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Communicating Science to Specialist and Non-Specialist Audiences: Challenges and Support Needs of Postgraduate STEM Students

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Abstract: *Communicating scientific research to non-specialist audiences presents challenges for postgraduate researchers, yet their specific communication needs require further investigation. This study examined STEM students' confidence, audience-adaptation challenges and support needs when communicating with specialist and non-specialist audiences. A questionnaire incorporating quantitative and open-ended questions was administered to 30 master's and PhD students at a research-intensive university in Saudi Arabia. The findings indicated that 76.7% of participants found non-specialist communication more challenging. Key difficulties included simplifying complex concepts without compromising accuracy, assessing audience knowledge and explaining research significance. Participants particularly valued audience-specific presentation practice, individual coaching and guidance on simplifying scientific language. The findings highlight the importance of integrating audience awareness and research-specific communication activities into postgraduate English for Specific Purposes programmes. Targeted practice and feedback may help students communicate complex scientific information more effectively across disciplinary boundaries*.

Keywords: Scientific communication, English for Specific Purposes (ESP), postgraduate STEM students, audience adaptation, non-specialist audiences' communication training

INTRODUCTION

Effective scientific communication is an essential skill for postgraduate students in science, technology, engineering and mathematics (STEM). Beyond developing specialist knowledge and conducting original research, postgraduate researchers are expected to communicate their findings to audiences with varying levels of scientific expertise. These may include disciplinary specialists, researchers from other fields, policymakers, industry professionals and members of the general public. Communicating effectively across these contexts requires more than subject knowledge; it involves adapting scientific language, selecting relevant information and presenting complex ideas in ways that are accessible and meaningful to the intended audience.

Communicating research to specialist and non-specialist audiences presents different linguistic and rhetorical demands. When addressing specialists, researchers can generally draw upon shared disciplinary knowledge, established terminology and familiar research conventions. In contrast, communicating with non-specialists requires greater attention to audience awareness, the explanation of technical concepts and the use of accessible language. Researchers must determine which details are essential, how much background information to provide and how to communicate the significance of their findings without compromising scientific accuracy. Brownell et al. (2013) emphasise that communicating science to the general public requires deliberate practice and should form part of formal scientific training.

These demands are particularly relevant to postgraduate STEM students, who are developing their identities as researchers while learning to communicate within and beyond their disciplinary communities. Although postgraduate programmes commonly provide opportunities to develop specialist communication skills through research seminars, conference presentations and academic writing, opportunities to practise communicating research to non-specialist audiences may be less consistent. Ritchie et al. (2022), in their investigation of STEM graduate students' perceptions of science communication, highlight the importance of understanding students' experiences and perspectives when developing communication training beyond traditional disciplinary settings.

From an English for Specific Purposes (ESP) perspective, effective communication involves responding to the linguistic, rhetorical and communicative demands of particular academic and professional contexts. For postgraduate researchers, these demands extend beyond mastering disciplinary terminology and academic conventions to include adapting research messages for audiences with different backgrounds and levels of subject knowledge. Kathpalia et al. (2020), in their study of science graduate students in Singapore, identified differences in communication needs associated with students' English-language proficiency and educational backgrounds. Their findings highlight the importance of identifying specific communication needs rather than adopting a uniform approach to postgraduate communication instruction.

Research has also examined the development of science communication skills through targeted training. For example, Fick et al. (2025) evaluated a science communication training programme involving 44 master’s students and reported improvements in several self-reported communication measures, alongside increased use of certain audience-involvement strategies. Such research demonstrates the potential value of structured communication training while highlighting the importance of distinguishing students' perceived confidence from their demonstrated communication performance.

Although previous studies have examined postgraduate students' science communication experiences, broader academic communication needs and the effectiveness of targeted training, further investigation is warranted into how students perceive the demands of adapting their own research for different audiences. In particular, examining their comparative confidence in specialist and non-specialist communication, specific audience-adaptation difficulties and preferred forms of support within a single study may provide a more comprehensive understanding of their communication needs. This is particularly relevant in international, English-medium research environments, where postgraduate students encounter diverse academic and professional communication demands.

The present study investigates postgraduate STEM students' perceived confidence, challenges and support needs when communicating scientific research to specialist and non-specialist audiences at a research-intensive university in Saudi Arabia. By examining these interconnected dimensions through an ESP needs-analysis approach, the study aims to provide insights that can inform targeted teaching materials, scientific communication workshops and feedback practices. Specifically, it addresses the following research questions:

RQ1: How confident are postgraduate STEM students in communicating their research to specialist and non-specialist audiences?

RQ2: What specific challenges do postgraduate STEM students experience when adapting their research for non-specialist audiences?

RQ3: What forms of support do postgraduate STEM students perceive as most useful for developing their ability to communicate research effectively to different audiences?

LITERATURE REVIEW

Scientific Communication and Audience Awareness

Effective scientific communication requires researchers to adapt their messages to the knowledge, interests and expectations of different audiences. Although scientific accuracy remains essential, the language, content and organisation of a message may vary considerably depending on whether the intended audience comprises disciplinary specialists or non-specialists. Audience awareness therefore extends beyond simplifying technical terminology; it involves identifying audiences' existing knowledge, determining which information is relevant and selecting appropriate strategies for explaining complex scientific ideas.

Foundational scholarship offers complementary perspectives on these demands. Brownell et al. (2013) emphasise that scientific expertise does not automatically translate into effective public communication and advocate incorporating communication training into scientific education. Fischhoff (2013) presents an audience-centred approach in which communication decisions are informed by an understanding of audiences' information needs. Together, these perspectives establish audience awareness as an integral component of scientific communication rather than an optional adjustment to a fixed research message.

This distinction is particularly relevant to postgraduate researchers. Communication within disciplinary communities is generally supported by shared terminology, established conventions and familiarity with specialised concepts. By contrast, communicating with non-specialists requires researchers to reconsider assumptions about prior knowledge, select an appropriate level of technical detail and explain the significance of their findings in accessible language. Effective communication therefore depends not only on subject expertise but also on deliberate linguistic and rhetorical choices.

