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Bridging Science and Society: The Role of University Science Communication Centers

Tendiendo Puentes entre la Ciencia y la Sociedad: El Rol de los Centros Universitarios de Comunicación Científica

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Abstract
The article addresses the interaction between science and society, focusing on the role of higher education institutions in promoting scientific literacy and knowledge management. It presents the case of a university Science Communication Center (SCC), exploring how this center contributes to effective linking between academia and the community through a dynamic knowledge management model. This model is structured in three phases: knowledge generation, knowledge transfer, and societal feedback, thus facilitating a continuous cycle of interaction and improvement. The article highlights the importance of scientific education from an early age and how it influences public perception and the utility of science in everyday life. It discusses the need for more robust public policies to address inequalities in access and performance in science and technology in Chile, exacerbated by the COVID-19 pandemic. Additionally, the SCC's open science approach is emphasized, which seeks to democratize access to scientific knowledge and foster more active public participation in science. The document concludes that, despite challenges such as funding and impact measurement, effective management of scientific knowledge and public science communication are essential for an informed and engaged society. This case serves as a reference for other institutions aspiring to enhance the interaction between science and society, highlighting the transformative role that universities can play in this process.

Keywords: knowledge management; scientific communication; higher education; scientific literacy; open science

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Resumen
El artículo aborda la interacción entre la ciencia y la sociedad, enfocándose en el papel de las instituciones educativas superiores en la promoción de la alfabetización científica y la gestión del conocimiento. Se presenta el caso de un Centro de Comunicación de las Ciencias (CCC) universitario, el documento explora cómo este centro contribuye a la vinculación efectiva entre la academia y la comunidad mediante un modelo dinámico de gestión del conocimiento. Este modelo estructurado en tres fases: generación de conocimiento, transferencia de conocimiento y retroalimentación de la sociedad, facilitando así un ciclo continuo de interacción y mejora. El artículo destaca la importancia de la educación científica desde edades tempranas y cómo esta influye en la percepción pública y la utilidad de la ciencia en la vida cotidiana. Se discute la necesidad de políticas públicas más robustas para enfrentar desigualdades en el acceso y rendimiento en ciencia y tecnología en Chile, exacerbadas por la pandemia de COVID-19. Además, se enfatiza el enfoque de ciencia abierta del CCC, que busca democratizar el acceso al conocimiento científico y fomentar una participación pública más activa en la ciencia. El documento concluye que, a pesar de los desafíos, como la financiación y la medición del impacto, la gestión eficaz del conocimiento científico y la comunicación pública de la ciencia son esenciales para una sociedad informada y comprometida. Este caso sirve como referencia para otras instituciones que aspiran a mejorar la interacción entre la ciencia y la sociedad, destacando el rol transformador que las universidades pueden jugar en este proceso.

Palabras clave: gestión del conocimiento; comunicación científica; educación superior; alfabetización científica; ciencia abierta

INTRODUCTION

Importance of scientific literacy

The various scientific and technological advancements necessitate citizens to stay updated on scientific topics to encourage informed decision-making. Moreover, access to multiple sources of information presents new communication challenges, including countering false information by citizens interested in evidence and adopting a critical stance toward different sources of information (Díaz, 2004; Suazo *et al.*, 2020; UNESCO, 2021). Thus, it is essential to ensure adequate science education, which correlates with a greater interest in science and technology, a stronger perception of its societal benefits and usefulness in daily life, especially concerning health and environmental care (Conicyt, 2018). This necessity for quality information access and critical thinking became more apparent during the COVID-19 pandemic, where vaccination processes faced interference from baseless information and fake news, emphasizing the importance of a shared understanding of

scientific facts (Hyland-Wood et al., 2021; Suazo, 2020). Additionally, an informed citizenry demands scientists to present results in an understandable manner, alongside accessible platforms for scientific information.

The importance of scientific education in tackling the complex challenges of the 21st century is undeniable. Scientific literacy, defined as the ability to think critically, analyze, and evaluate scientific concepts, is crucial for individuals to make informed decisions and actively participate in solving environmental problems, including climate change (Larrain, 2009; Reid & Hodson, 1993). Currently, there is a consensus on the significance of commencing scientific education early in the academic year, both for its educational value and its capacity to enhance children's willingness to inquire and seek explanations about nature and the environment. However, in Chile, where this article focuses, there are concerning disparities in science and technology, among socioeconomic levels and genders, exacerbated by the COVID-19 pandemic. The following studies confirm these disparities, indicating stable, uneven, and inadequate performance in science:

Survey of Social Perception of Science 2016 and 2022: The 2016 survey revealed a high valuation of scientific activity across all socioeconomic and educational levels, contrasting with the levels of interest and scientific consumption. This suggests a deficit in public policies regarding the population's demands and their effective facilitation of access to information and applied use of science and technology (Conicyt, 2018). The 2022 survey indicated that socioeconomic status is the primary predictor of participation in science, technology, knowledge, and innovation (STKI) activities, with participation declining with age, emphasizing the importance of promoting STKI activities from early ages (MINCIENCIA, 2022).

