frontiers | Frontiers in Communication

TYPE Original Research
PUBLISHED 15 August 2024
DOI 10.3389/fcomm.2024.1384389

OPEN ACCESS

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RECEIVED 09 February 2024
ACCEPTED 06 August 2024
PUBLISHED 15 August 2024

CITATION
Rehman N, Edkins V and Ogrinc N (2024) Using podcasts to bridge the gap between science communication and specialized scientific fields: a case study of mass spectrometry.
Front. Commun. 9:1384389.
doi: 10.3389/fcomm.2024.1384389

Using podcasts to bridge the gap between science communication and specialized scientific fields: a case study of mass spectrometry

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This study aimed to evaluate the use of podcasts in disseminating specialized scientific fields, such as mass spectrometry. Four podcasts featuring interviews with researchers working with mass spectrometry were produced. A mixed methods approach, comprising questionnaires and interviews, was used to gather listener feedback. Findings indicate that audience engagement is affected by factors like familiarity with science and relatability in content; therefore, to attract a wider audience, content must be presented to balance technical aspects with real-life examples to which listeners can relate. These findings will benefit researchers and stakeholders seeking to disseminate complex scientific topics using podcasts.

KEYWORDS

science podcasts, podcasting, mass spectrometry, public engagement, science communication

1 Introduction

The digital age has revolutionized how scientific information is shared with the public (Osterrieder, 2013; Collins et al., 2016; Jensen and Gerber, 2020). Among the emerging mediums in this digital landscape, the podcast has become a cultural phenomenon (Sullivan, 2019). Since their introduction in 2004 (Berry, 2016; MacKenzie, 2019), podcasts have become popular among scientists and researchers to communicate their research work to the public (Birch and Weitkamp, 2010; Davies and Hara, 2017; Llinares et al., 2018, p. 3; Kwok, 2019; MacKenzie, 2019; Quintana and Heathers, 2021).

Despite similarities to traditional broadcasting (Bottomley, 2015; Berry, 2016; Llinares et al., 2018, p. 2), podcasts offer increased flexibility since creators and listeners are not restricted by specific times (Llinares et al., 2018, p. 2). Software and tools that are freely available and easy to use can assist in the production of podcasts without requiring formal training (Boulos et al., 2006). Furthermore, there is no restriction on the number of speakers or the location (Boulos et al., 2006; Quintana and Heathers, 2021). The convenience and accessibility of podcasts through mobile apps and platforms like Apple Music, Spotify, and Google have made it easier for listeners to access them at any time (McGarr, 2009; Sullivan, 2019; Wade Morris, 2021). Apart from cognitive development through gaining information and being curious, podcast listeners have also expressed an openness to new experiences, social acceptance, and efficient use of their time as reasons for listening to podcasts (McClung and Johnson, 2010; Chan-Olmsted and Wang, 2020; Tobin and Guadagno, 2022).

Podcasts can cover various topics, with formats and languages tailored to specific audiences (Berry, 2016). The versatility of this approach is especially valuable when it comes to communicating scientific information (Chan-Olmsted and Wang, 2020). Currently, there are hundreds of science podcast series available, and this number continues to grow each year (MacKenzie, 2019; Quintana and Heathers, 2021). Between 2004 and 2010, 952 English-language science podcasts were published worldwide, including 532 from the US and 162 from the UK (MacKenzie, 2019).

While there is no set formula for gauging the success of a science podcast yet (MacKenzie, 2019), several metrics can help indicate its performance. A key metric is the podcast's overall ranking and number of followers, which indicates listener engagement (García-Marín, 2020). The BBC World Service, for example, hosts two weekly science podcasts with a social media following of 60 million Facebook fans, 40 million Twitter followers, and 160,000 Instagram fans (BBC, 2023a,b), demonstrating their continued success. The question is—what factors have contributed to their engagement and retention?

Reviewing the literature on this topic makes it clear that humor and storytelling narratives have benefited science communication (Picardi and Regina, 2008; Riesch, 2014; Drew, 2017; Barrios-O'Neill, 2018). Swiatek (2018) explains the importance of building a narrative akin to having a casual phone conversation. However, the question remains: could these factors also increase engagement for podcasts centered around specialized scientific content?

It is known that familiarity with science is a significant driver of public engagement with scientific research (Kouper, 2010; Weingart et al., 2021). For example, those with a strong interest in scientific content are more likely to make logical decisions and choices in their daily tasks based on scientific reasoning (Chantler et al., 2007; Shaw and McNamara, 2021). However, there is limited research on whether familiarity with sciences or having a scientific background influences people's choice of podcasts.

While the popularity of podcasts has been linked to the trendiness of topics (García-Marín, 2020) or the popularity of featured guests (Handley and Chapman, 2012, p. 246), communicating scientific subjects that can be categorized as specialized scientific subjects is equally important. However, these subjects present a unique challenge; engaging audiences with topics that may not be trendy or receive mainstream media coverage in such a way that makes them understandable to a diverse audience rather than to a specialized group (Weingart et al., 2021).

