Science Communication of Brazilian Software Engineering Research on LinkedIn

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ABSTRACT

This study investigates how Brazilian Software Engineering Research is communicated on LinkedIn, a professional social network, by analyzing the characteristics of posts, the profile of communicators and the interactions received by posts. We used web scraping and manual classification techniques to collect, extract and process attributes related to the content of posts, authors, and interactions. A total of 336 posts referring to scientific software engineering conferences (SBES, SBQS, CIBSE, and ICSE) were extracted and analyzed, and 172 were identified as being related to science communication. Our results suggest that science communication is predominantly carried out by individual profiles, with a greater frequency of industry professionals, with self-promotion being the main goal of the posts analyzed. We also observed extensive use of visual resources and the limited use of scientific elements that facilitate the understanding of research, such as methodologies and research results. These findings suggest that, although LinkedIn can broaden the reach of science communication, this still requires further improvement. Accordingly, we present recommendations to make scientific content more accessible, effective and engaging on LinkedIn.

KEYWORDS

Science Communication, Software Engineering, LinkedIn

1 Introduction

Science Communication (SciCom) is any action that aims to communicate scientific knowledge and popularize science. SciCom often involves the use of various media, such as television, print media, social media, blogs, museums, lectures and podcasts, to increase people's interest, developing their opinions and promoting their awareness, enjoyment, and understanding of science [6].

Scientific discoveries in Software Engineering (SE) introduce new processes and methodologies that simplify software development, facilitating access to practical and useful knowledge that aims to generate positive impact both for the daily work of professionals and for the industry [5]. Although SE research is one of the possibilities to improve practical activity, these benefits are only fully perceived when the results of scientific research are communicated efficiently to the target audience.

In particular, social media facilitate access to information previously restricted to specific channels, increasing the visibility of scientific research and enhancing interaction between individuals, creating a space conducive to discussions and two-way exchange of ideas with researchers [13]. They can also be used by researchers to foster collaborations and demonstrate social impact [8] in addition to increasing readership, as demonstrated by a 2016 study that found that publications with strong social media coverage were 11 times more likely to be cited [10].

LinkedIn, a professional network, when used for science communication can serve as a "bridge" between the academic environment and the industry. Science communication allows industry professionals to gain access to useful knowledge to integrate into their daily work and Software Engineering (SE) researchers to reach their intended audience, receive *feedback* on their work and find potential collaboration partners [20]. By adopting a science communication strategy on LinkedIn, SE researchers not only amplify the visibility and impact of their findings but also facilitate the adoption and implementation of new ideas, tools and techniques that benefit software development.

The work of Wyrich and Bogner [20] analyzed science communication based on LinkedIn posts related to the two major international conferences in the area of SE, the International Conference on Software Engineering (ICSE) and the International Conference on the Foundations of Software Engineering (FSE) and concluded that the communication of research in SE is occurring on LinkedIn.

The aforementioned research analyzed SE science communication in a global context, which motivated the need to investigate how this occurs in a national scenario based on the production of Brazilian researchers who publish in recognized scientific conferences in Brazil and Latin-America, such as the Brazilian Symposium on Software Engineering (SBES), the Brazilian Symposium on Software Quality (SBQS) and the Ibero-American Conference on Software Engineering (CIbSE), in addition to ICSE itself. To understand this phenomena, we study characteristics of posts, communicators, as well as interactions resulting from posts similarly to Wyrich and Bogner [20]. Thus, the following research questions were defined:

- RQ1. What are the main characteristics of popular SE research posts?

- RQ2. What is the profile of Brazilian research communicators in SE?
- RQ3. What type of interactions do these posts receive and how often do they occur?

To answer our research questions, LinkedIn posts by Brazilian researchers and institutions that reference major software-engineering conferences (SBES, SBQS, CIbSE, and ICSE) were collected and analyzed. We combined automated web scraping with manual classification to extract and process attributes related to post content, author profiles, and audience interactions.

A total of 336 conference-related posts were gathered, of which 172 were identified as science-communication posts. Our analysis highlights that science communication on LinkedIn is predominantly driven by individual, industry-affiliated profiles, with self-promotion as the primary goal. We also observed heavy reliance on visual resources and limited inclusion of scientific elements, such as methodologies and results, suggesting that while LinkedIn can broaden research reach, the presentation of content still requires improvement.

The paper is organized as follows: Section 2 covers Science Communication and LinkedIn fundamentals; Section 3 reports the related work; Section 4 describes our methodology; Section 5 presents the results; Section 6 discusses the findings and Section 7 concludes with final considerations and future work.

2 Background

2.1 Science Communication

Science Communication (SciCom) may be defined as the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science (the vowel analogy - AEIOU): Awareness, including familiarity with new aspects of science; Enjoyment or other affective responses, e.g. appreciating science as entertainment or art; Interest, as evidenced by voluntary involvement with science or its communication; Opinions, the forming, reforming, or confirming of science-related attitudes; Understanding of science, its content, processes, and social factors. Science communication may involve science practitioners, mediators, and other members of the general public, either peer-to-peer or between groups [6].

A wide variety of media and activities are necessary to cater for the large range of personalities, learning styles, social and educational backgrounds that people bring to their experience with science. Examples of formal science communication which, typically are well structured include: learning activities at schools, colleges, and universities; Academic and professional conferences. Examples of informal science communication which are more often voluntary, non-assessed include: Media programs on film, television, radio; Internet forums; Science competitions.

The utilization of social media platforms for science communication has been under consideration for some time [7, 9]. There is evidence that scientists are using social media for communicating specific aspects of their research, as a means of outreach to increase engagement and science literacy [3, 11, 13, 17].

