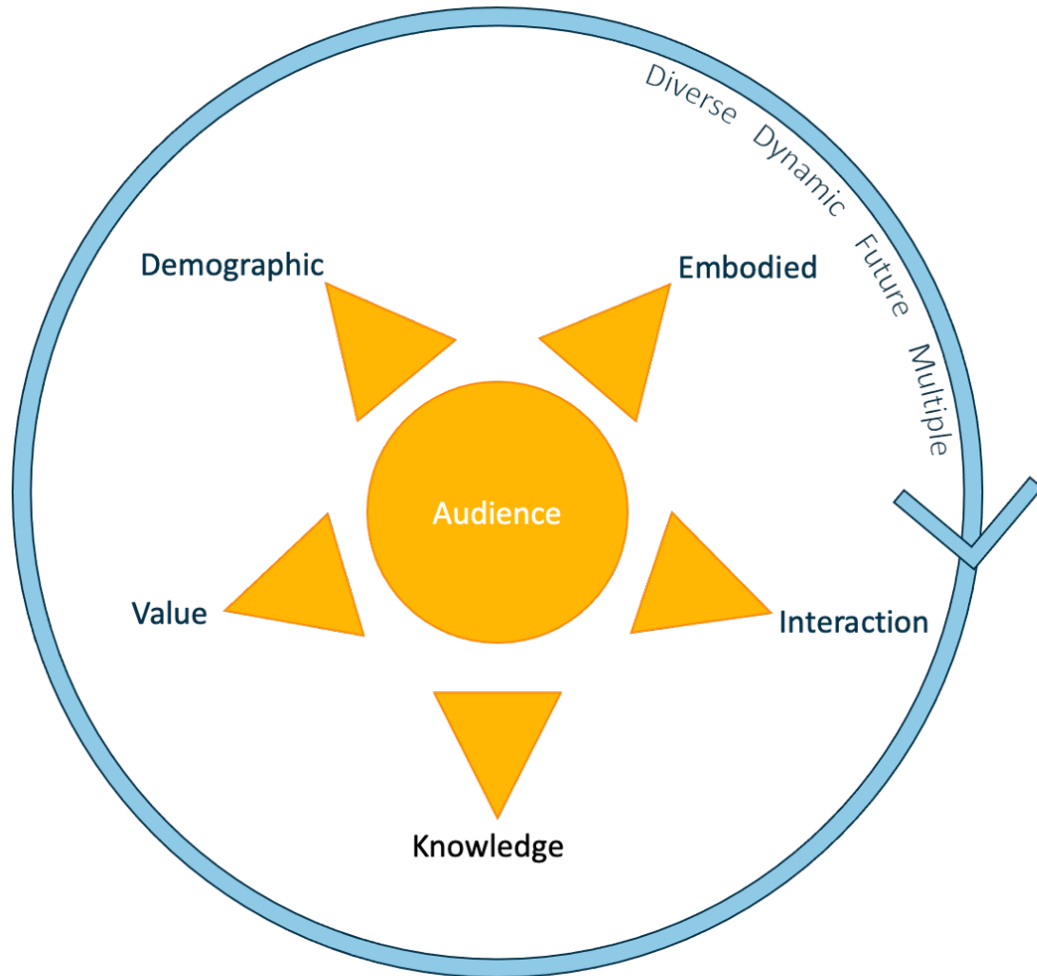


Figure 2. Visualisation of 10 distinct audience conception categories as used in this study. The 10 distinct audience categories are: demographic, diverse, dynamic, embodied, general, future, interaction, knowledge, multiple and value. These categories are split into singular descriptive categories (demographic, embodied, interaction, knowledge, and value) and then the surrounding multiple conceptual conceptions of audience (diverse, dynamic, future, and multiple), which altogether make up the broadest category of a general audience.

In this study, papers were further coded for conceptions of audience across multiple of these 10 above categories described in the above list and diagram (e.g., a paper can be coded for conceptions of audience that are value based, and that are interaction dependant), as well as coded for number of mentions of ‘audience’, and for explicit definitions of ‘audience’ or of an ‘audience’. Explicit definitions are where a paper explicitly states ‘for a target audience of xyz’ and/or ‘our audience being xyz’ and/or ‘our conceptions of audience are based on xyz’.

To validate the categories developed in the pilot phase via intercoder agreement, a randomised sample was drawn from these 1406 included research articles through numbering each paper alphabetically and using Microsoft Excel’s RANDBETWEEN function. Papers were coded by two coders until agreeance was over 90%. Intercoder agreeance met 93.51% agreeance from coding 6 papers (0.42% of the sample), cementing the coding guide.

Of the texts not included in this study, many of these featured the key term ‘audience’ either in the abstract only, or in the bottom matter of the paper (underneath the conclusion). Instances of audience occurring in the bottom matter were usually in the funding statements and/or the author biographies. As these parts of writing didn’t give colour to the ways in which the paper conceives of audience, they were excluded from this study.

In deconstructing the contexts around ‘audience’ in each of the included papers, the methods enable an overview of the current landscape of ‘audience’ conceptually in Science Communication research literature. To develop this method, the checklist from Bramer et al.’s *Creating A Systematic Search Strategy* (2018) was used, with components of the checklist modified as appropriate to ensure that the question being asked could be answered by the types of articles this systematic search in literature was returning.

Using this coding guide all 1360 included articles were analysed for conceptions of audience.

The results from this analysis are below in [Chapter 3: Results from the Systematic Search in Literature](#).

Following this, sampling of prominent international Science Communication Tertiary Educators, from the 2023 Public Communication and Science Technology conference speakers and chairs list will be surveyed with the prominent question being ‘[How do you teach students about audience\(s\)](#)’.

Chapter 4:

Results 1: from the Systematic Review of the Literature

This chapter explores the results from the systematic literature search detailing how papers in mainstream Science Communication literature conceive of audience.

In the 1360 papers analysed, each mentioned ‘audience(s)’ at least once, with an average of 8.27 mentions per paper, a median of 3 mentions of ‘audience(s)’, and a mode of 1 mention. The range for mentions of ‘audience’ in the included papers was 1 mention - 172 mentions.

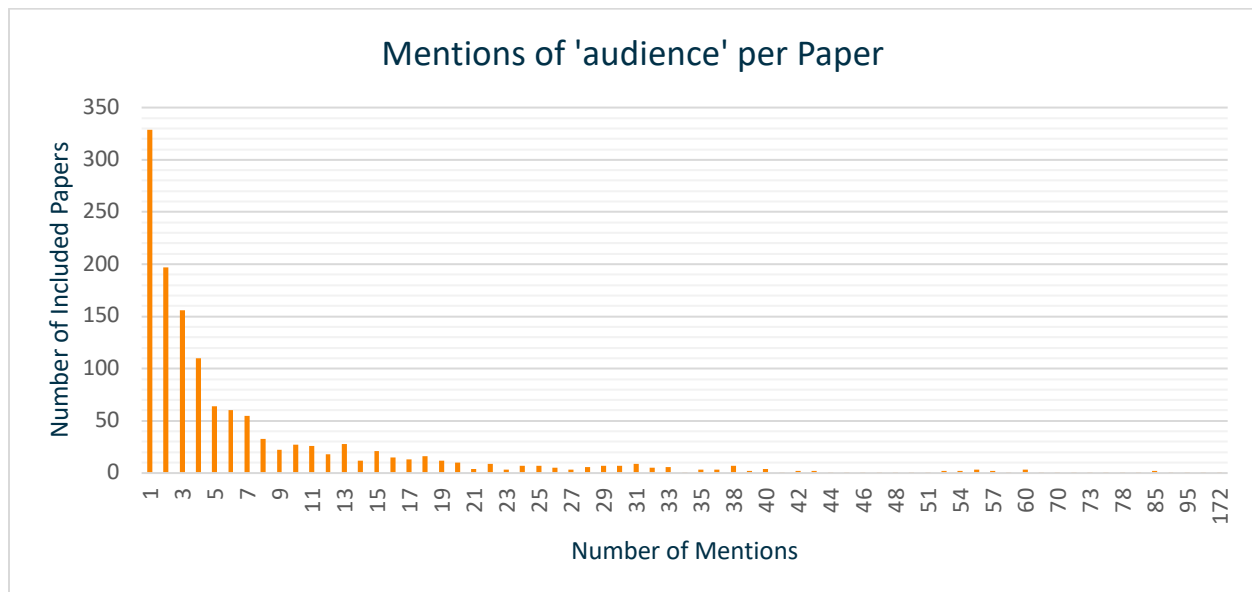


Figure. 3. Number of mentions of ‘audience’ from each included paper. 329 papers included 1 mention of audience, 197 papers included ‘audience’ 2 times, 156 had 3 mentions, 110 papers had 4 mentions, 64 papers had 5 mentions,

60 papers had 6, 55 had 7, 33 had 8, 22 had 9, 27 had 10, 26 had 11, 18 had 12, 28 had 13, 12 had 14, 21 had 15, 15 had 16, 13 had 17, 16 had 18, 12 had 19, 10 had 20, 4 had 21, 9 had 22, 3 had 23, 7 had 24- 25, 5 had 26, 3 had 27, 6 had 28, 7 had 29-30, 9 had 31, 5 had 32, 6 had 33, 1 had 34, 3 had 35-36, 7 had 38, 2 had 39, 4 had 40, 1 had 41, 2 had 42-43, 1 had 44-51, 2 had 53-54, 3 had 55, 2 had 57, 1 had 59, 3 had 60, 1 had 61-79, 2 had 85, 1 had 90, 1 had 95, 1 had 110, and 1 paper had 172 mentions of audience.