For this purpose, mass spectrometry, an analytical technique used to determine molecular compositions of various substances, was chosen to assess listener perception of specialized scientific content-based podcasts. Many scientific fields that play a role in the lives of the public make use of mass spectrometry, such as environmental analysis (Ogrinc et al., 2005), novel food safety (Schönleben et al., 2024), food and water quality assessment (Kaufmann, 2011; Kovačič et al., 2023), pharmaceutical research (Swales et al., 2019), and in critical areas such as personalized medicine (Heeren, 2015) and cancer research (Ogrinc et al., 2021). However, despite its recognition as a powerful analytical tool, the public remains unaware of its capabilities (Daughton, 2001).

This study has three objectives. First, it aims to assess public engagement with podcasts focused on specialized scientific fields, using mass spectrometry as a case study. Second, the study examines factors influencing how podcast listeners engage with scientific content, focusing on their prior familiarity with sciences. Third, it seeks to identify potential strategies to attract more listeners. The results of this study will enhance the effectiveness of creating science-based podcasts and bridge the gap between the public and their understanding of specialized scientific subjects.

2 Manuscript formatting

2.1 Methodology

The methodology discusses how the study podcasts were created and details the mixed methods approach used to gather feedback. Data was collected through questionnaires and interviews, followed by subsequent data analysis.

2.1.1 Podcast creation

The creation of the podcast series began with the development of four unique episodes to highlight the wide-ranging impact of mass spectrometry on various scientific fields. The episodes were designed to appeal to different listener preferences, with one being 10 min long, two being 15 min, and one lasting 30 min. This way, we could cover episodes comprising a quick update to more in-depth discussions. Each episode focused on a specific application of mass spectrometry in food and environmental analysis, proteomics and diagnostics, pharmaceuticals and forensics, and cancer research.

Experts were carefully chosen to ensure a balanced representation of gender, career stage, and geographical diversity. Each expert was invited to participate and provided a detailed briefing on the podcast's topic and objectives. The final selection of experts included two early-career researchers (one male, one female) and two experienced researchers (one male, one female) representing the Netherlands, Slovenia, France, and Belgium. All guests were required to sign a consent form for recording and publication, with provisions allowing them to review and approve the final edited version of their episodes to ensure accuracy and comfort with the shared content. A semi-structured interview guide (Table 1) was also provided to facilitate discussions. This format allowed guests to elaborate on their work experiences and discuss their motivations, challenges, and insights as researchers. Beyond addressing specific queries concerning their research fields, the interviews were designed to encourage researchers to articulate their views on the importance of mass spectrometry in society, enhancing the educational value of each episode.

Interviews were scheduled and conducted via Zoom to facilitate the involvement of international experts without geographical constraints. Post-recording, the audio was edited using Audacity, a popular open-source software for podcast production. Background noise and speech errors were removed to enhance clarity, and background music was added along with speed adjustments to create a more engaging listening experience.

2.1.2 Data collection

For this study, a closed-ended questionnaire was developed to gather insights into listeners' preferences and their perceptions of mass spectrometry as presented in podcasts (Supplementary material S1). Initially, we provided a brief overview of the confidentiality and data protection measures according to Articles 6–8 of the GDPR guidelines (Intersoft Consulting, 2013), adhering to the Ethics for Researchers (European Commission, 2013) and the Ethical Guidelines for Social

TABLE 1 Semi-structured interview guide for mass spectrometry podcast series.

Topic of discussion	Prompts for questions
Motivation and challenges	Development of interest in research and science Key motivations for pursuing a scientific career Challenges faced on the path to becoming a scientist
Role and experiences	Brief description of current role at (name of institute) Obstacles faced in the role Balancing hands-on experiments/ research with any management responsibilities
Understanding mass spectrometry and its applications	Explanation of mass spectrometry and how it is used Contribution of mass spectrometry in their expertise Contribution of mass spectrometry in other fields of interest to them.
Public accessibility to research and the technology	Public resources for finding detailed information about ongoing research Requests from commercial companies and other research institutes Requests for sample testing from individuals
Current projects	Interesting projects/collaborations/breakthroughs
Future of mass spectrometry	Importance and relevance of mass spectrometry to the scientific community Potential alternatives to mass spectrometry in the future
Perspectives	Balancing work commitments with other aspects of life Advice for aspiring scientists in scientific fields

Research (Social Research Association, 2021). This presentation ensured that participants made decisions based on informed consent to participate in this study. The questionnaire explored general podcast listening habits, including the frequency of listening and preferred podcast length, to assess respondent engagement. Respondents then listened to four episodes from the mass spectrometry podcast series to become familiar with the content. We also included questions to assess how well the guests explained the complex topic of mass spectrometry and the overall conversation style. To understand how different scientific narratives and personal stories from the researchers influenced listener engagement, we included questions about the diversity of experiences among the researchers featured in the podcasts.

The questionnaire, designed on Typeform, was pilot tested within the research group to refine its clarity and relevance, while mass spectrometry experts ensured content validity and the topic was covered comprehensively. Reliability was assessed using Cronbach's alpha, showing high internal consistency with a value of 0.72. To verify response authenticity, incomplete or duplicate entries were eliminated, and one response was removed. The questionnaire was distributed via LinkedIn and Twitter from August to October 2022, collecting 80 responses from participants in the European region. The inclusion criteria allowed participation from both regular and non-regular podcast listeners, including those without a scientific background.

