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Mapping and analysis of the Italian industrial and outreach space ecosystem, with a study of their social impacts.

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Abstract

Science and technology increasingly play a central role in society every day. Communicating these activities to the public becomes crucial, resulting in spreading interest in STEM-related career projects. Within this context, the space sector arises as a fertile ground for technological advancements and a model for addressing significant social challenges. This research, conducted by the innovative startup Astrospace Srl, a leader in the space information sector in Italy, aims to investigate three key areas: the level of interest and education in space among Italians, the proportion of Italians employed in the sector, and the impact of science and technology outreach on space dynamics. The study begins with a detailed mapping of space outreach entities in Italy, including local groups of astrophiles and astrophotographers, enthusiast associations, thematic groups, and university teams and projects. It also covers Italian companies active in the space sector, distinguishing them by their field of application. Following this process, we created a thematic database categorized by business type, size, and location. We collected information, opinions, and conducted surveys involving entities, companies, and individuals within the database. The analysis of this data will provide a detailed overview of the effectiveness of outreach activities and the state of the Italian space sector. Furthermore, the project seeks to develop a reproducible model for this research in other national and international contexts, marking a significant step towards a deeper understanding of the interaction between the public and the space sector. Through this work, Astrospace aims not only to identify pathways towards increased participation in space but also to positively influence future space outreach and education policies on an international level.

1. Introduction

In an era where space exploration is continually advancing human capabilities and driving scientific, industrial and strategic progress, public engagement and understanding of these developments are crucial. Widespread awareness and involvement in space-related efforts are essential for building support for scientific initiatives, shaping policy decisions, and inspiring future generations, encouraging interest in STEM (Science, Technology, Engineering, Mathematics) careers. As humanity prepares to return to the Moon and venture to Mars, the role of science communication in influencing public perception and motivating younger generations has never been more important.

By increasing public knowledge of scientific research, space missions, technological innovations, and the economic impacts of space activities, we enable individuals to better understand the value and relevance of space exploration. This awareness also helps people gain a unique perspective on the importance and fragility of Earth—insights made clearer through our exploration of space.

Moreover, the global space economy was valued at $630 billion in 2023, with projections reaching $1.79 trillion by 2035, driven by a compound annual growth rate (CAGR) of 9% over the period [1]. As the sector continues to expand, it will require a growing workforce to support its advancements. This highlights the crucial role of science communication in inspiring younger generations to pursue STEM fields, as they will become the skilled professionals who shape the space industry of tomorrow.

In Italy, to which this research is limited, the space sector employs approximately 7000 people directly, marking a 15% increase over the last 15 years, according to the latest report from SDA Bocconi's SEE Lab on Space Economy [2]. The nation's space economy, valued at €3 billion, is poised for further growth, mirroring global trends. As the demand for a skilled workforce becomes more pressing, public engagement and education in space-related topics play a crucial role. Outreach and communication efforts in this sector are diverse, ranging from small-scale initiatives led by amateur astronomers to organized events by institutions and professional science communicators. This variety reflects a diverse approach to engaging the public in space-related topics. However, there has been limited systematic research that maps the scope of these activities or assesses their impact.

This is why in Astrospace, Italy's first in its kind platform dedicated exclusively to the outreach and in-depth analysis of space dynamics, we have conceived this project [3], designed to explore, map, and analyze the landscape of space-related public outreach, communication, and education within the country. This was done inside Astrospace Lab, our section dedicated to research projects. Previous studies on scientific outreach have highlighted the importance of storytelling and visual representation in effectively engaging the public. As noted by Chiarelli et al. 2022 [4], visual and narrative techniques have proven successful in enhancing public interest in science outreach. Similarly, F. Scianitti [5] emphasizes the critical role of images in storytelling, helping to make complex scientific concepts more accessible. These principles apply to space science communication as well, even more in the current era through the use of online platforms, digital media, and high visual and emotional impact tools such as photos and videos, where narratives about exploration and discovery can captivate audiences and make the subject matter more relatable.

Our study seeks to contribute to this ongoing discussion by offering a detailed mapping of space-related outreach activities across Italy. The research is mainly based on a survey distributed to various entities involved in space science communication, including universities, science communicators, local astronomy groups, and space industry professionals. By examining their responses, we aim to provide a clearer picture of the Italian space outreach ecosystem and the effectiveness of different communication methods. This approach builds on existing models of outreach evaluation but adds a specific focus on the space sector.

The significance of this research lies in its potential to inform future outreach efforts, helping organizations to better align their strategies with public interests. By analyzing the types of activities conducted, the challenges faced, and the outcomes achieved, we aim to identify best practices that can be adopted across the sector. As Stannard et al. 2001 [6] suggests, successful science communication often relies on a blend of factual information and engaging storytelling to maintain audience interest. Our research explores how these methods are applied within the Italian context and what can be improved to increase the effectiveness of space outreach.

2. Methods

2.1 The survey

To gather comprehensive data on the interest, education, and employment in the space sector among Italians, as well as to assess the impact of science and technology outreach, we designed a detailed survey using the Tally platform[·] [7]. Tally was selected for its user-friendly interface, flexibility in survey creation, and robust data collection capabilities. This choice allowed us to reach a broad audience and ensure that responses were collected in an efficient and organized manner.

The survey was divided into three main sections, each tailored to address specific research questions:

1. Demographics and background information. This section aimed to collect basic demographic data, geographical location and main areas of interest.

2. Interest and education in space. In this section, participants were asked about their focus in space-related topics, the organization of online and offline outreach events, their main targets, their reach both offline and on social media and so on.

3. Impact of science outreach. The final section sought to assess how various outreach initiatives (e.g., public lectures, media coverage, educational programs) influence public interest and understanding of space. Participants were asked to evaluate the effectiveness of these initiatives and provide suggestions for improvement.

The questions were carefully selected and structured to align with the objectives of our research. Each section was designed to gather data that would allow us to map the current landscape of space interest and employment in Italy, but also to be used in the near future for further and deeper analysis. The sequence of questions was intentional: beginning with broad demographic data, moving through specific interest and employment queries, and concluding with questions about the impact of outreach efforts.

2.2 Distribution

2.2.1 The press release

To raise awareness about the research and encourage participation in the survey, we prepared and distributed an official press release. The press release outlined the objectives of the study and included details on how to access the survey and encouraged media outlets to highlight the initiative. The press release was distributed to a targeted list of journalists and media outlets with a focus on science, technology, and space-related topics.

2.2.2 The landing page

To provide comprehensive information about the research and facilitate access to the survey, we developed

[·] https://tally.so/

a dedicated landing page [8]. This page served as a central hub for potential participants, offering an overview of the research with a summary of the study's goals and significance, ensuring that visitors understood the impact of their participation, a direct link to the survey hosted on Tally, and details for further inquiries.