3.75% of papers (n=51) had an explicit definition of ‘audience(s)’ inclusive of a definition of the paper’s or the research project’s ‘audience(s)’. Perhaps more interestingly, some 96.25% of papers (n=1309) did not include a definition of audience(s) in their writing.

Across the 5 Journals used in this study, there were the most included research articles from *Public Understanding of Science* n=630, then from *Science Communication* n=437, followed by *Journal of Communication* with n=175, then *Frontiers in Communication* with n=47, and *Research for All* with n=21 included papers.

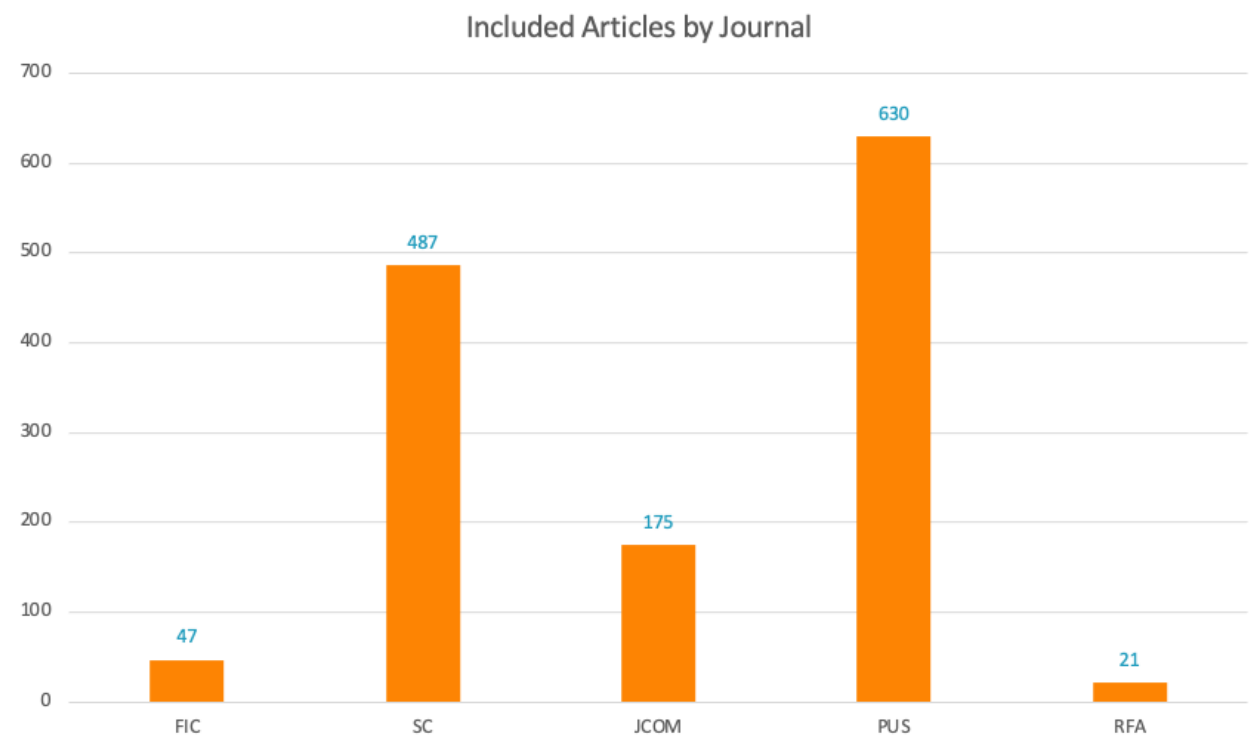


Figure. 4. Included Articles by Journal from the Systematic Search in Literature. (FIC) *Frontiers in Communication* n= 47, (SC) *Science Communication* n=487, (JCOM) *Journal of Communication* n =175, (PUS) *Public Understanding of Science* n=630, and (RFA) *Research for All* n =21).

The spread of papers studied ranged from 1979 - early 2023. From the 1360 included papers in this study 3 were published in 1979, 57 between 1980-1989, 124 between 1990-1999, 191 between 2000-2009, 636 from 2010-2019, and 349 between 2020 and early 2023.

The *Journal of Communication* has been publishing from 2002- present, and has a total of 1176 publications online, the sample used in this study is 14.88% of the journal's publications. *Science Communication* has been active since 1979 – present with an estimated total of 1650 papers (based on an average of 6 papers per issue, 6 issues per volume, 45 volumes) for an included sample in this study of 30.06%. *Frontiers in Communication: Science and Environmental Communication* has a total of 285 articles and has been publishing from 2007 – present, the sample included in this study is 7.36% of the journal's publications. *Public Understanding of Science* has been active since 1992 – present with an estimated total of 2560 studies (based on an average of 10 papers per issue, 8 issues per volume, 32 volumes) for an included sample in this study of a total of 24.60%. *Research For All* has 177 publications and has been publishing since 2017, the sample of papers used in this study is totals 11.87% of the journal's publications.

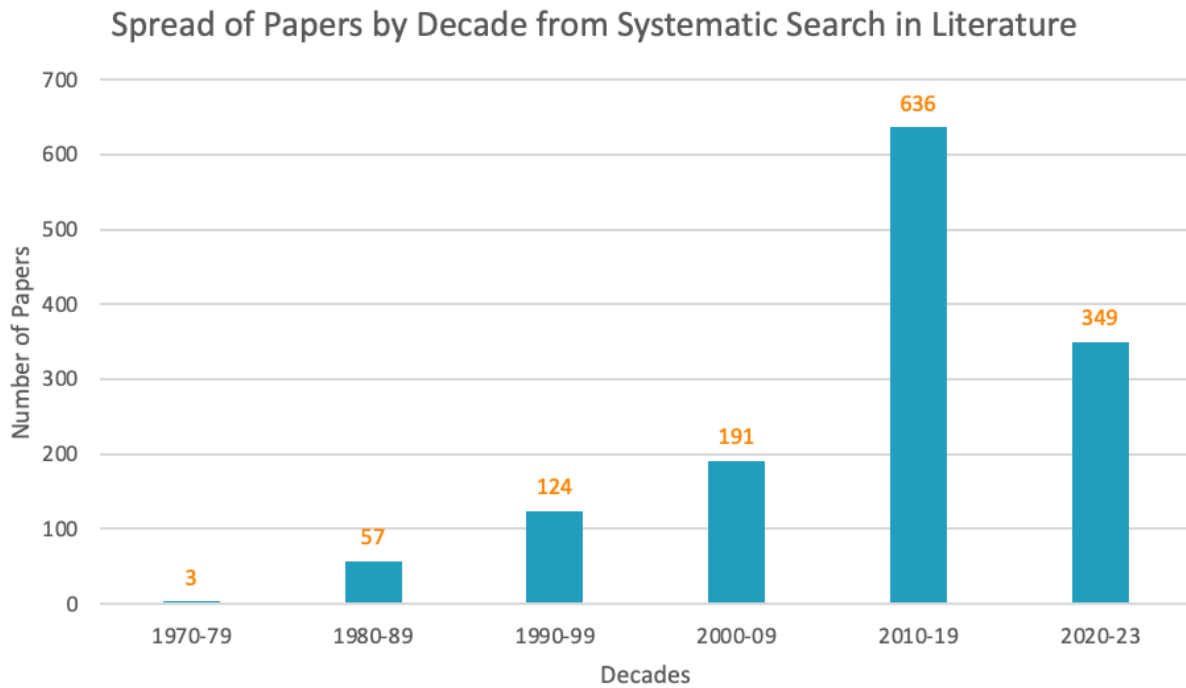


Figure. 5. Spread of Papers by Decade from the Systematic Search in Literature. N = 3 papers included from 1979, n=57 papers from 1980-1989, n=124 papers included from 1990-1999, n=191 papers from 2000-2009, n=636 papers from 2010-2019, and n=349 papers from 2020-2023.

We can now turn to the ways the papers conceived of audience. Here 76.32% of papers (n=1038) coded for interaction dependant conceptions of audience. Additionally, to the below table, 83.97% of papers (n=1142) coded for multiple categories amongst the 10 described. The following table contains the number of papers each category codes for and the corresponding percentage.

Audience Conceptual Category	No. of Papers Coded For	Percentage of Papers Coded For
Interaction Dependent	1038	76.32%
Multiple Audiences	910	66.91%
General	652	47.94%
Demographic	433	31.80%
Knowledge Dependent	376	27.65%
Dynamic	335	24.63%
Diverse	132	9.07%
Embodied	115	8.46%
Value Oriented	88	6.47%
Future/Potential	60	4.41%

Table 1. Frequency table from Systematic Search in Literature depicting the frequency of conceptions of audience in both numerical and percentage values.