PISA test (Programme for International Student Assessment) 2018 and 2022: The latest results showed significant stagnation in Natural Sciences since 2006 and in mathematics since 2009, with Chile falling below the OECD average. Analysis of the trend reveals a decades-long decline that predates the pandemic (Brunner, 2023; Izquierdo, 2023). This indicates that since 2006, approximately half of Chilean students have not achieved the minimum proficiency level in Mathematics. Additionally, gender gaps, which had been narrowing before the pandemic, widened for Mathematics and Science, reaffirming the significant impact of socioeconomic status on student participation in the education system.

TIMSS (International Trends in Mathematics and Science Study) Test 2019: Chilean student performance falls below the TIMSS scale center in both grades for Mathematics and Science, with 18% to 30% of students lacking basic knowledge in the evaluated areas. Only 1% of students in Chile reach the advanced level (*Agencia de Calidad de la Educación*, 2020).

These findings are concerning as the sciences are pivotal for the economic development of countries, involving knowledge generation, innovation, and technology (Laugksch,

2000; Makarova *et al.*, 2019), particularly in STEM (Science, Technology, Engineering, and Mathematics) education. National and international organizations concur that these disciplines play a crucial role in achieving the Sustainable Development Goals - SDGs (UNESCO, 2019), as solutions to today's challenges require a new multidisciplinary scientific workforce. However, in Chile, in 2022, total undergraduate enrollment associated with STEM study programs represented only 27.0% of the system's enrollment.

Hence, scientific education is an ethical imperative, as a country's development relies on its human capital. According to Sousa and Pilecki (2018), scientific education also holds a pivotal position in improving the quality of life and fostering responsible and informed citizen participation in community decisions (Quintanilla, 2006). Thus, as acts of democratization of science, engaged research is a means to enhance the public's understanding of science and the scientific process, and to increase public influence on knowledge production (Bell & Lewis, 2023).

Education institutions and knowledge management

The environmental crisis, social problems, and resource depletion are among the primary challenges of this era, supported by the 2030 Agenda and the SDGs. These challenges have further fueled interest in science, technology, and innovation as mechanisms to catalyze the transformations required by problems of such magnitude (Galdos *et al.*, 2020). Addressing these transformations necessitates not only science, technology, and innovation but also collaboration among various social actors to formulate action plans that foster alternative development trajectories toward greater sustainability. These actors include higher education institutions (HEIs), which, as knowledge-creating agents, play a significant role in social and technological innovation contributing to social progress (M'Gonigle & Starke, 2006; Galdos *et al.*, 2020).

This endeavor is also tied to what is termed knowledge management in higher education. Knowledge management in the context of HEIs involves capturing, developing, sharing, and effectively utilizing knowledge within an organization. It entails the ability to identify, organize, and disseminate academic and research knowledge to enhance teaching, learning, and innovation. Effective knowledge management has become a crucial element for educational institutions striving not only to impart education but also to advance and disseminate knowledge in society, fundamental for academic development and research in HEIs (Sánchez-Rodríguez *et al.*, 2021). Through effective knowledge management, HEIs can significantly enhance the quality of education they provide, enrich their research contributions, bolster their competitiveness, and respond more adeptly to the evolving needs of students and society.

It is predicated on the understanding that science, culture, and society are intrinsically interconnected dimensions. Thus, for democracy and the development of contemporary societies, it is essential to make specialized knowledge of the sciences and their methods of exploration and understanding of the world available to people. However, the increasing complexity of the organization, methods, and languages of science, coupled with the vast production of scientific knowledge, can pose obstacles for non-experts to grasp. A Science Communication Center emerges as an opportunity to bridge this gap, with the aim of sharing progress made so that other HEIs can benefit from the experience, encompassing its scope and challenges.

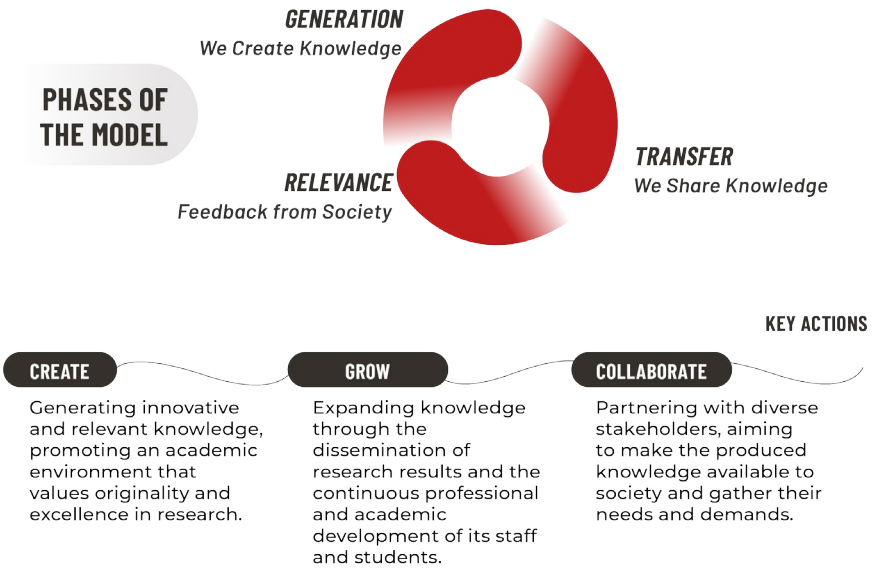
This center operates on the principle that the interaction between HEIs and society is a crucial element in ensuring the relevance of academia and its responsiveness to the evolving needs of the social milieu. Through active engagement with society, HEIs possess the capacity to address large-scale social challenges. In adition, feedback from society offers invaluable perspectives for universities to calibrate and orient their programs and research, ensuring alignment with contemporary challenges (Etzkowitz & Leydesdorff, 2000), including those outlined in the SDGs. This entails adapting educational and research strategies to the evolving needs of society and preparing students not only for successful careers but also to be engaged and conscientious citizens (Bok, 1982; Drucker, 1993). In doing so, universities fulfill their mandate to educate and conduct research while also becoming engines of social change and sustainable development.