2.2.3 Social media distribution

Along with the press release, the link to the landing page and so the Tally survey was distributed through various channels, thanks to Astrospace's leading position. In particular, we used our social media channels, our email newsletters, and partnerships with relevant organizations and associations within the space sector. We intentionally aimed for diversity in the survey's participant base to ensure that the data would be representative of the broader Italian population. Responses were collected over a two and a half-month period, **from July 22nd to September 10th**.

2.3 Data storage

Following the collection of survey responses, all data were systematically organized into a database hosted on Tally, which was directly integrated with a Google Spreadsheet. In addition to the primary database setup, we implemented a rigorous data backup protocol to safeguard the collected information. Every week, a complete backup of the Google Spreadsheet was created and stored on an external secure cloud storage service. Regular backups ensured that the data remained intact and secure.

2.4 Data analysis

Before conducting advanced analysis, the database underwent thorough data cleaning to ensure accuracy and consistency. Responses that were incomplete or irrelevant were removed using two custom Python scripts, run on the Google Spreadsheet integrated with Tally. Once cleaned, the data was prepared for both qualitative and quantitative analysis. Thematic coding was applied to open-ended responses to identify recurring themes related to the impact of space outreach. Quantitative analysis involved statistical tools to assess interest in space and STEM fields, employment in the space sector, and the distribution of outreach activities. This combined approach allowed for both statistical insights and a deeper understanding of the motivations and challenges faced by space outreach organizations in Italy.

2.5 Database development

In addition to the survey, Astrospace conducted a separate and autonomous mapping of space outreach entities across Italy. This independent process involved identifying organizations through various sources: publicly available data, online platforms, social media, and direct outreach. Each entity was categorized by its primary focus, location, and the type of activities conducted.

The resulting database, which includes organizations both from the survey and those mapped independently, will be made publicly available through an interactive map. We developed ad-hoc a public-facing page on Orbit.astrospace.it† [9] within the Astrospace Lab section, to present space outreach activities across Italy. This page features essential information about space-related organizations, including their names, types (e.g., companies, educational institutions, associations), and links to their websites or social media profiles. The goal of this publicly accessible database is to serve as a centralized resource, bringing together all entities involved in space outreach and education across Italy. By compiling these details in one place, we aim to provide a valuable tool for both the public and professionals interested in exploring and collaborating with the Italian space community. Moreover, the intent is to make it serve as a foundational resource for future research, both within this project and in related studies.

3. Results and discussion

In this section we present the visual and numerical results from the data analysis based on the collected responses to the survey. The total number of entities that responded to the survey is **82**. Of these, **71** entities stated that the focus of their outreach activities is space.

Just for the geographical distribution, we chose to add a separate brief description of the resulting, final database which includes organizations both from the survey and those mapped independently. The total number of entities of this database is **224**.

The subsequent analysis instead, both qualitative and quantitative, involves only the 71 entities that are primarily involved in space outreach.

3.1 Geographic distribution

Of the 71 space outreach entities, 57.14% responded that they are more active offline, while 42.86% are primarily active online. This distribution suggests that a significant portion of the organizations still prefer physical, territory-based engagement, likely due to the hands-on, interactive nature of astronomy and space-related activities.

However, a considerable proportion is also leveraging the growing importance of online platforms, reflecting the increasing trend towards digital outreach. Many, in fact,

†https://orbit.astrospace.it/database-della-divulgazione-spaziale-italiana/

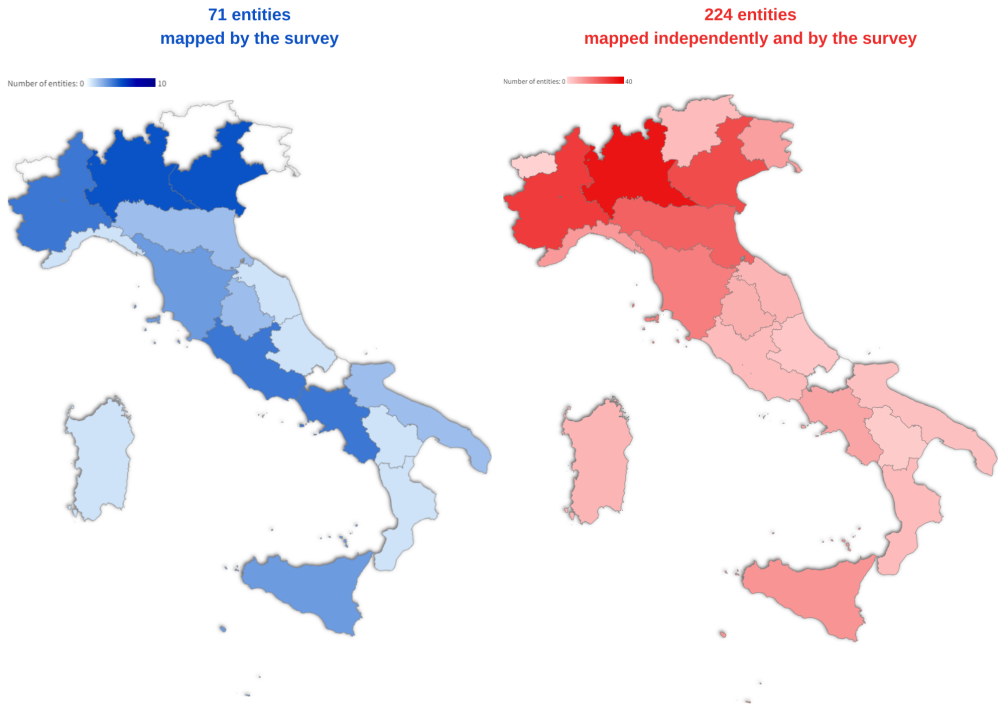

Fig. 1. Maps showing the geographic distribution of the science outreach entities talking about space in Italy. The map on the left includes only the entities that responded to the survey. The map on the right also includes the entities mapped by us independently

take advantage of the possibilities offered by the web and social networks in addition to the events and activities organized in presence.

In Fig. 1, the map on the left visualizes the geographic distribution of space outreach entities across Italy that do the majority of their activities offline. A qualitative examination reveals that the majority of space-related organizations, educational programs, and outreach efforts that answered our survey are concentrated in the northern regions, particularly in areas such as Lombardy, Veneto, Piedmont and Emilia-Romagna.

These regions, traditionally characterized by higher levels of industrial development and a robust presence of technological industries, naturally host a larger number of space companies, research centers, and university programs. In contrast, the central and southern regions show a comparatively lower density of space-related activities. Regions such as Calabria, Sicily, and Basilicata, while not devoid of space engagement, have fewer organizations actively involved in outreach and space science education. This could be attributed to structural factors, such as lower industrial activity and less investment in STEM initiatives in these areas. However, despite the lower concentration, some key players and active communities do exist, indicating a potential for growth. Campania and Lazio are excluded from this discussion, however.

