Special section: Communication of Socio-environmental Risks and Disasters
v. 67, p. 530-558, Jan./Jun. 2026 http://doi.org/10.5380/dma.v67i.98169 e-ISSN 2176-9109

DMA Desenvolvimento e Meio Ambiente

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Expanding dialogue: using digital communication as education tool to reduce landslide-related disaster risks

Diálogo em expansão: o uso da comunicação digital como ferramenta de educação para a redução de riscos de desastres associados a deslizamentos de terra

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Article received on **January 20, 2025** | Final version accepted on **September 3, 2025** | Published on **June 18, 2026**

Abstract: The present study is an investigation on the role of digital communication as tool contributing to landslide-related Education for Disaster Risk Reduction (EDRR) based on using "Encosta Viva" [Living Slopes] Project experiences due to the observed increase in extreme climate events and social vulnerability. Digital communication principles, mainly interactivity and multi-directionality, open room for new forms of information production, consumption, spread and sharing, besides playing relevant role in the disaster risk reduction field, according to which, knowledge production, based on the effective participation of the general public in it, is desired. The current study assesses how the project uses digital platforms – website and Instagram – as educational instrument by analyzing content, engagement and users up to December 2024. According to the results, digital communication provides significant EDRR potential because it allows continuous interaction between different sectors, including expert researchers, students and the general public through digital dialogism and inter-disciplinary actions. The reported experience also highlights the role of interdisciplinary university extension in developing the aforementioned project by connecting professors, students and communities. This association enables articulating university and society, which opens room for knowledge, practices and social experiences systematization. The analysis of networks (Souza & Quandt, 2008) allowed discovering new methodological possibilities, and it helped identifying the satisfactory communication practices and those demanding improvements, in addition to discussing the target audience. The research also enabled identifying challenges and highlighted the need for constant media content production and the uneven access to the internet.

Keywords: digital communication; education; landslides; disasters; risk reduction.

Resumo: Diante do aumento de eventos climáticos extremos e da vulnerabilidade social, o presente trabalho investiga o papel da comunicação digital como ferramenta para a Educação para Redução de Riscos de Desastres (ERRD) associados a deslizamentos de terra, utilizando a experiência do projeto Encosta Viva. Os princípios da comunicação digital, principalmente a interatividade e a multidirecionalidade, abrem espaço para novas formas de produção, consumo e disseminação de informações, podendo desempenhar um papel importante na área de redução de riscos de desastres, onde se deseja uma produção de conhecimento com a participação efetiva do público em geral. Por meio da análise de conteúdos, engajamento e usuários, observados até dezembro de 2024, o presente estudo examina como o projeto utiliza as plataformas digitais – website e Instagram – como ferramenta educativa. Os resultados indicam que a comunicação digital oferece um potencial significativo para a ERRD, permitindo, por meio do dialogismo digital e interdisciplinaridade, a contínua interação entre diferentes setores, incluindo, pelo menos, pesquisadores especialistas, estudantes, e o público geral. A experiência relatada evidencia ainda o papel da extensão universitária interdisciplinar no desenvolvimento do projeto, estabelecendo o eixo professor, estudante e comunidade. Essa relação viabiliza a articulação entre

a universidade e a sociedade, oportunizando a sistematização de saberes, práticas e vivências sociais. A análise das redes (Souza & Quandt, 2008) permite a descoberta de novas possibilidades metodológicas, auxiliando na identificação de quais práticas comunicacionais tiveram efeitos satisfatórios e quais devem ser melhoradas, além da discussão sobre o público-alvo. O trabalho permitiu, ainda, a identificação de desafios, destacando-se a necessidade de produção constante de conteúdo para as mídias e a desigualdade no acesso à internet.

Palavras-chave: comunicação digital; educação; deslizamentos; desastres; redução de riscos.

1. Introduction

The number of landslide-related disasters has been growing in recent decades in Brazil, and abroad. This scenario is made clear by the observed increase in the number and magnitude of these events, and in the extension of territories affected by them (Gariano & Guzzetti, 2016; Hernández-Moreno & Alcántara-Ayala, 2017; Centre for Research on the Epidemiology of Disasters & United Nations International Strategy for Disaster Risk Reduction [CRED-UNISDR], 2019; Gómez et al., 2023; Ministério da Integração e do Desenvolvimento Regional [MIDR] et al., 2024). According to the Digital Atlas of Disasters in Brazil (MIDR et al., 2024), the total of 1562 disasters associated with mass movement erosion were officially recorded in the country from 1991 to 2024. Part of such increase regards the global uncontrolled urbanization process, known for lacking proper planning, mainly in developing countries like Brazil (Da-Silva-Rosa et al., 2015). This process forces the poorest populations to occupy areas notably unfavorable for housing, which increases society's exposure to flood, landslide and drought dangers, among others (Tominaga et al., 2009; Valêncio et al., 2009). Furthermore, the increased number of landslide-related disasters is also linked to climate change, more specifically to extreme rainfall events (Intergovernmental Panel on Climate Change [IPCC], 2014; Gariano & Guzzetti, 2016). Accordingly, disaster risk reduction (DRR) actions must exceed structural measures focused on reducing hazard through interventions aimed at stabilizing hillsides prone to landslide episodes. Therefore, it is necessary updating non-structural actions mostly aiming the reduction of social vulnerabilities.

Thus, it is demanding to shift paradigms related to public policies focused on disaster risk reduction, which requires a more understandable approach to the problem (inter-disciplinary actions by physical and social systems), actions closely focused on people and the effective participation of several society sectors in addressing such risks (United Nations International Strategy for Disaster Risk Reduction [UNISDR], 2015; Marchezini & Londe, 2018).

Social participation in all risk management stages is a cross-cutting requirement that should be pursued in this new guideline. Society, mainly populations exposed to landslide threats, needs to engage in processes targeting the design and implementation of landslide risk management

policies, plans, standards and actions, as well as knowledge production. However, integration and collaboration practices regarding risk management actions taken by different society sectors (public agents, scholars and the population) remain a major challenge, since participation in them is often not effective and, most of the time, those who are most in need are not included in these actions (Eyerkaufer & Sedlacek, 2018).

Nevertheless, education should have the clear potential to sensitize society towards its effective participation in risk management actions. Despite the vast knowledge on disaster risks and components (hazard and vulnerability) at different levels, access to it remains quite limited (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2005). The Sendai Framework[1] (UNISDR, 2015) emphasizes the need for sharing information about risks and about how they are generated. It must count on the full and meaningful participation of stakeholders, since this information should be accessible, up-to-date, easy to understand, science-based, and added with traditional knowledge. Therefore, it is necessary to produce knowledge about local risks and make it popular, as well as foster discussions with different actors about the problem and its coping measures. Petal (2008) states that education on disasters must lead to the best understanding of natural and environmental conditions, and human actions and inactions, causing them. It must be done to encourage changes in individual and group behaviors, to motivate advocacy and increase expectations towards social policies focused on risk reduction.

Education for Disaster Risk Reduction remains as a relatively recent branch of the education field (Kitagawa, 2021; Roslan et al., 2022). However, despite the lack of major refinement in its concepts and analysis, several practical initiatives in formal and non-formal settings are already in place. They are part of institutional education systems, including museums, community associations and others.

Digital communication, which is based on interactivity (direct communication exchange between users and content), multi-directionality (messages are produced, spread and consumed on several channels by different senders and receivers, in real time), segmentation (target audience division into groups) and individualization (personalizing users' experience based on individual preferences) principles, is among non-formal education instruments. These communication-sharing mechanisms associated with digital media turn users into active participants in the sender/receiver and receiver/sender relationships.