Table 2 outlines the demographic details of the questionnaire respondents ($N = 80$), covering age groups, educational levels, and countries of residence. The largest age group was 26–35 at 42%, followed by 16–25 at 21%. Most respondents were highly educated: 34% held a Master's degree, 28% had a Doctorate, and 31% had a Bachelor's degree or college education. The geographical distribution shows that 30% of respondents were from the United Kingdom, making it the most represented country, followed by Germany (16%), Belgium (11%), and Poland and the Netherlands (10% each). Minor contributions from Slovenia, Italy, France, and Denmark each account for 5% of the sample, while responses from Romania and Norway are grouped under "Others" at 2% due to their lower representation.

TABLE 2 Demographic characteristics of questionnaire respondents (%; $N = 80$).

Demographics		%
Age group (in years)	16–25	21
	26–35	42
	36–45	16
	46–55	14
	56 +	7
Educational attainment	Doctoral degree	28
	Master's degree	34
	Bachelor's / College degree	31
	Vocational training / High school	9
Country of residence	United Kingdom	30
	Germany	16
	Belgium	11
	Poland	10
	Netherlands	10
	Slovenia	5
	Italy	5
	France	5
	Denmark	5
	Others	2

Following the questionnaire, personal interviews were conducted using a semi-structured format to assess the listeners' more profound opinions on the podcasts. Participants for these interviews were selected based on a screening criterion that required them to have listened to a podcast series on a commercial platform such as Apple,

Spotify, or SoundCloud within the past 6 months to ensure they had recent experience listening to podcasts.

Each interview incorporated predefined prompts (Supplementary material S2) to guide the discussion. Participants elaborated on specific aspects of the scientific content they found noteworthy while providing feedback on non-scientific variables. We recruited six participants ($N = 6$) from those who completed the questionnaire, using snowball sampling to ensure demographic diversity. The group included three females and three males, evenly split between the 16–35 and 36–55 age groups. Educational backgrounds were also varied, with two participants each from natural sciences, business and accounting, and social sciences and humanities. Geographically, the participants included one from Slovenia and the Netherlands and two from Germany and the UK.

The interviews were conducted remotely from December 2022 to January 2023. Before each session, participants were given an overview of the study's objectives, confidentiality protocols, and data processing and storage guidelines. This step was implemented to secure informed consent and ensure participants fully understood the use of the data collected from the interviews. Each interview lasted 30–45 min, during which participants were encouraged to share their experiences and perceptions freely. To ensure confidentiality and data integrity, all interview transcripts were anonymized.

2.1.3 Data analysis

The data from the questionnaire was analyzed using R software (Version 4.2.2). Descriptive statistics, including mean, median, frequency, and percentages, were used to understand the non-scientific and scientific aspects of the podcasts. We also conducted paired sample t-tests to evaluate changes in knowledge about mass spectrometry before and after listening to the podcasts. The normality of data was confirmed using the Shapiro–Wilk test to determine the validity of the t-test results. Cohen's d was calculated to measure the effect size of the changes in knowledge. Chi-square tests were used to explore the relationship between these knowledge changes and sociodemographic variables like educational attainment and age. We verified that the chi-square tests met the necessary assumptions and only p-values below 0.05 were considered statistically significant.

For the interview data, thematic analysis was conducted using MaxQDA software for systematic coding and data organization. First, we identified initial "thematic categories" or "codes" based on the raw data. These codes were refined by identifying recurrent patterns across participants and integrating examples from the raw data to develop thematic categories. For accuracy, we did thorough checks by reviewing the transcriptions against the original audio files, with each transcript reviewed twice. For intra-coder reliability, the same researchers recoded the data three different times and compared the results for consistency (Attride-Stirling, 2001; Braun and Clarke, 2006; Maguire and Delahunt, 2017).

Graphical representations were created using Power BI to interpret the data and identify patterns. All findings were categorized into scientific and non-scientific elements, followed by recommendations for improving the communication of complex scientific information through podcasts. Finally, to maintain response integrity, ellipses (…) were used to indicate the exclusion of larger text sections or interviewer prompts in quotations. All participants were represented using combinations of letters or alphanumeric identifiers to ensure anonymity.

2.2 Results and discussion

2.2.1 Engagement with non-scientific elements

Apart from the frequency of podcast consumption and preferred duration for podcasts, respondents were questioned about the conversation style and evaluated for their receptivity to personal statements made by the guests, such as the challenges they encountered in their journey as scientists. These components were then examined in the interview sessions with the participants.

2.2.1.1 Frequency of listening to podcasts and preferred duration

When respondents were asked to rate their frequency of listening to podcasts over the past 6 months, the results revealed a diverse range of habits: 28% listened "Seldom/Rarely", 25% "Sometimes", and 23% "Often". The remaining 24% were evenly split between those who listened "Very Often" and those who chose "Never". When considering preferred podcast durations, a clear trend emerged favoring shorter episodes. Most respondents (81%) preferred podcasts under 30 min, with the majority (56%) preferring podcasts between 15 and 30 min and a quarter favoring episodes less than 15 min. Within the smaller segment (19%) who preferred longer podcasts, most preferred episodes between 30 and 45 min (11%), and 8% opted for hour-long podcasts. Table 3 shows a distribution of these factors across different age groups and educational attainment levels.