In Fig. 1, the map on the right we see the geographic distribution of all the space outreach entities, including also the entities mapped by us. The patterns and trends are the same than the previous map, with Lombardy, Veneto and Piedmont showing the highest amount of outreach organizations. An interesting aspect of the map is the presence of several isolated hubs of activity in regions where the aerospace industry or astrophile communities have historically thrived. For example, the presence of astrophile groups and amateur astronomer associations in Sardinia and parts of the central Apennines reflects a growing interest in space exploration at a grassroots level, even in areas with less direct institutional support. This distribution suggests (but is not a proof of) some kind of correlation between economic development, existing technological infrastructure, and the concentration of space-related

activities. The data points to the need for targeted policies to foster space outreach and education in the southern and less developed regions, in order to create a more balanced national engagement with space sciences. These disparities also highlight opportunities for future investment and expansion in underserved areas, which could help stimulate local economies and nurture a new generation of space professionals across the country.

3.2 Type

The table presented in Table 1 was constructed based on the responses collected from the survey, including only organizations, groups, and individuals with a primary focus on space topics. Each respondent was categorized into one of several predefined types, such as research centers, science communicators or astrophiles groups, based on their activities and primary goals.

The most represented category is "Science communicator," with 24 respondents, highlighting the significant role of individual or independent educators in space outreach. This is followed by "Astrophiles groups" with 16 entries, which suggests a strong community of amateur astronomers contributing to the popularization of space science. Blogs and websites also appear frequently (8 entries), underlining the importance of digital platforms in space education.

Interestingly, only a few respondents identify as "Media" or "Cultural/Scientific Associations", indicating that while these entities are active in space outreach, the core of space communication seems to be driven by smaller, more independent actors. Additionally, university-linked entities, including associations and projects/teams, are less common. This discussion is, again, just related to the entities responding to our survey.

Anyway, the diversity in respondent types suggests that space outreach in Italy is a multifaceted field, with contributions from both formal organizations and passionate individuals, emphasizing the importance of both independent and community-driven efforts in disseminating space-related knowledge.

We also noted that in regions like Sardinia and Sicily (see Subsection 3.1), the distribution of space organizations by type is as follows: 75% are astrophiles groups, and 25% are blogs/websites. In Piedmont and Lombardy, the distribution is 33.33% astrophiles groups, 22.22% cultural/scientific associations, the others are independent science communicators, university associations, blog/websites or start-up. The focus in Sardinia and Sicily on amateur astronomy seems to reflect the favorable observational conditions in these regions, where we know that lower levels of light pollution, stable weather and clear skies make both islands ideal locations for astronomical observation. As a result, several important observatories and research facilities have been established in these regions. In Northern Italy, instead, there is a greater emphasis on technology and scientific associations, thanks to the region's more industrial and tech-driven landscape.

Type	**N**
Research center	1
Science communicator	24
Blog/Website	8
Media	3
Cultural/Scientific association	6
Group of enthusiasts	2
University association	2
University project/team	2
Science/Tech museum	1
Start-up	2
Astrophiles group	16
School	3

Table 1. Types of entities and their occurrences in the database of responding realities.

3.3 Areas of interest

From the 71 responses of entities involved in space outreach, we did a simple analysis on the areas of interest covered by their different activities, searching for consistent patterns and subtle shifts that could provide valuable insights into the focus of space science outreach and education efforts. Each entity could choose more than one area of interest. All the results are summarized in Table 2.

Astronomy and Astrophysics continues dominates the field, appearing in 76.06% of all responses. Closely following is Space Exploration, mentioned by 73.24% of respondents. The third most prevalent area is Space Technologies, cited by 57.75% of respondents. This significant interest reflects the growing importance of technological advancements in space exploration and their potential applications, both in space and on Earth.

Interestingly, the survey reveals some kind of trend towards interdisciplinary approaches in science communication. Art and Culture inspired by science and space appears in 29.58% of responses, while STEM in general is mentioned by 30.99%. This seems to indicate that many communicators are adopting an approach connecting scientific concepts with cultural expressions and broader STEM fields, to make space science more accessible and engaging to diverse audiences.

Space Economy is mentioned by 28.17% of respondents, while among the less frequently mentioned but still significant areas are Planetary Defense (19.72%), Artificial Intelligence (12.68%), Telecommunications

(12.68%), and Space Medicine (9.86%). These percentages may suggest emerging interest in cutting-edge fields that intersect with space science, potentially reflecting new directions in research and development.

Area of interest	Percentage
Astronomy and Astrophysics	76.06%
Space Exploration	73.24%
Space Technologies	57.75%
STEM in general	30.99%
Art and Culture inspired by science/space	29.58%
Space Economy	28.17%
Planetary Defense	19.72%
Artificial Intelligence	12.68%
Telecommunications	12.68%
Space Medicine	9.86%

Table 2. Main areas of interest for the 71 responding entities with a focus on space outreach.

When examining common combinations, we find that Astronomy and Astrophysics paired with Space Exploration remains the most frequent, appearing in 67.61% of responses. This strong association underscores the close relationship between observational astronomy and active space exploration in public communication. The combination of Astronomy and Astrophysics, Space Exploration, and Space Technologies appears in 47.89% of responses, highlighting the interconnected nature of these fields in modern space science. Additionally, the trio of Astronomy and Astrophysics, Space Exploration, and Art and Culture inspired by science/space is present in 23.94% of responses, suggesting some kind of trend towards blending scientific concepts with cultural and artistic expressions.

This survey paints a picture of a science communication landscape that is deeply rooted in traditional space science topics, but is increasingly embracing interdisciplinary approaches. The strong presence of art, culture, and general STEM alongside core space science subjects indicates a shift towards more diverse and accessible forms of communication.

3.4 Entities insights

Regarding the 71 entities involved in space outreach, we asked for the years of activity and for the number of active members now. The data, also depicted in the two donut charts in Fig. 2, reveals a diverse landscape. The 33.8% of the entities have been active for 2 to 5 years, but the 25.4% have been operating for more than 20 years. Just the 8.5% are relatively new, with less than 2 years of activity. Also the data on current membership shows varying sizes of these organizations, with 58.0% having 1 to 5 members and just 7.2% having more than 50 members.

These results paint an interesting picture of the space outreach sector. Many organizations are relatively young, with a third having been active for 2 to 5 years. This suggests a recent surge in interest in space outreach. However, there's also a significant portion (25.4%) of well-established entities with over 20 years of experience, indicating a stable foundation in the field.