1 Sendai Framework is an instrument adopted at the Third World Conference on Disaster Risk Reduction, held in 2015, in Sendai, Japan, which provides a set of guidelines aimed at guiding disaster risk management at global, national, regional and local scale, from 2015 to 2030. It is the very result of both consultations with stakeholders and intergovernmental negotiations, and its implementation and monitoring are supported by the United Nations Office for Disaster Risk Reduction (UNDRR) (UNISDR, 2015).

Accordingly, it is also possible revisiting Freire's (1983) concept of 'edu-communication' and dialogic communication.

> Interlocutors express themselves through the same system of linguistic signs in a dialogic-communicative relationship. Therefore, agreement between communicating subjects is essential for the communicative act to be effective. In other words, a subjects' verbal expression must be perceived within a meaningful framework common to the other subject (Freire, 1983, p. 45).

Communication coming from a dialogic perspective allows reasoning on community's role in building citizenship and on using communication for social change purposes (Kunsch & Kunsch, 2007) based on appreciation for dialogue, on experience sharing and on reciprocal interaction between individuals. Education is communication, dialogue, rather than knowledge transfer; it is an encounter of interlocutors who seek the meaning of meanings (Freire, 1983) to point out alignment with risk communication, based on dialogue.

Information flow, which traditionally consisted of a mediated transmission between speaker and receiver, changes after the internet, and it opened room for new forms of producing, consuming and spreading messages in the digital environment. Social network interfaces structured by visual, sound and textual elements connected by hyperlinks allow the public's insertion into a collaborative media–convergence model whose receiver or user role is as important as that of the sender. According to Bruns (2005), the Gatewatching model consists of the public's active participation in news selection, production and spread as a function previously reserved for old information "gatekeepers", the journalists. Technological updates in communication means allowed this revolution because actors from several society sectors are, currently, capable of using digital tools to address topics of individual or collective interest.

Alexander (2014) states that using social networks for disaster risk reduction (DRR) purposes is quite functional when it comes to opinion research, monitoring and opening public debate in order to collaboratively develop action plans, among others; but it is still understudied. Thus, digital media provides tools to help better understanding different emergencies, disasters, or crisis situations at different fields. It was described in a case study from 2020, which used data generated on social networks to assess the impact of public policies and fake news identification as effective action regarding health surveillance activities (Xavier et al., 2020).

Data from the 2023 Continuous National Household Sample Survey, also known as "*PNAD Contínua*" (Instituto Brasileiro de Geografia e Estatística [IBGE], 2024), showed that the rate of individuals in the age group over 10 years who have access to the internet in Brazil increased from 93.5% to 94.1% in urban areas, and from 78.1% to 81.0% in rural areas. These data have also shown that 96.7% of the Brazilian population uses smart-

phones, whereas the rate of households who have a computer decreased from 40.2% to 39.0% between 2022 and 2023. These data highlight how digital communication is increasingly present in individuals' daily life, in Brazil; after all, mobile devices provide new ways to produce and circulate information. As Othon and Coelho (2016) stated:

> Currently, the internet can be carried "in your pocket", and it leads to constant contact with the virtual world and to individuals' consequent immersion in a hybrid territory. The growing smartphone market, among mobile technology devices, has shown that society is increasingly involved with the mobility culture and with the convergence of several communication functions within a single device (Othon & Coelho, 2016, p. 221-245)

Therefore, digital communication emerges as a non-formal education tool with great potential to be used in EDRR (Education for Disaster Risk Reduction) due to digital media's vast room for interaction, monitoring and continuous updating (Alexander, 2014). At the same time, this practice faces challenges posed by the individual impact of information. In other words, these open spaces, alone, do not guarantee the public's actual efficient influence by the content, which leads to the need for using dialogue and interactivity techniques and tools to broader messages' reach and receptivity.

Thus, those willing to leverage digital media as communication channel with civil society, mainly with communities exposed to risks, at Disaster Risk Reduction (DRR) scope, should adopt dialogical tools to help making these research topics popular. It is essential to enhance investigations based on the experience of using digital communication to achieve this goal, and it must be based on the network analysis methodology known as Social Network Analysis – SNA (Souza & Quandt, 2008). Collected data relational aspects enable identifying new possibilities for using digital media as a non-formal education tool aimed at disaster risk reduction.

> Historically, SNA has been applied in several scientific fields with multiple purposes to help assessing different social phenomena, mainly in analyzing innovation, investigative journalism, terrorist network mapping, epidemics mapping and demographic mobility outspreading, and, particularly, in decision-making processes and knowledge management studies in inter-organizational networks, in the administrative field (Souza & Quandt, 2008, p. 1)

The aims of the present study were to describe, discuss and assess '*Encosta Viva*' [Living Slopes] Project's digital communication experience by using its website and Instagram (social media platform) as non-formal education tools to reduce the risks of landslide-associated disasters. A survey on metrics related to access to and engagement on the social network, and the analysis of the website's content were conducted. The described activities are part of "Encosta Viva" [Living Slopes] Project (Mendonça, 2024) by

Federal University of Rio de Janeiro, which develops a vast set of socio-educational actions to reduce landslide-related disaster risks and to encourage the participatory management of different social actors.

2. Social communication in face of risks

According to Beck (2011), knowing the danger and its consequences are the factors determining the existence of dangerous situations, and it makes risk knowledge politically relevant. Furthermore, knowing that many dangers and risks escape the population's immediate perceptual capacity and make them "invisible", being aware of them must be a socially acknowledged action. This author has stated that this knowledge process is political because it involves awareness of and decision-making on underlying risk factors resulting from how society works; in other words, being subject to competition for different interests and to the viewpoints of those driving modernization and the affected groups. Awareness of risks and their components (danger and vulnerability) depends on social processes of definition. Outcomes of power struggles between actors make risks imperceptible, suppressed, minimized and, consequently, amplified and outspread, given the poverty rates observed in developing countries. Therefore, in this case, disasters are often attributed to the population's cultural "blindness".

Based on the framework described by Beck (2011) and on Sendai Framework precepts (UNISDR, 2015), risk communication is of paramount importance in the process to outspread knowledge on this topic, including public debates and the primary participation of individuals unevenly affected by disasters, and it opens a window of possibilities for the production of new knowledge.

Risk communication is basically interdisciplinary, since it encompasses knowledge fields such as Social Psychology, Law, Administration and Social Communication (Rinaldi & Barreiros, 2007; Loose et al., 2021). Furthermore, it is multi-sectoral, because it includes institutions, the media and the general public. Yet, it is one of risk management pillars covering hazards and vulnerabilities (UNISDR, 2015). Risk communication also accounts for influencing social and cultural behaviors regarding risk factors by sensitizing the involved social actors (Covello et al., 1986; Covello & Sandman, 2001). This term became popular in the 1980s and was defined by the National Research Council as:

> Interactive process of sharing information and opinions among individuals, groups and institutions. It is a dialogue in which multiple messages that express concerns, opinions or reactions to the messages themselves or to legal and institutional arrangements of risk management are discussed (National Research Council [NRC], 1989, p. 21).

Oliveira et al. (2023) highlight that the risk communication model focused

on technical aspects has prevailed, although it proved itself deficient, besides marginalizing the affected population.

Therefore, the goal of this practice – in addition to outspreading relevant information to the public in an easy-to-understand, simple, transparent and accessible way by adjusting the message to the target audience – is to encourage knowledge sharing by different stakeholders. Risk communication is successful when the involved actors understand the risk issues and taken actions. However, it does not guarantee that personal decisions regarding personal well-being will be made, since it actually depends on how people perceive and deal with risks (Rohrmann, 2008; Wu & John, 2021).