Strategic model for knowledge management

In Chile, the National Accreditation Commission (CNA) for Higher Education Institutions proposes a set of quality standards, which include criteria related to research, creation, and/or innovation results, as well as community engagement. These standards challenge institutions not only to generate knowledge but also to actively participate in knowledge transfer processes, develop collaborative networks, and involve students in research activities.

The Knowledge Management Model of the Autonomous University of Chile (Suazo, 2023) is a dynamic system designed to promote the production and dissemination of high-quality knowledge relevant to society. This model consists of three interconnected phases, as described in Figure 1:

Figure 1: Knowledge management model of the Autonomous University of Chile



Phase 1: Knowledge Generation

In this initial stage, the University employs various strategies to produce new knowledge driving academic and scientific progress. To achieve this objective, the institution: (i) fosters original, high-quality research across all fields of study; (ii) establishes capabilities, infrastructure, human capital, policies, and mechanisms; (iii) nurtures innovation, creativity, and critical thinking; and (iv) provides specialized support, financing programs, and training spaces for researchers to develop their research skills. Specifically, during this phase, the institution formulates research, innovation, transfer, and postgraduate policies, along with regulations governing research, such as those concerning intellectual and industrial property and the establishment of centers, institutes, and research groups. Additionally, collaborating organizations are integrated within the directorates, and ethical-scientific and bioethics and biosafety committees are instituted.

Phase 2: Knowledge Transfer

Upon generating knowledge, the university organizes and disseminates it to society through various formats tailored to diverse audiences, aiming to make it accessible to different sectors and foster communities centered around knowledge. To achieve this, the university establishes connections with specialized communities through academic publications, conferences, seminars, as well as through academic journal platforms and institutional repositories. To ensure that this knowledge reaches decision-makers and policymakers in both the public and private sectors, the institution advocates for the implementation of research findings into policies and practices. To this end, the University emphasizes interdisciplinary and inter-institutional collaborations, forging partnerships with other research centers, industries, and local communities to maximize the impact and applicability of the generated knowledge. Within this framework, the Technology Transfer Office (TTO), dedicated to engaging with the productive sector, plays a crucial role. Internally, the university promotes an educational ecosystem enriched by research and the generation of disciplinary knowledge, manifested in specific programs linking teaching and research, such as the scientific initiation program, student scientific societies, and student participation in research groups.

Phase 3: Societal Feedback

In this stage, the university assumes an active listening role, gathering and analyzing the needs and demands of society to guide its future research directions. Particularly in this phase, the university systematizes the development of applied and mission-oriented sciences, grounded in scientific knowledge and aimed at observing the environment and addressing societal problems. In this context, the university strengthens its innovation and transfer capabilities and provides specific support to access applied research grants in national and global founding system. Consequently, the institution demonstrates presence and impact through applied research targeting global and regional challenges related to sustainable development goals and regional development plans.

Drawing on this foundation, coupled with the ethical imperative of disseminating knowledge to serve societal challenges, this article aims to illustrate the practical implementation of a knowledge management model, delving into the proposal of a University Science Communication Center (SCC). Together with scientific dissemination groups and the university publishing house, the SCC serves as a vital interface facilitating dialogue between scientists and society, while also establishing itself as a local and international reference in science communication.

METHODOLOGY

The article presents the results of a case study, aiming to conduct a comprehensive analysis of a specific case and its context to comprehend its evolution or progression (Creswell, 2014). In this study, the unit of analysis is the Science Communication Center, which was examined through a thorough and systematic analysis of its background, foundations, and historical development. The guiding question for this analysis was: How is a knowledge management model related to and implemented by a higher education institution? To address this question, the article provides a detailed description of the SCC, elucidating how it evolved over time in tandem with advancements in scientific communication and education.

RESULTS

The Science Communication Center (SCC) is an initiative of the Autonomous University of Chile in 2018 with the initial aim of bridging the gap between scientific work and the general public, thereby contributing to a better understanding of research's significance and its societal impact. At its inception, the SCC expressed concerns about the proliferation of pseudoscientific theories leading to public confusion in decision-making processes, highlighting the necessity for scientific knowledge to address this issue. Additionally, it sought to foster ongoing communication among researchers, professors, and students, while supporting the organization of seminars, conferences, and academic events to facilitate the sharing of discoveries and advancements across various disciplines. As of 2024, it remains the sole science communication center within a higher education institution nationwide.