Regarding membership, the sector may seem dominated by small teams, of course regarding our small dataset. Nearly 60% of organizations operate with 5 or fewer members, highlighting a trend towards compact, possibly volunteer-driven initiatives. Larger organizations with over 50 members are less common, perhaps reflecting the challenges of sustaining bigger teams in this niche.

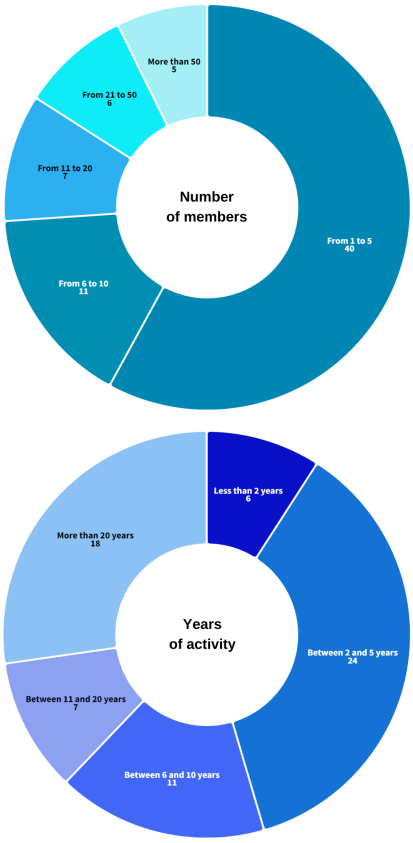

Fig. 2. Charts showing the number of active members per each entity and the years of activity.

3.4.1 Gender disparity

Regarding the gender of the entities' members, both individuals and organizations, data reveals a notable gender disparity, shown by Fig. 3. The majority of them report a

male-dominated environment, with "male majority" representing almost **71%** of responses. In contrast, "balanced" and "female majority" are reported at more or less 20% and 8%, respectively.

This distribution underscores a broader issue observed in STEM fields globally: a significant gender gap. The predominance of males in space outreach roles reflects a familiar trend where women are underrepresented in technical and scientific professions. While these results are compelling, it is important to acknowledge that our sample size is relatively small, even if these findings offer valuable insights. The small sample means that these results might not fully capture the diversity of the broader field but provide an initial estimate of gender representation within the specific context of space outreach in Italy, however, this gender imbalance in space-related fields seems to be still presents, although numerous efforts have been made in recent years to overcome this gap. The results highlight the need for continued efforts to promote gender diversity and inclusion in STEM.

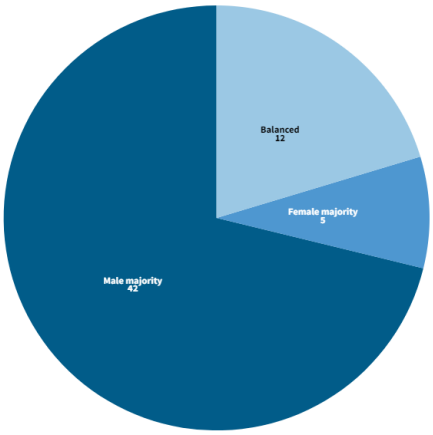

Fig. 3. Charts showing the gender percentage between members of the different space outreach organizations.

3.5 Outreach events

Regarding the events organized **offline** by the 71 different entities, the results show that 50 answered "Yes", indicating that the **70.42%** do organize offline events. Conversely, 21 respondents (29.58%) answered "No". These findings suggest that a significant majority of space education organizations engage in offline event organization as part of their activities. This reflects the considerations made in Subsection 3.1.

3.5.1 Offline events

Of the 50 respondents, as we see in the above section of Table 3, almost half (21, or 42%) organize between 1 and 5 events. However, a good percentage (22%) organize more than 20 events per year. This results suggest that a significant portion of space outreach organizations focus on organizing a small number of events, which could be due to limited resources or a more niche audience. On the other hand, the fact that 22% of the organizations are very active points to a strong commitment to public engagement in space-related activities. This division may reflect the varying capacities and strategies of different organizations, with some focusing on quality and impact over quantity, while others aim for broader outreach through frequent events.

Offline events	**N**
From 1 to 5	21
From 6 to 10	14
From 11 to 20	4
More than 20	11
People per event	**N**
Less than 50	13
Between 50 and 200	33
Between 200 and 500	2
More than 500	2

Table 3. Above: number of events offline in a year and number of realities organizing them, between the 50 answering they organize them. Below: average number of people attending offline events during the year and correspondent number of realities.

As we see from the below section in Table 3, the majority of offline events (66%) declared by the 50 entities have between 50 and 200 attendees, indicating that most offline space-related events attract moderate-sized audiences. Interestingly, a smaller but significant portion (26%) of events have fewer than 50 participants, suggesting some intimate or niche gatherings. Only a minority of events (4% each) attract more than 200 attendees, indicating that large-scale events are less common among these outreach efforts.

3.5.2 Places

From the responses to the question about the spaces available to entities for these events, the data reveals that a significant portion of organizations (33.3%) rely on public, non-rented spaces for their events, which suggests that accessibility and affordability are key factors. Another substantial group (11.1%) uses a combination of their own spaces with public areas, and another 11.1% uses public spaces along with other options. The frequent use of public spaces reflects the focus on cost-efficient solutions. Some entities also use open spaces in nature, for activi-