Analyzing the data across different age groups highlighted notable contrasts. The oldest age group (56+) showed a distinct pattern: 40% never listened to podcasts, while 60% listened often. In the youngest age group (16–25), 35% listened "Seldom/Rarely", and 29% each chose "Sometimes" and "Often". The 26–35 age group also showed varied preferences, with 38% listening "Seldom/Rarely", 26% "Sometimes", and 15% choosing both "Often" and "Very Often". The 36–45 age group's responses were more balanced, with 31% each listening "Never" and "Sometimes", but none listening "Very Often". In contrast, 37% of those aged 46–55 listened "Very Often", the highest percentage in any group.

Preferences for podcast durations also varied by age. Respondents aged 56 and older preferred podcasts lasting 16–30 min (60%). In the 46–55 age group, 37% preferred episodes of 15 min or less, and 27% chose podcasts lasting 46–60 min. The 36–45 age group strongly favored 16–30 min episodes (77%). Among those aged 26–35, 65% preferred 16–30 min podcasts, with 12% opting for 46–60 min. For the 16–25 age group, 47% favored 16–30 min, with none preferring the 46–60 min duration.

Educational attainment also influenced listening habits. Respondents with a Doctoral degree had the highest frequency of listening "Often" (36%) and "Very Often" (27%). Those with a Master's degree tended to listen "Seldom/Rarely" (44%), with only 11% listening "Often". Respondents with a Bachelor's or College degree preferred listening "Sometimes" (33%) and "Often" (25%). Responses were more evenly distributed for those with vocational training or high school education, with 29% listening "Never" and "Seldom/Rarely".

Preferred podcast durations varied considerably across educational levels. Those with Doctoral degrees preferred a range of durations, with 32% each favoring episodes of 15 min or less and 16–30 min and 23% opting for 31–45 min. Master's degree holders mainly preferred 16–30 min (70%). Respondents with a Bachelor's or

TABLE 3 Frequency of listening to podcasts and preferred duration across different age groups and educational attainment levels (%; $N = 80$).

	Frequency of listening (%)					Preferred duration (%)			
Category / group	Never	Seldom / rarely	Sometimes	Often	Very often	15 min or less	16–30 min	31–45 min	46–60 min
Age (years old)									
16–25	0%	35%	29%	29%	7%	35%	47%	18%	0%
26–35	6%	38%	26%	15%	15%	20%	65%	3%	12%
36–45	31%	7%	31%	31%	0%	8%	77%	15%	0%
46–55	18%	18%	18%	9%	37%	37%	18%	27%	18%
56+	40%	0%	0%	60%	0%	40%	60%	0%	0%
Educational attainment levels									
Bachelor's / College degree	17%	21%	33%	25%	4%	21%	62%	17%	0%
Doctoral degree	9%	14%	14%	36%	27%	32%	32%	23%	13%
Master's degree	7%	44%	30%	11%	8%	22%	70%	0%	8%
Vocational training / High school	29%	29%	14%	14%	14%	29%	57%	0%	14%

College degree also favored 16–30 min (62%). Those with Vocational training or High school education leaned towards 16–30 min (57%), with 29% preferring episodes of 15 min or less.

Interviews revealed that most participants preferred podcasts under 30 min, citing decreased attention spans and numerous distractions. Many mentioned that shorter episodes (less than 30 min) were "reasonable" and "manageable" within their daily routines ($N = 4$). Participants commonly appreciated the ability to listen while multitasking, such as during meals or while checking emails ($N = 12$). This finding aligns with Perks and Turner (2018), who stated that frequent podcast listeners often integrate podcasts into their multitasking habits. However, one participant preferred longer episodes, enjoying the "in-depth discussions" and "detailed analyses" that hour-long podcasts provide. The data suggests that while shorter podcasts are broadly preferred, a market for longer content still appeals to those who favor extended listening sessions.

The study's findings also align with prior research conducted by Sutton-Brady et al. (2009), who found the short-form podcast model to be a successful learning tool for postgraduate and undergraduate students. This preference for shorter podcasts may be attributed to various factors, such as technological advancements, fast-paced modern lifestyles, and the motivation and interest of listeners (Lodge and Harrison, 2019).

2.2.1.2 Podcast tone and conversation style

Respondents rated the conversation style, i.e., language, structure, formality, and patterns in discussion podcasts on mass spectrometry using a 5-point scale. The results showed that 85% of respondents found the tone "About right", 13% "slightly too formal", and 3% "slightly too informal". There were no extreme opinions on the tone being too formal or informal.

All respondents aged 16–25 and 36–45 found the tone "About right". In the 26–35 age group, 82% approved, but 18% found it slightly too formal. In the 46–55 group, 73% were satisfied, 18% thought it was slightly too formal, and 9% slightly too informal. Among those 56% and over, responses were split: 40% found the tone "About right", 40% slightly too formal, and 20% slightly too informal. Most respondents found the tone "About right" regarding educational attainment levels. All respondents with vocational training or a high school diploma agreed with this view. Among bachelor's or college degree holders, 96% approved of the tone, while 4% found it "Slightly too informal". Among those with a master's degree, 85% were satisfied, but 15% thought it "slightly too formal". Doctoral degree holders were less uniform in their opinions: 68% approved, 27% found it "slightly too formal", and 5% slightly too informal.