The risk-management organizational or administrative spectrum holds the bodies responsible for risk prevention and reduction, and disaster response and recovery. Protocols established for a potential disaster, which are often part of contingency plans, are at this scope. The series of information, notifications and procedures issued by bodies like the National Center for Monitoring and Alerts of Natural Disasters (Centro Nacional de Monitoramento e Alertas de Desastres Naturais [CEMADEN], 2025) and Civil Defense agencies is a practical example of it in landslide cases. This information is often passed on to the involved actors and to media organizations. This process involves information sharing and interaction with society from the social communication perspective, and it takes place through several communication means, such as newspapers, radio, TV and digital media (social networks and messaging applications). However, Marchezini and Londe (2018) highlight gaps in alert systems' communication component and emphasize the relevance of questioning the validity of risk communication processes that only spread information in a single-sectoral way, without the effective participation of the vulnerable population.

Risk communication during crisis situations, such as socio-environmental disasters, is broadly assessed, and it is observed at disasters' response and recovery stages. However, risk prevention and mitigation communication must be a long term and continuous action in order to be effective. According to Loose et al. (2021):

> It is also important emphasizing that, although risks and disasters are related to each other, they are not always discussed together – and the same happens in the Communication field. A disaster is understood when a risk stops being a prediction and becomes a concrete fact, and causes a series of damages and losses. Communication focused on disaster falls into a more factual and immediate service perspective, whereas that focused on risks has a preventive dimension to mobilize actions that avoid or minimize the effects of the disaster (Loose et al., 2021, p. 40).

Social communication as EDRR (Education for Disaster Risk Reduction) instrument can develop its potential in this very context. The understanding of information as fundamental right (*Constituição da República Federativa do Brasil de 1988*, 1988) and way to exercise citizenship; technological up-

dates in telecommunications and reconfiguration content production, distribution and consumption of content; impact of digital media on message transmission and reception increase on a daily basis; enhance the dialogue production among science communicators, communities and the involved social actors.

The shift from traditional communication media, such as newspapers, magazines and radio, to digital media reconfigured communication practices also allowed the emergence of new actors in the telecommunication sector (Ferraretto & Kischinhevsky, 2010), most notably, in the general public. According to García-Avilés et al. (2008) and Salaverría and García-Avilés (2008) these technologies' convergence also resulted in the integration of tools, spaces, work methods and languages. The digital media enables a more understandable content sharing between senders and receivers, without the need for a mediating vehicle. This is a remarkable change because it allows the public to decide – even if under the influence of factors such as Instagram algorithms[2] and online search tools, like Google – their topics of interest and those deserving to be outspread. The revitalization of tools, spaces and languages in the scientific spread context has opened a new channel of dialogue between the scientific community and citizens. According to Bueno (2010), science communication works by "(...) democratizing access to scientific knowledge and [by] establishing conditions for the so-called scientific literacy. It, therefore, helps including citizens in the debate on specialized topics that can have impact on their lives and work" (Bueno, 2010, p. 2).

Thus, digital communication provides the possibility of playing an integrated role in engaging several civil society sectors in addressing the risk reduction issue, which allows scientific spread and knowledge sharing. This process triggers and reinforces the discussion, conception and execution of policies, plans, standards and actions aimed at more efficient outcomes. This is especially true when it comes to recognizing and preventing risk situations, and to promoting dialogue among different involved actors to tackle the matter, since the internet connects the population to communicators and scientists.

Unlike mainstream and mass media, whose topics tend to be specific and follow a media agenda, and newspapers prioritize the coverage of singular events and discontinuous occurrences that have impact on their audience (Loose et al., 2021), interactive and segmented digital communication can be a path to more democratic and continuous risk communication among different social agents.

2 In 2016, Instagram announced the use of an algorithm to rank the most relevant subjects to each user. It modifies the chronological order of posts, according to interactions (likes, comments, profile visits). According to Moreira (2021), the company owning Instagram claims that it will make publications invisible, it will only be a change in relevance. However, it also intends to monetize "relevance" through payments made by users.

3. 'Encosta Viva' [Living Slopes] Project

'*Encosta Viva*' [Living Slopes] extension project by UFRJ Polytechnic School was launched in 2010 to conceive, plan and conduct socio-educational workshops on landslide-associated disasters in order to help making individuals aware of some participation forms capable of contributing to a more efficient and equitable risk management (Mendonça, 2024). The project is coordinated by the Geotechnics professor (one of this articles' authors) and counts on contributions by researchers from different science fields, and from extension students enrolled in undergraduate courses, namely: civil engineering, environmental engineering, geology, geography, architecture and urbanism, social work and social communication. The project's socio-educational activities take place in different formal (schools and universities) and non-formal education spaces, such as museums, community NGOs, civil defense agencies and university events.

The principles guiding the project activities were built upon both scientific literature on DRR (Disaster Risk Reduction) and the project's own experiences, with emphasis on incorporating workshops to different educational structures; on activities mostly based on observations and experiments, in addition to theoretical presentations; on interactivity and participation in activities; on connection with local communities reality, especially those exposed to landslide threats; on considering the public's risk perception; on dialogic association between different participants in the activities in order to produce new knowledge; on the potential to generate critical thinking about the reality, to favor the construction of personal and social capacity and to enable the transformation of social power relationships. The project's DRR activities used different dynamics and instruments like models, videos, games, field activities and discussion roundtables (Mendonça & Lucena, 2013; Mendonça & Valois, 2017; Mendonça et al., 2019a; Mendonça et al., 2019b; Mendonça & Abrantes, 2021; Reginensi et al., 2022).

It is worth highlighting the partnership set with "Espaço Ciência Viva" [Living Science] Museum back in 2015 (Paula et al., 2015). This museum is located in Rio de Janeiro City and its goal is to outspread scientific knowledge on different topics. This partnership allowed the project to launch workshops known as "Science Saturdays" on landslides for students from visiting schools and for the general public, on a monthly basis.

Educational activities overall aim the physical and social aspects concerning the landslide-associated disasters topic, which cover the following elements: concepts of landslide and disaster, natural and anthropogenic factors contributing to landslides, hillsides social and physiographic occupation processes, disasters' possible impacts on communities; disaster risk reduction actions; emergency-evacuation alert system and how it can help reducing risks.

The workshop "When the Earth Gives Way" is the most often educa-

tional activity carried out by the project group in schools and museums. It uses an interactive model in a simple and playful way to introduce and discuss the afore mentioned physical and social aspects (Mendonça et al., 2019b).

The project also aims at training extension students on this topic and at encouraging them to reason on the socio-environmental reality of 'at-risk territories' at the time to elaborate and develop pedagogical tools based on interaction and public participation in socio-educational activities. This experience helps students to acquire a systemic view of landslide-associated disasters issue, which is a rarely, or not addressed, topic in undergraduate courses. This experience is an opportunity for students to learn about underlying risk factors and to perceive the interdisciplinary and inter-sectoral nature of this matter.

4. The digital medium of 'Encosta Viva' [Living Slopes] Project

4.1. Digital communication construction and pathways

The digital environment of 'Encosta Viva' [Living Slopes] Project was built and is coordinated by the present authors. It consists of digital platforms – website and Instagram.

The project's website (Projeto Encosta Viva, 2024) was first designed in 2021 to document its in-person activities, such as workshops and discussion groups. The website was development during the pandemic time, when digital communication means got more intense and the digital medium became essential, even for scientific outspread. The website was also designed to include a repository of scientific articles related to the project.