After six years of operation, the SCC underwent a paradigm shift in its approach and scope, emphasizing Public Communication of Science and Technology (PCST) on a national and international scale. This shift recognizes the importance of disseminating scientific and technological knowledge to the public while actively involving them, aligning with the principles of citizen science. PCST encompasses multidisciplinary activities aimed at communicating, disseminating, and promoting scientific and technological knowledge among diverse audiences to enhance scientific literacy, public understanding of science, and citizen engagement in scientific research and its societal implications. It addresses how scientific culture integrates into popular culture and establishes and maintains relationships between scientists and non-scientists. PCST encompasses various practices, including scientific dissemination, scientific journalism, and public relations in science, all aimed at facilitating public understanding and engagement with science (Alcíbar, 2015).

Objective, Mission, and Vision:

Objective: "To have a significant impact on the enhancement of PCST, both nationally and internationally."

Mission: "To generate and disseminate scientifically relevant knowledge to society and promote the creation of forums to capture public interests, opinions, and perceptions regarding various scientific topics."

Vision: "To be a proactive force in fostering science's interaction with various societal sectors and transforming the university into a hub for scientific culture and the development of innovative initiatives in PCST."

The SCC strives to generate and disseminate scientifically relevant knowledge to society while fostering forums to capture public interests and opinions on scientific issues. This revised mission signals a broader commitment to promoting scientific culture and fostering innovative initiatives in PCST, moving away from the "deficit model" (Wynne, 1991), which posits that public lack of scientific knowledge is the primary barrier to understanding and accepting science. Instead, the SCC adopts a more participatory and collaborative approach to science communication, aiming to initiate a two-way dialogue between science and society, engaging the public in the creation of relevant scientific knowledge and evidence-based policy formulation. Bucchi and Trench (2014) even advocate for a three-way dialogue that includes representative participation from society in research ideas and scientific governance, fostering active citizenship crucial for modern democracies to interact with science and its institutions.

Team

As for its team, it is made up of a team of science and communication professionals who manage various expressions of public science communication, such as seminars, courses, research, scientific journalism and scientific dissemination with a view to contributing to the development of the PCST in the country and establish new communities around knowledge, through the creation of Scientific Culture Programs that address scientific topics relevant to society in a profound and accessible way.

Programmatic strategy

With respect to methodology, the SCC has a set of Scientific Culture Programs at its base. The Scientific Culture Programs represent a comprehensive strategic approach aimed at continuously and progressively addressing issues of public interest that are aligned with science and research. This model focuses on developing relevant and contingent content on big topics that can be communicated in a deep and accessible way

through a variety of communication formats. Until 2024, the Science Communication Center has developed four scientific culture programs: "Alexandr-IA" (for the dissemination of artificial intelligence), "Gea" (for the communication of Planetary Health), "How are you?" (for mental health communication) and "Scientific Citizenship" (for the study of Public Communication of Science and Technology and citizen participation). These programs are aimed at audiences not specialized in scientific fields, and seek to encourage public conversation, collaborate in the understanding of issues, and promote the appropriate use of tools related to science and technology in society. The description of each program is in table 1:

Table 1. Description of SCC programs

Program	Description
Alexandr-IA (Artificial Intelligence)	Alexandr-IA is an outreach program designed to promote public understanding, awareness, and discussion on topics related to artificial intelligence (AI). This program aims to bring complex AI concepts closer to the general population, promoting their literacy and reducing the ignorance and fears associated with this emerging technology. Through a variety of activities and resources, such as interactive workshops, informative talks, podcast and online content, "Alexandr-IA" seeks to facilitate the understanding of AI and its impact on different aspects of daily life, from health to the economy.
How are you? (mental health)	"How are you?" promotes public understanding, awareness and discussion of issues related to mental health in a manner based on scientific evidence. This program aims to bring mental health topics closer to the population, reduce the stigma associated with mental disorders, and promote self-care and support practices for people facing mental health challenges. It uses different strategies and approaches framed within the knowledge management model to reach different audiences and transmit information in an entertaining and rigorous manner, thus promoting knowledge and understanding of mental disorders, as well as the prevention and care of mental health.

GEA (Planetary Health)	Gea is a Scientific Culture Program designed to promote the understanding of planetary health and establish public conversation about how the degradation of human health is a consequence of the degradation of the different ecosystems of nature, based on updated scientific evidence. This program aims to explain how the water crisis, dietary behavior and urban development affect human physical and mental health and also address the impact of humanity's actions on the health of ecosystems.
Scientific Citizenship	This program promotes the development of Public Communication of Science and Technology (PCST) and Citizen Science at a local and international level. To do this, cultural objects are created that motivate public conversation around scientific culture; research and training activities are carried out that promote critical thinking and skill development in the areas of PCST and Citizen Science; and the generation and strengthening of communities with interest in various areas of scientific culture is promoted.

Principles of the Science Communication Center

To carry out a PCST project, the SCC has established a series of principles, aligned with the principles of responsible research and innovation, that guide the creation, curation and transfer of content, in such a way as to promote responsible disciplinary performance and aligned with the institutional seal of the university.