Empirical research involving postgraduate students reinforces the importance of these choices. In a mixed-methods study involving 161 STEM graduate students, Ritchie et al. (2022) found that

participants recognised audience awareness as an important communication skill. Among respondents who described the skills required for science communication, 73% referred to knowing their audience. However, 72% of participants reported that they had not received formal training in public-facing science communication at their graduate institution. The authors acknowledge that some students may have been unaware of existing training opportunities. These findings indicate a potential gap between recognising the importance of audience awareness and accessing opportunities to develop relevant communication skills.

Recent intervention research provides further insight into the development of these skills. Fick et al. (2025) evaluated a science communication training programme involving 44 master's students and reported improvements in several measures of self-reported communication ability and knowledge, alongside increased use of selected audience-involvement strategies. Unlike studies focusing primarily on students' perceptions, their evaluation also examined recorded presentations. However, the absence of a control group limits the extent to which these improvements can be attributed to the training programme.

Collectively, these studies establish audience awareness as both a conceptual principle and a practical training concern. Foundational research explains the importance of considering audience knowledge and information needs, while postgraduate studies demonstrate the relevance of these demands to students' communication experiences. Building on this literature, the present study compared postgraduate STEM students' perceived confidence when communicating their own research to specialist and non-specialist audiences.

Challenges of Communicating Science to Non-Specialists

Adapting scientific research for non-specialist audiences involves interconnected linguistic, cognitive and rhetorical challenges. Researchers must explain unfamiliar concepts, select essential information and communicate the significance of their findings without misrepresenting scientific evidence. These demands create potential tensions between accessibility, scientific precision, credibility and audience engagement.

Technical terminology represents one of the most widely examined challenges. Specialist language enables precise communication within disciplinary communities but can create barriers when audiences lack the background knowledge needed to interpret it. Experimental research suggests that the relationship between jargon and audience understanding is more complex than a straightforward preference for accessible vocabulary. Across nine experiments involving 6,698 participants, Cruz and Lombrozo (2025) found that jargon could increase satisfaction with scientific explanations even when it reduced comprehensibility. They suggest that non-specialists may interpret unfamiliar terminology as addressing gaps in an explanation, potentially leading them to overestimate its quality.

These findings complicate conventional advice to avoid jargon. The challenge is not simply whether to include technical terms, but when they are necessary, how they should be explained and whether their use supports genuine understanding. For postgraduate researchers, effective terminology choices therefore require consideration of both scientific precision and the audience's ability to interpret the explanation.

Simplifying complex concepts without compromising scientific accuracy presents a related challenge. Scientific explanations frequently involve abstract mechanisms, methodological qualifications and specialised theoretical relationships. Making these accessible requires researchers to distinguish between information essential to the central message and details that can be omitted without distorting the findings. Taddicken and Thoms (2025) examined the comprehensibility of scientific experts through linguistic analyses and audience responses, investigating how linguistic and content complexity relate to perceived understanding. Their research highlights the multidimensional nature of comprehensibility, which cannot be reduced to vocabulary choice alone.

Analogies and metaphors introduce further considerations. Familiar comparisons can help audiences connect unfamiliar scientific concepts to existing knowledge. However, inappropriate analogies may oversimplify scientific processes or imply relationships that do not accurately represent the underlying science. Scharlau et al. (2024), in their investigation of metaphors in explanations addressed to audiences with different levels of expertise, challenge the assumption that metaphor use necessarily decreases as audience expertise increases. Their findings suggest that the use of metaphors depends on explanatory purpose and context, reinforcing the importance of selecting comparisons appropriate to the audience and communicative task.

Beyond individual language choices, researchers must determine which aspects of their work are relevant to non-specialists and how to organise this information effectively. Ritchie et al. (2022) identified barriers associated with communicating highly specialised thesis research to public audiences, including difficulties explaining unfamiliar concepts and demonstrating the relevance of research. Their findings complement experimental research on audience comprehension by highlighting postgraduate students' own experiences of adapting scientific information.

Collectively, these studies indicate that effective audience adaptation requires coordinated decisions about terminology, conceptual explanation, information selection and engagement. However, experimental studies examining audience responses and questionnaire studies investigating students' communication experiences address different dimensions of this process. To contribute to the latter area, the present study examined postgraduate STEM students' perceived difficulties across ten aspects of non-specialist communication and identified the challenges they considered most significant.

Postgraduate STEM Students' Communication Needs

Postgraduate STEM students encounter diverse communication demands throughout their research programmes. These include presenting research findings, explaining complex scientific concepts, participating in interdisciplinary discussions and communicating the wider significance of their work. However, students differ in their previous communication experiences, linguistic backgrounds and access to formal training. Understanding these differences is important for identifying their communication needs and developing appropriate academic support.

From an English for Specific Purposes (ESP) perspective, postgraduate students should not be regarded as a homogeneous group with identical communication requirements. Kathpalia et al. (2020), in their investigation of science graduate students in Singapore, identified differences in communication needs associated with students' English-language proficiency and educational

backgrounds. Their findings highlight the importance of examining learners' specific academic communication requirements rather than assuming that general language instruction can adequately address the needs of all postgraduate students.

Previous communication experience is another important consideration. Ritchie et al. (2022) found that graduate students recognised a broad range of science communication activities and audiences, although their reported engagement and training experiences varied. Participants also identified barriers to communicating their own research to non-specialists. These findings suggest that students' communication needs extend beyond language proficiency to include familiarity with different audiences, opportunities for practice and support in making specialised research accessible.

Perceived confidence is particularly relevant when examining these needs. Although confidence may influence students' willingness to participate in communication activities, it should not be equated with demonstrated competence. Ritchie et al. (2022) investigated students' self-perceptions and communication experiences, while subsequent training evaluations have examined confidence alongside other outcomes. Harrington et al. (2024), for example, evaluated an interdisciplinary postgraduate communication programme and reported improvements in writing confidence and selected writing practices. Similarly, Fick et al. (2025) examined self-reported outcomes alongside observed communication strategies. Together, these studies demonstrate the importance of distinguishing students' perceptions of their abilities from evidence of their actual communication performance.