The website was developed in WordPress, as extension of UFRJ Polytechnic School website. It was the first step towards the projects' availability online. It was possible curating relevant information after searching for and compiling documents related to the project's history and activities. Therefore, more than just a documentation protocol, the website was developed as the means for informally outspreading knowledge. Currently, the website is mostly developed in CSS and Elementor plugin. Figure 1 shows its homepage.

The website comprises eight pages, as described below (Figure 2):

1. Homepage: brief introduction of the project, contents on the site, and highlights on the latest news.
2. The Project: two sections – "Get to Know the Project", project introductions, including its definitions, mission and history; and "Who We Are", featuring all current team members, as well as former members and partners or supporting institutions.

Figure 1
Encosta Viva [Living Slopes] Project website's homepage showing the sections.

3. Fundamental Concepts: "Disasters vs. Landslides", "History of Landslides in Brazil" and "Social Construction and Risk Management" – contents mostly developed by extension workers.
4. Education (two sections): "Formal Education", the project's activities in schools; and "Non-Formal Education", activities outside the formal school discipline matrix, such as the workshop "When the Earth Gives Way".
5. Discussion Roundtables: about the conducted activities.
6. News: about in-person activities carried out by the project, its members and the outspread of relevant events for the addressed topic.
7. Articles: repository of scientific articles about the project's activities.
8. Contact: contact information and call to social networks.

Then, back in 2023, all team members engaged in content production and they counted on the involvement of students from different knowledge fields. The produced texts presented interdisciplinary contents and they became an integrated exercise for extension workers. It is important highlighting that the covered topics stemmed from team discussions held in weekly meetings.

The project's target audience in the workshops in schools, museums and other spaces showed the activity facilitators (extension students and the project coordinator, among whom, the authors of this article) and their interest in following the project on social media. In addition, extension students' interest in engaging in the project's social media allowed the creation of an Instagram profile for '*Encosta Viva*' [Living Slopes] Project in April 2023 (Figure 3 and Figure 4). The 'stories' tool (temporary posts) was used as means of dialogue to outspread knowledge on DRR in a more accessible and interactive way. Feed posts (permanent posts) were used to spread information and to record socio-educational activities. The posts often result from research on a matter related to the topic and from an initial text, which is revised to make sure that it would be understandable

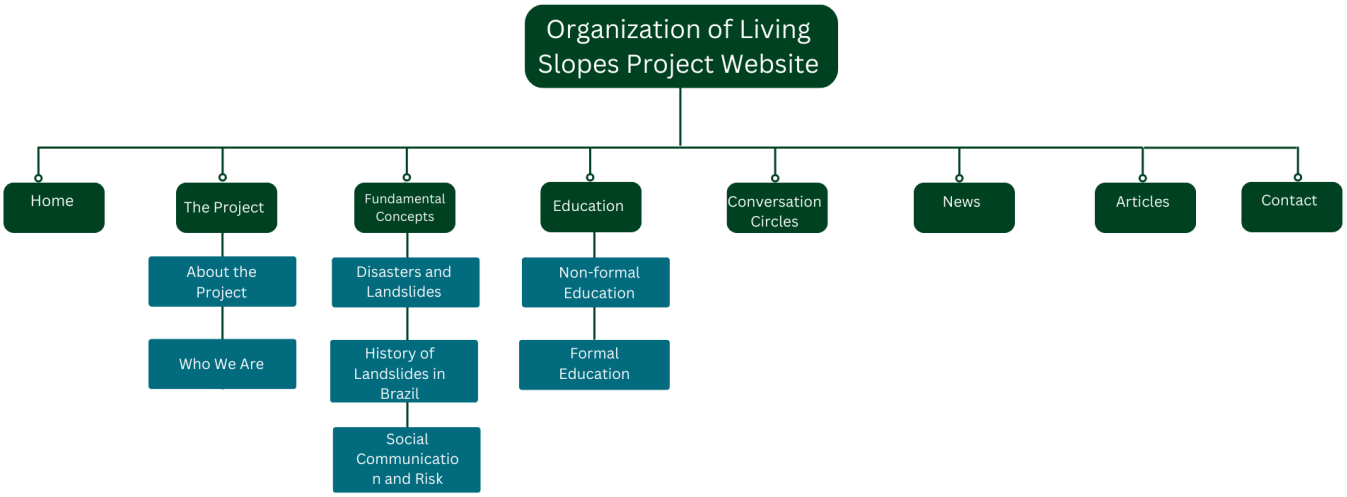


Figure 2

Organization of '*Encosta Viva*' [Living Slopes] Project website.

to everyone, whether literate in the matter, or not. Although videos, such as Instagram's Reels (short videos), are the most viewed media in Brazil (Reuters Institute, 2024), most contents were first created by using still images due to their easier production.

Nevertheless, there is also audiovisual content production, such as the video "How to produce your own rain gauge", which was made available on Instagram on October 4, 2023[3] – it was created by the whole project team. In addition to informative content, the project's social media also records in-person activities, such as educational workshops, academic presentations and lectures. The audience is encouraged to document their participation in workshops, such as those held during the 'Science Saturday' events.

A monthly planning process was elaborated by the team to produce the digital content for Instagram. The team comprised two communication students (one from Journalism and the other from Radio and TV) and four students from other courses; they were in charge of supporting these activities. The Research topics are defined to match the subjects' relevance and urgency. The topics are divided among all participants based on this definition and research results are turned into synthetic texts by the students to allow knowledge spread on Instagram. The artwork is developed on Canva graphic design platform after the content is reviewed by the communication students and the project coordinator. Canva is an online tool to create social media graphics, presentations, infographics and other visual materials. Finally, the post is published on the project's social network. The goal is to publish one post on the feed every 15 days and at least one 'story' on a daily basis.

The goal was to reach 500 Instagram followers during the analyzed period-of-time, but this target was not met due to a series of factors de-

3 Link to the video "How to make your own rain gauge": https://www.instagram.com/p/CviPRh9pJRp/

Figure 3

Home page of '*Encosta Viva*' [Living Slopes] Project's Instagram profile with stories (Highlights).

scribed below. 'Encosta Viva' [Living Slopes] published contents are quite specialized. Despite its scientific and educational relevance, it is difficult to produce and keep efficient organic engagement without advertisements or paid advertising. Extension workers' difficulty in balancing the project schedules and other academic demands, as well productivity loss due to the academic calendar, are other obstacles. Furthermore, the need for systematic training on science communication and on other communication tools aimed at newcomers to the project is highlighted because, although it involves a hyper-connected generation, educational science communication production demands specific technical factors.