Ethics: Scientific and academic integrity is promoted at all stages of the research process, from the formulation of questions to the dissemination of results. In this sense, special care is taken in verifying sources, checking that the disseminated studies have peer review, and that data verification can be accessed transparently at all times.

Gender equality: Gender equality and equal opportunities are promoted throughout the process involving the dissemination of science. To do this, linguistic considerations are taken into account, diversity in the selection of topics, visibility of female references, inclusion of the gender perspective in the development of content, promotion of equitable participation in dissemination activities, such as seminars, panels or others; in addition to promoting education and training in scientific matters with a gender perspective.

Governance: From the public communication of science, there is the potential to improve transparency, inclusion and responsibility in the management of research, positively impacting public perception and trust towards science. To do this, clear and

precise information is provided about the research processes with their methods, results and possible impacts. All this with the possibility of having two-way spaces to receive questions, criticism and feedback from citizens.

Open Science. PCST is integrated within the Open Science paradigm, playing a crucial role in promoting interaction between scientists and the general public. This Open Science approach is not limited to any particular scientific field, but encompasses both basic and applied sciences, as well as natural, social and human sciences. (UNESCO, 2021). It is further agreed that Open Science is necessary to address the global problems of the present, to accelerate the achievement of the Sustainable Development Goals and to make research practices more transparent, collaborative and inclusive.

From this paradigm, open access is encouraged. Thus, all content generated and disseminated by the is free and unrestricted access. Anyone can download, copy or print content without payment limitations. The costs associated with the creation and distribution of content are assumed entirely by the institution, and it is disclosed with licenses that allow its reuse without restrictions.

Another pillar of open science is the involvement of different social agents and citizen participation. What is known as Citizen Science thus becomes relevant. This participatory approach allows citizens to integrate into scientific processes, contributing experimental data, raising new questions or co-creating, together with researchers, a new scientific culture. There are different levels of participation, all of which add value to research, while citizens acquire new knowledge and skills, as well as a deeper and more engaging understanding of scientific work. The result of this open, networked, and transdisciplinary scenario produces an improvement in science-society-politics interactions, which leads to more democratic research (Serrano *et al.*, 2016). In Citizen Science, all people who participate in research without it being part of their employment are considered volunteers, so a scientist from another area, an artist, a student, parents or children can be volunteers for projects that are carried out. open to participation (Fundación Ciencia Ciudadana & Universidad Autónoma de Chile, 2017).

Scientific education: the SCC promotes the development of communities through knowledge, so that citizens can participate in debates about research and innovation and promote the increase in scientific vocations. In this area, sciences for citizenship and education for sciences are fundamental.

Multidisciplinarity: The SCC encourages joint work between communication professionals and scientists from different disciplines. With both perspectives it is possible to achieve better communication of science, more complete, accessible and meaningful to the general public. To achieve this, teams are promoted with researchers from different disciplines, specialized journalists, graphic designers, social media experts, audiovisual communicators, among others. The multidisciplinary view allows us to adapt the content

and format of the different dissemination products, developing strategies according to the target audience, according to the different levels of scientific knowledge, interests and needs.

Knowledge management model applied to the SCC

A model is a framework that guides actions within an institution. The following describes how the knowledge management model is applied both in the SCC and at the level of each program within the SCC.

Application of the model to the SCC

Phase 1 Generation of knowledge:

During this phase, the SCC, utilizing its Scientific Culture Programs, formulates strategies to generate innovative and pertinent knowledge pertaining to the specific theme of each program. The Center generates its own knowledge through its team of researchers, while also compiling research outcomes from institutes, centers, and research groups affiliated with the university. This collective knowledge serves as the foundation for stimulating public discourse and crafting informative content for the programs. The content is interpreted and tailored for the general public, thereby fostering the interpretation and dissemination of scientific knowledge.

Phase 2 Knowledge transfer:

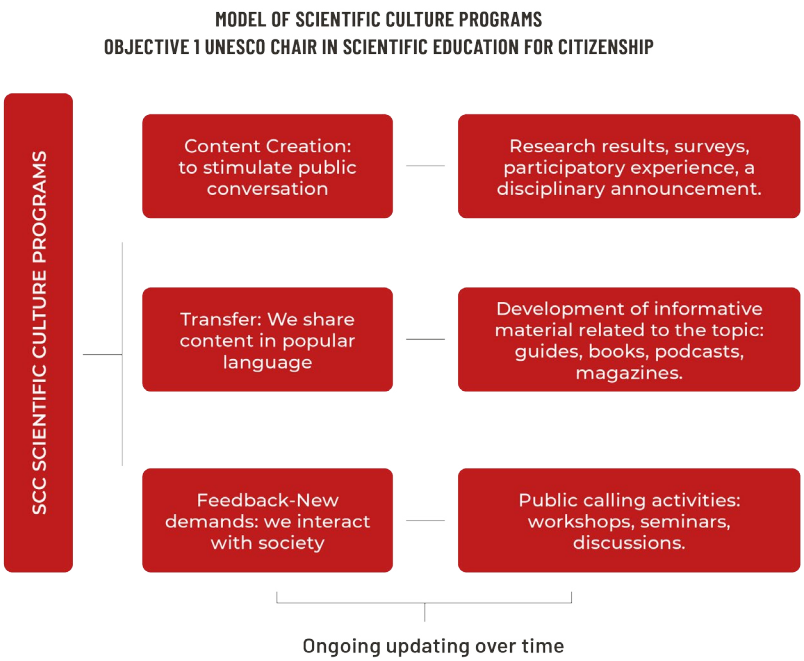
The transfer phase is intricately aligned with the objective of facilitating societal appropriation of knowledge. During this stage, the Science Communication Center employs diverse products and dissemination strategies, including magazines, podcasts, and interactive content, to disseminate the content of the programs to various audiences. Additionally, the interdisciplinary and inter-institutional collaborations highlighted in the model enable the creation of content aimed at fostering scientific and technological vocations, particularly among young people.