Demographic Conceptions of ‘Audience’

Papers that conceive of ‘audience’ through this category were considering ‘audience’ in relation to the structures of populations. In total 31.80% of papers (n=432) conceived of audience in terms of demographics. Below are some examples:

“Studies that targeted only children (n=4), as the user audience”

“the characteristics of the audience who were the focus of the paper (for example women, immigrants)”

“the benefits of scientific research to the Taiwanese audience”

Multiple papers conceived of ‘audience’ through multiple different demographic categories for example conceiving of audience through age, gender, and occupation simultaneously. From the total $n=432$ demographic conceptions, 326 papers conceived of audience in terms of 1 demographic category, 77 papers conceived of audience in terms of 2 demographic categories, 18 papers conceived of audience in terms of 3 demographic categories, 8 papers conceived of audience in terms of 4 demographic categories, and 3 papers conceived of audience in terms of 5 demographic categories.

These total 582 demographic conceptions further divide into 106 papers conceiving of audience by age, 127 papers conceiving of audience by occupation, and 129 papers conceiving of audience by geographic location. The remaining of these 582 demographic conceptions categories further divide into education $n=58$ (education level $n=50$, school level $n=5$, literacy level $n=3$), gender ($n=30$), status $n=32$ (class $n=15$, economic status $n=8$, citizen status $n=6$, elite status $n=1$, wealth status $n=1$, incarnation status $n=1$), political affiliation ($n=22$), explicit general demographics ($n=23$), ethnicity ($n=13$) religious affiliation ($n=10$), languages spoken ($n=9$), family makeup ($n=6$), generation ($n=4$), disability status ($n=3$), cultural background ($n=2$), household composition ($n=2$), marital status ($n=2$), race ($n=1$), appearance ($n=1$), vaccine status ($n=1$).

Diverse Conceptions of ‘Audience’

Papers that conceived of ‘audience’ as diverse, or outside the ‘normal’ for the context presented, either specific or non-specific were coded in those respective categories. This research found that 8.23% of papers (n=112) conceived a non-specific diverse audience, some examples below:

“While still using awe in their work, this participant strove to incorporate ‘loads of different emotions’ (Int4) to engage as diverse an audience as possible.”

“Most trainings are not designed to account for diversity, nor are they specifically designed to help scientists engage with diverse audiences.”

This study also found that 2.80% of papers (n=38) conceived of audience in a specific diverse context including the following examples:

“reaching a diverse audience that include deaf sign language users, oralized deaf people and hearing language learners”

“a culturally and spatially diverse audience was selected, which featured participants from a range of sociodemographic backgrounds, social groupings, ages, and nationalities.”

“the Briefs now reach a wider audience that includes persons with disabilities and their families”

18 of the included papers, a total of 1.34% included conceptions across both specific and non-specific diverse audience categories. In total 9.07% of papers (n=132) conceived of audience as diverse.

Dynamic Conceptions of ‘Audience’

Papers that conceived of ‘audience’ as dynamic were coded accordingly for conceptions of audience as active, dynamic, and/or changing, resulting in 24.63% of Science Communication papers (n=335) in this category. Examples from papers that contained dynamic conceptions of audience include the following:

"an awareness of the audience as participants in the construction of meaning."

“Online platforms and crowds could potentially play a role on both sides of the process, by lowering entry barriers on the supply and by allowing audience preferences to independently express themselves on the demand side, with less centralized gatekeeping.”

“‘Audiences, are not merely passive receivers of risk information, but have the capacity and inclination to engage actively in interrogation of risk communications and other related risk information.’”

Within the systematic review of the Literature the category of dynamic conceptions of ‘audience’ was the 7th most abundant categorisation.

Embodied Conceptions of ‘Audience’

Results from coding found that 8.46% of these papers conceived of audience as through physical considerations and/or spatial considerations of ‘audience’ (n=115), including the following examples:

“spoke to a packed audience at Carnegie Hall.”

“a concrete audience (a totality that is bounded by an event or physical space)”

This is the 8th most common category of conceptions of ‘audience’.

General Conceptions of ‘Audience’

47.94% of Science Communication papers (n=652) regarding audience conceived of audience as general, non-specified, mass, broad, and/or public, examples of this include:

“Any content that is appropriate for a general audience...”

“Conveying complex scientific narratives to a broad audience has been an ever-present challenge for science communicators and educators.”

“the creators most well-known to mass audiences, behind the most popular movies and shows”

Coding for conceptions of a general ‘audience’ in this systematic literature search resulted in this category being the 4th most frequent categorisation of ‘audience’.

Interaction Dependant Conceptions of ‘Audience’

Coding from the systematic review of the literature found that 76.32% of these papers conceived of ‘audience’ through the way an audience interacts with a platform/work/social media (n=1038), examples include:

“While audiences may have different motivations for seeking out media content”

“Because the journal is open-access, anyone (policy makers, laypeople, activists, etc.) can view it”

“when there is an audience watching”

“At the pop up stalls, however, it is likely that some people were older than 60, meaning we engaged with a diverse audience”

This category other than the category coding for multiple responses from within the coding was the singular most frequently coded category. Overall interaction dependant conceptions of ‘audience’ were the 2nd most frequent category.

Knowledge Specific Conceptions of ‘Audience’

This study found that 27.65% of papers found that ‘audience’ was conceived in a way specific to the knowledge that they do or do not hold. This category is not necessarily linked to occupation or education within the demographic audience conceptual category, though the two may be correlated the knowledge specific category and the demographic category are conceptually distinct.

The following examples are of knowledge specific conceptions of ‘audience’:

“Ethical considerations that bear on the framing, simplifying, or popularizing of scientific results for nonexpert audiences”

“Could it be that scientists and decisionmakers are part of the audience whose understanding of science, and more specifically of science in society, needs updating?”

“Adolescents were chosen as a target audience because they are continuously exposed to new information, both in and out of school.”

In coding for knowledge dependant ‘audience’ conceptions it was found that this categorisation was the 6th most frequent category of ‘audience’ conceptions from the systematic review of the literature.

Future/Potential Conceptions of ‘Audience’

Results from the systematic review of the literature found that 60 papers (4.41%) conceived of an audience as appearing at a future point in time, and/or of a hypothetical potential audience.

Examples of future/potential conceptions of ‘audience’ include:

“While producing their film, students were in a social-bubble, continuously assessing whether their descriptions and depictions would be understood by their audience.”

“The potential audience for the media coverage runs into many millions of readers, viewers, and listeners’

“though some addressed a broader potential audience, with a range of strategies and degrees of success”

Overall, this categorisation of ‘audience’ conceptions was the 10th most abundant category, as well as the 2nd least frequent category.

Value Oriented Conceptions of ‘Audience’

The systematic search in literature resulted in 6.47% of papers (n=88) being coded for conceptions of ‘audience’ as value oriented, based on values that the audience holds and/or are thought to hold. Examples of value oriented

“deep sense among audiences that science is important, and that science should be valued.

“If an audience does not believe that a speaker has their interests at heart (goodwill), does not share their sense of values (goodness)”

“ In sum, this research demonstrates that improving climate change acceptance should involve careful consideration of the target audience’s values”

This category was the 9th most frequent category and also the 3rd least frequent category.

Conceptions of Multiple ‘Audiences’

66.91% of papers (n=910) conceive of ‘audience’ as more than one audience and/or audiences as a plurality, some examples follow below:

“shares first-person stories about science with public audiences”

“That is why, COVID-19 led the audiences to reconnect”

“Mass media discourses of emerging sciences and technologies have been analyzed in comparison with public discourses shared by mass audiences.”

These results from the Systematic Search in Literature highlights this category as the 3rd most prolific category in conceptions of ‘audience’.

Conceptions of 'Audience' from Multiple Categories

Of the 1360 papers included in this study, 1142 of them (83.97%) conceived of audience in multiple of the above categories mentioned, for example one paper containing conceptions of audience across both demographic and diverse categories. This category was the single highest and most frequent category (see *Table 1*) as coded for in the Systematic Search in Literature.

Chapter 5.

Methods 2: How Do We Teach Audience?

Having explored how we talk about ‘audience’ in the literature, we now turn to educators in Science Communication to look at answering the question ‘How do you teach students about ‘Audience(s)’’. In exploring that overarching question, this second methods section aims to gather evidence to answer the initial 3 Research Questions of this study:

- Q1. How do we conceive of audience in Science Communication?
- Q2. How do we communicate concepts of audience in Science Communication teaching and research literature?
- Q3. Is there a disconnect in our conceptions of audience and our explicit communications of audience as a Science Communication community?

To aid in answering these 3 Research Questions [Methods 2: How Do We Teach Audience?](#) explores the knowledge that is being imparted to upcoming Science Communicators and/or Science Communication (or similar) students, through an online survey. This survey was sent out via email to a sample of global Science Communication tertiary educators (n=123). The sample of participants was selected from the list of speakers and chairs from the 2023 Public Communication and Science Technology (PSCT) conference. This is the biannual conference promotes a global network for, and of, Science Communication, and typically includes a range of science communicators and educators. The conference’s speakers and chairs list was agnostic to, and randomised to gender, country and career stage biases as it was ordered through panel

discussions from a sample of global Science Communicators. Individuals from the original list (n=456) of speakers and chairs from the 2023 PSCT conference were selected to be participants for this study if they appeared to teach at a tertiary level educational institute from their biographies, resulting in a total of 123 participants.