The choice of platform depends on the audience, communication goals, platform culture, and the scientific community's context [9]. Instagram, focused on visual content, targets a broad audience, with a focus on education or awareness [11]. Twitter, with its concise textual format and fast updates, is more suitable for discussion with experts. However it has faced limitations regarding content credibility [12]. On LinkedIn, the interest in industry makes the platform conducive to discussions related to the demands of the productive sector [14, 20].

2.2 LinkedIn

LinkedIn has over one billion members and is recognized as the leading professional social media, especially in technical and business sectors [7]. In Brazil, it is the third country worldwide in number of users [15].

Its algorithm determines what shows up in your feed, who sees your posts, and how content spreads across the platform. While LinkedIn doesn't publish every detail, its Engineering Blog [16] provides some explanation of how the algorithm is generally understood to work. Regarding to content creation and initial distribution, when someone post something, LinkedIn shows it to a small segment of your first-degree connections (direct network), to test if it's interesting or valuable. What matters for LinkedIn is post format (text, image, video, etc), keywords, hashtags, time of posting, and how active your audience is [19].

Additionally, according to the platform's help page states that "there is no single request (*request*) for searching on LinkedIn", and that the *order* of a search result is determined by each user's profile, activity and connections [1]. Since we collected all posts returned from each query, changes in the order of the posts did not impact our results.

Furthermore, if a post performs well with one's direct connections, it can spread to 2nd- and 3rd-degree connections, especially if the audience interacts with it publicly. For example, if your connection comments on your post, their connections may see it in their feed. This is how posts "go viral" on LinkedIn [16]. When deciding what to show in a feed, LinkedIn considers: personal relevance (how closely connected you are to the person who posted and whether you've interacted with similar content or topics before); content type preference (if you usually interact with videos, it'll show you more videos); post freshness (newer posts are favored unless older posts that are still trending); and professional context (LinkedIn prioritizes content that appears work-relevant).

Finally, LinkedIn actively filters out spam, clickbait, and low-quality posts. Posts that include excessive tagging, engagement baiting ("like if you agree"), or irrelevant hashtags may be down-ranked. External links (especially if they take users off LinkedIn) can sometimes reduce reach unless they're highly engaging.

3 Related Work

An exploratory search in the Scopus, IEEE and ACM Digital Library databases using the *string "science communication"* AND *"linkedin"* returned 25 papers. Three of them address the use of social media in general for science communication, without focusing on any particular media or area of knowledge [7, 8, 13] and only one paper addresses the use of LinkedIn for science communication in software engineering: the work by Wyrich and Bogner [20]. We will discuss this paper further in the rest of this section.

Wyrich's and Bogner's work [20] was based on the observation that SE research is shared and discussed by industry professionals on LinkedIn, but that there was still no systematized knowledge of *how* this occurs. They authors sought to investigate how this communication occurs, analyzing how SE research is communicated; how people respond to SE disclosures shared on LinkedIn; and what positive examples of science communication have in common.

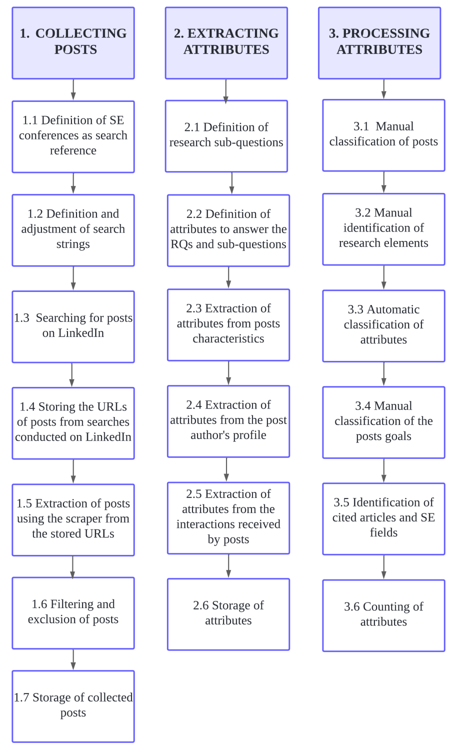
They analyzed 98 LinkedIn posts about papers presented at the International Conference on Software Engineering (ICSE) and International Conference on the Foundations of Software Engineering (FSE) conferences taking into account post author's affiliation, goal of the post, among other aspects.

Their results indicate that 59.3% of the authors have professional affiliations and 40.7% have academic affiliations. Regarding the intention of the posts, 83% of them were classified as: raising awareness about the paper, i.e., promoting the paper at a high level, encouraging people to read it without mentioning details; raising awareness about the results (exposing the results of the paper); discussion of the results (in addition to presenting the results, promoting some discussion). The other posts were classified as self-promotion (acceptance and awarding of papers).

In the interactions analyzed, they found that posts by academics received, on average, more reactions and shares than those by industry professionals. However, 71% of the comments came from industry and only 29% from academia. Based on positive examples, strategies for sharing research were suggested, such as seeking to promote discussion of the results, using accessible language and structured texts.

The research described in this paper, unlike the aforementioned work, adopts a local perspective, focusing on the communication carried out by *Brazilian* researchers, industry professionals and institutions from the main conferences in the area of SE. Several aspects that are not addressed in the aforementioned research are also analyzed, such as a more detailed analysis of the characteristics of the posts and the profile of the communicators.

Figure 1: Methodological Procedures



4 Methodology

This section describes the methodology we adopted to investigate how science communication of Brazilian research in software engineering occurs on LinkedIn. Our methodology was structured in three stages: (1) collecting posts from LinkedIn, (2) extracting the attributes from the content of each post and (3) processing the extracted attributes quantitatively and qualitatively. These stages are presented in Figure 1.