Phase 3 Feedback from society:

During this phase of ongoing interaction, scientific culture programs continuously adapt and respond to the evolving needs and demands of society. Understanding of the topics is reinforced through courses, seminars, discussions, and contests, which gather the opinions and concerns of participants. This phase is dynamic and active, involving the SCC's target audience, who provide valuable input regarding new needs for the creation of future content.

Scientific culture programs are consistently enriched with fresh content and organize periodic activities, both independently and in collaboration with new institutions, to foster a dynamic ecosystem of scientific communication within Chile and Latin America. This approach is also aligned with one of the objectives of the UNESCO Scientific Education for Citizenship Chair, whose team is part of the SCC. Their objectives include designing and implementing activities aimed at promoting critical thinking and enhancing scientific literacy among citizens, particularly school-aged girls.

Figure 2: Application of the knowledge management model of the Autonomous University of Chile to the SCC

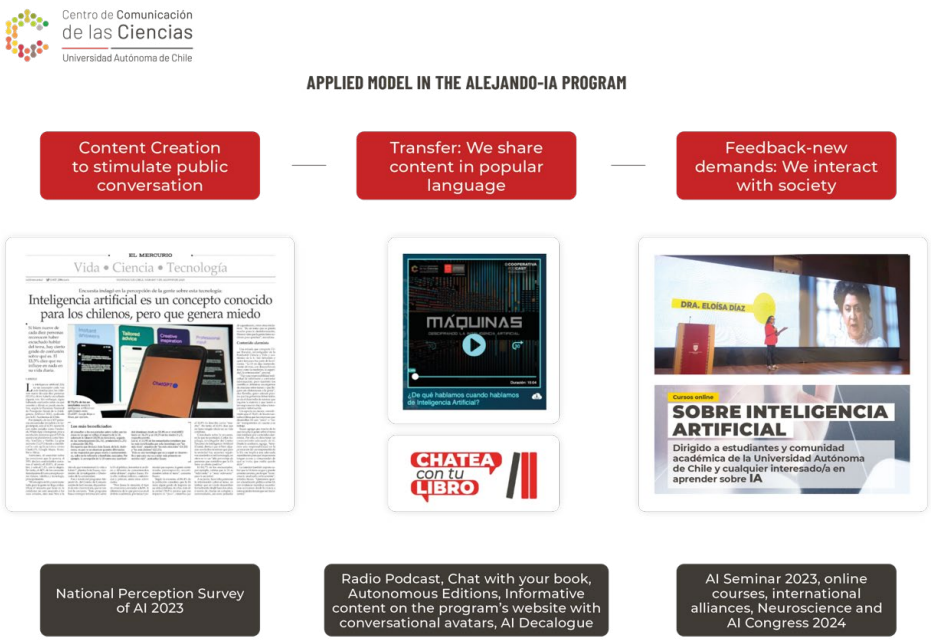


Application of the model to one of the SCC programs

The case of the Alexandr-IA program serves as an exemplary illustration of the knowledge management model, commencing in 2023 with the initiation of the National Survey of Social Perception of Science (Phase 1). This survey was crafted with the aim of comprehending society's perceptions and opinions regarding artificial intelligence, identifying pivotal aspects such as the apprehension expressed by certain individuals towards this technology. Utilizing these insights as a foundation, and spurred by the public discourse generated by this information, the program undertook a series of transfer activities directed at directly addressing these concerns and disseminating scientific and technological knowledge in an accessible manner. Among these activities, marking the transition towards Phase 2, were the broadcast of podcasts on a national radio station (Podcast Machines in *Cooperativa* radio), the creation of informative content on the Alejandría website, the development of the AI Decalogue for teachers in collaboration with the Secretary of Education of Bogotá, and participation in the "*Chatea con tu Libro*" (Chat with your Book) initiative in partnership with University publishing house. These initiatives aimed not only to inform and educate but also to stimulate active participation and dialogue with society.

In actions where interaction was encouraged and public opinions and concerns could be gathered (Phase 3), two international seminars on Artificial Intelligence were convened, alongside online tutored courses. As a culmination of this cycle, plans are underway to conduct a second iteration of the AI social perception survey in 2024, refining the questions and approaches based on lessons learned and emerging needs identified in the feedback process. Thus, the program embarks on a new cycle of knowledge management, where continuous interaction with society remains indispensable to adapt and effectively respond to evolving challenges and demands (see Figure 3).