The survey was hosted on the online survey platform Qualtrics. The survey contained the following 6 questions, the first two of which form exclusionary criteria (the participant must select yes to continue participating in the survey).

1.) Do you teach Science Communication (or a similar related topic) at the tertiary education level? [One selection allowed]

- a. Yes
- b. No

2.) Do you teach your students about audience/audiences? [One selection allowed]

- a. Yes
- b. No

3.) How do you teach your students about audience/audiences?

[Open text box response]

4.) How do you define audience/audiences in your teaching?

[Open text box response]

5.) At what stage(s) do you teach your students about ‘Audience(s)’?

[multiple selections allowed]

- a. At the start of my teachings
- b. Early in my teachings
- c. Mid-way through my teachings
- d. Toward the end of my teachings
- e. At the end of my teachings

6.) How relevant is the key concept of ‘Audience(s)’ to your teaching?

[One selection allowed]

- a. Very relevant
- b. Quite relevant
- c. Somewhat relevant
- d. Not very relevant
- e. Not relevant

The written data, from Q3 and Q4 text box responses, was then coded using the same coding as used to analyse the research articles in the earlier results chapter (Chapter 4: Results from the Systematic Review of the Literature). This coding categorised the articles into 10 categories, see pages 16-18. The other questions from this survey that did not have text answer boxes were analysed (including inclusionary question) and graphed.

This study was approved by the ANU Human Ethics committee (Protocol 2023/313).

Chapter 6.

Results 2: How Do We Teach Audience?

Of the 123 participants invited to be included in this survey, n=45 surveys were completed, which was 36.58% of the total sample. This sample size reflects elements of both ‘measure entire population’ and ‘resource constraints’ categories from Lakens’ *Sample Size Justification* paper (2022), as a sub-category of active tertiary education level educators in Science Communication the 2023 PSCT conference was a globally populated sample. Though this sample does not account for the full population of active tertiary educators in Science Communication, it contacted all 123 of the reduced sample size (reduced based on resource constraints of this being an Honours project) and yielded responses from 36.58% of the sample.

Question 1: Do you teach Science Communication (or a similar related topic) at the tertiary education level?

88.89% (n=40 from n=45) of participants said they taught Science Communication (or a related topic) at the tertiary education level.

Question 2: Do you teach your students about audience/audiences?

94.74% of respondents (n=36 of n=38) who teach Science Communication (or a similar related topic) at a tertiary level teach their audience about audience/audiences.

Question 5 At what stage(s) do you teach your students about 'Audience(s)'?

Question 5 allowed for multiple selections and was answered by n=25 participants, resulting in 14 responses for 'At the start of my teachings', 20 responses for 'Early in my teachings', 13 responses for 'Mid-way through my teachings', 5 responses for 'Toward the end of my teachings', and 4 responses for 'At the end of my teachings'.

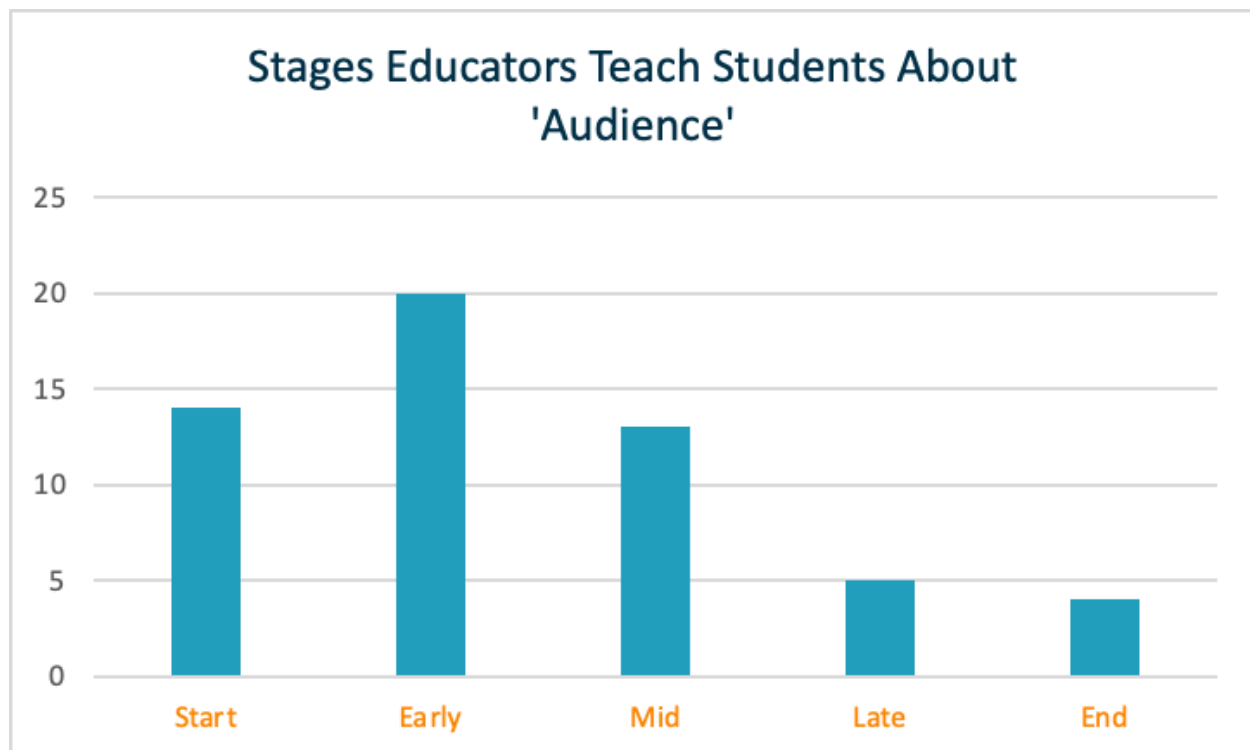


Figure. 6. Survey Responses (n=25) to Q5: 'At what stage(s) do you teach your students about 'Audience(s)'? [multiple selections possible]

Question 6 How relevant is the key concept of 'Audience(s)' to your teaching?

Question 6 allowed for single responses only, and was answered by n=25 participants, resulting in 76% of answers (n=19) indicating that 'audience(s)' is 'Very Relevant' to their teachings, a

further 24% of answers (n=6) said that the key concept of ‘audience(s)’ was ‘Quite Relevant’ to their teachings.

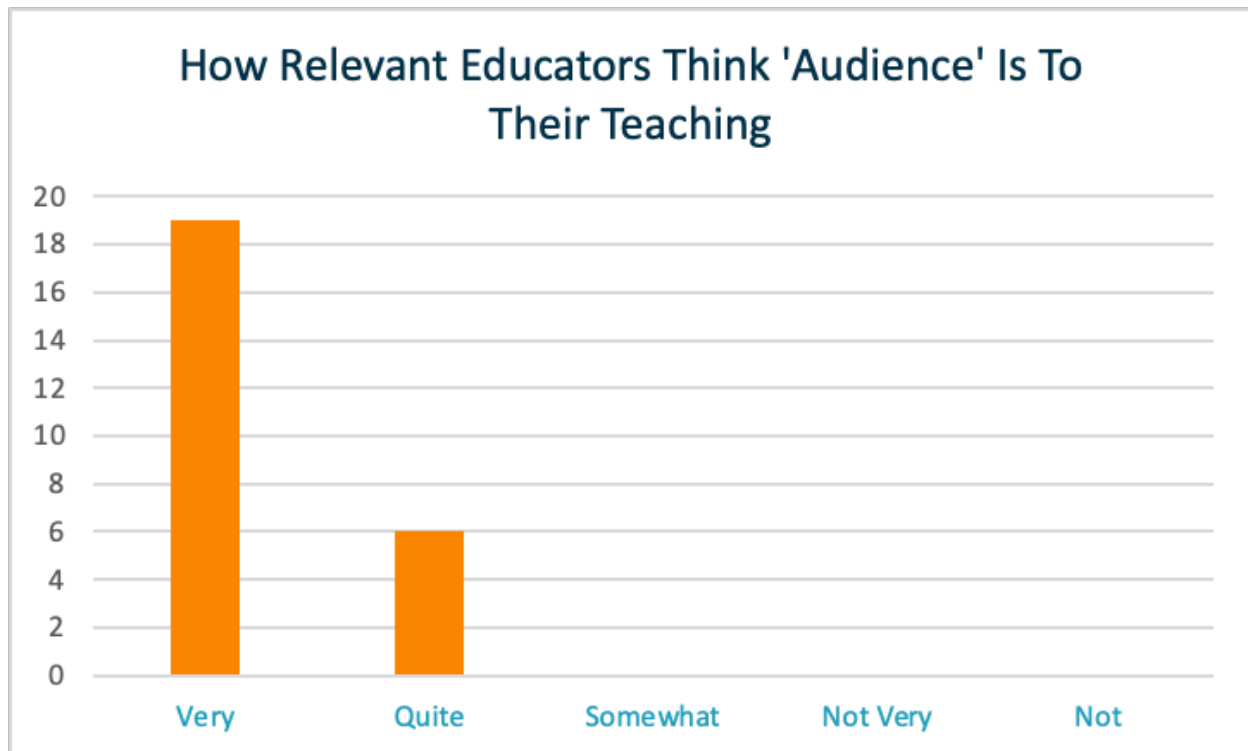


Figure. 7: Survey Responses (n=25) to Q6: ‘How relevant is the key concept of ‘Audience(s)’ to your teaching?’