Nevertheless, existing studies differ considerably in their research contexts, communication activities and outcome measures. Research examining general perceptions of science communication does not necessarily establish whether postgraduate students feel equally confident communicating their own research to disciplinary specialists and non-specialists. Similarly, improvements following particular training programmes do not establish which communication tasks students perceive as most challenging or which forms of support they consider most useful.

To address these issues, the present study employed a questionnaire-based needs analysis involving postgraduate STEM students at an international, English-medium research university. It compared students' perceived confidence when communicating with specialist and non-specialist audiences and examined their previous communication experiences. Information about participants' degree level, disciplinary background and English-language background provided additional context for interpreting their responses, without assuming that these characteristics independently determined their communication confidence.

ESP Approaches to Science Communication Training

English for Specific Purposes (ESP) provides a framework for identifying postgraduate researchers' communication needs and translating these into targeted educational provision. Dudley-Evans and St John (1998) identify needs analysis as a central component of ESP course design, while Long (2005) advocates a task-based approach to identifying learners' language requirements. Applied to postgraduate science communication, these perspectives support examining the communicative tasks

students undertake, the difficulties they encounter and the support they require to communicate effectively with different audiences.

An ESP-informed approach to science communication training therefore extends beyond general presentation skills. It encompasses adapting disciplinary terminology, explaining complex concepts, selecting information appropriate to particular audiences and communicating the significance of research. These skills are particularly relevant when postgraduate students are required to present the same research to audiences with different levels of scientific expertise.

Recent studies have investigated different approaches to postgraduate communication training. Harrington et al. (2024) evaluated an interdisciplinary programme incorporating communication instruction, workshops, internships and peer-review activities. Their findings indicated improvements in selected measures of writing confidence and engagement with writing practices. Fick et al. (2025), by contrast, evaluated a more focused science communication training programme addressing comprehensibility and audience involvement. Their evaluation reported improvements in several self-reported outcomes and increased use of selected audience-involvement strategies. Although both studies provide evidence supporting structured communication training, their differences in instructional scope and evaluation methods limit direct comparisons between the approaches.

The importance of authentic communication contexts is also reflected in Cagle et al. (2025), who investigated an interdisciplinary graduate course incorporating community-engaged approaches to addressing scientific misinformation. Although the course focused on communicating scientific information rather than presenting students' own research, it illustrates how postgraduate communication training can extend beyond conventional academic settings and encourage engagement with audience perspectives.

Collectively, these studies suggest that postgraduate communication training can incorporate complementary approaches, including structured workshops, authentic communication tasks, presentation practice and feedback. However, an important distinction exists between evaluating the effectiveness of training programmes and identifying students' perceived support needs. An intervention may produce measurable improvements without necessarily being the form of training students consider most useful. Conversely, students' preferred activities may not always produce the greatest improvements in demonstrated communication performance. Both perspectives are relevant when developing communication support that addresses postgraduate researchers' needs.

This distinction informed the ESP needs-analysis approach adopted in the present study. Rather than evaluating a particular training intervention, the study investigated postgraduate STEM students' perceptions of different support options, including individual coaching, feedback from subject specialists and language instructors, presentation practice, peer feedback and guidance on simplifying technical language. By examining these preferences alongside students' reported communication challenges, the study identified areas that could inform the development of targeted teaching materials, workshops and feedback practices appropriate to their academic communication needs.

METHODOLOGY

Research Design

This study employed an exploratory, cross-sectional design incorporating quantitative and qualitative elements to investigate postgraduate STEM students' perceived confidence, communication challenges and support needs when presenting scientific research to specialist and non-specialist audiences.

The study adopted an English for Specific Purposes (ESP) needs-analysis approach, which emphasises identifying learners' communication needs to inform targeted academic language instruction. Quantitative data were collected to examine students' confidence when communicating with different audiences, their perceived audience-adaptation difficulties and their preferred forms of communication support. Qualitative data provided further insight into participants' experiences and explanations of their responses.

The integration of quantitative and qualitative findings enabled a broader examination of postgraduate students' perceived communication needs and informed the study's implications for ESP instruction and science communication training.

Research Context and Participants

The study was conducted at a research-intensive university in Saudi Arabia, where English is the principal language of academic instruction and research communication. The sample comprised 30 postgraduate STEM students, including 15 Master's and 15 PhD students, from biological and environmental sciences, physical sciences, engineering, computer and data science, and mathematics.

Participants were recruited through voluntary convenience sampling. An electronic invitation was distributed to eligible postgraduate students, providing information about the study and inviting them to complete an online questionnaire.

Background information was collected on participants' degree level, broad disciplinary area, nationality, English-language background and previous experience of communicating research to specialist and non-specialist audiences. These characteristics were used to describe the sample and contextualise the findings.

The sample size and single-institution setting were appropriate for an exploratory investigation of perceived communication needs. However, these characteristics limited the extent to which the findings could be generalised to other postgraduate populations.

Research Instrument

Data were collected using a structured questionnaire comprising 15 questions organised into five sections. The questionnaire was developed specifically for this study and aligned with its three research questions.

Section A (Questions 1–5) collected information about participants' academic and language backgrounds and their previous experience of communicating research to specialist and non-specialist audiences.

Section B (Questions 6–8) examined participants' confidence in communicating their research to each audience using identical five-point rating scales. Participants also identified which audience they found more challenging and briefly explained their choice.

Section C (Questions 9–11) investigated ten aspects of communicating research to non-specialists, including technical terminology, conceptual explanation, scientific accuracy, background information, content selection, analogies, research significance, message organisation, linguistic appropriateness and audience engagement. Participants rated the difficulty of each aspect, selected up to three principal challenges and responded to five statements concerning audience adaptation.

Section D (Questions 12–13) examined communication support needs. Participants rated the perceived usefulness of ten support options, including workshops, individual coaching, presentation practice and feedback. They also identified up to three priority areas for further training.

Section E (Questions 14–15) contained two open-ended questions inviting participants to describe their greatest communication challenges and identify the forms of training, practice or feedback they considered most useful.

The questionnaire was piloted with five postgraduate STEM students who were excluded from the main sample. The pilot assessed question clarity, the appropriateness of response options and completion time.