The Instagram platform was previously used to engage the public in DRR-related socio-educational activities before the projects' Instagram page was launched. In 2022, an experiment gathering students' personal experience with the environment and their perception about the environment they live in, was conduct at Laudímia Trotta Municipal School, in Tijuca neighborhood, Rio de Janeiro City, as part of a series of project activities. Students attending the activity were asked to join a photography contest about environmental issues in their communities. They got very interested in participating in it. Students were asked to voluntarily submit pictures from their neighborhoods, or from locations they use to visit, where they find some sorts of environmental threats associated with human activity. They also had to write a caption or title for each picture (Figure 5a). In total, 42 students joined the contest, and each student sent in two pictures via Instagram, on average. The images were curated by the project's team and those in compliance with the topic were selected and posted on a specific Instagram account for the photography contest. Counting took place through "likes", and it engaged the students' communities, family members and friends, as well as extension workers. The contest triggered conversations among participants about the topics disclosed in the pictures on the

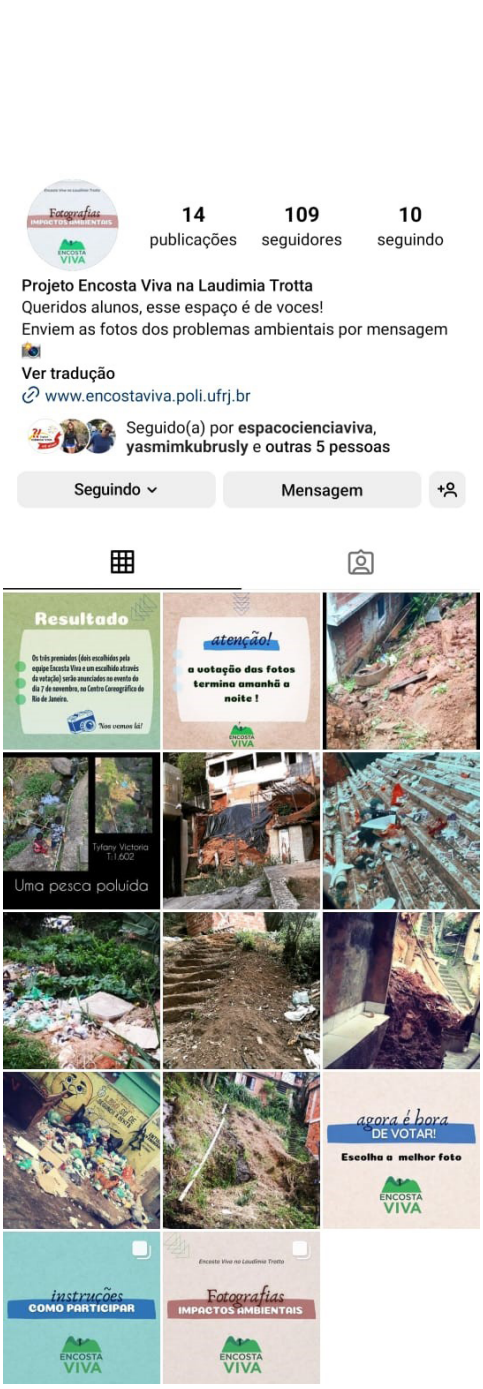
platform. The three most voted pictures were awarded prizes at the end of the contest (Figures 5b and 5c).

Figure 4

Instagram feed posting schedule. (a) April 2024 to November 2024. (b) April 2023 to October 2023.

4.2. 'Encosta Viva' [Living Slopes] Project digital communication analysis.

Digital platform contents follow interactivity, multi-directionality, segmentation, individualization and multi-functionality patterns; therefore, '*Encosta Viva*' [Living Slopes] Project digital communication was analyzed by assessing its communication practices on its website and Instagram. The hypertexts of contents produced by expert researchers, extension students and the general public, as well as the interactivity and information sharing on disaster risk reduction (DRR), were also analyzed. According to Souza and Quandt (2008), the social network analysis (SNA) allows humanities, social sciences and behavioral sciences researchers to find new methodological possibilities:



A

B

C

Figure 5

Instagram posts related to the photography contest. (a) Grid of posts with a set of pre-selected pictures published by the team. (b) Winner picture. (c) Second place picture.

> The scientific use of network perspectives to approach political, social and economic phenomena has warned humanities, social sciences and behavioral sciences researchers about new methodological possibilities. Social network analysis (SNA), in particular, is a multidisciplinary-origin methodological tool (psychology, sociology, anthropology, mathematics, statistics) (Souza & Quandt, 2008, p. 1).

Accordingly, if one bears in mind the use of networks by '*Encosta Viva*' [Living Slopes] Project to bring the public closer to the DRR topic through writings, sounds and audiovisual language resources, it is possible stating that analyzing the project's social networks was a good way to identify the communication practices leading to satisfactory effects and those that can still be improved.

The digital content produced by '*Encosta Viva*' [Living Slope] Project follows hyper-textual presentation patterns, which is based on using images, videos, illustrations, hyperlinks and other elements that combine writings, sounds and visual language adjusted to the "self-service reading" (Xavier, 2010) typical of social networks. The project's socio-educational actions, such as attending the Science Saturday and documenting the activities carried out by the team, are also discussed.

Content, such as explanations about technical terms and their applications for the local community; sharing relevant information to people exposed to threats and vulnerable conditions; showing how to identify the signs of a possible landslide or where to find escape routes, is created for scientific outspread. It is important emphasizing that all contents invite the social network users to engage in discussions and in thought-provoking debates through questioning, making comments and sharing their own experiences.

4.2.1. Analysis of the project's profile on the social network – Instagram.

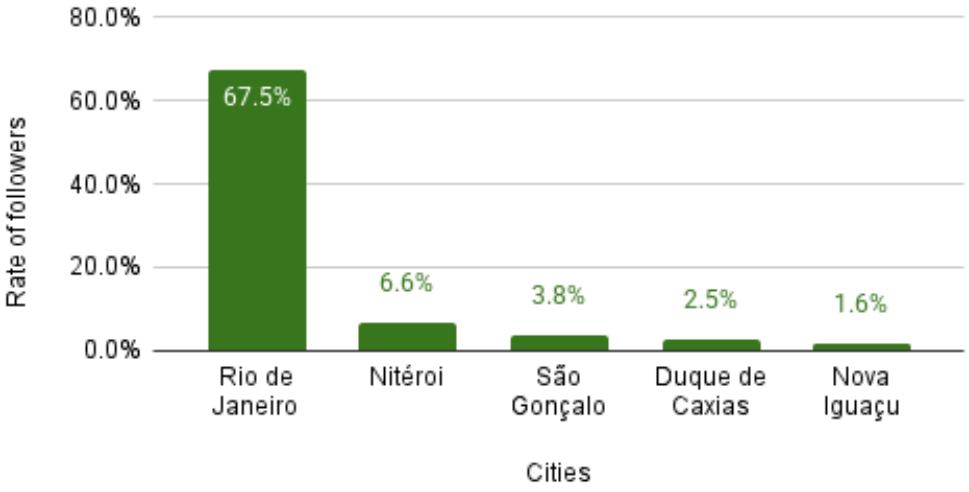
Metrics were collected from data provided by the Instagram platform, which actively monitors users' interactions and the content of '*Encosta Viva*' [Living Slopes] Project posts on Instagram. Metrics related to Instagram users' profile were collected in Meta Business Suite tool, on December 12, 2024. This tool provides a general demographic overview of users interacting with the profile's content (Figure 6) and of the main posted content (Figure 7) based on data available up to December 2024.

The analysis of these figures allows inferring that:

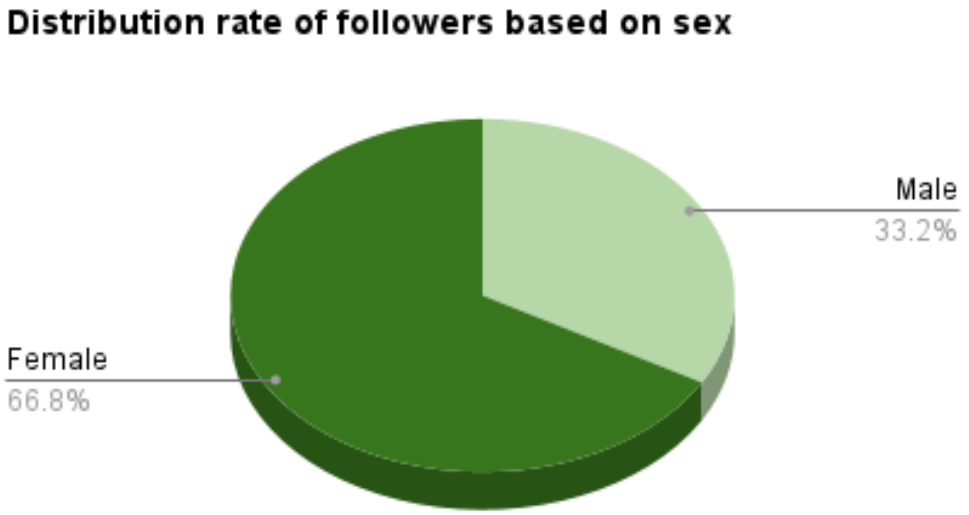
1. '*Encosta Viva*' [Living Slopes] profile research comprises different cities in Rio de Janeiro State. Rio de Janeiro City stood out among these cities (67.5%), and it was followed by Niterói (6.6%), São Gonçalo (3.8%), Duque de Caxias (2.5%) and Nova Iguaçu (1.6%) – all cities located in Rio de Janeiro metropolitan area. There were accesses recorded for other cities, states and countries, but at low rates. It is clear that the produced content manages to reach users in municipalities with sig-

nificant history of landslide-associated disasters; however, its reach is limited if one takes into consideration the relevance of such disasters in Brazil (MIDR et al., 2024). This limitation may derive from the profile's short lifespan (less than two years), from the limited promotion of the profile (which does not use any paid tools for boosting it on social media) and from the limited capacity of the project's team to produce new contents. On the other hand, there was intense public engagement in the profile during the photography contest, and it highlights the greater success of publications about playful activities; it also encourages greater interactivity among users.

2. The project's social media users are mostly women (66.8%) and adults in the age group 25 to 34 years (37.8%). Regarding age group, (21.4%) of users rage from 18 to 24 years and (22%) from 35 to 44 years; this rate is quite lower in the age group over 65 years. The elderly population is vulnerable to hazardous situations due to their physical, economic and social conditions (Ngo, 2012). This finding highlights a current digital communication limitation, since social networks are not widely used by older adults. Alexander (2014) reinforces this observation by stating that individuals over 55 years old tend to prefer conventional information sources.
3. '*Encosta Viva*' [Living Slopes] Project profile's feed was substantiated by the following topics when it comes to content production: documenting the project's socio-educational activities (16 publications) and scientific content outspread (24 publications), which have specific approaches, such as explaining the physical phenomenon known as "fallen lands" – a specific mass–movement type.
4. Temporary posts in 'stories' cover a wider variety of topics and are published more often. 'Stories' contents use to last 24 hours, which makes their quantitative analysis impossible. Only 'stories' added to the Highlights and permanently kept on the Instagram profile were taken into account. These 'stories' distribution consisted of presentations at academic events (13 posts), sharing news about the topic (9 posts), information about using rain gauges for alert systems (9 posts), announcements about future Science Saturday events (6 posts), project team introductions (5 posts), records of held workshops (2 posts) and of other carried out educational activity types (1 post).
5. A whole variety of content types are possible and they regard outspreading the project's socio-educational actions, such as contents on the landslide-associated disasters topic. It should be highlighted that having extension students producing contents is an opportunity to extrapolate knowledge to places beyond the classroom, in addition to providing the project with an interdisciplinary and inter-sectoral approach. The challenge of meeting social media demands for frequent content



A



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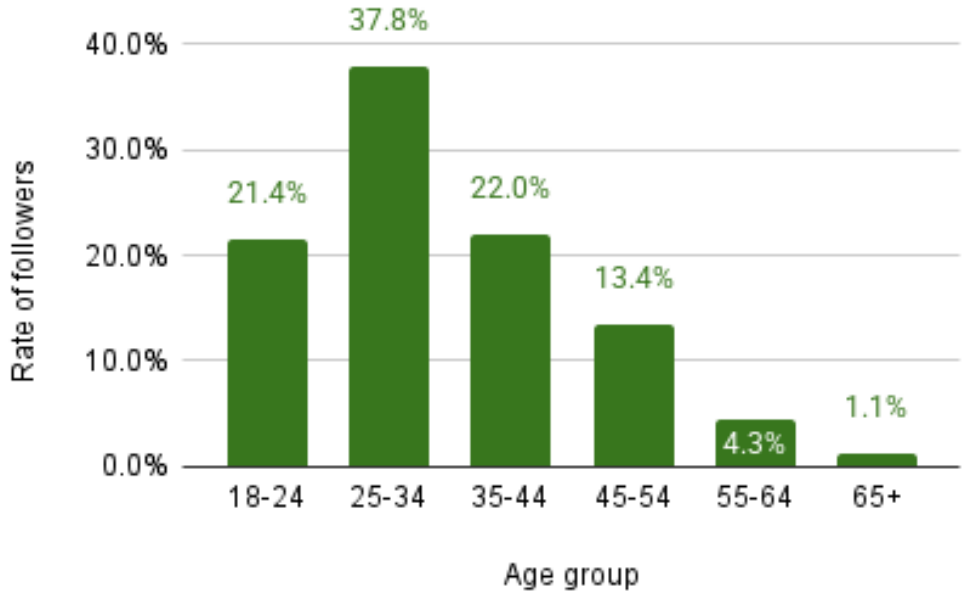
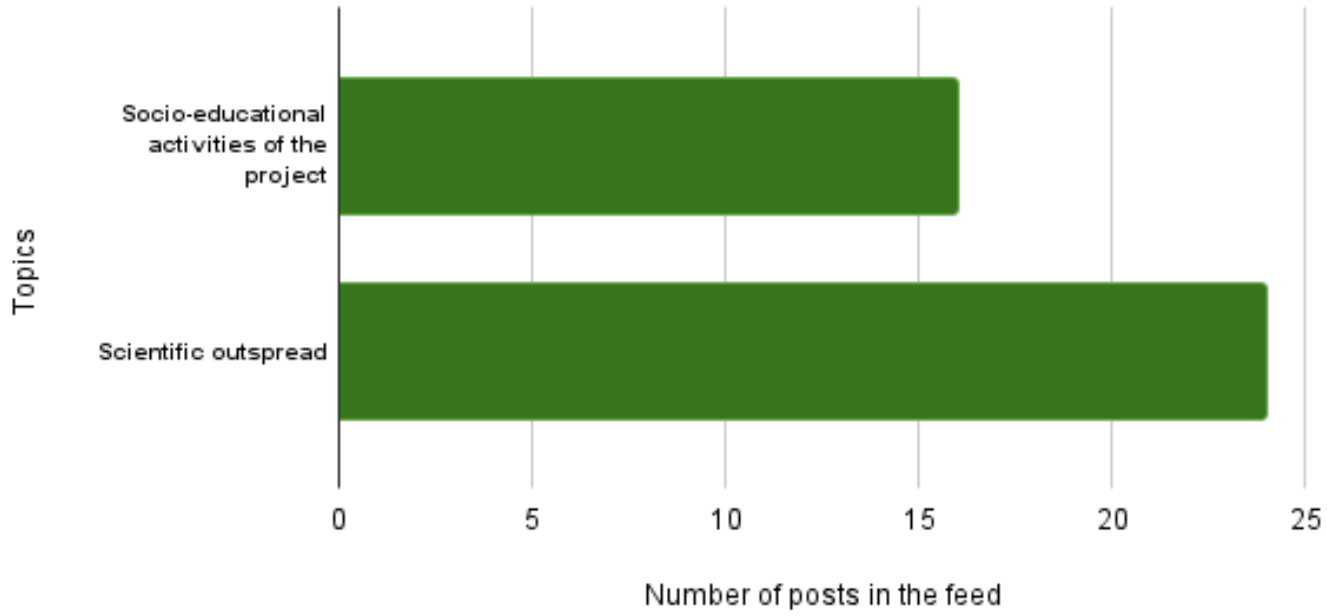


C

Figure 6

Data of '*Encosta Viva*' [Living Slopes] Project Instagram users up to December 2024. (a) Distribution rate based on users' city, in five main cities. (b) Distribution data based on sex. (c) Distribution based on age group.