Question 3: How do you teach your students about audience/audiences?

When asked how they defined audiences, the educators (n=23) gave a variety of rich responses. Here I explore a variety of aspects, including how central this concept was, how educators thought about ‘audience’ in multiple ways, how responses were built around the idea of ‘know your audience’, and how a wide array of responses indicates the varying methods of practically teaching ‘audience’.

Some of the responses to Question 3 that are class ‘audience’ as central to Science

Communication practices include:

“It's central to almost everything.”

“We run an MSc in science communication and 'audiences' are embedded throughout our core and optional modules”

“Know your audience is a core tenet of science communication. For communication to be effective then communicators need to know who they are talking to. What do they already know about the topic, what do they need to know? What do they value, believe? This flows through all course materials as my students tend to create materials for an audience they must define.”

After pointing to centrality, educators also offered ways for students to ‘know their audience’, which aligns with the earlier coding for explicit definitions of audience, a category which can demonstrate this understanding of ‘know your audience’:

“We teach students to identify who their target audiences are”

“encouraging students to think about who or what they want to engage with.”

Some responses to Question 3 indicated that ‘audience’ was taught with ideas of multiple audiences, which is consistent with the conceptions of the earlier outlined multiple ‘audiences’ category:

“consider different audiences”

“I teach our student to be aware that there are many different audiences and that you need to think well about which subgroup you are working with, what their needs are and whether this fits your goal.”

“on target audiences ... address epistemological differences between, e.g., journalists, policy-makers, scientists and 'citizens'”

“the inherently diverse nature of audiences, and the importance of segmenting audiences, picking relevant audiences according to strategic communication goals”

Many of the responses to Question 3 indicated practical ways in which students were taught about the concepts of audience, this list an interaction dependent conception of audience, highlighting a large variety of teaching methods including roleplaying games, creation of personas, audience identification, workshops, and other varieties as seen in the below examples:

“I use some roleplaying games to give students a feel for different audiences”

“With the help of various science communication and psychology theories, we ask them to make personas, preferably based on real / available data”

“I teach about the creation of research-based personas.”

“supporting course resource information outlines how to identify an audience, what is important when considering how to communicate with different audiences”

“In a couple of ways. I cover some theoretical aspects about how we might conceptualise audiences (from Michael's PiGs and PiPs to distinctions between audience, public, participants etc). And then I cover some practical ways we can go about mapping out audiences from social psych to worksheets.”

“We use participatory theatre, games and workshops.”

“I first have them read some background material about knowing your audience, then I have them write a short paragraph about their own research. They exchange paragraphs with people in different fields and highlight unfamiliar terms, etc. We discuss how this relates to the concept of audience, then they hear a short lecture on interpretive techniques (themes, big ideas, storylines, and characteristics of audiences). They develop big ideas and storylines for presenting their own research. The course goes on to connect these concepts to principles of teaching and learning, and connects to kids as a special kind of "audience", developmental stages in kids, opportunities to observe kids manipulating materials, etc.”

“In the general introductory course the audience is initially represented as the receiver of information but of course the receiver can also become a sender when interaction takes place (and switch between these two roles). In my product development course the audience mainly features in the form of the 'target audience'. This is often a very specific predetermined group. Students are asked to do target audience research (roughly defining the group, determining the starting position and the preliminary knowledge of the TA).”

“I have them read a book chapter about audiences (Longnecker, N. (2023). Good Science Communication Considers the Audience. In: Rowland, S. & Kuchel, L. (eds): Teaching Science Students to Communicate: A Practical Guide. Springer. ISBN: 978-3-030-91627-5.) I present lecture material about audiences, e.g. looking at motivations and barriers for informal learning opportunities, including John Falk's visitor identities.”

“The concept of audiences is covered in quite a few ways, by inclusion in lectures, examining case studies and real life examples (for example when thinking about concepts like audience segmentation) and by reading and analysing, with discussion, journal articles and book chapters that include audiences as concepts.”

“A combination of lecture-style materials, combined with readings of third party material.”

“We do exercises to show the difference between students' "intuitive" sense of what people know and actual data about what people know (for example, national data about belief in cigarettes causing lung cancer).”

Question 4 How do you define audience/audiences in your teaching?

Responses (n=23) to Question 4: ‘How do you define audience/audiences in your teaching?’ included responses that resisted definitions juxtaposing coding for definitions of audience, responses that centred interaction compatible to the earlier defined interaction dependant categorisation of ‘audience’, responses that are value-dependant, and responses of a dynamic audience conception, and responses that include multiple audiences conceptually consistent with the earlier categorisation of multiple audiences.

Responses that resist definitions of audience from Question 4 are:

“I do not present the students with an actual definition of audience/audiences. In the product development course they have to define their target audiences themselves. In many instances the target audience can be unclear - can determine itself (e.g. 'users' of a specific communication product) but in general I refer to audience with different

wordings depending on the context (communication situation): participants, listeners, public, co-creators, stakeholders, actors, group, public, etc.”

“I don't have a specific definition.”

Responses that are centred around communication to and interaction with audience from

Question 4 include:

“I mostly categorize them accordingly to the situation = listeners for podcasts, readers for articles, participants for co-creation processes.”

“The people you need to communicate with in order to achieve a desired goal.”

“In several ways, depending on the nature of the communicative act. Broadly speaking there are those in receipt of information, those in dialogue or exchange of information, and those where action of some form is involved.”

The following response highlights not only dynamic and value dependent conceptions of audience, but also through this is an example of conceptions of audience through multiple categories.

“I then ask: Who are they? Why are they listening/reading/participating? Why do they care? And finally: What do you get out of having them in the room?”

This following response includes diverse, dynamic, and knowledge oriented, conceptual categories of ‘audience’:

“As highly plural /diverse (there is no 'general public'). As active co-constructors of knowledge and or the content that is being communicated (about). As knowledgeable persons, maybe not always scientifically knowledgeable about the technology or science

at stake in the communication, but very likely experienced with the influence or impact of the science / technology at stake in the communication.

Responses from Question 4 that involve conceptions of multiple audiences, and were coded for using the guide from Methods 1: include:

“I describe three types of audiences - interested audience, uninterested audience, and skeptical audience. We discuss factors affecting communication approach for different audiences.”

“We talk about the concept of audience as just different groups of people with different goals and interests (university students, your lab group, K-12 students, public audiences (which further break down into a number of different audience types), etc.”

As Question 3 and Question 4 were questions with an open text box allowing for written responses, the given written answers were coded using the same coding guide as developed in the pilot and as also applied within the systematic review of the literature method.

An example of how the written answers were coded, the following quote was coded for diverse conceptions of audience, dynamic conceptions of audience, conceptions of multiple audiences, and multiple conceptual categories of audience (relevant sections are underlined:

“An understanding of the inherently diverse nature of audiences, and the importance of segmenting audiences, picking relevant audiences according to strategic communication goals and then understanding the needs, expectations and concerns of that specific audience segment - this informs every aspect of science communication strategy.”

We can now turn to the overview of the ways that educators conceived of audience, summarised in the below *Table 2*. The most common conceptual category from the survey responses was interaction dependant conceptions of audience with an average frequency of 60.86% of survey responses conceiving of audience through that category. Additionally, to *Table 2*, 69.56% of papers conceived of audience through multiple conceptual categories. The following table contains the number of frequency for each category of audience conceptions from written survey results, presented as percentages.

Audience Conceptual Category	Q3: How do you teach your students about audience/ audiences?	Q4: How do you define audience/ audiences in your teaching?	Average from Q3 & Q4
Interaction Dependent	47.82%	73.91%	60.86%
Multiple Audiences	47.82%	65.21%	56.51%
Knowledge Dependent	21.73%	34.78%	28.25%
Demographic	26.08%	21.73%	23.90%
Dynamic	21.73%	21.73%	21.73%
General	4.34%	21.73%	13.03%
Embodied	4.34%	17.39%	10.86%
Value Dependent	13.04%	4.34%	8.69%
Diverse	4.34%	4.34%	4.34%
Future/Potential	0%	0%	0%

Table 2. Frequency table from the Survey depicting the frequency of conceptions of audience in both numerical and percentage values.

Chapter 7.

Discussion

Combining data from the included 1360 papers and the 45 survey respondents, this study found that there is a large breadth in the field of Science Communication for conceptions of ‘audience’. The conceptions of audience that are discussed in context of the literature and that are held and taught by educators are demographic, diverse, dynamic, embodied, general, interaction dependent, knowledge specific, future/potential, value oriented, and multiple audiences. In pursuit of exploring ‘[How do we conceive of audience in Science Communication?](#)’ this chapter will discuss some of the key thematic findings revealed from the unfurling of audience, including a move away from the deficit model, contributions to inclusive Science Communication, and also the use of a general public audience conception across both research and teaching.