The chemistry between speakers was highlighted by some participants ($N = 4$) as crucial for an engaging podcast. Their unanimous preference for the second podcast stemmed from its conversational style and the integration of personal stories and everyday examples, noting it as a key factor in its success. LL31 emphasized dynamic interaction, stating, "*The conversation was lively and engaging, and I truly believe that chemistry between the speakers is crucial for a good podcast. The second one had it perfect.*"

All participants ($N = 6$) found the podcasts more engaging due to the inclusion of narratives and anecdotes. Some other participants ($N = 3$) found them entertaining and informative, especially regarding practical applications of the scientific process discussed. Another commended the second episode for its intricate and exuberant presentation, emphasizing its clarity. According to Drew (2017), incorporating humor and storytelling enhances podcast engagement, especially those covering scientific topics. This study supports that finding, demonstrating that a conversational style that includes personal narratives and humor can make complex topics more

understandable and accessible to a wider audience (Kaplan et al., 2020).

2.2.1.3 Perspective on different experiences

Respondents were asked to use a 5-point Likert scale to identify any disparities in the challenges faced by podcast guests to explore listeners' perceptions of these differences. Results indicated that 38% of respondents remained neutral, while 24% disagreed and 13% strongly disagreed that there were notable differences. Conversely, 11% agreed, and 15% strongly agreed that disparities existed. Personal interviews provided further insights, revealing that variations in experiences seemed more related to career stages—differentiating between seasoned and early-career researchers—than any other factor. Participants were particularly intrigued by discussions about work-life balance, which they felt was a common issue affecting everyone today.

When asked about the unique aspects of discussing work-life balance in this context, more than half of the participants ($N = 4$) noted that they perceived all guests, regardless of their career stage, as finding it a struggle. They also noted the stress of managing family and work commitments in research fields that require research and management. CT25 recalled, "*I remember when you asked about achieving work-life balance; it was interesting to learn how professors maintain that balance in their lives.*"

Other participants ($N = 4$) highlighted different aspects that made the podcasts engaging. Some ($N = 2$) praised the use of storytelling by some of the guests, commenting on how it seemed as if the speakers were truly fans of their work and were eager to learn more themselves. Another participant found the podcast intriguing due to its mention of a diverse team, noting the interest in how the guest worked with people from different backgrounds who contributed new ideas and commending this openness to diversity in their workplace.

2.2.2 Engagement with scientific elements

Respondents were asked about several key factors to understand how listeners perceived the scientific content in the podcasts. These included the amount of information provided, their knowledge levels before and after listening, and how well they grasped concepts related to mass spectrometry and its applications. During the interview, participants also discussed whether their familiarity with scientific subjects influenced their interest and comprehension of the podcasts.

2.2.2.1 The amount of information given in the podcasts

Respondents were asked to rate, using a 5-point Likert scale, whether they felt that "Overall, the guests gave the right amount of detail to help the audience understand their field of work". The responses revealed that 35% strongly agreed, 40% agreed, 19% were neutral, and 6% disagreed.

Most participants ($N = 5$) described the podcast's content as "clear", "to the point", and "concise". They noted that the information on mass spectrometry and its applications was "appropriate" and "easy to follow", providing a good understanding of the subject. One participant felt that the information was sufficient, highlighting the adequacy of the subject knowledge and its applications. In contrast, others ($N = 4$) indicated that the content was accessible even to those without a scientific background. One participant remarked that more information would have been overwhelming, leading to a loss of interest, especially for those who do not have a scientific background. The feedback suggests that the podcast effectively balanced detail and clarity, making complex topics understandable to a broad audience.

2.2.2.2 Knowledge of mass spectrometry before and after listening to the podcasts

The questionnaire utilized an ordinal scale to evaluate participants' comprehension of mass spectrometry before and after listening to the educational podcasts. The shifts in knowledge, depicted in Figure 1 as a heatmap, show a significant transformation. Most respondents (53%) initially acknowledged they had no prior knowledge, described as "I knew nothing." Another 14% indicated they "knew very little," and 8% had a basic familiarity ("I knew a little"). Only a minority felt they had a substantial understanding, with 19% indicating "I knew quite a bit" and 8% opting for "I knew a great deal". Following the podcasts, the distribution of reported knowledge improved significantly: 34% of respondents reported learning "quite a bit". The majority (43%) said they learned "a little", and 24% felt they learned "very little". Importantly, there were no responses at the extremes of learning "nothing" or "a great deal", emphasizing moderation in learning outcomes.

Results from the paired sample t-test confirm these self-reported shifts. The average pre-podcast knowledge score was 2.15, with a standard deviation of 1.42, illustrating participants' wide range of initial understanding. Post-podcast, this average increased to 3.10, and the standard deviation narrowed to 0.76, indicating a more uniform understanding across the group. This improvement was statistically significant, evidenced by a paired sample t-test (t-statistic: -5.48, p-value: 4.88×10^{-7}).