4.1 Collecting posts on LinkedIn

Initially, we searched Scopus for the most productive Brazilian researchers, identified their profiles individually on LinkedIn, but did not find significant participation from this group of productive researchers on the platform. For this reason, we adopted a conference-centered approach, selecting events based on publication volume. According to ACM Digital Library data, Brazilian Symposium on Software Engineering (SBES), Brazilian Symposium on Software Quality (SBQS) and International Conference on Software Engineering (ICSE) account for most publications (52%) by Brazilian authors. We selected the two main Brazilian software engineering (SBES, SBQS), the most prestigious software engineering conference (ICSE), and the main one in Latin-America (Ibero-American Conference on Software Engineering - CibSE).

The search on LinkedIn was carried out using the search terms mentioned in Table 1 in January 2025, considering LinkedIn posts until December 2024. For each scientific conference three strings were used: the full name of the conference in Portuguese ("*simpósio brasileiro de engenharia de software*", for example), the full name of the conference in English ("brazilian symposium on software engineering") and the acronym of the conference together with the term "*artigo*" ("SBES + *artigo*", for example). The term "*artigo*", in English meaning paper, was included in some search strings to ensure that the results were more qualified and appropriate to the research questions of this work. When searching only for the acronym of each scientific conference, such as "SBES", LinkedIn returns numerous results that contain these characters, but that are not relevant to the research, which makes it impossible to select posts that meet the established criteria.

Each of the 12 search strings were entered into the LinkedIn search field, returning a feed of posts ordered chronologically. The URLs corresponding to each search string were manually stored in a spreadsheet. Next, a web scraper developed in python loaded the search URLs and accessed the feed of posts from the corresponding search. The Selenium[1] and BeautifulSoup[2] libraries were used to access the posts. The collected posts were stored in a spreadsheet

[1]https://www.selenium.dev/
[2]https://beautiful-soup-4.readthedocs.io/

Table 1: Conferences, search strings, and total posts extracted from LinkedIn

Conference	Search strings	Posts extracted	Posts after Filters 1, 2, and 3
SBES	"simposio brasileiro de engenharia de software"	51	37
SBES	"brazilian symposium on software engineering"	22	15
SBES	"SBES + artigo"	410	38
CIbSE	"congresso ibero americano em engenharia de software"	4	2
CIbSE	"ibero american conference on software engineering"	86	47
CIbSE	"CIbSE + artigo"	13	5
SBQS	"simposio brasileiro de qualidade de software"	164	108
SBQS	"brazilian symposium on software quality"	12	7
SBQS	"SBQS + artigo"	134	54
ICSE	"international conference on software engineering"	354	11
ICSE	"conferência internacional de engenharia de software"	6	5
ICSE	"ICSE + artigo"	19	7

that served as a database for the next step, in which the attributes of the posts were extracted. In this step, **1,296** posts were collected. The initial total of posts extracted in each string can be seen in Table 1, in the "posts extracted" column.

The extracted posts were filtered to better qualify the selection of posts. Initially, the first filter applied (Filter 1) selected only the posts that contained the search *strings* in the content, resulting in 595 publications. This filter eliminated posts that, although they were in the search results, were not connected to the conferences - a behavior observed when using acronyms in the LinkedIn search.

Then, the second filter (Filter 2) restricted the set of posts to those published by Brazilian authors, reducing the total to 396 posts. Finally, the third filter (Filter 3) removed the duplicate posts, leaving 336 unique posts in the final data set. The column "posts after Filters 1, 2 and 3" in Table 1 shows the final amount obtained in this step.

4.2 Extracting attributes from posts, authors and interactions

The definition of the attributes for extraction was performed based on the three Research Questions (RQ1, RQ2 and RQ3). Each question was broken down into sub-questions that allowed us to identify the primary attributes available on LinkedIn to answer them. Table 2 presents the set of sub-questions for each RQ and the respective extracted attributes. These attributes were obtained accessing the post URLs stored in the previous collection step, through an another web scraping algorithm.

Attributes used to answer about the characteristics of posts (RQ 1) were extracted from the Post content. To answer the questions about the profile of the post authors (RQ 2), attributes were extracted from the URL of the post author profile. Finally, to answer RQ 3, attributes were extracted from post interactions.

Table 2: Research questions, sub-questions, and extracted attributes

R.Q.	Sub-question	Attribute
RQ 1.1	What are the goals of the posts?	Post content
RQ 1.2	What topics / SE areas are mentioned in the posts?	Post content
RQ 1.3	Which scientific elements of a paper are presented?	Post content
RQ 1.4	Are there images that help to understand the results?	Post content
RQ 1.5	What LinkedIn formatting features are used?	Post content
RQ 1.6	What is the average length of the posts?	Post content
RQ 1.7	What languages are the posts written in?	Post content
RQ 2.1	Do the post authors have individual or institutional profiles?	Author profile URL
RQ 2.2	Whoever shares scientific research is the author of the research?	Post content
RQ 2.3	Is the affiliation of individual profiles academic or professional?	Author profile URL
RQ 2.4	Among the authors, which gender shares most often?	Author profile URL
RQ 2.5	In which city are the authors located?	Author profile URL
RQ 2.6	Who are the authors with the most science communication posts?	Author profile URL
RQ 3.1	What is the average, median, and standard deviation of interactions per post?	Post interactions
RQ 3.2	What is the average, median, and standard deviation of interactions by profile type and author affiliation?	Post interactions
RQ 3.3	What is the average number of interactions according to the formatting features used?	Post interactions
RQ 3.4	What are the top 5 individual posts with the highest average interactions?	Post interactions
RQ 3.5	What are the top 5 institutional posts with the highest average interactions?	Post interactions

4.3 Processing attributes

At this stage, the extracted attributes were processed manually and automatically in order to generate other specific attributes to answer the research sub-questions. However, this was only done for those posts that actually promoted science communication which resulted in the creation of an attribute to identify whether a post actually promoted science communication (attribute **Provide science communication**). To be considered a science communication post, the presence of at least one typical element of a scientific research (here referred to as a scientific element) was required, such as paper title, research problem, research goal, methodology, result, or abstract.