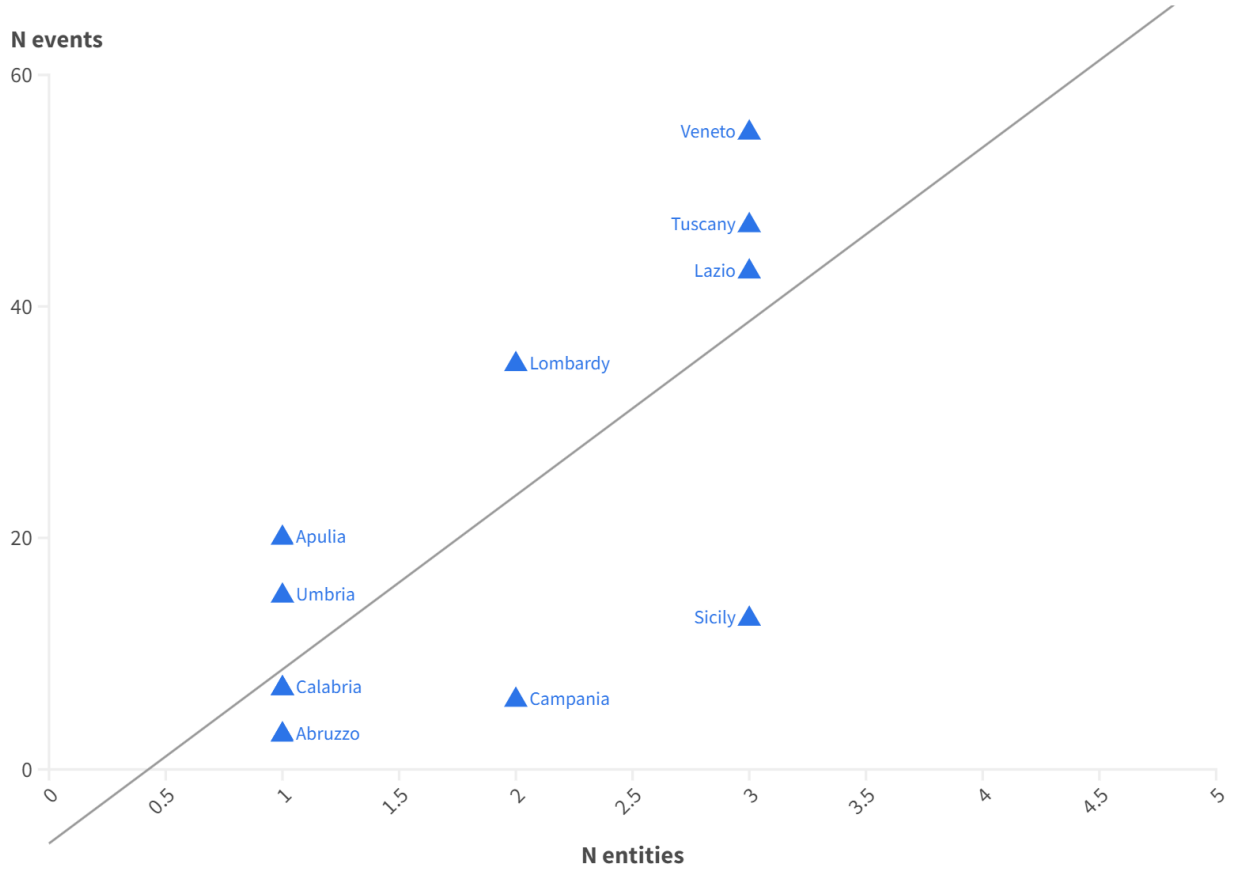

Fig. 4. Plot showing the average number of science outreach events offline organized annually by the various associations across different Italian regions. The x-axis represents the number of associations in each region, the y-axis represents the total number of events organized in that region, and each point on the graph corresponds to a different Italian region.

ties such as astro-trekking or activities for children. Only a smaller percentage use rented or shared spaces, which could imply that larger-scale or more formal events are less common.

3.5.3 Diffusion

In order to compare the average number of science outreach events offline organized annually by the various associations across different Italian regions, we produced the plot in Fig. 4. The x-axis represents the number of associations in each region, while the y-axis represents the total number of events organized in that region. Each point on the graph corresponds to a different Italian region.

To construct the total number of events for the y-axis, we made some assumptions based on the responses provided by the associations. For the answer ”from 1 to 5” events, we estimated an average of 3 events. For ”from 6 to 10” events, we used an estimate of 7 events. The ”from 10 to 20” category was estimated at 15 events, while responses indicating ”more than 20” were set at 20 events. We then summed the estimated number of events for all associations in each region to derive the total number of events for that region.

The scatter plot visually demonstrates which regions are more active in science outreach, with regions having more associations generally correlating with a higher number of events. Some regions stand out, like Veneto, Tuscany and Lazio, with both a high number of associations and a substantial total number of events. Instead, regions with fewer associations tend to organize fewer events, and for example Sicily seem to be less efficient in making events even if the number of entities is high.

We again highlight that the results presented in this plot are indicative of the data set used, which comes from

associations that responded to the survey. This means that the graph does not provide a complete picture of all outreach activities across Italy, but rather offers insight into the regions represented in the survey. The conclusions should therefore be understood within the context of the data's limitations.

3.5.4 Online reach

Regarding the number of people reached online on average, which we requested from the different entities as an estimate of the number of followers on the main social media channel or the average number of views on the blog/website, the results are reported in Table 4. Here we see in the second column the online reach for all 71 space outreach entities, including those that reported working primarily offline. In the third column, instead, we filtered the results just for the organizations that reported working primarily online.

Online reach	**Tot %**	**Filtered %**
Less than 1000	38.03%	25.81%
Less than 5000	32.39%	25.81%
From 5001 to 10 000	8.45%	9.68%
From 10 001 to 50 000	9.86%	12.90%
From 50 001 to 100 000	4.23%	9.68%
From 100 000 to 250 000	1.41%	3.23%
More than 250 000	4.23%	9.68%

Table 4. Online reach of space outreach organizations, as an estimate of the number of followers or the average views on the blog/website, for all 71 space outreach entities (second column) and filtered for the entities mostly active online (third column).

When comparing all respondents to those who primarily engage in online space outreach, some key differences emerge. In the overall group, 38.03% of organizations reach less than 1000 people, while 32.39% fall between 1000 and 5000. However, in the group focused mainly on online outreach, these numbers are lower, with 25.81% reaching less than 1000 and 25.81% between 1000 and 5000. This suggests that organizations that focus primarily on online activities tend to have slightly larger audiences compared to the general pool of respondents. Interestingly, the proportion of organizations with an audience between 10 001 and 50 000 increases for online-focused organizations, compared to the general group. This indicates that a higher percentage of online-focused organizations are able to reach a moderate-sized audience. Both groups show similar percentages for organizations with audiences between 50 001 and 100 000 and those with more than 250 000 followers. The lower proportion of organizations with fewer than 1000 followers (25.81% vs. 38.03%) in the online group seems to highlight that these organizations tend to reach broader audiences compared to those engaging in a variety of outreach methods.

3.5.5 Age target

Regarding the age range preferences of the audience for space outreach organizations, the data indicates that the majority of space outreach efforts target adults, with the 31 to 45 years old age group being the most common (37.61%), followed closely by the 19 to 30 years old group (29.06%). This suggests that these organizations predominantly engage young professionals and middle-aged individuals.

A smaller, but still significant, portion of outreach is directed towards older adults, with 20.51% of organizations identifying the 45 to 65 years old age group as a primary audience. Meanwhile, outreach efforts towards younger audiences, such as teenagers (13 to 18 years old) and children (0 to 12 years old), are less frequent, at 8.55% and 4.27% respectively.

However, if we compare the age group of people participating to space outreach organizations that focus on online activities versus those that focus on offline activities, we obtain the results in Table 5.

Age range	**Online-focused**	**Offline-focused**
0 to 12 y.	-	6.76%
13 to 18 y.	11.63%	6.76%
19 to 30 y.	39.53%	22.97%
31 to 45 y.	32.56%	40.54%
45 to 65 y.	16.28%	22.97%

Table 5. Age range targets for online and offline-focused organizations.