Data Collection Procedure

The questionnaire was administered electronically over a two-week period. Eligible postgraduate STEM students received an invitation explaining the purpose of the research, the voluntary nature of participation and how their responses would be handled.

Participants completed the questionnaire online at a time convenient to them. The estimated completion time was approximately seven to ten minutes.

Following the data-collection period, responses were exported to a spreadsheet and checked for completeness and consistency. The final dataset comprised 30 participants.

Data Analysis

Quantitative data were analysed using descriptive statistics, including frequencies, percentages, means and standard deviations, where appropriate. Given the sample size of 30 participants, the analysis focused on describing patterns in students' perceptions rather than making population-level generalisations.

To address the first research question, mean confidence ratings for specialist and non-specialist audiences were compared descriptively. Participants' responses identifying which audience they found more challenging were also examined.

For the second research question, mean difficulty ratings were calculated for the ten audience-adaptation challenges. The frequency with which participants selected each challenge among their three principal difficulties was also examined. Responses to the five audience-adaptation statements provided additional context.

For the third research question, mean usefulness ratings were calculated for the ten communication support options. The frequency with which participants selected particular training priorities was also examined.

Open-ended responses were analysed thematically. The analysis involved familiarisation with the responses, initial coding, identification of recurring patterns and refinement of themes relevant to the research questions. Anonymised extracts were selected to illustrate the identified themes.

Finally, the quantitative and qualitative findings were considered together to explore connections between students' perceived communication difficulties and their preferred forms of support. This integration informed the study's pedagogical implications for postgraduate ESP instruction and science communication training.

Ethical Considerations

Participation was voluntary, and the questionnaire did not request participants' names or student identification numbers. Participants received information about the purpose of the study and how their responses would be used.

Responses were handled confidentially, and potentially identifying details were excluded from the reporting of open-ended responses. The researcher's teaching relationship with potential participants was also considered to minimise perceived pressure to participate. The study received an institutional exemption from ethical review.

RESULTS

Participant Characteristics

The study included 30 postgraduate STEM students from a research-intensive university in Saudi Arabia. The sample comprised 15 Master's students (50.0%) and 15 PhD students (50.0%) from a range of disciplines, including biological and environmental sciences, physical sciences, engineering, computer and data science, and mathematics.

Fourteen participants (46.7%) were Saudi students, while 16 (53.3%) were international students. Regarding English-language background, six participants (20.0%) reported English as their first or

main language, whereas 24 (80.0%) reported English as an additional language. The participants' characteristics are summarised in Table 1.

Table 1. Participant characteristics (N = 30)

Characteristic	Number	Percentage
Degree level		
Master's	15	50.0%
PhD	15	50.0%
Nationality		
Saudi	14	46.7%
International	16	53.3%
English-language background		
English as a first/main language	6	20.0%
English as an additional language	24	80.0%

Confidence in Communicating with Specialist and Non-Specialist Audiences

Participants reported higher confidence when communicating their scientific research to specialist audiences (M = 4.10, SD = 0.76) than to non-specialist audiences (M = 2.93, SD = 0.94), as shown in Table 2 and Figure 1.

Table 2. Confidence in communicating research to different audiences

Audience	Mean (M)	Standard deviation (SD)
Specialist	4.10	0.76
Non-specialist	2.93	0.94

Note. Five-point scale: 1 = Not at all confident; 5 = Extremely confident.

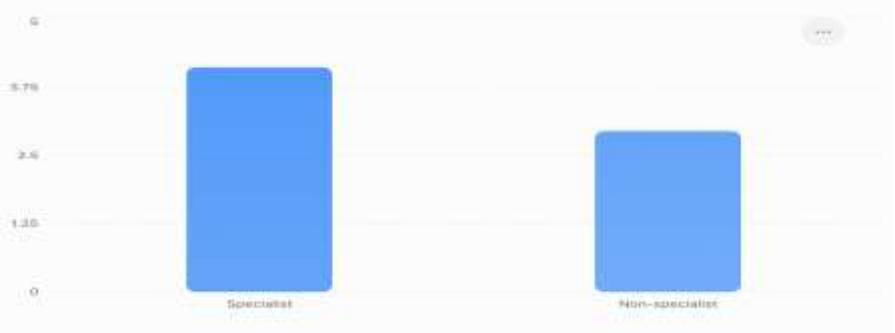

Figure 1. Mean confidence by audience

When asked which audience they found more challenging, 23 participants (76.7%) identified non-specialist audiences. Three participants (10.0%) identified specialist audiences, another three (10.0%) considered both audiences equally challenging, and one participant (3.3%) reported finding neither audience particularly challenging (Table 3 and Figure 2).

Table 3. Participants' perceptions of the more challenging audience

Audience	Number (n)	Percentage
Non-specialist	23	76.7%
Specialist	3	10.0%
Both equally challenging	3	10.0%
Neither particularly challenging	1	3.3%
Total	30	100%

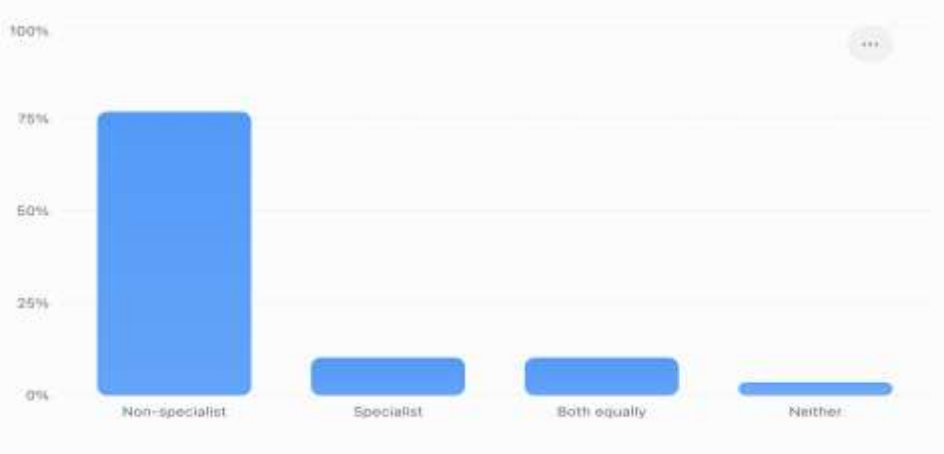

Figure 2. Audience perceived as more challenging

Overall, participants reported lower confidence in communicating with non-specialist audiences, and the majority identified these audiences as more challenging. These findings provide a basis for examining the specific difficulties students reported when adapting their research for audiences outside their disciplines.

