Public policies for scientific dissemination and divulgation: a theoretical review from the Peruvian contex

Políticas públicas para la divulgación y difusión científica: revisión teórica desde el contexto peruano

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Abstract

This article aims to analyze the public policies promoted in Peru to encourage research. To this end, a documentary study was carried out; a content analysis was conducted, with information from articles published in databases of worldwide impact Scimago Journal / Country Rank; laws and regulations, as well as reports and official records from national agencies, such as the National Superintendence of Education (SUNEDU). The content analysis method allowed for a systematic description and a critical and reflexive analysis of the information. The results obtained show a favorable growth in the number of scientific publications, but slow when compared to other Latin American countries. This situation is due to the parameters established by the State, as well as the institutional capacity required for the design, implementation and evaluation of policies, which are key factors for success. It is concluded that public policy on science, technology and innovation in Peru often aims to have a greater visibility of science as a way to promote and increase the collection of knowledge in journals and universities.

Key words: Public policies, scientific research, scientific dissemination and divulgation, State, science.

Resumen

Este artículo tiene como objetivo analizar las políticas públicas que desde el Perú se promueven con la finalidad de suscitar la investigación. Para lograr tal fin se planteó un estudio documental, se realizó un análisis de contenidos con información de artículos publicados en bases de datos de impacto mundial Scimago Journal & Country Rank, leyes y reglamentos, así como de informes y reportes oficiales de organismos nacionales como la Superintendencia Nacional de Educación (SUNEDU). El método de análisis de contenido permitió realizar una descripción sistemática, haciendo además un análisis crítico y reflexivo de la información. Los resultados obtenidos demuestran un crecimiento favorable en el número de publicaciones científicas, pero lenta al compararse con otros países latinoamericanos, esta situación obedece a los parámetros establecidos por el Estado, así como a la capacidad institucional que se requiere para el diseño, la implementación y la evaluación de las políticas, las cuales son factores clave para el éxito. Se concluye que, la política pública de ciencia, tecnología e innovación en Perú, muchas veces apunta a tener una mayor visibilidad de la ciencia como una forma de promover e incrementar la colección de conocimiento en revistas y universidades.

Palabras clave: Políticas públicas, investigación científica, divulgación y difusión científica, Estado, ciencia.

Introduction

Science can be considered as the dominant source of knowledge in society. Hence, scientific knowledge has been identified as "the officially privileged form of knowledge and its importance for life in contemporary societies is undisputed" (Bastos et al., 2019, p. 181). Its communication represents "the transmission of scientific knowledge from its sources to the most diverse recipients" (Sanchez, 2013, p.55) therefore, it needs a wide and systematic dissemination to ensure that the scientific community and society have access to the results of research conducted by universities and specialized centers.

When assuming responsibility for the generation of science, towards the scientific endeavor, nations define policies aimed at defining and allocating budgets, calls for proposals in competitive funds, and define mechanisms to ensure the dissemination and diffusion of scientific findings generated in research spaces. In addition, it is required to involve actors of the scientific society such as research centers and groups and independent researchers or researchers attached to an institution (Sánchez, 2016; Vidales, 2009).

In addition to this, incentive plans are defined for scientific production, but also, and no less relevant, a system of norms and information that allows regulating the actions of scientific work from its genesis to the dissemination of results to the community (Anglada and Abadal, 2018; López, 2014) In the case of Latin America, public policies related to science outreach have been influenced by a large number of factors: 1) plans that the various governments have for the development of the country, 2) responses to policies that are established from international agencies, and 3) the way in which science is conceived in society (Loray, 2017; Castillo and Rovira, 2016).

In this sense, as a result of strategically established alliances between countries, their willingness, commitment and active participation of national and international organizations, mechanisms are created to provide support to the systems that promote science, technology and innovation at the national level from the country's own vision and perspective (Alvarado et al (2022).

Particularly in Peru, the dissemination and disclosure of knowledge is consciously promoted with the aim of not only fostering knowledge of the results of studies that may be interesting and useful for other researchers, but also allows to learn about common research interests, establish alliances between peers to complement ideas and share experiences, which can become indispensable resources to expand the context in which the study is conducted and even promote its replicability and application in different areas. A study without dissemination becomes a poorly valued resource and does not even fully meet its objective (Villaveces, 2011).

Based on the above, the objective of this article is to analyze the public policies promoted in Peru with the aim of generating research. To this end, a documentary study was carried out to analyze the information content of articles published in databases of worldwide impact, Scimago Journal & Country Rank, laws and regulations, as well as reports and other documents of interest.

Methodology

This article was developed based on the qualitative approach through "the situational analysis of the phenomenon that allows the construction of knowledge and the capture of the sense that each one has about its own internalized reality and its appropriation" (Miranda and Ortiz, 2020, p. 18). A documentary study was proposed based on the requirement of the systematized search of material (official documents) to proceed to the selection, considering inclusion criteria (Hernández and Mendoza, 2018). An information content analysis of articles published in global impact databases

Scimago Journal & Country Rank, laws and regulations, as well as official reports and records of national agencies such as CONCYTEC and the National Superintendence of Education (SUNEDU) of Peru was performed.