Ways that Science Communication researchers and educators conceive of ‘audience’ as captured in this research reveals a central split in the types of conceptions. There are categories of ‘audience’ that are descriptions taking into account one aspect of ‘audience’, typically there are also categories that are largely conceptual built on multiple aspects of descriptions of ‘audience’. For example, a demographic conception of audience such as the age of an audience takes into account just the one descriptive category such as an audience’s age. However, a diverse conception of an audience may look at the age of an audience and that is physically attending a presentation and classify this combination of demographic and embodied categories as unusual, and therefore conceive of this audience group as diverse. These two varieties of audience categories, though with different stems, are both helpful and can be most useful when applied in

conjunction with each other, as with all of the identified conceptual categories. The more information given about an audience and the more robustly considered an audience, the richer Science Communication as a field can be about our teachings in, conceptions of, and work around ‘audience’. These are the foundational thoughts behind *Figure. 2* which captures the singular descriptive categories (demographic, embodied, interaction, knowledge, and value), then the categories with the surrounding multiple conceptual conceptions of audience (diverse, dynamic, future, and multiple), which make up the encompassing multiple multivalent conceptual category of a general audience.

Unfurling the concept of audience as written about by Science Communicators in Science Communication research about audience highlights the richness, variety, and interesting concepts of audience that each coexist within this environment. Understanding this richness, variety, and pulling out the interesting components may be useful to Science Communication researchers, students, and teachers, as a demonstration of the current landscape of ‘audience’ in Science Communication.

Moving Away from the Deficit Model?

The act of conceiving of audience as dynamic, as autonomous, and as sometimes having sway over the Science Communication practise acknowledges a more realistic, robust, and varied audience that science communicators are attending to. In applications of the deficit model, one expert disseminates ‘knowledge’ to many passive, non-expert ‘audience’ members in an act of one-way communication (Davies 2008). The dynamic category of audience as described in this study fits more as a conception of audience that allows for Science Communication through the two-way or dialogue method of communication, commonly discussed as being better practise

than the deficit model and widely considered by many science communicators as the aim to progress towards as a field inclusive of practitioners (Reincke et al. 2020; Seethaler et al. 2019). Further active, autonomous, and dynamic conceptions of ‘audience’ are highlighted in work from Hom where ‘audiences’ are explicitly defined as not being mere ‘passive receivers’ (2011), a conception that clearly contrasts deficit models of communication. 24.67% of papers conceived of audience in a dynamic way, as did 21.73% of Science Communication educators, the consistency between these two statistics suggest no huge amount of movement away from the deficit model. This is consistent with the critique from Metcalfe (2019), which explored through an audit how a large number Science Communication activities in Australia apply the deficit model despite hoping to move more towards dialogue and participatory models.

Despite this finding, there is a potential pathway toward participatory models of Science Communication as represented through the interaction dependant category from this study. Interaction dependant concepts were the most common conceptual category overall, with frequency in 76.32% of papers and across 60.86% of written survey responses. In conceiving of ‘audience’ in an interaction dependant way, there may be priming for a movement towards dialogue and/or participatory models of Science Communication.

The deficit model often assumes and seeks to fill a knowledge gap for its one-directional communication, particularly surrounding science literacy (Nisbet & Scheufele, 2009). This has an interesting interaction with the knowledge dependant audience category, results from this study found that 27.65% of papers (n=376) included an average 28.25% of survey responses conceived of audience in a knowledge specific way. This category interacts often with demographics (usually education level such as ‘university student’ and occupation such as ‘scientist’ or ‘professor’). Knowledge specific conceptions are often about audiences that are

educated, audiences that work in science or STEM (inclusive of academia), and/or audiences that have knowledge in a specific area. This category is also occupied by ‘audience(s)’ that are conceived of in terms of knowledge they don’t have, as these conceptions often explicitly describe an audience’s knowledge areas by what area(s) of knowledge these people do not hold, which interactions with conceptions of the deficit model.

Examples from the knowledge dependant conceptual category include thoughts of ‘audiences’ based on knowledges they do not have “filling knowledge deficits of public audiences”, “whose understanding...needs updating”, and “nonexpert audiences”. Many of these conceptions come from a specific deficit model communication understanding, wherein ‘experts’ must give knowledge to the lesser, passive, nonexpert ‘audience’. This is also inclusive of the above excerpts that also perceive of ‘audience’ based on the audience’s technical understanding and knowledge such as those who are “continuously exposed to new information”, this positioning of always learning has such positive conceptions that it not only reinforces the need for a deficit communication model, but also looks down on those who are not continuously learning, as if those sorts of people, groups, and audience have less value somehow.

Papers included in this study were pulled from 5 journals (*Journal of Communication*, *Science Communication*, *Frontiers in Communication: Science and Environmental Communication*, *Public Understanding of Science*, and *Research For All*) with a sample size of papers from journal ranging between 7.36% - 30.06% per journal. This sample size includes studies from 1979 – 2023, with an increasingly larger sample of papers taken from each consecutive (full) decade included in the study range. These sizes suggest that thematic movement, such as a move away from the deficit model, can be seen across this large scale and are more likely to skew towards the newer data points including more recent decades.

This study gives colour to the landscape of ‘audience’ in Science Communication research and teaching, through audience conceptions there is potential amongst both areas for movement away from deficit models, and toward dialogue, and participatory models.

More Inclusive Science Communication?

Papers that use a specific diverse audience conception are a form of inclusion and equity. This study found that only 2.17% of written survey responses and 2.8% of the literature conceives of audience as diverse in a specific manner. The low numbers of these conceptions of a ‘diverse audience’ illustrates the lower levels of attention to accessibility, inclusion, and equity within Science Communication academia and education, reinforcing studies that point to Science Communication as having a White, ableist, and patriarchal nature (Canfield & Menezes 2020; Judd & McKinnon 2021). Science Communication practices inclusive of learning, outreach, and research, are challenged by and often underserve diverse minoritized and marginalised audiences as a result of underlying and systematic reasonings (Dawson, 2019). New tools may offer increased ways to be more inclusive with our Science Communication through including diverse audiences in the conversation, the framework suggested by this study is one such tool.

Embodied conceptions of ‘audience’ were present in 8.46% of these papers included in this study (n=115) and in an overall average of 10.86% of survey responses. An embodied audience is a conception that has been used prominently by Hill et al. (2022) to depict one of three main streams of conceptions of audience found alongside the interacting categories of demographics and values in a study on Science YouTubers. Embodied ‘audience’ conceptions as included in this study have involved conceptions of ‘audience’ bodies, of the 3D/physical/virtual space occupied by ‘audience’, and other similar descriptors.

As a conceptual category, embodied audience' perceptions hold a lot of potential for accessible events and disability-friendly considerations. Considerations that without which may exclude a minority from Science Communication, but when audience is conceived as physical, as embodied in the first place, there is potential for the scope of Science Communication to become more inclusive. When conceiving of audience through multiple conceptual categories at once, rather than prioritising any one singular category, the less frequently used conceptual categories are given as much weighting as the common ones, and may therefore allow for diverse, more inclusive thoughts to grow.

‘General Public’ – a Fading Term?

General audience conceptions and descriptions of audience as a general public' is phrasing that might be fading out of popularity in Science Communication as its non-specificity limits its usefulness. Science Communicators who research the 'public' describe the term as being multivalent and lacking precision (Mahony & Stephansen 2017). As the 'public' can be an audience (Luzon 2013), it is clear that 'audience' also encapsulates this multi-valency and imprecision.

Some Science Communication research papers use the phrase 'the public' interchangeably with the key concept of 'audience' (Luzon 2013), and some papers imply that the 'audience' is a subsection of 'the public' (Wonneberger et al. 2020). Though the concept of 'the public' in Science Communication already has multiple ideas and practices existing at the same time (Mahony & Stephansen 2017), the same is also highlighted in this study with the key concept 'audience(s)' and the multiple ideas and practices in place with its conception in the field of

Science Communication, categorised into 10 distinct categories in this study. Indeed, the results of this study show that 83.97% of papers used more than one category to conceive of their audience, as even one author can hold many ideas about the conception(s) of ‘audience(s)’. In contrast to the prolific sweeping generalisation of ‘audience’ as seen from within the systematic review of the literature where 47.94% of the included papers conceived of audience in a general non-specific way, there was a decreased percentage of a general conception of ‘audience’ from the survey results (13.03%). A general non-specific conception of ‘audience’ in the fourth most abundant audience category from the systematic review of the literature. Conceptions of a general ‘audience’ through the survey responses contained language surrounding ‘public’ or ‘publics’ and also of a general non-descript ‘target audience’ which was also prevalent in the results from the systematic review of the literature. These conceptions though similar to some of those from the systematic search of the literature, are less prevalent amongst answers from Science Communication educators (13.03% to 47.94%). This decreased prevalence suggests that this is a conception of ‘audience’ that the field of Science Communication is trying to distance itself from and that this conception does not need to be established. Overall, general conceptions of ‘audience’ in Science Communication are exactly as the name suggests: general. Describing ‘audience’ only through implications and generalisations such as ‘public’, ‘target’, ‘broad’, and ‘mass’ depletes from the rich conceptual understanding that could be shared. There seems to be a movement away from descriptions of a general ‘audience’ from Science Communication educators when compared to results from the Systematic Search in Literature which yields responses going back to 1979. With increased access to the global information stream, the “invisibility” granted by concept of “a more general audience” is decreasing (Bucchi & Trench, 2021), suggesting a fade from nonspecific audience conceptions as these generalisations become

less useful. Work from this study and from leading Science Communicators suggests a modern unfurling of audience is not a general one.