All manual classifications were performed by the first author, who fully read and classified each post. In the second stage, a second researcher reviewed all posts and flagged those that could potentially be interpreted differently, thereby identifying possible disagreements. Each of these flagged posts was then discussed jointly by the authors until consensus was reached.

Through this manual analysis of the post text, other attributes were created. The **Goal of the post** attribute was created to indicate the author's intention when posting (RQ 1.1). The goals were classified as: a) paper presentation, when the intention was to announce that a paper was presented at the conference; b) paper award - when the intention was to inform the recipient of an award; c) paper acceptance, when the intention was to communicate that an paper was accepted; d) paper publication, when the intention was to announce that the paper was published in annals or journals; e) presentation of a lecture, when the intention is to communicate research through a lecture; f) paper report, when the intention is exclusively to share information about a paper.

Also through manual analysis, attributes corresponding to the scientific elements found in the post text were created, for example, **Paper Title**, **Research Problem**, **Research Goal**, **Methodology**, **Results** (RQ 1.3). Based on some of these attributes, it was possible to manually create the attribute **Research Area in ES** to identify the research area disclosed in the post (RQ 1.2). To answer whether the person sharing a scientific research is the author of the research (RQ 2.2), the attribute **Is Author** was created.

The following attributes were created automatically, using specific algorithms and libraries: **Number of images** (RQ 1.4); **Number of emojis, hashtags, URLs and tags** (RQ 1.5); **Number of characters** (RQ 1.6); **Post language**, generated from the post text using the *langdetect* library (RQ 1.7); the **Profile type (individual or institutional)** attribute, identified by analyzing the parameters present in the author's profile URL (RQ 2.1); the **Author affiliation (academic or professional)** attribute, obtained by evaluating the type of institution informed in the post author's Workplace attribute (RQ 2.3); the **Gender** attribute, identified by the *gender-guesser* library from the authors' names (RQ 2.4); the **City** attribute (RQ 2.5) from the author's profile.

Later, some extracted attributes were processed using an algorithm that counted frequencies, average, median and standard deviation to answer the other research questions.

4.4 Limitations

We acknowledge that the posts collected from the four conferences in which the Brazilian software engineering researchers publish most frequently may not represent the most comprehensive sample, either because researchers can share posts from other conferences, or they can disseminate research results without explicitly mentioning the name of a particular event. Considering this limitation, the results can be used to guide future research with more representative sample.

Another limitation was the difficulty in locating older or highly specific content, which required multiple attempts and adjustments to refine the search strings—a challenge also noted by Wyrich and Bogner [20]. Our search results appears to cover a fixed period of time that includes posts made 27 months ago, at most. Therefore, it was not possible to evaluate older posts. Specifically in our search, the oldest posts were from October 2022 while the newest posts were from December 2024.

The manual classifications performed during the analysis stage were conducted subjectively and are therefore subject to interpretation, representing a potential limitation of this study. To mitigate this potential bias, all classifications were reviewed by a second researcher.

5 Results

This section presents the results addressing the research questions and sub-questions defined in Table 2. Section 5.1 shows the temporal distribution of the 336 posts and their classification regarding science communication. Section 5.2 answers RQ1 and its sub-questions, describing the characteristics and formatting of science communication posts. Section 5.3 answers RQ2 and its sub-questions, presenting the profile of the post authors. Finally, Section 5.4 answers RQ3 and its sub-questions, analyzing the interactions received by the posts through reactions, comments, and shares.

5.1 Post distributions

Figure 2 shows the temporal distribution of the **336** posts collected, with the lines representing the four scientific SE conferences. On the horizontal axis, we have the frequency of the posts covering from October 2022 to December 2024, while the vertical axis indicates the number of posts published per month. An increase in posts can be seen close to the dates of the conferences. For example, the posts that mention the SBQS are concentrated mainly in the month of November, the period when the conference takes place. This the same for October and SBES, and ICSE around late April/early May.

As described in Section 4, the extracted posts were classified into two groups: posts that promote science communication and posts that do not promote science communication. Of the 336 posts analyzed, **172** (51.2%) were classified as science communication, that is, posts that reference papers or research, citing elements of a scientific work such as paper title, research problem, research goal, methodology, results or abstract.

The remaining 164 posts (48.8%) were classified as posts that do not promote science communication, as they do not contain references to the content of the research. Although they mention the conferences in which the works are presented, these posts are mainly limited to communicating general information and promoting the conferences, without addressing the content of the research itself.

Figures 3 and 4 illustrate the comparison of posts between these two groups, distributed among the four conferences we studied. The distribution presented in Figure 3 suggests that the SBQS and SBES conferences, both national, concentrate 79.6% of the total science communication posts; while Figure 4 indicates that a little more than half of the posts (54.9%) that do not disclose science information are attributed to the SBQS.