A Chi-squared test revealed significant initial associations between knowledge levels and demographic factors such as educational attainment ($\chi^2 = 36.27$, $p < 0.00$) and age ($\chi^2 = 30.13$, $p = 0.017$). These findings suggest that educational background and age significantly influenced participants' initial understanding. However, no significant associations were detected between these demographic factors and knowledge gains post-podcast, indicating that the educational content effectively bridged initial knowledge disparities. These podcasts enhanced listeners' understanding of mass spectrometry regardless of age and educational background, demonstrating that carefully designed podcasts effectively elevate scientific literacy on specialized subjects among diverse audiences.

2.2.2.3 Understanding of mass spectrometry and its applications

Using a 5-point Likert scale, participants were asked to indicate their level of understanding of both the explanation of mass spectrometry and its applications. For the explanation of mass spectrometry, 44% of respondents strongly agreed they understood it, 48% agreed, 2% were neutral, and 16% disagreed. None of the participants strongly disagreed. Regarding the applications of mass spectrometry, 23% strongly agreed that they understood, 28% agreed, 33% were neutral, and 18% disagreed, with no one strongly disagreeing.

A heat map (Figure 2) illustrates these findings, showing that 43% of respondents agreed or strongly agreed that they understood the explanation and applications of mass spectrometry. Interestingly, among those who strongly agreed they understood mass spectrometry, none disagreed about understanding its applications, but 13% of those who agreed they understood mass spectrometry did not understand its applications. Approximately 21% of participants were neutral about

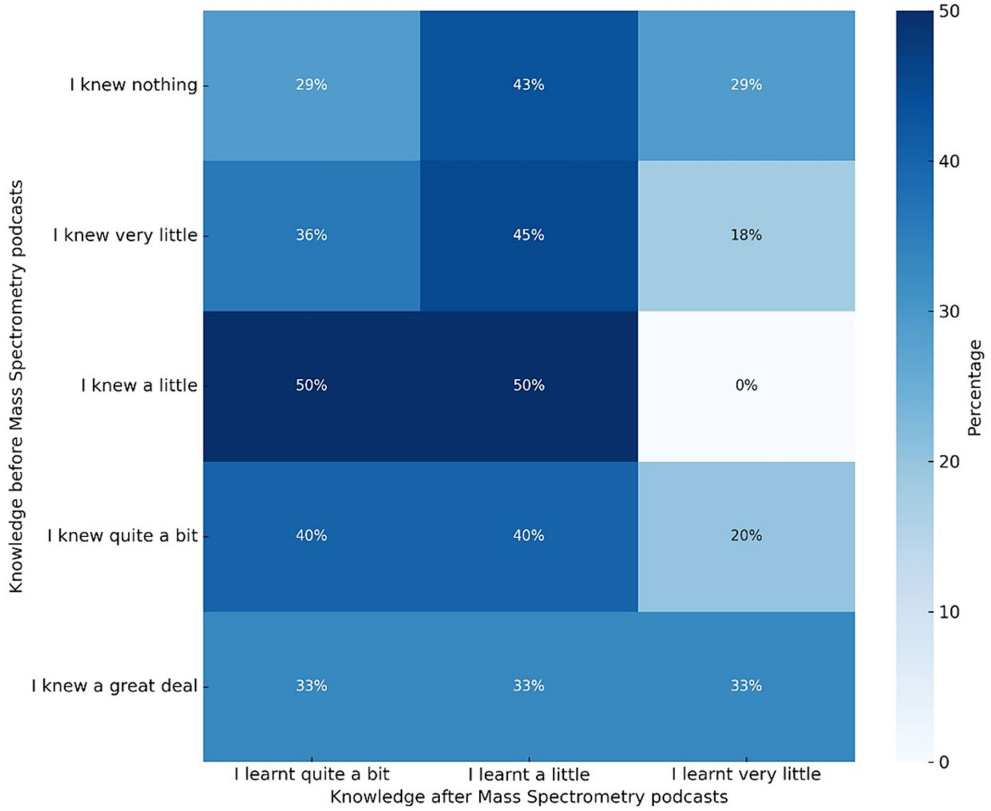

FIGURE 1
Knowledge of mass spectrometry amongst respondents before and after listening to the podcasts.

their understanding of both. Among these neutral respondents, 27% disagreed with the applications, and 8% agreed. Half of those who disagreed with understanding mass spectrometry also disagreed about the applications, while the other half were neutral or agreed.

A paired sample t-test compared the responses for understanding mass spectrometry and its applications, revealing a statistically significant difference ($p = 0.017$). The mean understanding score for mass spectrometry was 3.75, compared to 3.55 for its applications. However, the effect size, measured by Cohen's d, was 0.20, indicating a slight difference. Further analysis of confidence intervals adds context to these findings. The 95% confidence interval for understanding mass spectrometry ranged from 3.53 to 3.97; its applications ranged from 3.32 to 3.78. The confidence interval between these means ranged from −0.12 to 0.52, including zero, which suggests the actual difference might be negligible and the respondents' understanding of mass spectrometry and its applications are similar.

2.2.2.4 Role of familiarity in understanding scientific content

The study revealed that participants particularly valued podcast content that resonated with them on a personal level. Some participants ($N = 4$) highlighted how discussions around why guests opted for science in their careers and how their work shaped their life's trajectory were surprisingly relatable, aligning with Murray's (2019) findings that podcasts can serve as a means for listeners to hear experts in a more personal and relatable manner, which is more effective than merely reading their profiles and academic work.