Challenges of Communicating Scientific Research to Non-Specialist Audiences

To address the second research question, participants rated ten potential challenges associated with communicating their scientific research to non-specialist audiences. Responses were recorded on a five-point scale ranging from 1 (not at all challenging) to 5 (extremely challenging).

As shown in Table 4, simplifying scientific research without compromising accuracy received the highest mean difficulty rating (M = 4.37), followed by explaining complex scientific concepts in an accessible manner (M = 4.20) and determining how much background information to provide (M = 4.03).

Selecting the most important information (M = 3.93) and explaining the wider significance and impact of research (M = 3.87) were also rated as challenging. Other reported difficulties included using appropriate analogies and examples (M = 3.77), reducing technical terminology (M = 3.70) and maintaining audience interest and engagement (M = 3.63).

Organising information clearly (M = 3.47) and adapting vocabulary and formality (M = 3.33) received the lowest mean ratings, although both remained above the midpoint of the scale.

Table 4. Perceived challenges of communicating research to non-specialist audiences (N = 30)

Communication challenge	Mean (M)
Simplifying research without losing scientific accuracy	4.37
Explaining complex scientific concepts	4.20
Judging how much background information to provide	4.03
Selecting the most important information	3.93
Explaining research significance and wider impact	3.87
Using appropriate analogies and examples	3.77
Reducing technical terminology	3.70
Maintaining audience interest and engagement	3.63
Organising information clearly	3.47
Adapting vocabulary and formality	3.33

Note. Ratings were recorded on a five-point scale, where 1 = not at all challenging and 5 = extremely challenging.

Table 5. Mean difficulty ratings for ten aspects of non-specialist communication

Challenge	Mean
Simplifying without losing accuracy	4.37
Explaining complex concepts	4.2
Background information	4.03
Selecting important information	3.93

Challenge	Mean
Explaining significance and impact	3.87
Analogies and examples	3.77
Reducing technical terminology	3.7
Audience engagement	3.63
Organising information	3.47
Vocabulary and formality	3.33

Overall, participants reported the greatest difficulties in adapting complex scientific content for audiences without specialist knowledge. Simplifying research while maintaining scientific accuracy, explaining complex concepts and determining the appropriate amount of background information emerged as the three highest-rated challenges. These findings were consistent with those reported in Section 4.2, in which 76.7% of participants identified non-specialist audiences as more challenging than specialist audiences.

Communication Support Needs

To address the third research question, participants rated the perceived usefulness of ten forms of support for developing their ability to communicate scientific research to specialist and non-specialist audiences. They also identified up to three areas in which they would benefit most from additional training.

Perceived Usefulness of Communication Support

The three highest-rated forms of support were opportunities to practise presenting the same research to specialist and non-specialist audiences (M = 4.60), individual communication coaching (M = 4.47) and guidance on simplifying scientific language while maintaining accuracy (M = 4.43).

Feedback from academic communication instructors (M = 4.30) and workshops focusing on non-specialist communication (M = 4.23) also received high usefulness ratings. Overall, participants expressed a preference for practical, research-specific activities and opportunities to receive targeted feedback.

Table 6. Perceived usefulness of communication support (N = 30)

Form of support	Mean (M)
Practising the same research for specialist and non-specialist audiences	4.60
Individual communication coaching	4.47
Guidance on simplifying scientific language while maintaining accuracy	4.43
Feedback from academic communication instructors	4.30
Workshops on non-specialist communication	4.23
Feedback from supervisors and subject specialists	4.17
Examples of effective scientific communication	4.10
Practice using analogies, examples and storytelling	4.03
Peer feedback and presentation practice	3.93
Video recordings and self-reflection	3.77

Note. Ratings were recorded on a five-point scale, where 1 = not at all useful and 5 = extremely useful.

Table 7. Five highest-rated forms of communication support

Support	Mean
Audience-specific presentation practice	4.6
Individual coaching	4.47
Simplifying scientific language	4.43
Instructor feedback	4.3
Non-specialist workshops	4.23

The results indicated that participants placed particular value on opportunities to practise adapting their own research for different audiences, receive individualised feedback and develop strategies for simplifying scientific information without compromising accuracy.

Training Priorities

Participants were also asked to select up to three areas in which they would benefit most from additional communication training. The reported training priorities are presented in Table 8.

Explaining complex scientific concepts was the most frequently selected priority (n = 18, 60.0%), followed by simplifying research without compromising scientific accuracy (n = 16, 53.3%) and explaining research significance and wider impact (n = 13, 43.3%).

Engaging non-specialist audiences (n = 10, 33.3%) and adapting technical language for non-specialists (n = 8, 26.7%) were also identified as training priorities. By comparison, presentation delivery and public speaking received the fewest selections (n = 2, 6.7%).

Table 8. Participants' reported communication training priorities (N = 30)

Training priority	n	%
Explaining complex scientific concepts	18	60.0
Simplifying research without losing scientific accuracy	16	53.3
Explaining research significance and wider impact	13	43.3
Engaging non-specialist audiences	10	33.3
Adapting technical language for non-specialists	8	26.7
Building communication confidence	6	20.0
Using analogies, examples and storytelling	5	16.7
Structuring presentations for different audiences	4	13.3
Answering questions from different audiences	3	10.0
Presentation delivery and public speaking	2	6.7

Note. Participants could select up to three training priorities; therefore, percentages do not total 100%.

Overall, participants' training priorities were consistent with their reported communication challenges. Explaining complex scientific concepts and simplifying research without compromising accuracy emerged as prominent difficulties and training priorities. Participants also expressed a preference for practical, research-specific support, particularly opportunities to present their research to different audiences, individual coaching and guidance on simplifying scientific language.