The greater representation of national conferences in science communication can be attributed to the fact that the posts analyzed in this study are mostly posts by Brazilian researchers and industry professionals. The SBQS conference stands out for concentrating the largest number of posts in both groups, indicating that this

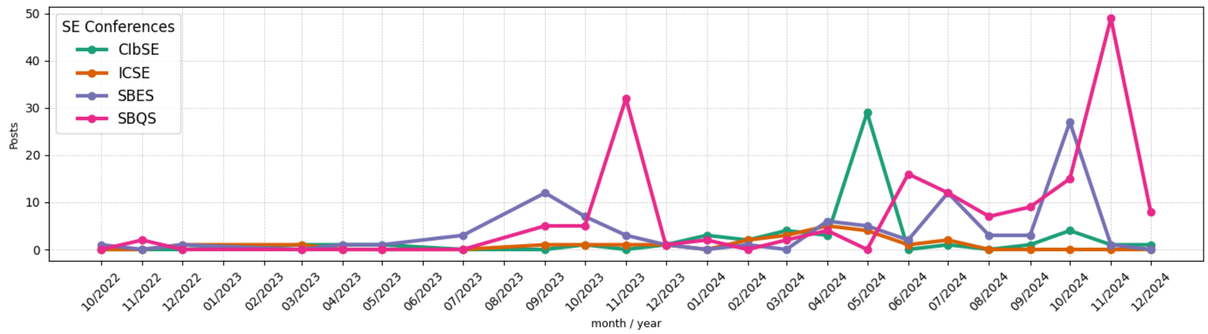


Figure 2: Temporal distribution of posts

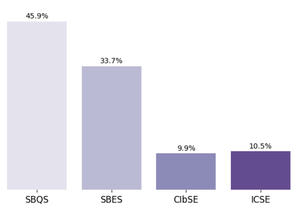


Figure 3: Distribution of science communication posts

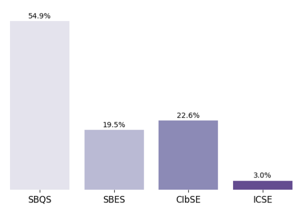


Figure 4: Distribution of non-science communication posts

conference has a strong presence on LinkedIn regardless of the purpose of the post. In the group of posts that do not promote the conference, the number of posts that mention the SBQS conference is notable, indicating the existence of a significant effort to promote this conference.

At this point it is important to be clear that for the remainder of this paper, we focus exclusively on the **172** posts that are related to science communication. Although the other 164 posts communicate general conference information, we will not take them into account in our analysis of science communication about Brazilian software engineering research.

5.2 RQ 1 - Characterization of SE science communication posts

Regarding the goals (RQ 1.1), the posts were classified based on the intention expressed by the author, which resulted in the classification, presented in Figure 5: **paper presentation** - to announce that a paper was presented at the conference (41.9%); **paper acceptance** - to communicate that an paper was accepted at the conference (27.3%); **paper award** - to inform the receipt of an award (19.8%); **paper report** - when the intention is to share information about an paper (6.4%); **paper publication** - to announce the publication of a paper (2.9%); and **lecture presentation** - to report on the performance as a speaker at the conference (1.2%). In addition to these goals, one post was classified as "fact checking" (0.6%). This is the post with the highest number of interactions received, whose goal did not fit into any of the predefined categories. In this case, the author addresses a topic relevant to the scientific community: the communication of *fake news* and the importance of verifying the information disclosed. Examples of posts illustrating each goal category are presented in Table 3.

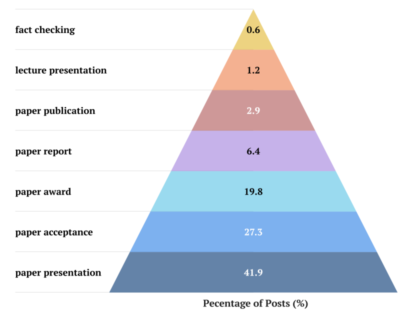


Figure 5: Goals of science communication posts

Table 3: Examples of posts classified in each goals

Goals	Post Example
Paper presentation	Link
Paper acceptance	Link
Paper award	Link
Paper report	Link
Paper publication	Link
Lecture presentation	Link
Fact checking	Link

When analyzing the most frequent goals of the posts (paper presentation, paper acceptance and paper award), which together add to 89.2% of the posts, it is clear that the vast majority of posts do not have the primary intention of reporting on an paper. The posts have elements of science communication, but the main purpose of the post is to share a personal achievement in some of the conferences. In other words, even indirectly, these self-promotional posts also contribute to the communication of scientific knowledge among the Brazilian SE community on LinkedIn.

As for RQ 1.2, the main software engineering area addressed in the posts were identified by analyzing the papers published by the authors in the text of the post. In total, 110 cited papers were identified. The most frequent areas, with at least 10 **posts** were: **human aspects in SE** (13.3%), **software testing** (12%), **requirements engineering** (8.7%), **software maintenance** (8.7%), **agile development** (8.7%) and **artificial intelligence in SE** (8%).

RQ 1.3 focused on the scientific elements mentioned in the 172 posts analyzed. These elements are those typically found in scientific papers, such as paper title, research problem, research goal, methodology, results and abstract. It is worth noting that the presence of at least one of these elements in the texts of the posts was the criterion used to select the posts classified as science communication.

As shown in Table 4, the most frequently cited elements are: the **title** of the paper, present in 69.8% of the posts and the **goal** of the research, cited in 34.3% of the posts. It is observed that, although the posts promote science communication, most end up limiting themselves to elements that do not contribute to the understanding of the research. Only 13.4% describe the **research problem**, 12.2% mention the **methodology** used, 11% of the posts refer to the **results** achieved and 2.9% include the **abstract**. This information, when detailed, helps in understanding the research published.

Although it does not provide much information about the research, the title of the paper, cited by most posts, makes it easier to locate the work, since only 33 posts (19.2%) include a URL to the full paper. In addition, only 10 posts use visual resources, such as graphs or diagrams, to help understand specific steps of the research (RQ 1.4). Finally, we observed that 42.4% of the posts cite or tag the co-authors of the work.