Audience Definitions Useful in Teaching Science Communication?

The wide range of conceptions from this study indicate that there is a great deal of richness to be communicated about audience as a key concept in Science Communication. As over 95% of research papers included in this study do not give an explicit definition of ‘audience’.

Contrastingly, 91.30% of Science Communication educators provide a definition of ‘audience’ when teaching, allowing this paper to also explore held definitions in the field of Science Communication as well as implied conceptions.

It is surprising that 96.25% of papers (n=1309) do not include a definition of audience, particularly given that half this research data was from a sample of articles produced through searching the term ‘audience’ in prominent Science Communication journals. This points to a conceptual communication gap in Science Communication research. The conceptual communication gap is our communication of how we conceive of audience, as this research demonstrates that Science Communication research is richly thinking of audience, but that these conceptualisations have not been richly communicated, captured, and explicitly stated before. The found gap from this research data is consistent with Bucchi & Trench’s observations that audience conceptions are “often under-defined and remain implicit rather than explicit” (2021, pp. 291). As the gap from Bucchi & Trench is posited in a Handbook, a piece of communication

material used to educate, its prioritisation is consistent with the contrasting findings between literature and educators.

There are a large number of definitions of audience from Science Communication educators, indeed only 2 survey responses resisted a definition of audience. 91.30% of Science Communication educators teach a definition of audience. These responses when paired with the large range of conceptions of audience suggests that most Science Communicators in teaching, education, and research hold an understanding of ‘audience’. These held conceptions of ‘audience’ seem to be useful to educators, indicating that an unfurling of held conceptions of ‘audience’ from both could be of most benefit to Science Communication education. Perhaps this trend is to allow for space for students to ground their understanding in teaching spaces before diving in to the implicit nature of literature.

Reinforcing Audience as Important

Evidence gathered within this study consistently reinforces ‘audience’ as important to the field of Science Communication. A key response from within written responses named audience as “central to almost everything”, with another response stating that knowing “your audience is a core tenet of science communication” – these two responses strongly posit the significance of audience from Science Communication educators, 76% of whom agree that ‘audience’ is *very* important (n=19).

Audience conceptual categories such a value oriented and dynamic intrinsically reinforce the concept of ‘audience’ as important within Science Communication. Linked to audience segmentation studies, value oriented conceptions of ‘audience’ are somewhat common,

appearing in 6.47% of included Science Communication research articles and also in 8.69% of survey responses. Some researchers in Science Communicators centre their work around the deeper impacts of values, behaviours, and intentions when it comes to ‘audience’ (Hine et al. 2014; Metag and Schafer 2018; Klinger et al. 2022). Often audience segmentation studies conceive of audience through their values, usually through their science-related values such as environmental, worldviews, and science politics (Hine et al. 2014). Audience segmentation studies, through concerning themselves with the very values that make a person that then makes an audience, inherently places significant value on the importance of audience within Science Communication. Likewise, in conceiving of audience through their autonomy in choice making, intention setting, and activity - through a dynamic lens, there is an automatic acknowledgment that ‘audience’ is important enough to warrant this conceptual category. This importance is furthered supported by the number of papers and science educators that conceived of audience as dynamic throughout this study 24.63% (n = 355) of Science Communication research and 21.73% of Science Communication educators.

The Multivalency of Audience

The multivalent nature of audience has been revealed consistently throughout this study. As evidenced throughout the ability to have 10 distinct conceptual categories, ‘audience’ is a key concept that holds many meanings, applications, and values in theoretical, practical, and potential formats.

One such example of a singular conceptual category that within itself demonstrates the multivalent nature of audience is the demographic audience category. Subcategories within the

conceptual audience category of demographics include gender, geographic region, occupation, vaccine status, and age of ‘audience’. These descriptive implicit conceptions help others to better understand the conception of audience that a given author holds. Demographic conceptions of audience are centred around descriptions of audience that relating to structures of population(s) of people, 31.80% of papers included coded for ‘audience’ this way, as did 23.90% of survey responses. Leading Science Communication work in applications of audience identifies ‘audiences’ as being a critical component to designing Science Communication practice:

“communication should be designed with audience demographics in mind” – Besley
2018

The implied encompassing nature of audience demographic as a conceptual category further demonstrates the multivalency of this category, as well as positing its importance and interdependency. Furthermore, to the multivalency of audience demographics, this study has revealed how some papers conceive of audience in multiple ways even through the demographic category, up to 5 categories. This supports the idea of demographics being both important and multivalent as a conception of audience.

Crucially, research in this Honours Thesis captures that 56.51% of survey responses include a conception of multiple audiences, as do 66.91% of papers included from the systematic review of Science Communication Literature, where conceptions of ‘audience’ as multiple was the third most prolific category overall. Conceptions of audience that are multiple are also conceptions of audience that are also multivalent, the plural form of audience acknowledges the many ways that audience holds meaning, intent, applications, and values.

Additionally, as 1142 (83.97%) of the papers included in this study conceived of audience in multiple of the original 10 categories mentioned, this suggests that the ways in which Science Communication research as a whole are abundant and varied. An outright majority of papers included in this study conceive of audience in more than one of the initial 10 conceptual categories outlined earlier in this thesis. It is clear that the ways in which we conceive of audience as Science Communication researchers is both varied and numerous. This is further evidenced by 66.91% (n=910) of papers that conceive of audience as a multiplicity, acknowledging the wide range of groups of people, which also relates to the wide and varied understanding of audience that exists amongst Science Communication researchers. In considering audience as multivalent there is an opportunity to allow for each conception and piece of work on 'audience' in Science Communication to exist as valuable, as true, and as meaningful. This overarching view of 'audience' is not dismissive of any conception, categorisation, or position, rather it encompasses them all. A multivalent conception of audience does not weaken those single category specific definitions, rather an overarching understanding that multiple conceptions of audience may strengthen the field of Science Communication as this provides richness, depth, and prevents against conceptual stagnation.

Chapter 8: Conclusion

Answering Research Question 1: How do we conceive of audience in Science Communication?

Collected data from this research shows that in Science Communication we conceive of audience in an abundant variety of ways, though usually only implicitly. Only 3.75% of papers explicitly define and describe their conceptions of audience, though there are 10 distinct categories that both implicit and explicit conceptions usually fall across. Contrasting the implicit nature of written Science Communication research, 94.74% of surveyed Science Communication tertiary educators teach the concept of ‘audience’ to their students, 91.30% of the surveyed group teach an explicit definition of ‘audience’. Only 3.75% of Science Communication research articles that mention audience give an explicit definition of either ‘audience’ conceptually or an audience(s). This results in the field of Science Communication having an implicit rather than explicit definition, which means the richness we mean to impart into our use of the key concept ‘audience(s)’ can be lost in our own communication to each other. We can see this richness of conception diffused in this research project across both written and taught academic outputs. Through these data points it is clear that there is a wealth of audience conceptions in the field of Science Communication, and this research study has 10 audience conception categories are demographic, diverse, dynamic, embodied, future, general, knowledge specific, interaction dependant, multiple, and value oriented, that are heavily entwined with ideas about multiplicity in an audience. This study found that 83.97% of included papers conceived of audience through more than one category, as did 69.56% of survey responses. These multi-valiant conceptions of audience are large, and in fact are more frequent than conceptions of interaction dependant audiences, which was the single most frequent of the 10 categories. Furthermore, the ways in

which the field of Science Communication conceives of audience is shifting away from a deficit model focus, as well as away from a nonspecific general audience conception. Most Science Communication literature and educators conceive of audience as multi-valiant.

Answering Research Question 2: How do we communicate concepts of audience in Science Communication teaching and research literature?

My research pursued 10 distinct conceptions of audience: demographic, diverse, dynamic, embodied, future, general, knowledge specific, interaction dependant, multiple audiences, and value oriented. These areas of audience conceptions can be used as a framework to richly describe the audience one is communicating to/about/for in Science Communication research and practice.

Including these 10 distinct categories is the idea of multiple audiences, i.e. audiences made up of differing variations from these 5 descriptive conceptions of audience. Some of these distinct conceptions have multiple subcategories, such as the umbrella of descriptions under demographics including age, gender, geographic location, and the diverse category containing conceptions both specific and non-specific. One large descriptor of audience found across multiple studies (n=652) is the ‘general’ conception of audience, which can be more broad than helpful as a category in unfurling audience, in *Figure. 2* this category is represented by the entire figure. These categories are split into singular descriptive in the inner sun of *Figure. 2* (demographic, embodied, interaction, knowledge, and value), then the surrounding multiple conceptual conceptions of audience (diverse, dynamic, future, and multiple), making up the multiple multivalent concept that can be that of a general audience.