Figure 3: Application of the knowledge management model of the Autonomous University of Chile to the Alejando-IA program of the SCC



ANALYSIS

The Open Science paradigm advocates for a new social contract between science and society, placing emphasis on broader stakeholder inclusion and political deliberation regarding the long-term implications of scientific and technological innovations (Nowotny *et al.*, 2003). Specifically, it necessitates exposing citizens to scientific knowledge disseminated in a language that enables them to grasp its relevance to their lives and encourages appreciation for the societal value of science (Pabón, 2017). Mere provision of information is insufficient; individuals must actively appropriate this knowledge by integrating it into their daily lives to enhance their quality of life, such as making informed political decisions, adopting healthier lifestyle choices, and taking actions to preserve the environment (Pabón, 2017; Jaillier *et al.*,2015; Suazo *et al.*, 2020).

Over the span of six years, the SCC at the Autonomous University of Chile has endeavored to tackle this challenge, evolving from a platform for disseminating university-generated research to a dynamic space aiming to catalyze the interaction of science with

various societal sectors. This transformation seeks to transform the university into a hub for scientific culture and the incubation of innovative proposals in PCST, a focus this article aimed to delve into. This shift has entailed adapting the planning and communication of activities and content to align with the knowledge management model it seeks to promote, necessitating a comprehensive review of existing practices and the implementation of new strategies fostering co-creation and active participation of diverse teams. The intention is for the model developed and implemented to serve as a blueprint for other higher education institutions aspiring to advance science communication in line with the Open Science paradigm.

The establishment of a SCC has yielded several benefits. For the university, it has facilitated the public positioning of university-generated science and enabled the institution to recognize the social and public value of research beyond traditional metrics. For researchers, it has prompted reconsideration of their knowledge transfer processes from a more holistic perspective, fostering a comprehensive approach to addressing complex issues involving various stakeholders, and receiving institutional validation for diverse dissemination strategies that may require time and resources. Lastly, at the societal level, citizens can access quality scientific evidence presented in accessible language, empowering them to make informed decisions. However, four major challenges remain to be addressed:

Resources for public science

A significant challenge lies in influencing public policy, given the limited allocation of funds for public science and knowledge transfer modalities beyond academic papers. This budget constraint hampers the implementation of broader and more effective communication strategies, which necessitate both human and financial resources. Consequently, the sustainability of these initiatives largely depends on institutional commitment.

To address this challenge, contemporary literature aims to promote public policy initiatives that foster public interest and engagement in knowledge (Bubela et al., 2009). Additionally, there are efforts to enhance public understanding of science in a manner that stimulates curiosity and facilitates exchange and dialogue between science and society (Vásquez-Guevara, 2021). These initiatives are crucial for overcoming budget limitations and ensuring the longevity of spaces dedicated to science communication.

New ways of measuring impact

The successful execution of science outreach programs also encounters a significant challenge, namely, accurately measuring their impact. Despite the growing recognition of the importance of scientific dissemination, evaluating the efficacy of such initiatives remains an under-researched area with limited incentives. The challenge stems from the absence of

standardized methodologies and appropriate metrics to comprehensively assess the impact of these programs. While quantitative aspects such as the reach and event participation can be measured, evaluating the actual influence on public understanding of science proves much more intricate. A nuanced approach is necessary, one that encompasses both short-term outcomes like increased knowledge and interest in science, as well as long-term impacts involving shifts in attitudes and behaviors. Therefore, there is a pressing need to develop and implement innovative methodologies and metrics tailored to the diversity of contexts and audiences in the realm of public science communication (Suazo & Saracostti, 2024).

From a systemic perspective, this process has encountered challenges in its implementation. One of the primary obstacles is the persistence of traditional metrics in evaluating institutions and researchers. These metrics, primarily focused on academic paper production, hinder exploration of alternative forms of knowledge dissemination such as scientific outreach. Moreover, the overemphasis on traditional metrics undermines the engagement of key stakeholders in undertaking public science communication initiatives.

Improve coordination with the media

In general, there has been little institutional coordination towards a more strategic and long-term approach to scientific dissemination. Rather than a cohesive strategy, an ecosystem characterized by individual stakeholder goodwill in proposing and participating in outreach activities has been observed. This lack of structure at the national level can hinder long-term planning and coordination efforts in public science communication.

Another challenge in science communication pertains to the relationship between scientific work and the media. Research by Salgado *et al*. (2017) indicates that academics perceive a low presence of researchers in the media for disseminating their work, partly attributing this to a lack of networks with the media and limited interest from media outlets in disseminating scientific knowledge. These findings underscore an inadequate dialogue between researchers, media, and journalists, inhibiting the widespread transmission of scientific information and knowledge. Hence, there is a need to enhance coordination between academics, scientists, specialists, Associations of Journalists and Professionals for Science Communication, and the media (Tabja *et al*., 2017), while also fostering communication networks among these actors to establish new dissemination channels across various media platforms such as television, radio, social networks, and public spaces frequented by citizens like shopping centers and cinemas (Conicyt, 2018). Such efforts align with UNESCO guidelines outlined in the manual "Journalism, 'Fake News,' & Disinformation," providing information professionals with tools to combat disinformation from fake news (UNESCO, 2018).