An analysis of the posts that combine all the elements (title, research problem, research goal, methodology and results) of a scientific paper revealed a total of only four posts: *post 1*, *post 2*, *post 3* and *post 4*. When investigating whether the results were also followed by a discussion commenting on the implications of the results achieved, we noticed that only *post 3* did so.

Table 4: Scientific elements found in science communication posts

Scientific element	Number of posts	Percentage %
Paper Title	120	69.8
Research Goal	59	34.3
Research Problem	23	13.4
Methodology	21	12.2
Results	19	11.0
Abstract	5	2.9

The characterization of the posts also involved analyzing the formatting resources used in the posts. The formatting resources analyzed include images, videos, emojis, URLs, hashtags and tags (RQ 1.5). **Images** are present in 83.7% of the posts, and most of them are photos taken by the authors at conferences, such as the moment of the presentation or receiving awards. **Tags** (when the author tags other users in the post content) were used in 64% of the posts and **Hashtags** are used in 37.2% . Meanwhile, ***Emojis*** were used in 36% of the posts, **URLs** are present in 28.5% of posts, and of these URLs, 45.7% direct to the full paper, facilitating access to the published scientific content. Considerably less used are **Videos**, with only 2.3%.

As part of the post characteristics, SE science communication posts have, on average, 976 characters (RQ 1.6) with a standard deviation of 679 characters. Regarding the language used (QP 1.7), 79% of the posts were written in Portuguese and 21% in English.

5.3 RQ 2 - Profile of post authors

Among the 172 SE science communication posts studied, 148 (86%) were published by individual profiles, while 24 (14%) came from institutional profiles (RQ 2.1). We also observed that the majority of individual authors (85.8%) were communicating research of their own authorship (RQ 2.2). This means that software engineering science communication on LinkedIn occurs predominantly through personal initiatives to share their own work, being less frequent as an institutional practice.

Regarding the professional affiliation of individual profiles (RQ 2.3), 68 authors (45.9%) declared a professional affiliation on their LinkedIn profile, 51 (34.5%) declared an academic affiliation, and 29 (19.6%) declared both types of affiliations. In other words, post authors who declare themselves as professionals working in the industry and those who declare themselves as researchers are both active in science communication, with greater participation by industry professionals.

Regarding the gender of the authors (RQ 2.4), there is a predominance of men. Of the individual profiles of communicators, 65% are male, while 18.9% are female, and the remaining percentage was not identified. The authors of the posts are distributed throughout all regions of Brazil (RQ 2.5), with a greater concentration in the cities of Rio de Janeiro, Recife, Curitiba, Manaus, and Aracaju, that is North, Northeast, Southeast, and South of Brazil.

The profiles with the most science communication posts (RQ 2.6) in the analyzed period are shown in Table 5, considering the type of profile (Individual or Institutional) and, in the case of the individual profile, the Academic (A) or Professional (P) affiliation (Af)[3]. A difference can be noted between the frequency of individual and institutional profiles. This result reinforces that science communication is predominantly a personal initiative of researchers interested in increasing the visibility of their research, and not an institutional action.

5.4 RQ 3 - Interactions received by posts

The 172 SE science communication posts received a total 10,385 interactions, with an average of 60.4 interactions per post, a median of 42, and a standard deviation of 99 (RQ 3.1). Table 6 shows the total number of interactions, average, median, and standard deviation by type of interaction. It is also worth noting that some posts did not receive certain types of interaction: 2 (1.1%) posts did not receive any reaction, 58 (33.7%) posts were not commented on, and 103 (59.8%) posts were not shared.

Regarding the authors' profiles (RQ 3.2), individual profiles have, on average, 65.7 interactions per post, a median of 44.2 and a standard deviation of 103.4. Institutional profiles presented, on average, 48.7 interactions per post, with a median of 34 and a standard deviation of 65.8. Authors with individual profiles and academic

[3] Click on the author's name to be directed to LinkedIn.

Table 5: Individual and institutional profiles with the most science communication posts

Author Name	N. of posts	Profile type	Af.
Marcos Kalinowski	5	Individual	A
Johnny Marques	5	Individual	A
Rodrigo Santos	5	Individual	A
Fabio Gomes Rocha	5	Individual	A e P
Fabiano Falcão	4	Individual	P
Instituto de Computação - UFAM	3	Institutional	N/A
Instituto de Desenvolvimento Tecnológico - INDT	3	Institutional	N/A
Fronteiras da Eng. de Software	2	Institutional	N/A
Laboratório de Sistemas Inteligentes (Brain)	2	Institutional	N/A

Table 6: Statistical measures of types of interactions

Interations	Total	Average	Median	Standard deviation
Reactions	9452	55	39	84,4
Comments	677	3,9	2	9,3
Shares	256	1,5	0	7,2

affiliation received, on average, 87.3 interactions per post, with a median of 54 and a standard deviation of 162.3, while authors with professional and academic affiliation received, on average, 55.9 interactions, with a median of 37 and a standard deviation of 68.1, and authors with only professional affiliation received, on average, 46.8 interactions, a median of 37.5 and a standard deviation of 43.7.

Analyzing the interactions received by posts that use formatting resources (QP 3.3), as described in Section 5.2, it is observed that posts with emojis have the highest average, with 79.9 interactions, while the average number of interactions in posts without emojis is 49.3 interactions per post. Next, posts with hashtags have an average of 71.5 interactions and posts without hashtags have an average of 53.8. Those that tag other users have an average of 67.2 and those that do not tag any other user have, on average, 48.3 interactions, posts with images have an average of 64.1 and those without images, 40.9. Posts that include URLs have an average of 58.5, while those that do not include URLs have an average of 61.1, and posts with videos have an average of 23.5 interactions per post, while those without videos have an average of 61.3. Therefore, it is understood that it is possible that formatting resources help to increase interaction in posts.