The literature review consisted of a totally hermeneutic approach of documentary-bibliographic type, which allowed to raise actions and search procedures, selection, organization and analysis of the most relevant criteria of the study approached from the documentary sources (Hernández and Mendoza, 2018). From hermeneutics, the interpretative activity and systematic reflection was carried out in order to capture the meaning of the texts, through authors' different positions who reflect the world from their own reality (Arráez and Moreno, 2006).

The content analysis method allowed for a systematic description of the textual information related to the topic under study, making a critical and reflexive analysis of the information. Therefore, the research is characterized as a literary review that allows to collect from the documentary evidence how public policies developed in Peru have been developed, with the purpose of promoting research. Table 1 shows the official documents consulted in this study.

Policies, programs and strategies for scientific dissemination and diffusion in Peru.

Public policy refers to a work system of the governing bodies, carried out directly or through representatives, aimed at directly impacting the lives of the country's inhabitants. They represent a set of objectives, decisions and actions performed by a government to solve the problems that citizens face at a given moment. These policies are the result of a process of analysis, design, implementation and evaluation that seeks to improve the quality of the population life (Canto, 2021).

From a specific perspective, public policies related to the dissemination of science, technology and innovation can be defined as State responses to relevant topics for society's sectors and for their welfare (Oszlak and O'Donnell 1995). They become strategies that guarantee the development of countries as long as they are the result of consensus among the State. It is important to clarify that public policies on science and technology are generally "carried out by government ministries and institutions in each nation. They govern the production and dissemination of science, technology and knowledge" (Paz, 2022, p. 120).

Public policies for the promotion and dissemination of science in the Peruvian context should stimulate interest in science among people of all ages. By presenting science in a simple and positive way, critical thinking is stimulated and the scientific spirit is promoted, encouraging research, discovery and the questioning of preconceived notions from a transcendental perspective.

In the Peruvian context, public policies have been implemented for scientific dissemination and popularization. Some government agencies such as the National Council for Science, Technology and Technological Innovation (CONCYTEC), established the National Science and Technology Policy and the Program for the Popularization of

Table 1.
Official documents consulted in the study

Document	Agency	Year
Baseline study of public spending on science, technology and innovation in Peru	CONCYTEC/World Bank	2020
Main bibliometric indicators of Peruvian scientific activity 2012-2017	CONCYTEC	2019
Actions for the enhancement of science, technology and innovation in Peru	Consultative Commission for Science, Technology and Innovation (CCCTI)	2021
National policy for the development of science, technology and technological innovation - CTI	CONCYTEC	2018
National Digital Repository of Science, Technology and Innovation of Peru	ALICIA	2020
Public Policy in the field of Peruvian Science and Technology.	Inter-American Development Bank (IDB) (2018)	2018
Public Policy and Science Outreach	United Nations Educational, Scientific and Cultural Organization (UNESCO) (2018)"	

Note: The table shows agencies that have issued information on research dissemination in Peru.

Science, Technology and Innovation. These are some of the governmental entities that have led the dissemination of Peruvian scientific research.

Regarding the policies and programs implemented to encourage investment in STI, the National Plan of Science, Technology and Innovation for Competitiveness and Human Development 2006-2021 established goals and actions to promote investment in this field. The Peruvian government has allocated financial resources and established incentives to boost private investment in R&D, with the aim of strengthening the country's competitiveness and productivity.

Table 2.
Programs that guide science dissemination in Peru

Documents	
Project CONCYTEC-World Bank (2020)	The Government of the Republic of Peru opened a BIRF 8682-PE loan contract with the World Bank for the execution of the "Project to improve and expand services of the National System of Science, Technology and Technological Innovation-SINACYT", aimed at improving the efficiency of the system, as well as to contribute to the economic creation and development of the country's competitiveness to reduce the fragility of the productive apparatus and achieve sustainable development based on knowledge and innovation (National Council of Science, Technology and Technological Innovation - CONCYTEC (2020).
CONCYTEC (2019)	For the period 2012 -2017, Peru was ranked 72nd in the world with a reduced scientific production, in Latin America it was ranked 7th, with 2,700 documents in 2017, while countries like Mexico reached more than 23,000 works in the same period. Despite the lower figure, the entity points out that since 2015 there has been sustained growth (According to CONCYTEC, 2019).
Consultative Commission for Science, Technology and Innovation (CCCTI) (CCCTI) (2021)	This CONCYTEC-World Bank project (2020), and the Consultative Commission on Science, Technology and Innovation (CCCTI) (2021), despite the challenges imposed by 2020 due to the coronavirus epidemic, means that it will be able to allocate around 80 million soles to improve the functioning of the National System of Science, Technology and Innovation (SINACYT) (2022), clearly becoming public scientific policy and media communication in Peru. It is necessary to mention that digital technologies are at the forefront of development and provide countries with a unique opportunity to accelerate great economic growth and connect citizens with services and employment. In times of crisis, ranging from natural disasters to pandemics like the one the world experienced with COVID-19, digital technologies keep people, governments and businesses connected. They can generate innovative solutions to complex development challenges and help countries skip traditional stages of development and move, for example, from digital banking to blockchain and telemedicine. The World Bank Group has been working with several Latin American countries, including Peru, Colombia and Chile, to evaluate and improve their innovation programs. These reviews of public spending on science, technology and innovation are carried out with the aim of stimulating sustainable and lasting growth in the region. In Peru, for example, a baseline study of public spending on science, technology and innovation has been carried out, using the methodology developed by the World Bank.
CONCYTEC (2016)	Without a doubt, closing gaps is essential, as is continuing to move towards a knowledge economy. At CONCYTEC (2016), we are very happy that this work, which has taken two years, has finally seen the light, said (2023), president of the National Council of Science, Technology and Technological Innovation (CONCYTEC) of Peru in the year 2023, in an interview with the newspaper El Comercio.