The results show that online-focused organizations are more likely to target younger audiences, with 39.53% of them focusing on the 19 to 30 years old demographic. This age group is likely more engaged with digital platforms, which explains the higher percentage. Meanwhile, the 31 to 45 years old group also represents a significant portion of their audience (32.56%).

For offline-focused organizations, the 31 to 45 years old group is the largest audience (40.54%), followed by 19 to 30 and 45 to 65 years old.

Interestingly, younger audiences (13 to 18 years old) are more engaged by online organizations (11.63%) compared to offline ones (6.76%), highlighting the role of digital platforms in engaging also younger people. Conversely, offline organizations cater more to older audiences (45 to 65 years old) and even reach younger chil-

dren (0 to 12 years old), a demographic less likely to be the focus of online outreach.

3.5.6 Gender target

Regarding the gender of people reached by the outreach activities, as depicted by Fig. 5, the data shows that the vast majority of space outreach organizations report a **balanced** gender composition in their activities, with 73.61% of respondents indicating this. However, 23.61% of organizations have a male majority, reflecting the gender imbalance commonly seen in STEM fields. Only a small fraction of organizations, 2.78%, report a female majority in their activities, highlighting the ongoing challenge of gender equity in space-related outreach and participation.

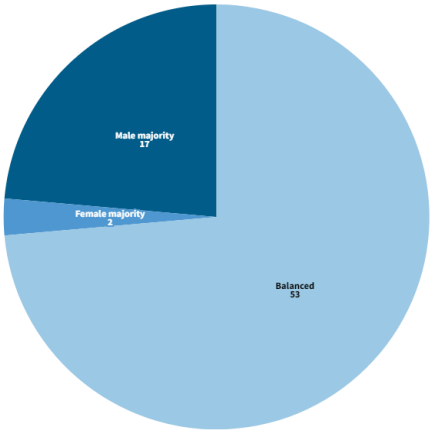

Fig. 5. Charts showing the gender percentage of the people targeted by the different space outreach organizations.

3.6 Interest

We asked the different space outreach entities what they perceive to be the average interest in space among followers and people participating in the different activities organized online and offline. The results highlight that the majority of participants and followers in these activities exhibit a **high** level of interest in space, with over 60% of the responses indicating it. An additional 28% express a very high level of interest. Only about 11% of the respondents rated the interest as a moderate engagement. No realities stated that participants show little interest regarding the covered topics.

3.7 Motivations

When we asked for the motivations that drive participants and followers to engage with the outreach activities, the entities responded as shown in figure Fig. 6. The horizontal bar chart clearly visualizes the overwhelming lead of passion, suggesting that intrinsic motivation is a powerful force in the space outreach community. People are engaging with these activities because they feel a deep, personal connection to the subject matter, reinforcing the idea that space exploration has an inspiring and almost emotional appeal. Culture and personal curiosity is another major driver: many participants are motivated by a desire to learn more about space science and related fields. This underscores the educational value of outreach initiatives, where curiosity is a catalyst for participation. The combination of study support and professional development further highlights the role of education, both formal and informal. Programs that offer not only entertainment but also educational content and learning resources could reach a broader audience by appealing to both students and professionals in the field. Word of mouth and networking indicate that social interaction plays a substantial role in engagement: people are not only coming to learn but also to share and connect with others. Entertainment and fidelization suggest that space outreach can also be a source of enjoyment and personal satisfaction. The entertainment factor is important for maintaining engagement over time, especially with a wider public that may not have direct professional or educational ties to space science.

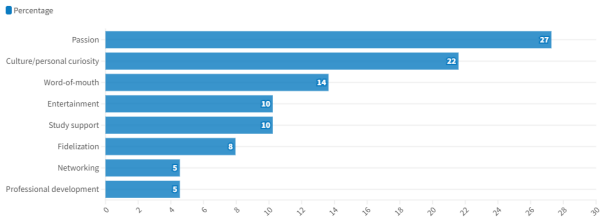

Fig. 6. Chart showing the motivations that drive participants and followers to engage with the outreach activities, and the percentage of responses from the 71 entities.

4. Conclusions

4.1 Trends

Analyzing the trends in participation declared by the different entities, the results reveal a general trend of increasing interest and participation in outreach activities, with 38.57% of respondents reporting a significant increase and 31.43% noting a slight increase. Some of the respondents indicate that participation has remained stable, while only a very small percentage report a slight or significant decrease. The corresponding motivations behind these trends offer an insight into the factors influenc-

ing participation levels. For the organizations that experienced an increase in participation, a key driver seems to be a higher frequency of activities combined with improved quality. By offering more engaging and valuable experiences, these organizations successfully attracted larger audiences. Moreover, many of the organizations highlighted the impact of increased online activities, which helped them reach broader audiences. Also collaborations with other organizations or institutions were frequently mentioned as a factor in increasing participation. Some organizations attributed their success to broader cultural or social trends that increased public interest in space and science, but also participants' feedback and referrals were identified as significant factors, demonstrating the power of community engagement and reputation in driving future participation. The small number of organizations that experienced declines in participation cited several challenges. Some reported that offering fewer activities or lower-quality programs negatively impacted their engagement levels. In a few cases, organizations saw less enthusiasm from their audience, suggesting that maintaining or increasing engagement requires consistent innovation and adaptation to audience needs. A lack of qualified personnel, volunteers, or funding also contributed to lower participation, emphasizing the need for adequate resources to sustain successful outreach efforts.

4.2 Funding sources

The responses to the survey provide also interesting insights into the diverse funding sources for space outreach activities and the perceived adequacy of these funds. Additionally, the data reveals how many organizations have received public or private funding in the past two years. Organizations reported a wide range of funding sources, including sponsorships, event revenues, donations, membership fees, public funding, advertising revenues and merchandising. However, the majority of respondents indicated that their funding sources are **not sufficient** to cover their needs. Only a minority stated that their current funding is sufficient.

Notably, public funding plays a role for some organizations, but it is not a universal solution. Some entities that rely on public funds still reported that they are inadequate, reflecting the limited or sporadic nature of such grants. Similarly, organizations receiving private grants and donations also indicated that they are not always enough to sustain their activities in the long term.

Interestingly, only a minority of organizations have received public or private funding in the last two years. Of those who did, public funding was more common, with many organizations citing it as a crucial source. Private funding was less frequently mentioned but still significant for some entities, particularly those that rely on donations and private grants from foundations.

The results suggest that many organizations rely on a mix of funding sources, but this diversification does not always translate to sufficiency. This indicates that space outreach organizations may need to explore new or more sustainable funding strategies to secure their long-term viability. And even when public funding is available, it is often not sufficient to meet all the needs of the organizations. This highlights the potential for improving access to or increasing the amounts of public funding, particularly for small or medium-sized organizations that may struggle to secure consistent support.