When comparing the interactions received in the posts that mention the analyzed conferences, ICSE has an average of 120.1 interactions per post, a median of 37.5, and a standard deviation of 264.2. Next, SBES has an average of 58.9 interactions, a median of 41, and a standard deviation of 72.3, followed by CIbSE with an average of 58.5 interactions, a median of 60, and a standard deviation of 37, and by SBQS, with 48.2 interactions per post, a median of 39, and a standard deviation of 34.6. Regarding ICSE, although this conference has the lowest total of posts collected (23), these posts concentrated 2,162 interactions, i.e., 20.8% of all interactions received.

It is worth noting that the high standard deviation found in some of the results above is due to the fact that only one of the posts collected, authored by an individual academic profile, concentrated 1,113 interactions, representing 10.8% of the total interactions received by the science communication posts we analyzed. This also explains the high standard deviation of the interactions received by ICSE, since it is the conference cited by this post.

The five individual posts[4] with the most interactions are displayed in Table 7, which presents the author, the Academic (A) or Professional (P) affiliation (Af), and the purpose of the post (RQ 3.4). This table indicates that individual profiles with academic affiliation predominate among the authors of the posts with the most interactions. In addition, four posts have as their main purpose the sharing of personal achievements (such as an award and presentation at the conference). The exception is post 1, categorized as "*fact checking*", as already mentioned in Section 5.2. The author of this post discusses the widespread communication of a fake study in SE. This post was included in the sample because the author mentions the ICSE conference, when he reports that this "fake" research had reached a larger audience than papers published at that conference.

Table 7: Individual posts with the most interactions

Post	Author	Af.	Goal	Interactions
1	Marcos Kalinowski	A	*fact checking*	1128
2	Marcos Kalinowski	A	Paper award	439
3	Otavio Lemos	A	Paper presentation	352
4	Nayane Maia F. Alves	P	Paper presentation	199
5	Kiev Gama	A	Paper presentation	187

When analyzing in detail the types of interactions and, in this case, the content of the comments, we noted that *post 1* and *post 2* received, respectively, 98 and 39 comments, with many of them discussing the topic proposed by the post, not limited to congratulations and thanks. Discussions, provoked by both the author and the readers generate more visibility and consequently interactions with the post. Another aspect observed was the number of shares. In the case of post 1 there were 90 shares, in post 2 there were 12 and in post 3 there were 14, unlike posts 4 and 5 with, respectively, 0 and 2 shares. Table 8 presents the posts with the most interactions between institutions (RQ 3.5). Post 1 announces an award for best thesis received. Another two posts also intend to communicate awards and the last two inform about paper acceptances.

6 Discussion

Similarly to Wyrich and Bogner [20], this research was based on the premise that LinkedIn is a social network that has been used to share software engineering research. This seems to be confirmed, considering that, of the 336 posts collected over approximately 27 months, 172 (51.2%) present at least one of the elements that

[4] Click on the post number to be redirected to LinkedIn.

Table 8: Institutional posts with the most interactions

Post	Institution	Goal	Interactions
1	Instituto de Matemática e Estatística (IME-USP)	Paper award	330
2	INDT - Instituto de Desenvolvimento Tecnológico	Paper presentation	104
3	Departamento de Informática PUC-Rio	Paper award	93
4	LEDES - Laboratório de Engenharia de Software	Paper award	66
5	INDT - Instituto de Desenvolvimento Tecnológico	Paper acceptance	65

characterize science communication: paper title, problem, goals, methodology, results or abstract.

However, the majority (89.2%) of the posts classified as science communication did not have as their main focus on science communication per se, but rather on sharing personal achievements (self-promotion). Therefore, we argue that the communication of Brazilian SE research on LinkedIn occurs, to a large extent, as a result of the authors' intention to share their personal achievements. Although this approach is more individual in nature than focused on the communication of knowledge, it still fulfills an important function: making science visible to the public, even if indirectly through more personal posts. This scenario is in line with LinkedIn's own proposal, which is characterized as a space for the recognition and promotion of professional activities.

This trend is not unique to software engineering or LinkedIn. In some fields, science communication on social media is closely linked to building the researcher's personal brand. This is evident on Instagram, where researchers in such areas as health, nutrition, education, psychology, and other areas use personal branding strategies and act as digital influencers [8]. Therefore, we consider that they pattern of digital platforms used for science communication does not depend solely on the field of knowledge, but rather reflects, above all, the technical features, user culture, and audience profile of each network.

The analysis of the presence of scientific elements (again, paper title, research problem, research goals, methodology, etc) in the science communication posts revealed that the paper title was the element present in the majority (69.8%) of the posts. Although the posts often employ visual formatting resources and strategies, the same is not true regarding the presentation of scientific content, which requires more details and greater depth. This corroborates the fact that most posts are self-promotional, with reports of personal experiences and more general information about the research. According to Beck et al. [4], methodological details and results are often sacrificed in favor of accessibility and visual appeal. In the hierarchy of post quality proposed by Wyrich and Bogner [20], the highest level should include the title, one or two sentences about the topic, the URL for the paper, the main results, and a discussion of the implications of the research. In line with that proposal, *we recommend that, for communication to be effective, it should also address the motivation or research problem, the research goal, and the methodology — in other words, all the elements expected in formal science communication — in a clear and concise manner.* It is important to keep in mind that the abstract of the research paper itself, when well structured, can provide all this information.