Qualitative Findings

The open-ended questions explored participants' perceived challenges when communicating their scientific research to non-specialist audiences and the forms of training and feedback they considered most beneficial. Thematic analysis identified three themes: simplifying scientific concepts while maintaining accuracy, understanding and engaging non-specialist audiences, and the need for practical training and personalised feedback.

Simplifying Scientific Concepts While Maintaining Accuracy

The first theme concerned the difficulty of explaining complex scientific concepts in accessible language without compromising scientific accuracy. Participants described challenges in determining which technical details were essential and which could be omitted when communicating with non-specialist audiences.

One participant explained:

My biggest challenge is explaining complex scientific concepts without oversimplifying them. I worry that leaving out important details might give the audience an inaccurate understanding of my research.

Other responses highlighted difficulties in replacing familiar technical terminology with accessible language while preserving its intended meaning.

These findings were consistent with the quantitative results reported in Section 4.3, in which simplifying research without compromising scientific accuracy and explaining complex scientific concepts received the highest mean difficulty ratings.

Understanding and Engaging Non-Specialist Audiences

The second theme concerned understanding audiences' background knowledge, selecting appropriate information and communicating the wider significance of research.

Participants described difficulties in anticipating what non-specialist audiences already knew. This uncertainty made it challenging to determine how much introductory information to provide and which concepts required further explanation.

As one participant explained:

I find it difficult to know how much background information to include. Sometimes I assume people already understand certain concepts, but then I realise they don't.

Other responses highlighted difficulties in explaining why research matters beyond a specialist discipline, particularly when connecting scientific findings to familiar experiences, practical applications or wider societal concerns.

These findings highlighted the importance of audience awareness when adapting scientific information for non-specialist audiences.

The Need for Practical Training and Personalised Feedback

The third theme concerned participants' preferred forms of communication support. Responses emphasised opportunities to practise communicating their own research to different audiences and receive feedback tailored to their individual needs.

One participant stated:

I would benefit from practising the same presentation for specialist and non-specialist audiences. This would help me understand how to change the language and level of detail.

Another participant highlighted the value of individual coaching:

One-to-one coaching would help because I could work on my own research rather than using general presentation examples.

Additional responses identified workshops on analogies and storytelling, feedback from non-specialist listeners and opportunities to review recorded presentations as potentially useful forms of support.

These preferences were consistent with the quantitative findings reported in Section 4.4.1, in which audience-specific presentation practice (M = 4.60), individual coaching (M = 4.47) and guidance on simplifying scientific language (M = 4.43) received the highest usefulness ratings.

Summary of Qualitative Findings

The three themes highlighted the interconnected challenges of maintaining scientific accuracy, adapting research to non-specialist audiences and accessing appropriate communication support. The qualitative findings complemented the quantitative results by providing further insight into participants' reported difficulties and preferred forms of training and feedback.

DISCUSSION

Confidence in Communicating Science to Specialist and Non-Specialist Audiences

The first research question examined postgraduate STEM students' confidence in communicating their scientific research to specialist and non-specialist audiences. Participants reported greater confidence when communicating with specialists (M = 4.10) than with non-specialists (M = 2.93), while 76.7% identified non-specialist audiences as more challenging. These findings suggest that confidence in communicating within a specialist discipline does not necessarily extend to communicating the same research to audiences without specialist knowledge.

One possible explanation is that communication within a discipline benefits from shared terminology, concepts and research conventions. When addressing non-specialist audiences, however, students must make more deliberate decisions about language, content and the audience's existing knowledge. They need to determine which concepts require explanation, how much technical detail to include and how to communicate the significance of their research without assuming specialist knowledge.

These findings are consistent with Brownell et al. (2013), who emphasise the importance of explicitly developing science communication skills during scientific education. Similarly, Fischhoff (2013) highlights the need to understand an intended audience and select information according to its needs. The present study adds a postgraduate STEM perspective by identifying a difference in students' self-reported confidence across specialist and non-specialist communication contexts.

The findings also relate to Ritchie et al. (2022), whose investigation of STEM graduate students' perceptions of science communication highlighted the importance of audience awareness. In the present study, participants' lower confidence when addressing non-specialists suggests a perceived

need for opportunities to practise adapting their research for audiences with different levels of scientific knowledge.

From an English for Specific Purposes (ESP) perspective, specialist and non-specialist communication can be viewed as distinct but complementary academic and professional skills. Postgraduate students may be familiar with presenting research to supervisors, research groups and disciplinary peers, but they may require additional support when communicating beyond their specialist fields. Audience-specific activities could therefore complement conventional academic presentation training by helping students adapt scientific information to different communication contexts.

These findings must nevertheless be interpreted in relation to the study's self-report design. The questionnaire measured perceived confidence rather than directly assessing participants' communication performance. Consequently, the results identify a perceived need for support in non-specialist communication but do not establish that participants were objectively less effective when addressing such audiences.

Challenges of Adapting Scientific Research for Non-Specialist Audiences

The second research question investigated the specific challenges postgraduate STEM students experienced when communicating their research to non-specialist audiences. Simplifying scientific research without compromising accuracy received the highest difficulty rating (M = 4.37), followed by explaining complex scientific concepts (M = 4.20) and determining how much background information to provide (M = 4.03). These findings suggest that students' difficulties extended beyond technical terminology to include broader decisions about content selection, scientific accuracy and audience awareness.

A central challenge was balancing accessibility with scientific accuracy. When addressing non-specialist audiences, postgraduate researchers must decide which technical details can be simplified or omitted without misrepresenting their research. This process requires more than replacing specialist terminology with everyday vocabulary; it involves identifying the essential scientific message and presenting it in a form that remains both accessible and accurate. The qualitative findings reinforced this difficulty, with participants expressing concerns that oversimplification could lead to an inaccurate understanding of their research.

This finding relates to Cruz and Lombrozo (2025), who examined how non-specialists evaluate scientific explanations containing jargon and distinguished between perceived explanation quality and actual comprehensibility. While their research focused on audiences' responses to scientific explanations, the present study examined the challenges postgraduate students perceived when producing such explanations. Together, these perspectives highlight the importance of considering both scientific accuracy and audience comprehension.