For organizations that rely heavily on donations and private grants, the lack of sufficiency points to a need for stronger engagement with private donors or foundations. Encouraging greater involvement from the private sector, whether through sponsorships, grants, or partnerships, could help alleviate financial pressures. With many organizations indicating that their funding is insufficient, it is crucial for space outreach initiatives to develop more robust sustainability plans. Overall, in fact, the data suggests that while space outreach organizations are resourceful in securing a variety of funding sources, most still face significant financial challenges. Future strategies should focus on improving funding adequacy and exploring new opportunities for public and private sector support.

4.3 Science outreach method

We created a treemap visualization (in Fig. 7) to link and analyze the key macro-areas, activities, and their contributions to increasing interest in space across different organizations.

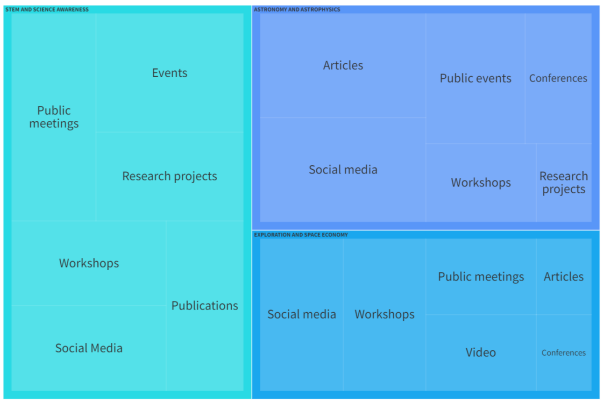

Fig. 7. Treemap showing the key macro-areas, activities, and their contributions to increasing interest in space across different organizations.

The visualization divides the activities into three main macro-areas: Exploration and Space Economy, Astronomy and Astrophysics and STEM and Science Awareness. Each macro-area is represented by a large block, with various sub-blocks that indicate the specific activities carried out by organizations within those areas, such as public meetings, workshops, articles and social media, which are commonly employed to engage with the public. The size of the blocks within each macro-area indicates how significant is the contribution level of each activity, ranging from very significantly to with no influence, making it easy to identify which activities are perceived as more or less effective in raising awareness and interest in space. The larger blocks indicate higher contributions.

The treemap effectively illustrates that social media, public meetings and workshops are among the most common activities used to engage audiences across all macro-areas. Notably, activities within the STEM and Science Awareness and Astronomy and Astrophysics macro-areas tend to have a more significant impact. In contrast, there are also a few instances, particularly within Exploration and Space Economy, where activities like conferences are perceived to have a moderate or low influence on raising space interest. This highlights a potential area where outreach strategies might need to be adjusted or expanded to increase their effectiveness. Overall, the visualization also emphasizes that while certain methods are highly impactful, others may require adaptation to better meet the goal of raising interest in space-related topics.

4.4 Main challenges

The most significant challenge that the different entities face in their outreach activities is the difficulty in reaching the public, closely followed by a lack of financial resources. These two challenges suggest that outreach strategies may be inadequate or underfunded. Managing an effective online presence is another prominent challenge, along with dealing with misinformation and fake news, which indicates the difficulty organizations face in maintaining visibility and credibility in a competitive and sometimes misinformed digital environment. This is especially relevant in the current social media landscape where misinformation can spread rapidly (see [10] or [11]).

The lack of institutional support further compounds these issues, suggesting that organizations might struggle to find reliable backing from institutions or governments, which could hinder their long-term sustainability. Other important challenges include difficulty standing out in the current media landscape and maintaining long-term public interest. These issues highlight the broader difficulty of keeping audiences engaged over time in a competitive and fast-changing information environment.

4.5 Possible improvement

The responses to the question regarding what aspects should be prioritized to improve science communication in Italy highlight key areas of concern for organizations engaged in science outreach. The most frequently mentioned elements include collaboration between institutions and communicators, the availability of public funds for outreach projects and the promotion of scientific culture in schools. Many organizations also point to the preparation of communicators, underlining the importance of training and professional development to ensure effective science communication.

Several respondents mentioned access to public funds as a critical issue, often paired with the need to simplify access to these resources. Additionally, large-scale event organization emerged as another important factor, reflecting the growing need for public engagement through significant, high-visibility activities. A few respondents highlighted the challenges of communicating via social media and digital platforms, emphasizing that these channels require specific skills and strategies to effectively reach and engage audiences. Moreover, the availability of professors and researchers was mentioned, indicating that collaborations with academic figures are viewed as essential for credible and effective science communication.

In summary, the results suggest that to advance science outreach in Italy, it is crucial to strengthen institutional collaborations, ensure adequate public funding, improve training for communicators and focus on building scientific culture in schools. The call for more structured support systems, including easier access to resources and better use of digital platforms, reflects the evolving landscape of science communication, where both traditional and modern approaches must be balanced.

4.6 Feedbacks

The feedback provided by respondents highlights various aspects of their work in the field of space and science communication. Several key points emerge:

1. *Volunteering vs. professionalism.* One recurring theme is the balance between voluntary efforts and professional science communicators. Some respondents emphasize that science outreach should largely be volunteer-based, where experts share their knowledge as a service to the community. However, they also stress the importance of institutional support for volunteers, particularly in terms of access to resources and logistical support.

2. *Challenges with public institutions*. Many respondents mention a lack of cooperation and support from public institutions, both in providing physical spaces for events and in facilitating partnerships between organizations and schools. These obstacles make it difficult to carry out ef-

fective outreach.

3. *Innovative approaches to outreach.* Some respondents shared their creative approaches, such as incorporating historical artifacts from space missions into lectures, focusing on inclusive outreach for individuals with disabilities, and using platforms like Telegram to build a strong online community for astronomy enthusiasts.

4. *Concerns over sensationalism.* There is concern about the growing trend of sensationalist approaches in astronomy outreach, which prioritize "wow" moments over a deeper understanding of celestial phenomena. Respondents emphasize the need to focus on meaningful education rather than superficial entertainment.

5. *Lack of financial and human resources*. Multiple respondents highlight the need for more financial support and trained volunteers. While they have a wealth of ideas and enthusiasm, limited resources hinder their ability to expand or improve their projects.

In Table 6 we summarize the key themes shared by respondents, offering a snapshot of the main challenges and perspectives in science communication.

5. Final discussion

This study provides an interesting snapshot of space outreach in Italy. By mapping and analyzing these organizations, it offers insights that are indicative of broader trends within the country's science communication landscape, allowing for a deeper examination of their dynamics and revealing not only their geographic distribution, but also the challenges and motivations they face. While the results cannot fully represent the entire spectrum of space outreach activities in Italy, they serve as an important indicator of the sector's evolution.