Regarding the visual resources of the posts, it is clear that images are used in the vast majority of posts (83.7%), while in the research by Wyrich and Bogner [20] they appear in only 30% of the posts, suggesting that the Brazilian SE community makes broader use of visual resources. We also observed that posts with images have, on average, 64.1 interactions, while posts that do not display images have 40.9 interactions on average. LinkedIn [16] states that posts with images tend to receive twice as many comments as posts with only text. Based on these results and LinkedIn's statement, *we recommend the use of images in conjunction with a well-structured narrative, as a good practice for scientific communication, as their use tends to stimulate readers' interest and attract more comments.*

Software Engineering science communication on LinkedIn is mostly done (62.2%) by individual authors with professional affiliations with the industry. A similar scenario was found in the work of Wyrich and Bogner [20] who found that 59% of the authors are affiliated with the industry. The fact that the industry profile is the majority among the authors of the posts may be related to the fact that it is a profile more accustomed to using this tool, which is, in fact, designed to promote individuals and contribute to the construction of personal marketing [18].

Users with academic profiles, on the other hand, might not yet have the culture of using social media to engage non-academic audiences. In addition, there are also aspects that do not favor the practice of science communication on channels such as social media, such as the overload of activities that academics are usually involved in, as well as the lack of knowledge on how to do this type of communication. Given the time constraints and the impossibility of following more comprehensive recommendations, *we recommend, as an alternative, publishing the paper's abstract directly in a post.*

Despite industry authors being the authors of most posts, when analyzing the frequency of posts, we found that authors with academic affiliations have a higher frequency of posts per author. This means that, while there is a greater diversity of professional profiles contributing to science communication, academic authors participate in smaller numbers but are more active and consistent in the communication of SE research. It is interesting to note that from the perspective of LinkedIn [16], the consistency of posts in a given niche builds specialized authority. Thus, an author becomes identified as a reference in the area, increasing the visibility of his/her posts. Therefore, *we recommend that authors publish regularly while maintaining thematic consistency.* This helps establish the author as a reference in the field, increasing the visibility of their posts.

When analyzing the science communication posts with the highest engagement, one example stands out. A post written by Professor Marcos Kalinowski (PUC-Rio) received 1,128 interactions. In it, he discusses the importance of validating scientific information and the risks of communicating "fake" research. The high level of engagement is likely related to the relevance of the topic, the author's recognition as a researcher, and the didactic structure of the message, which outlines steps to identify reliable research.

Furthermore, according to LinkedIn [16], combining an author's consistent communication with the use of a more personal tone to share their experiences helps to establish a more direct connection with the public, which seem to have made this post more engaging, generating more interactions. Also, if a post gets early likes, comments, or shares, it's more likely to be shown to more people. The types of engagement ranked are comments followed by shares and reactions [16]. Another aspect for generating engagement in a post is the number of tags. In the second post with the highest engagement, also written by professor Marcos Kalinowski (PUC-Rio), a number of 36 users and institutional pages were tagged. *We recommend that authors encourage interaction on their posts by responding to comments or tagging users, signaling initial engagement to LinkedIn so that the post continues to spread.*

From the perspective of the conferences analyzed, SBES and SBQS stand out for concentrating the majority of science communication posts. This scenario is not surprising, since these are the national conferences that concentrate the largest and most qualified scientific production in the SE area. ICSE, on the other hand, presented the highest average engagement among the conferences, mainly driven by the interactions of Professor Marcos Kalinowski's post. The Brazilian Symposium on Software Quality (SBQS) stood out in the group of posts not directly related to science communication, being the conference with the largest number of promotional posts, most of which were published on the conference's own page.

7 Final Remarks

This study investigated how Software Engineering research is communicated on LinkedIn, focusing on Brazilian scientific production associated with the the SBES, SBQS, CIBSE and ICSE conferences. The results identified 172 posts that promote science communication. Most of these posts were primarily intended to promote their authors. Individual profiles were responsible for the vast majority of posts, and of these, most had professional affiliation with the industry. However, the posts that received interactions (reactions, comments and shares) were those created by academic authors.

These results help to better understand how LinkedIn is being used to communicate research in SE and provide ideas and recommendations on how to use it more effectively. In a scenario where many scientific papers have restricted access, understanding the role of LinkedIn as a tool for science communication, which promotes a dialogue between academia and society and strengthens the visibility of research and its authors, enables its strategic use for the democratization of knowledge.

This work makes an important contribution to both the field of science communication and higher education, as it is one of the few studies that analyze the use of the social network LinkedIn for communicating within a specific field. The methodological procedures and research artifacts provided can be used to replicate this study in other areas of knowledge.

The professional focus, its more than 1 billion users, and the close relationship between research in SE and its application in professional practice make LinkedIn a space with great potential for the communication of research and engagement with other academics and professionals in this area. This movement contributes to the construction of a network of scientific knowledge among researchers, professionals, and institutions.

Despite LinkedIn's potential to broaden the reach of science, science communication on the platform still faces challenges — including the frequent presence of self-promotional narratives and the limited use of scientific elements in post content. We hope our recommendations can mitigate these issues.

For future work, we suggest that a broader analysis of the content and authors of the comments could complement the understanding of post engagement and impact. This would make it possible to know, for example, which profile comments the most, whether industry professionals or researchers. Another suggestion includes conducting a survey, or even in-depth interviews, with authors who frequently engage in science communication. This approach would help uncover the motivations behind sharing research on LinkedIn, the challenges faced, and the strategies they consider most effective for reaching their intended audience. Investigating the point of view of those who consume the information, to verify the most attractive strategies for presenting the research content would also be important.

ARTIFACT AVAILABILITY

The artifacts used in this research, such as spreadsheets, scrapper source code and notebooks, are available in an online repository [2], ensuring transparency and accessibility. This allows other industry professionals to validate our results and replicate our research design in future studies.

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