Another prominent challenge was explaining complex scientific concepts to audiences without specialist knowledge. Effective adaptation may require students to restructure their explanations rather than simply shorten existing academic presentations. This interpretation is consistent with the relatively high difficulty rating for selecting the most important information (M = 3.93), suggesting

that identifying and prioritising the central scientific message is an important aspect of audience adaptation.

Determining the audience's background knowledge was also a significant difficulty. Participants reported uncertainty about how much introductory information to provide and which concepts required further explanation. This was reflected in the qualitative findings, where one participant described the difficulty of anticipating what non-specialist audiences already understood. Fischhoff (2013) similarly emphasises the importance of identifying an audience's information needs when designing scientific communication.

Participants also reported difficulties explaining the wider significance of their research (M = 3.87). Communicating scientific findings to non-specialists may require researchers to move beyond disciplinary explanations and establish connections with practical applications, familiar experiences or wider societal concerns. These skills are particularly relevant when communicating with interdisciplinary audiences, industry representatives, policymakers and the wider public.

Notably, reducing technical terminology (M = 3.70) received a lower difficulty rating than simplifying research without compromising accuracy (M = 4.37). This distinction suggests that students perceived audience adaptation as a broader challenge than avoiding jargon. Although replacing technical terms may improve accessibility, the underlying concepts may remain difficult to understand unless the explanation is also adapted to the audience's knowledge and needs.

From an English for Specific Purposes (ESP) perspective, these findings highlight the importance of addressing the linguistic, rhetorical and conceptual dimensions of scientific communication. Postgraduate students may benefit from activities that require them to identify the central message of their research, anticipate gaps in audience knowledge, select appropriate supporting information and develop accessible explanations without compromising scientific accuracy.

Overall, the findings suggest that the principal challenge of communicating with non-specialist audiences involves more than simplifying language. It requires students to adapt specialised scientific knowledge into explanations that are accurate, accessible and meaningful to audiences with different levels of expertise.

Communication Support Needs and Training Preferences

The third research question examined the forms of support postgraduate STEM students considered most useful for developing their ability to communicate scientific research to specialist and non-specialist audiences. The findings indicated a preference for practical, research-specific support, particularly opportunities to practise presenting the same research to different audiences (M = 4.60), individual communication coaching (M = 4.47) and guidance on simplifying scientific language while maintaining accuracy (M = 4.43). These preferences were consistent with the challenges identified in the quantitative and qualitative findings.

Audience-specific presentation practice received the highest usefulness rating. This suggests that participants valued opportunities to adapt their own research for audiences with different levels of

scientific knowledge rather than relying exclusively on general presentation exercises. Preparing specialist and non-specialist versions of the same presentation could help students recognise how audience expectations influence their choice of language, the amount of background information required and the level of scientific detail included.

This finding aligns with Brownell et al. (2013), who advocate the explicit development of science communication skills, and Fischhoff (2013), who emphasises the importance of designing scientific communication around an audience's information needs. Within postgraduate English for Specific Purposes (ESP) instruction, audience-specific presentation practice offers a way of applying these principles to students' own research contexts.

Individual communication coaching was the second highest-rated form of support. Unlike general workshops, individual coaching can address the particular linguistic, rhetorical and conceptual demands of a student's research. For example, targeted feedback may help a student explain a complex scientific process, select an appropriate analogy or communicate the wider significance of their findings. The qualitative responses reinforced this preference, with participants highlighting the value of receiving feedback on their own research rather than working exclusively with general presentation examples.

Guidance on simplifying scientific language while maintaining accuracy was the third highest-rated support option. This preference corresponded closely to the principal challenge identified in Section 4.3, where simplifying research without compromising scientific accuracy received the highest difficulty rating (M = 4.37). The alignment between these findings suggests that participants could identify forms of support that addressed their perceived communication difficulties. The training priorities reported in Section 4.4.2 reinforced this pattern, with explaining complex scientific concepts (60.0%) and simplifying research without compromising accuracy (53.3%) receiving the most selections.

These findings are also relevant to research on postgraduate science communication training. Harrington et al. (2024) reported improvements in writing confidence and communication practices following an interdisciplinary programme incorporating workshops, repeated practice and peer review. Fick et al. (2025) similarly reported improvements in several measures of science communication competence following structured training, although changes in communication performance were less consistent. These studies provide a basis for considering structured practice and feedback while also highlighting the importance of evaluating training outcomes.

From an ESP perspective, the findings suggest that postgraduate communication provision could combine structured workshops with opportunities for research-specific practice and individual feedback. Workshops could introduce strategies for audience analysis, simplifying complex concepts and communicating research significance, while individual coaching could help students apply these strategies to their own research. Such an approach would accommodate the varied communication demands associated with different STEM disciplines and research topics.

However, the present study examined participants' perceived support needs rather than the effectiveness of particular training approaches. High usefulness ratings do not establish that audience-

specific practice or individual coaching would produce greater improvements than other forms of support. Evaluating their effectiveness would require further research incorporating direct assessments of students' communication performance.

Overall, the findings indicate that participants valued opportunities to practise adapting their own research, receive personalised feedback and develop strategies for communicating complex scientific information accurately and accessibly. These preferences provide a basis for considering how postgraduate ESP provision might respond to students' reported communication needs.

Implications for Research and Practice

The findings of this study have implications for English for Specific Purposes (ESP) instruction and postgraduate scientific communication training. They highlight the importance of developing students' ability to adapt complex scientific information for audiences with different levels of disciplinary knowledge. They also provide a basis for considering how audience-specific communication activities, targeted feedback and research-specific support could be incorporated into postgraduate education.

Implications for ESP Curriculum Design

The finding that 76.7% of participants identified non-specialist audiences as more challenging suggests that audience adaptation warrants explicit attention in postgraduate ESP curricula. Alongside communicating with supervisors, disciplinary peers and other specialists, postgraduate students may need to explain their research to interdisciplinary and non-specialist audiences.

ESP courses could therefore incorporate structured activities requiring students to communicate the same research to different audiences. For example, students could prepare two versions of a research presentation: one for specialists and another for non-specialists. Comparing these versions would provide opportunities to examine how audience knowledge influences terminology, the amount of background information provided, the selection of scientific details and the explanation of research significance.