The research highlights that space science communication is shifting towards a more interdisciplinary and application-oriented approach. While astronomy and space exploration remain central, there is a growing emphasis on topics like space technologies, space economy, and their societal implications. This shift suggests that communicators are increasingly aware of the broader impacts of space science, such as its relevance to technological innovation and cultural development. By incorporating diverse perspectives, these efforts are likely to engage wider audiences and deepen public understanding of how space exploration influences everyday life. The trend towards blending art, culture, and STEM topics underscores the desire to make space science more accessible and relatable to a broader demographic.

The mix of young, small organizations and long-standing entities presents a dynamic picture of Italy's space outreach ecosystem. A significant portion of the organizations surveyed have been active for two to five years, reflecting a recent surge of interest likely fueled by global excitement about space exploration. On the other hand, well-established organizations with over 20 years of activity continue to serve as the bedrock of outreach, maintaining their influence through a wealth of experience. This diversity allows for a variety of outreach approaches, from grassroots, community-driven efforts to more formal, large-scale initiatives, which together enrich the space communication landscape.

Gender disparity within these organizations, with a significant male majority, is another key finding. While the space outreach sector has made strides in promoting diversity, this imbalance suggests that more targeted efforts are needed to encourage gender equity. Given the persistent underrepresentation of women in STEM, space outreach organizations could play a pivotal role in fostering more inclusive environments by promoting female participation, both as communicators and audience members. Addressing this gap would not only improve gender representation but also enhance the diversity of perspectives within the field, which is essential for innovation and public engagement.

The study also highlights the growing importance of online platforms in space outreach. Organizations focusing on digital outreach tend to reach broader audiences compared to those primarily engaged in offline activities. However, the data also shows that the majority of organizations, even those active online, have relatively small audiences, underscoring the challenges of expanding reach in a crowded digital landscape. Despite the effectiveness of online outreach, the need for consistent activity, high-quality content, and collaboration with other organizations remains critical for growth. This suggests that digital platforms, while useful, are not a panacea and must be complemented by strategic efforts to engage and retain audiences.

Financial sustainability is a major challenge for space outreach entities in Italy. The majority of respondents indicated that their current funding is insufficient to meet their needs, with many relying on a mix of sponsorships, donations, public grants, and event revenues. While public funding plays a crucial role for some organizations, it is often not enough to sustain long-term activities. This funding gap underscores the need for more robust and diversified financial strategies, including stronger engagement with private donors, foundations, and corporate sponsorships. The fact that many organizations struggle with inadequate resources suggests that space outreach in Italy may be hindered by financial constraints, limiting the potential for growth and innovation in the sector.

A related issue is the lack of institutional support, which many organizations cited as a barrier to their suc-

Area of interest	Feedbacks
Volunteering vs. Professionalism	Emphasizes that science communication should rely on voluntary efforts, with institutional support for volunteers.
Challenges with Public Institutions	Lack of access to physical spaces and collaboration with schools and public institutions is a barrier to effective outreach.
Innovative Approaches to Outreach	Respondents are using unique methods like space mission artifacts and inclusive outreach for individuals with disabilities.
Concerns Over Sensationalism	Criticism of sensationalism in astronomy outreach, where entertainment is prioritized over real scientific understanding.
Lack of Financial and Human Resources	Financial constraints and a lack of trained volunteers are major obstacles to expanding and improving outreach efforts.

Table 6. Key themes in science communication feedback from respondents.

cess. Collaborations between public institutions, schools, and outreach entities are crucial for amplifying the impact of space communication. However, the absence of systematic, institutionalized support makes it difficult for organizations to access necessary resources, including venues for events, logistical assistance, and academic partnerships. This lack of support further compounds the challenges of financial sustainability and audience engagement. To foster a more supportive environment, public policies must prioritize investment in science communication, ensuring that organizations receive the backing they need to thrive.

The feedback gathered from respondents also reveals concerns about the direction of space communication in Italy. Some communicators expressed frustration with the increasing sensationalism in the field, where the "wow factor" often overshadows meaningful education. While engaging the public with exciting content is important, the goal of outreach should be to deepen understanding of space science and inspire critical thinking.

6. Next steps

Looking ahead, this study represents only the first step in a larger initiative by Astrospace Lab. Our initial goal was to create a comprehensive mapping of space outreach and public engagement activities in Italy, and this research provides a foundational understanding of the current landscape. However, this is only the beginning. The database we have created will be continuously updated, and future studies will expand to include a wider range of organizations, reaching a broader audience and incorporating new parameters for analysis. By refining our research methods and broadening the scope of our inquiry, we aim to track the growth and evolution of space outreach in Italy over time.

Ultimately, we envision this project becoming an annual study, allowing us to monitor long-term trends and provide actionable insights for improving space communication in Italy. Beyond outreach, we plan to expand our research to include industrial and research activities in the space sector, offering a more comprehensive view of Italy's role in global space exploration. By fostering collaboration between outreach organizations, industry, and research institutions, we aim to create a more connected and informed space ecosystem that benefits society at large, and to play a crucial role in ensuring that the public is well-informed and engaged with space science. By fostering a culture of scientific curiosity and exploration, we hope to promote long-term societal benefits such as critical thinking, innovation, and a deeper understanding of the world and the Universe. Furthermore, by raising awareness of space science and exploration, we inspire the next generation of scientists, engineers, and explorers who will continue to push the boundaries of what is possible.

References

[1] M. Co., "Future of space economy research," *McKinsey & Company*, 2024.

[2] SDA Bocconi School of Management - SEE Lab, "Space economy, space industry, space law," SDA Bocconi School of Management, 2023. [Online]. Available: `https://www.sdabocconi.it/en/faculty-research/research-centers/see-lab`.

[3] Astrospace, "Il primo database della divulgazione spaziale in italia," *Astrospace.it*, 2024.

[4] G. Chiarelli, "The INFN experience in supporting and improving hep outreach," *Proceedings of ICHEP 2022 Conference*, 2022.

[5] F. Scianitti, "The role of images in the storytelling of the invisible," *EPS-HEP 2017*, 2017.

[6] R. Stannard, "Communicating physics through story," *Phys. Educ. 36-30*, 2001.

[7] "Tally." (2024), [Online]. Available: `https://tally.so/`.

[8] A. Lab, "Landing page: Il primo database della divulgazione spaziale in italia," *Astrospace ORBIT*, 2024.

[9] A. Lab, "Database della divulgazione spaziale in italia," *Astrospace ORBIT*, 2024.

[10] F. O. et al., "Fake news on social media: The impact on society," *Inf Syst Front 26, 443–458*, 2022.

[11] B. K. et al., "A systematic review on fake news research through the lens of news creation and consumption: Research efforts, challenges, and future directions," *PLoS ONE 16(12)*, 2021.