Most participants ($N = 5$) appreciated the practical applications of mass spectrometry, especially in everyday contexts such as food quality assessment. For instance, the technology's role in verifying the freshness of produce resonated with those interested in a healthy lifestyle, while discussions on personalized medicine were particularly relevant for participants with personal or family experiences of rare diseases. However, the feedback was not uniformly positive. Many participants ($N = 4$) critiqued the first episode for its lack of depth and practical examples, noting that this diminished its relatability and engagement. This criticism underscores findings by Stocklmayer and Bryant (2012) that scientific content is more engaging when presented in a context relevant to the audience's daily lives.

The diversity of perspectives, especially the enthusiasm of researchers featured in the podcasts, was another aspect that all participants ($N = 6$) found enriching. This aspect enhanced their understanding of mass spectrometry and maintained their interest in what might otherwise have been a daunting topic. This approach reflects Bandura's (2001) social cognitive theory, which suggests that motivational dialogue can significantly enhance comprehension and encourage the practical application of learned concepts. These findings also suggest that a listener's pre-existing familiarity with scientific topics plays a crucial role in their engagement with content. As Wade and Kidd (2019) conclude, curiosity can drive interest towards scientific topics, expanding the listener's knowledge and increasing engagement with unfamiliar or specialized content areas. Despite the inherently technical nature of the podcasts, the content appealed to those with a specific interest in the field. This niche appeal highlights

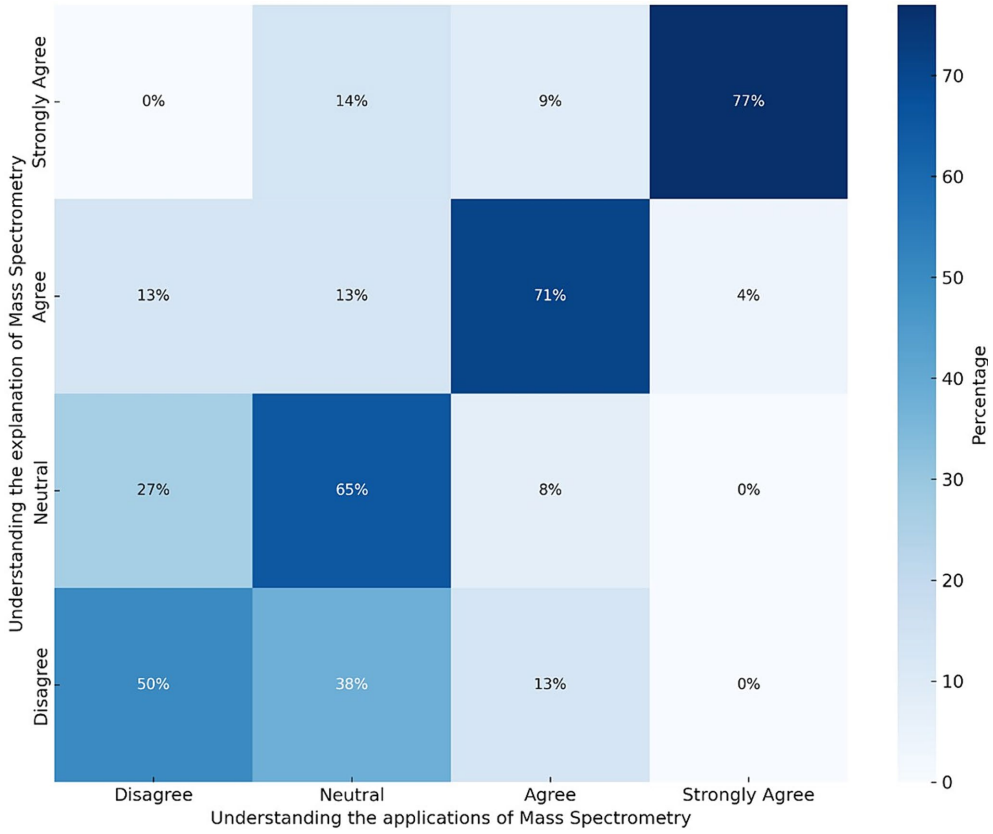

FIGURE 2
Perception of mass spectrometry and its applications amongst respondents.

the importance of aligning scientific content with the audience's existing interests and backgrounds to foster engagement.

2.2.3 Suggested improvements for the podcasts

The participants provided several suggestions for improvements to make the podcasts more appealing to a broader audience. A common theme in the feedback was the use of technical terms, particularly "mass spectrometry". Many participants ($N = 4$) suggested changing the name to make it more accessible, with MK28 participant recommending, "*If you use more layperson's terms, more people will listen to these podcasts.*" Another participant proposed renaming it to "A Day in the Life of a Scientist" to make it more relatable.

Participants ($N = 3$) suggested focusing more on practical applications of mass spectrometry to make the podcast more engaging. They emphasized the importance of understanding how mass spectrometry is used across various fields, with CF31 stating, "*As I understand, it is used for so many other things as well, and I would like to know more.*" Additionally, they recommended creating a series format that avoids repetitive details and instead introduces guests while discussing their fields and interesting cases they have encountered.