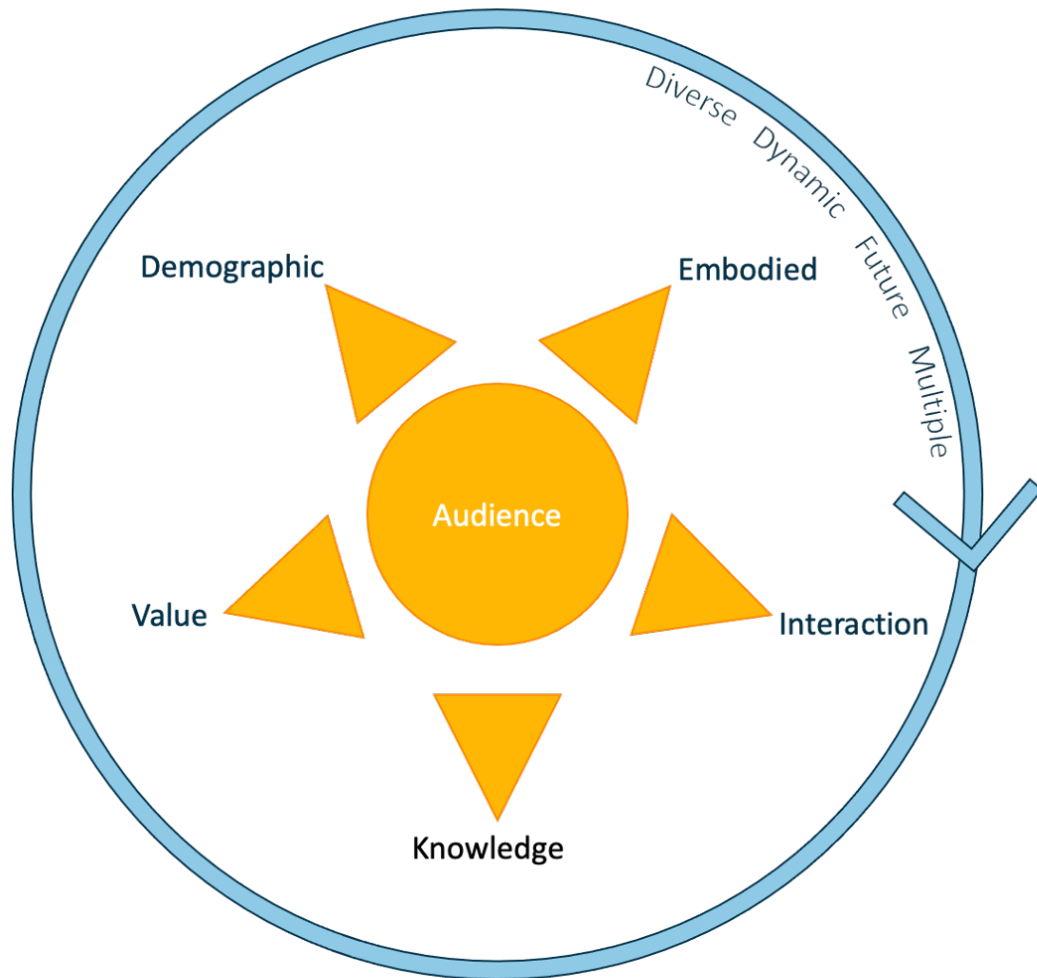


Figure. 2. Visualisation of 10 distinct audience conception categories as used in this study. The 10 distinct audience categories are: demographic, diverse, dynamic, embodied, general, future, interaction, knowledge, multiple and value. These categories are split into singular descriptive in the inner sun (demographic, embodied, interaction, knowledge, and value) and then the surrounding multiple conceptual conceptions of audience (diverse, dynamic, future, and multiple), which altogether make up the broadest category of a general audience).

This tool can be used to conceptualise audience the 10 distinct yet entwined categories when conceptualising audiences and/or an audience. These 10 categories have been developed from a sample of over 1360 Science Communication papers and from 45 surveys with Science Communication tertiary educators. Furthermore, the data forming these conceptual categories have been compared to responses from Science Communication and related studies tertiary educators. In conceptualising and communicating ‘audience’ through these 8 categories and multiplicity, the richness of understanding of ‘Audience(s)’ can be known, shared, and further developed on.

Answering Research Question 3: Is there a disconnect in our conceptions of audience and our explicit communications of audience as a Science Communication community?

Yes, this paper found a disconnect in our conceptions of audience and our explicit communications of audience. Though ‘audience’ is considered a **very** relevant aspect to teaching Science Communication, only 3.75% of studies about ‘audience’ have an explicit definition of audience or their audience. This research does, however, find that though >95% of papers implicitly communicate about audience, a majority of these audience conceptions are plural 83.97%. This suggests a large overlap with the study results from the survey section of this research where 94.74% of Science Communication educators teach ‘audience’ in their tertiary classes, with 76% of these educators agreeing that ‘audience’ is **very** relevant to their teaching.

In unfurling ‘audience’ through use of the 10 categories used throughout this study and as visualised in *Figure.2* we may move to more explicit definitions of ‘audience’ or of our audience, potentially moving far beyond the <95% of Science Communication papers that

communicate ‘audience’ only implicitly. In doing so we may be able to ensure that every Science Communicator and/or Science Communication collaborator (including early career Science Communication researchers such as myself) are equipped with more robust, rich, and usable conceptions of audience.

Study Limitations and Future Directions

As ‘Unfurling Audience’ was an Honours project, it was scoped accordingly. In the future there are many different directions this research could lead to, bases of knowledges these data points can contribute to, and further work in the understanding of ‘audience’ that can be built on from this work.

There is potential to use this research as a lead in point for further work in different directions of understanding ‘audience’. Research in audience segmentation, audience values, diverse audiences, inclusion-oriented Science Communication, and communicating science to experts can use this work as a lead in point. Through using a wider range of journals (as this study only had scope to include 5: *Journal of Communication*, *Science Communication*, *Research for All*, *Public Understanding of Science*, *Science and Environmental Communication*) and increasing possible search terms (terms in addition to ‘audience’) a broader yet more targeted approach may be taken to unfurling ‘audience’ in a particular interest area such as those listed above. This would also continue to further build a robust understanding and database on ‘audience’ within Science Communication.

The data from this study can contribute to bases of knowledges and work in similar areas to understanding of ‘audience’ through time in Science Communication. In its current form this study was limited by the time and resource bounds of an Honours project, which kept the data set correspondingly sized. Related topics this data may help to form a base knowledge and/or knowledge in are History of Science Communication, History of Science, Demographic history, and understanding of key concepts in the field of Science Communication. These related topics can also extend the bounds of this current study as due to the scope of this project, only English based sources (inclusive of journals, and surveys) were used. Ideally, this study could be furthered in the future by including data points from multiple different languages to further contribute to a robust understanding of ‘audience’ in Science Communication.

There is scope within the data collected in this study but not within the time bounds of the project to map out correlations between audience conceptual categories, date, and journal published in. This would further entwine with recommendations made in the paragraph just above, allowing for particular complementary date to accompany the future historical based studies. Graphing these may also be visually helpful for communication of this and similar studies, and is a particular directional focus that this study may be taken in for journal publication. Correlations between conceptions of audience have potential to further interact with the below suggestion to focus a similar study across disciplines.

Additionally, work in this area from related fields either within science, the social sciences, business, and other potentially related interdisciplinary areas. It would be interesting to compare audience conception categories across disciplines, create an interdisciplinary map, and discuss

perhaps where the different conceptions converged and/or diverged across time. Due to the centrality of ‘audience’, there are almost an endless number of disciplines and subdisciplines for further work in this area. This work could be a key piece of interdisciplinary studies and may lead on to a huge variety of work not limited to ‘audience’ but empowered by it.

Furthermore, additional work in a similar research niche to unfurling ‘audience’ could be done through extensions of this dataset. The survey portion of this study was limited to a finite snapshot scope of academics involved in the 2023 PSCT conference. In future studies it would be useful to collate survey responses across multiple years and from a broader academic context to understand more broadly out more fully how ‘audience’ is, and has been, taught. Additionally, in future studies it would be interesting to include Science Communication practitioners also as this would cast a greater richness over the ever evolving landscape of Science Communication. To heighten all of these responses, interviews (as follow up to the survey) could potentially provide a deeper level of information on ‘audience(s)’ to this study, which may open up more of a rich unfurling of audience than this study was able to provide. In targeting both research and educational teachings, this study is able to capture where Science Communication lies with the key concept of ‘Audience(s)’ in the year of 2023.

Unfurling ‘Audience(s)’ is an essential research step in understanding the current state and past state(s) of the field of Science Communication, and how we conceive of audience in both our teaching and research outputs, further studies can help to develop this. ‘Audience’ is a key concept. Science Communication as a practice is about communicating science to an audience,

therefore it is critical that as a field we understand how audience is conceptualised, and continue to work towards both unfurling and building up this concept.

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