SOURCE: Elaborated by the authors based on data from the project's Instagram profile collected by Meta Business Suite.



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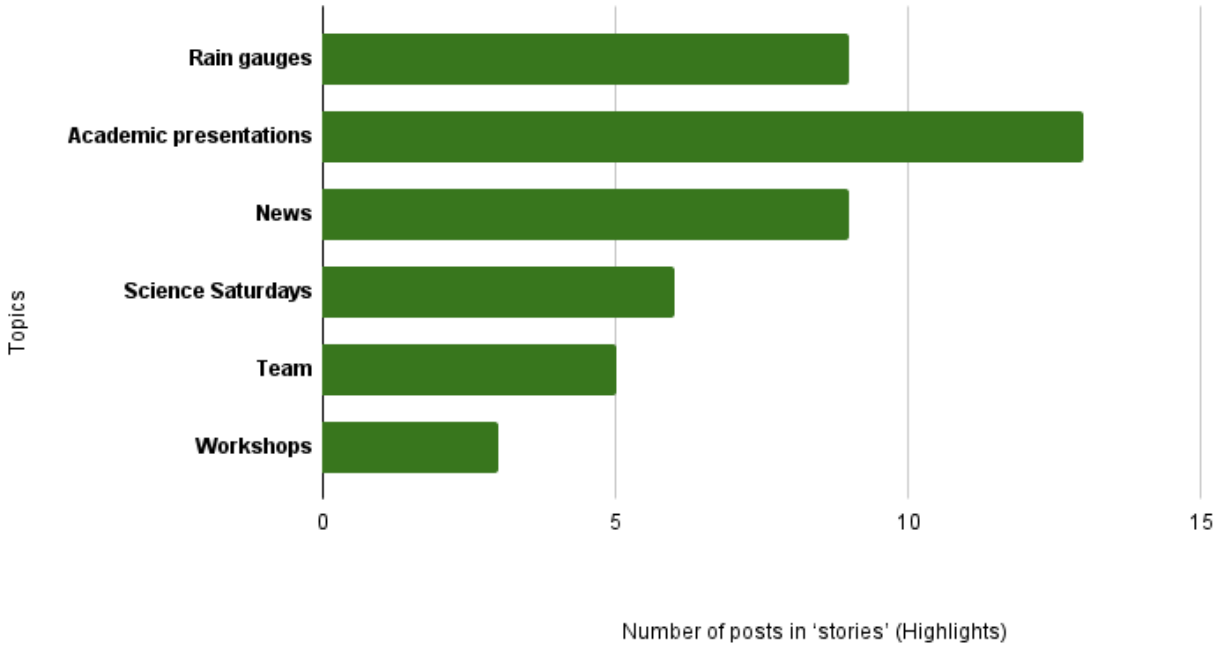

B

Figure 7

Distribution of content categories set for posts on '*Encosta Viva*' [Living Slopes] Project's Instagram account up to December 12, 2024. (a) Number of posts in the feed. (b) Number of posts in 'stories' (Highlights).

SOURCE: Elaborated by the authors based on data from the project's Instagram profile collected by Meta Business Suite.

posting (permanent publications or stories) is noteworthy among these research lines, as content production is often limited by students' multiple academic demands.

Data analysis showed that posts recording a larger number of shares and likes brought more followers to the profile. Similarly, in-person events acknowledged for intense direct contact with the audience foster greater engagement on social media. This finding is consistent with data about Rio de Janeiro City, where the project achieves in-person events; the city accounts for the largest numbers of users (Figure 6a). Accordingly, scientific communication should be seen as a broader network anchored on several socio-educational approaches.

According to the UN (Organização das Nações Unidas Brasil [ONU Brasil], 2020), women account for 80% of individuals mostly affected by socio-environmental disasters and climate change due to pre-existing vulnerabilities (Valeri, 2023), such as limited access to financial and social resources, as well as unequal power relationships in society. Despite the scarce literature on their role in disasters' prevention (Ruszczyk et al., 2020), women are the main active agents at post-disaster times, since they are often responsible for the children or for the elderly. Furthermore, their skills are rarely recognized in disaster risk-reduction policies and practices, which results in their greater marginalization.

Women underrepresentation in disaster research and policymaking is significant, mainly when initiatives are developed in the service provision field (Ruszczyk et al., 2020). According to the analyzed metrics, women account for approximately 70% of the total projects' Instagram followers, and it points out an ecofeminist perspective, in other words, a paradigmatic shift, according to which, women tend to become key agents in risk–communication transformation. Based on the literature, this rate is not a coincidence. The interest in the landslide-related disaster risks topic can be a symptom of search for greater knowledge and of need for social transformation, as disclosed by the collected data.

Instagram still presents difficulties regarding interaction with followers on this social network's profiles. The first difficulty concerns the delivery of content structured by algorithms that personalize users' home pages based on their preferences and interactions on social networks, and boost content creators through paid ads. '*Encosta Viva*' [Living Slopes] Projects' content does not involve paid marketing on its social network because it is entirely organic. Therefore, it hinders the profile's reach and, consequently, information distribution. Turning attempts to interact with users into effective interaction is another observed challenge; it means arousing users' interest and engagement, so that they take actions regarding the content through likes, comments, shares and contact with the project team. Dialogic communication through digital media is more frequently observed through the

temporary posting tool known as 'stories', when users can "anonymously" interact, and also through direct messages (DMs) in response to provocations made in the feed.

Yet, private messages sent to the project via direct messages (DM) have questions and comments about the addressed topics. They also show teachers' interest in conducting the project's workshops in their schools and institutions, as well as students' interest in joining the project as extension workers.

Interactivity was the focal point of the digital communication practice developed through the photography contest conducted in the project's Instagram profile. There was constant dialogue with students enrolled in the school where the activity took place. They sent messages seeking instructions and answers to questions related to the suggested activity. Even family members engaged in the contest, since most of the mobile devices and Instagram accounts belonged to students' guardians. The account was activated and restricted in 2022; therefore, it was not possible to generate the current profile metrics by using the Meta Business Suite tool. However, currently, the profile has 109 followers; the following graph (Figure 8) presents interaction data based on 'likes' and 'comments' on the contest's photography posts: it totaled 838 likes and 58 comments. Although this profile is currently inactive, the experience points to an effective interactivity potential, as well as to a new dialogue with the participating community, which could be a path for future actions in other schools and events. From a metrics perspective, the three pictures accounting for the largest number of likes also achieved the large number of comments. This finding points towards greater engagement when there is more than one way to interact with users.

4.2.2. Analysis of the project website

The content available on '*Encosta Viva*' [Living Slopes] Project's website results from the collaboration by extension workers from different undergraduate courses. Therefore, it leads to interdisciplinary productions that provide more understandable content, as it is demanding by this subject matter. This content aims at using the space as portal to provide technical and scientific information in an accessible, interactive and multifunctional way (scientific outspread, activity logs, news, repository of articles related to the project).

Hypertext elements following the presentation pattern of digital content are used to ensure a more fluid and intuitive reading experience, at providing the audience with a visual overview of the addressed topics through infographics, images, illustrations, historical news and more.