Another suggestion was to include elements that would allow listeners to learn more about the personal lives of the guests and their interest in the field, aiming to make the podcast series more enjoyable and relatable. Participants ($N = 3$) expressed a keen interest in understanding how the guests chose their careers. They proposed that including questions such as, "*How did you become involved in this field*?" would provide valuable insights. One participant explained that if the guests had pursued their careers in greater detail, it would offer a deeper understanding of the various paths available in the field of research, making the content more relatable and inspiring for the audience.

To improve the format, some participants ($N = 2$) suggested altering the podcast format to include group discussions, which they found more interesting than one-on-one conversations. Additionally, the absence of video was noted as a drawback. Participants believed that a video podcast could capture the body language and excitement of guests, adding an emotional connection that is often missing in audio-only formats.

Participants ($N = 2$) also suggested discussing stress management in highly scientific fields, noting that this information would be valuable to listeners in similar work environments. Participant MV26 mentioned, "*I would love to hear about how to cope with stress and the feelings of imposter syndrome.*" Participants emphasized that hearing multiple people discuss stress and coping mechanisms can be reassuring and helpful, particularly in mental health. They noted that such discussions are not limited to scientific fields and have broader implications for well-being in other non-scientific fields.

The results show that most listeners are more interested in personal stories than in the science itself. Engaging storytelling is an important element of successful science podcasts. Personal stories can make scientific content more relatable and compelling, keeping

listeners entertained while they learn (Bray et al., 2012). Keeping this in mind ensures that the audience remains interested and invested in the content. Also, the observation that listeners are more interested in personal stories than science suggests significant value in integrating human narratives with scientific content. By doing so, science podcasts can achieve a balanced approach that educates, engages, and inspires their audience providing a platform for experts to discuss their work from their perspectives (Besley and Nisbet, 2011; Middleton, 2016; DeMarco, 2022).

2.2.4 Study limitations and future research

A limitation of this study is the low number of participants for the questionnaire, with the majority belonging to younger age groups and having higher educational attainment. This distribution could be explained by the requirement to listen to podcasts before attempting the questionnaire, which takes up a considerable amount of time for a topic that may or may not interest the listeners. Research findings may also be biased due to the distribution of questionnaires via personal networks and social media channels. Since the questionnaire and podcast were circulated through links shared by the researchers, the sampled population may not be representative and may include individuals who already had some knowledge about mass spectrometry, further introducing potential bias. Another limitation is the measurement of knowledge. While we included questions in the survey to gauge participants' understanding of mass spectrometry, we relied solely on their responses as the metric without a further formal investigation in the form of an examination to evaluate knowledge acquisition. Lastly, the study's focus on mass spectrometry podcasts may limit the applicability of the findings to other scientific disciplines. Different fields have unique challenges and opportunities for podcast-based science communication, and further research is needed to explore these variations.

Future researchers can build upon these findings by addressing these limitations. Expanding the participant pool to include a more diverse demographic range and reducing reliance on personal networks and social media channels for recruitment will help provide a more representative sample. Further research should also consider the impact of different podcast formats, such as video podcasts versus audio-only formats, on listener engagement and comprehension. Investigating the effectiveness of incorporating multimedia elements, like visual aids or interactive components, could also provide insights into optimizing podcast delivery for complex scientific content. Additionally, longitudinal studies tracking changes in listeners' knowledge and perceptions over time would help understand the long-term educational impact of scientific podcasts. Such studies should assess whether repeated exposure to scientific podcasts leads to increased scientific literacy and interest in scientific careers.

3 Conclusion

Based on the results of this study, podcasts were found to be effective tools for educating and informing listeners about specialized scientific topics. All respondents indicated learning at least some level of detail about mass spectrometry from these podcasts. For the discussion of technical research, incorporating humor and storytelling elements was appreciated by the listeners, enhancing engagement and comprehension. The study also found that most participants showed a positive acceptance of the conversational style and the duration of the mass spectrometry podcasts. These preferences varied depending on the listeners' age group and educational attainment level, highlighting the importance of tailoring podcasts to the target audience. Younger listeners and those with higher educational attainment tended to prefer shorter, conversational episodes that included relatable narratives and practical applications.

Overall, the findings suggest that well-designed scientific podcasts have the potential to bridge knowledge gaps and make complex topics more relatable and engaging. To maximize their impact, science communicators should consider incorporating the elements discussed in this study.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

NR: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft. VE: Conceptualization, Methodology, Supervision, Validation, Writing – review & editing. NO: Conceptualization, Funding acquisition, Methodology, Supervision, Validation, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. The study was performed with the financial assistance of the FoodTraNet Project funded by the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement no. 956265.

Acknowledgments

The authors would like to thank the podcast guests (Prof. Dr. Ron Heeren from the Maastricht MultiModal Molecular Imaging Institute/ University of Maastricht, Prof. Dr. Alexander van Nuijs from the Toxicological Centre, University of Antwerp, and Dr. Nina Ogrinc from the Leiden University Medical Center) for their time and participation in the podcast series.

Conflict of interest

NR and VE were employed by WRG Europe Ltd.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2024.1384389/full#supplementary-material

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