These activities could be integrated into existing academic communication courses, research presentation workshops and other postgraduate development programmes rather than requiring separate provision.

Implications for Scientific Communication Training

The findings suggest that scientific communication training should extend beyond general presentation skills to address the challenges of adapting specialised scientific content. Participants reported particular difficulty simplifying research without compromising accuracy, explaining complex concepts and determining how much background information to provide.

Training activities could focus on identifying the central message of a research project, selecting essential information and explaining technical concepts in accessible language. Students could also practise using appropriate analogies and examples, anticipating gaps in audience knowledge and

explaining the wider significance of their research. Such activities would provide opportunities to develop explanations that communicate both what the research involves and why it matters.

Individual communication coaching could complement these activities. Its high perceived usefulness rating (M = 4.47) suggests that participants valued opportunities to receive guidance directly related to their own research. Combining structured workshops with individual coaching could accommodate the varied communication demands of postgraduate students across STEM disciplines.

Implications for Assessment and Feedback

The findings also have implications for the design of authentic assessment tasks and targeted feedback. Postgraduate ESP programmes could assess not only language accuracy and presentation delivery but also how appropriately students adapt scientific information for an intended audience.

Assessment criteria could address the clarity of the central message, accessibility of scientific explanations, appropriate selection of technical detail, preservation of scientific accuracy and communication of research significance. Using these criteria across specialist and non-specialist presentation tasks would allow students to examine how effective communication varies according to audience and purpose.

Formative assessment could involve presenting research to non-specialist peers, receiving feedback and revising explanations accordingly. Collaboration between ESP instructors and subject specialists could further strengthen this process by combining feedback on language, organisation and audience awareness with feedback on scientific accuracy.

Repeated practice, recorded presentations and guided self-reflection could also provide opportunities for students to identify areas for improvement and monitor their communication development over time.

Implications for Research

This study contributes to ESP needs analysis by examining postgraduate STEM students' perceived confidence, audience-adaptation challenges and preferred forms of communication support within a single investigation. The findings suggest that scientific communication needs extend beyond linguistic proficiency and general presentation skills to include decisions about scientific content, audience knowledge and the wider significance of specialised research.

For researchers investigating postgraduate scientific communication, the study highlights the value of examining specialist and non-specialist communication as related but distinct contexts. It also illustrates how confidence ratings, perceived difficulty measures, training priorities and qualitative responses can be combined to develop a more detailed account of students' reported communication needs.

However, the study involved a relatively small sample of 30 participants from a single institution and relied on self-reported perceptions. The findings should therefore be interpreted as an exploratory

account of communication needs within this particular context rather than as evidence of participants' actual communication performance or the effectiveness of specific training approaches.

Further research could investigate how students' perceived needs correspond to their demonstrated ability to communicate research to different audiences. Studies incorporating direct assessments of communication performance could also examine whether audience-specific practice, individual coaching and targeted feedback lead to measurable improvements.

CONCLUSION

This study investigated postgraduate STEM students' perceived confidence, communication challenges and support needs when presenting scientific research to specialist and non-specialist audiences. Drawing on questionnaire responses from 30 master's and PhD students at a research-intensive university in Saudi Arabia, it examined the demands of adapting specialised research for audiences with different levels of scientific knowledge.

The findings revealed that participants reported greater confidence when communicating with specialists, while 76.7% identified non-specialist audiences as more challenging. Their principal difficulties included simplifying scientific research without compromising accuracy, explaining complex concepts and determining how much background information to provide. These findings suggest that communicating research beyond specialist disciplines involves more than simplifying technical terminology; it also requires careful decisions about scientific content, accuracy and audience knowledge.

Participants expressed a preference for practical, research-specific support, particularly opportunities to present the same research to different audiences, individual communication coaching and guidance on simplifying scientific language while maintaining accuracy. These preferences suggest that audience-specific presentation practice and targeted feedback could be valuable components of postgraduate ESP provision.

The study contributes to ESP needs analysis by identifying audience adaptation as an important dimension of postgraduate scientific communication. Although its small, single-institution sample and reliance on self-reported perceptions limit the transferability of the findings, it provides an exploratory account of students' communication needs and a basis for developing more audience-centred ESP instruction.

Future Research

The findings of this study identify several directions for further investigation into postgraduate STEM students' scientific communication needs, particularly their ability to adapt research for specialist and non-specialist audiences.

First, future studies could involve larger samples drawn from multiple universities and STEM disciplines. Expanding beyond the present study's 30 participants from a single research-intensive university in Saudi Arabia would allow researchers to examine communication challenges across

different institutional and disciplinary contexts. Larger samples could also support comparisons between master's and PhD students and between students with different language backgrounds and levels of communication experience.

Second, further research could examine the relationship between students' perceived confidence and their demonstrated communication performance. As the present study relied on self-reported questionnaire responses, it did not directly assess participants' ability to communicate research to different audiences. Future investigations could incorporate recorded presentations, audience feedback and structured assessment criteria to evaluate how effectively students adapt their language, scientific content and explanations for specialist and non-specialist audiences.

Third, longitudinal and intervention-based studies could evaluate the effectiveness of specific communication training approaches. In particular, researchers could investigate whether audience-specific presentation practice, individual coaching and targeted feedback lead to measurable improvements in communication performance. Assessments conducted before and after structured training, together with follow-up assessments, could provide evidence of both immediate improvements and the extent to which students retain and apply the skills developed.

Finally, future research could incorporate the perspectives of non-specialist audiences, academic supervisors, subject specialists and ESP instructors. Comparing their assessments with students' self-reported experiences could reveal differences between perceived and observed communication difficulties. These perspectives could also inform the development of assessment criteria and training activities that address both scientific accuracy and audience comprehension.

Collectively, these directions would extend the present exploratory needs analysis by examining actual communication performance and evaluating the outcomes of targeted training. Such research could contribute to the development of evidence-informed ESP provision that supports postgraduate researchers in communicating complex scientific information accurately and accessibly to diverse audiences.

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