The goal of the article repository is to democratize access to the description and analysis of experiences carried out by the project, so that they can be reproduced or taken into consideration by other actors and institu-

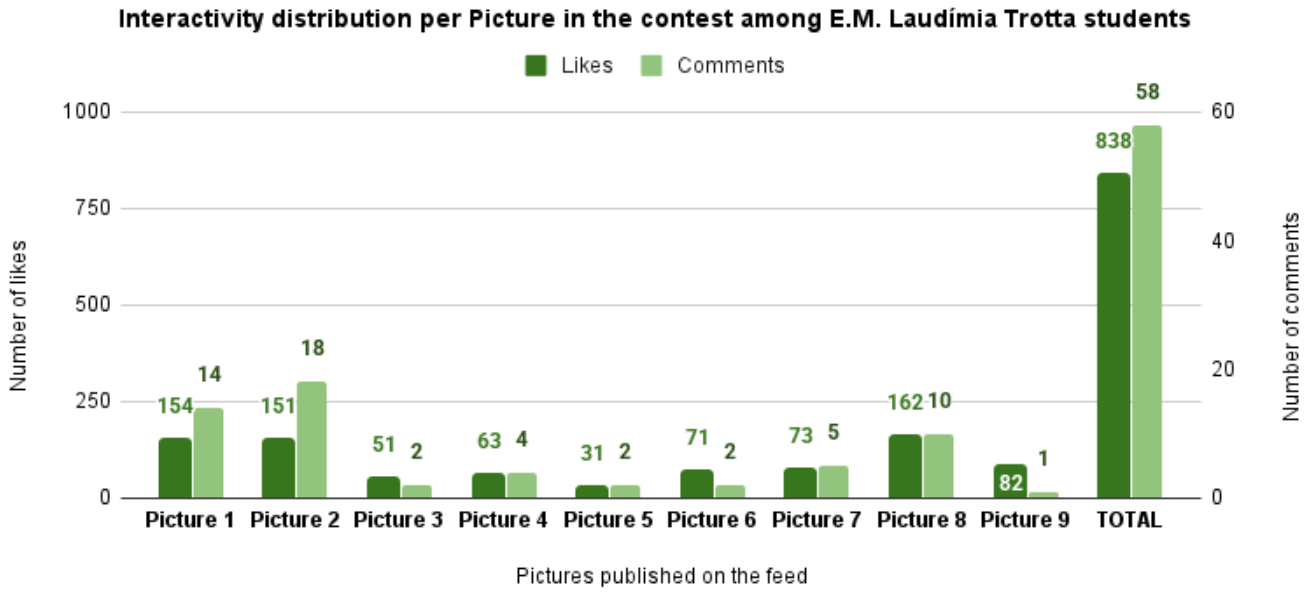

Figure 8

Interactivity distribution among E.M. Laudimia Trotta students based on pictures in the contest profile.

SOURCE: Produced by the authors, based on data collected from the Instagram profile.

tions involved in EDRR activities. Guimarães et al. (2009) emphasize the relevance of outspreading research institutions' intellectual production as essential element to achieve equitable access to scientific information, even more so when one deals with recent topics such as EDRR, as shown by Kitagawa (2021) and Roslan et al. (2022).

Currently, the online repository holds scientific articles about the project's activities (located on the Articles page) and some written content (on the Fundamental Concepts page and on its sections). These texts address the following topics: What are disasters?, Causes of landslides, Landslides impacts, Landslides history in Brazil, The Sendai Framework; The social construction of landslide-related risk and population in risk reduction; The environmental racism issue; Risk management elements and Landslide risk reduction actions.

It is worth mentioning that the website's construction and maintenance also faced challenges related to developing a responsive layout; i.e., functions that properly work in computers, mobile phones and tablets. Using plugins (extensions to enhance the site) was essential in this regard, but continuous CSS and HTML formatting language studies remain necessary to improve its responsiveness and, consequently, to achieve a better experience for its users (UX). Therefore, the website's pages and posts were tested by team members on different personal electronic devices.

The Homepage structure (Figures 1, 9, 10) was the most laborious and modified work throughout the website's development process because the page holds too much information and different sections based on interactive elements, such as call-to-action buttons, latest news and banners. Most importantly, it is the starting point for users' navigation. Yet, the website and project designs are highlighted in this page, which demands several improvements and redesigns.

The website was expected to do not have the same interactivity as social media, so its content is also shared on Instagram to allow greater website access and integration in the project's online platforms. Decision was made to publicize '*Encosta Viva*' Project's participation in events and project highlights throughout the year in the 'News' section. The republication of news related to landslides from other sources, such as newspapers, magazines and podcasts, was only achieved on Instagram.

5. Final considerations

This study addressed the digital expansion of '*Encosta Viva*' [Living Slopes] Project, which focus education on landslide-related disaster risk reduction by presenting two approaches in this regard, namely: its website and Instagram profile. Thus, this research introduces different content and interaction forms, besides highlighting its positive points and limitations. These aspects can be taken into consideration in other digital communication initiatives regarding landslide risk reduction.

Using digital communication by producing interdisciplinary interactive and multidirectional content made available on '*Encosta Viva*' [Living Slopes] Project's website and Instagram profile is a way to connect with publicist audience. It resulted in the increased visibility and interactivity of its socio-educational actions. Digital communication has high potential to help scientific outspread and education for disaster risk reduction (DRR), since digital platforms are a space for dialogue and knowledge sharing with the general public, and with different sectors of society. Therefore, it helps making it more inclusive, popular, democratic and participatory.

However, digital communication faces limitations or challenges, such as internet connectivity (content cannot be accessed if users are offline), social vulnerabilities observed in the country (which leads to unequal access to information and to the digital environment), older adults' lower access to social networks (this population is among those most affected by disasters) and the need for consistently producing new contents.

Along with digital communication, risk communication requires continuity and dialogical communication, as seen in the literature. A search for developing and using available resources focused on the individual is clear in the proposition of having this study as initial analysis applied to '*Encosta Viva*' [Living Slopes] Project's digital environment.

The analyzed data points towards organic growth in the project's Instagram profile visibility, although it is happening more slowly than expected, as well as in users' reaching and in the number of followers. '*Encosta Viva*' [Living Slopes] Project's experience in the digital environment shows that a continuous effort in content production is necessary for the interactivity process, including information outspread, rather than just constant dialogue and learning with the audience. It also requires using re-

Figure 9

Homepage section "Education for Risk Reduction".

SOURCE: Projeto Encosta Viva (2024).

Figure 10

Homepage section "Latest News".

SOURCE: Projeto Encosta Viva (2024).

sources, such as polls and prompts about users' daily lives and experiences in their communities, or questioning their perceptions and perspectives on risks and their management. The adopted tools have encouraged knowledge sharing and fostered awareness through the digital engagement of involved actors. It was done in order to help reducing societal vulnerabilities to risk of disasters lived by individuals as its main focus.

According to the Sendai Framework principles, using the digital social communication approach as DRR tool (Disaster Risk Reduction) in an interactive, interdisciplinary and accessible way (comprising visual, sound and textual elements) to fosters greater engagement of several civil society sectors in developing the DRR culture and, consequently, in pursuing more efficient DRR public policy results.

Finally, the study highlighted the relevance of digital communication as university extension activity. Research activities, interaction and dialogue with the audience outside the university to achieve the interdisciplinary and inter-sectoral treatment of landslide-related disasters, comply with the extension program's goal, namely: achieving transformative interaction between university and other sectors of society.

Acknowledgements

We thank Federal University of Rio de Janeiro (UFRJ), the National Council for Scientific and Technological Development (CNPq), Rio de Janeiro State Research Foundation (FAPERJ) and 'Espaço Ciência Viva' for their support and collaboration.

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