Strengthen communication skills of researchers

Effectively communicating scientific knowledge to non-specialized audiences is essential for promoting scientific literacy and combating misinformation. However, many researchers and academics lack the necessary communication skills for this task, as they are often trained to communicate within academic circles using discipline-specific terminology (Brownell *et al.*, 2013; Kennedy, 2007). As a result, dissemination efforts tend to focus on academic spaces such as conferences and journals.

To address this gap, it's crucial to promote strategies and training programs that equip researchers and academics with the skills to communicate their knowledge in an accessible manner to the public. Initiatives like the UNESCO Chair aim to achieve this objective by fostering competency in science communication among professionals. By enhancing researchers' ability to communicate effectively with non-specialized audiences, these efforts can help individuals distinguish between reliable information and fake news circulating on social networks, which are primary sources of information for many young people (UNESCO, 2021).

By empowering researchers and academics to communicate effectively with the public, these initiatives contribute to building a more informed society capable of critically evaluating information and making evidence-based decisions. This, in turn, promotes scientific literacy and fosters a culture of trust and credibility in scientific knowledge.

Strengthen links with schools

Integrating scientific literacy into educational practices is crucial for fostering environmental awareness and promoting sustainable actions in communities. Universities, with their mission to promote science and reduce educational disparities, play a pivotal role in this endeavor. Collaboration between citizen science initiatives and school education can inspire students to consider STEM careers by demonstrating the real-world impact of their contributions (Fitzgerald *et al.*, 2020).

However, pre-university scientific education in Chile still has room for improvement. Practical experiences are often limited to experiments, observations, and demonstrations, neglecting problem-solving skills. To enhance learning outcomes, effective science teaching methods should be applied, supported by the use of new technologies (Santibáñez et al., 2010). Additionally, integrating school experiences with extracurricular activities and real-world applications can provide students with a more holistic understanding of scientific concepts.

By strengthening pre-university scientific education and emphasizing practical learning experiences, Chile can better prepare its students for future careers in STEM fields and foster a culture of scientific inquiry and innovation. This, in turn, can contribute to addressing environmental challenges and promoting sustainable development in the country.

Expand an open knowledge management model

Advancing open science requires overcoming cultural and institutional obstacles that hinder the expansion of its various pillars, such as open access and the involvement of diverse stakeholders in citizen science processes. Despite these challenges, the SCC believes that its strategic model can have a significant impact on strengthening the PCST both nationally and internationally in the short and medium term.

To overcome these obstacles, innovative and effective strategies must be implemented, accompanied by greater awareness of the importance of scientific dissemination. This includes promoting a culture of open and participatory communication within the scientific community.

Effective communication and collaboration mechanisms with various social actors are essential for facilitating feedback between Higher Education Institutions (HEIs) and society. This dynamic interaction ensures that academic activities remain relevant and contribute to the collective well-being. Viewing HEIs as active participants in the processes of scientific and technological change highlights their role as spaces for the convergence of knowledge and actors, moving away from reductionist perspectives that see universities as the sole agents of knowledge development (Suazo, 2024). Instead, it promotes an interactive and collaborative vision where multiple stakeholders contribute to advancing science for the benefit of society as a whole.

CONCLUSION

The article provides a comprehensive view of the importance of scientific communication and knowledge management in higher education institutions, with a particular focus on a University Science Communication Center (SCC). This case illustrates how an effective strategy of communication and knowledge management can improve the relationship between science and society, fostering an informed and engaged citizenship.

The document highlights the relevance of scientific literacy in the contemporary context, where science and technology play essential roles in society. Scientific education not only promotes interest and understanding of science, but is also fundamental for economic development and environmental sustainability. Additionally, it addresses the inequality in access to and performance in scientific education in Chile, underscoring the need for effective public policies that promote greater inclusion and equity.

The knowledge management model of the SCC, which encompasses the phases of knowledge generation, transfer, and feedback, provides an operational framework for maximizing the social impact of science. This model not only focuses on knowledge

production, but also on its effective dissemination and adaptation based on community feedback, ensuring that science is accessible and relevant to the general public.

The SCC's focus on "open science" is particularly innovative. By promoting a more transparent, collaborative, and inclusive science, the center is poised to address contemporary global challenges more effectively and democratically. This approach is in line with international initiatives that seek to democratize access to scientific knowledge and increase public participation in scientific processes. However, the document also recognizes significant challenges, such as the need for sufficient resources for science communication and the difficulty of measuring the impact of these activities. These challenges require ongoing attention and innovative strategies to overcome budgetary limitations and improve the evaluation of science outreach programs.

The article demonstrates how effective management of scientific knowledge can facilitate deeper and more meaningful interaction between science and society. It provides a valuable example of how universities can play a fundamental role in this process, not only as generators of knowledge, but also as mediators between science and the public. It is essential to continue efforts to strengthen these activities, ensuring that scientific knowledge is accessible and relevant to all sectors of society, and that educational institutions can effectively respond to the needs and challenges of our time.

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