In the opinion of Romaní et al., (2018), the scientific dissemination and divulgation are connected to "a two-way communication process, in which scientists deliver knowledge through a defined channel and transmit content adapted to the idiosyncrasy, needs, context and level of understanding of the receiver (p. 515). It is a social strategy, that seeks to democratize science and enable the social construction of knowledge, as well as making knowledge accessible.

For these authors, Peru has a National Science and Technology Policy that contemplates the importance of scientific dissemination. As of 2016, Peru has a Program for the Popularization of Science, Technology and Innovation (PPOP), which includes strategies, projects, activities and indicators aimed at promoting scientific culture in Peruvian society. Various public policies have been implemented for scientific dissemination and divulgation; having specifically the National Science and Technology Policy, the Program for the Popularization of Science, Technology and Innovation, subnational policies, the National Institute of Health, the Peruvian Journal of Experimental Medicine and Public Health, studies on the dissemination of scientific research and the Journal of Government and Public Management.
From legal and official documents, projections are made under certain objectives in this line of scientific dissemination in the country. Based on this, an analysis of the most important documents on this topic is presented in Table 2:

In relation to the PPOP (Peru), various activities have been developed that, according to Romaní (2018), included the implementation of museums, an open laboratory program, scientists returning to school, among others (Table 3).

The PPOP, according to Romaní et al., (2018), includes strategies, projects, activities and indicators aimed at promoting scientific culture in Peruvian society, coupled with this,

Table 3.
Program for the Popularization of Science, Technology and Innovation (PPOP) executed by Public Research Institutes

Program Activities	Description	Indicator
Implementation of museums.	Museographic exhibition consisting of a physical space that generates interactive offers that combine art and science, expressed in multisensory language.	Number of visitors
Scientists go back to school Number of teachers updated in Science and Technology	Strategy in which scientists with experience in teaching science to schoolchildren provide advice to teachers to transmit knowledge of science, technology and environments in the classroom	Number of teachers updated in Science and Technology
National Science Week	The central event of this activity is the "Peru with Science" Fair, which presents to the general public the contribution of science and research to the development of Peru.	"Participation in the Fair Peru with Science"
Open laboratories	Activity that seeks to encourage research institutions to disseminate their results and allow the general public to learn about, give their opinion and propose, based on their experience, what is being done in the laboratories.	Number of visitors
Science and technology dissemination actions	These are scientific dissemination actions such as conferences, exhibitions in which citizens can have direct contact with Science and Technology.	Number of events
		Number of participants

Note: Romaní et al. (2018)

the National Institute of Health in Peru has implemented scientific outreach strategies in the field of public health, thus, scientific outreach in Peru is also done through social networks and web platforms, which allows the exchange of professional and scientific knowledge among various audiences. Based on the above, science, technology and innovation dissemination strategies in Peru include knowledge transfer, the National Science and Technology Policy, the Science, Technology and Innovation Popularization Program, the National Institute of Health and scientific dissemination through social networks and web platforms.

To carry out the development and progress of existing policies and programs, strategies are defined as actions that make it possible to implement what is defined in these programs and to make progress in the dissemination of science, technology and innovation, science outreach activities are developed, such as science fairs, science workshops for children and young people, or advertising campaigns, The Peruvian National Commission for Scientific and Technological Research (CONICYT) provides funding for projects to promote and disseminate science and technology through different programs.

Table 4 below summarizes the strategies that have been adopted to promote science, technology and innovation activities in Peru:

In the country, the National System of Science, Technology and Technological Innovation (SINACYT), is made up of institutions and natural persons, dedicated to research, development and technological innovation (R&D&I) in science and technology, as well as its promotion. Its governing body is the National Council for Science, Technology and Techno-

Table 4.
Strategies adopted to promote science, technology and innovation activities in Peru

Strategies	Purpose
Knowledge transfer.	It is supported by the Law of the National System of Science, Technology and Innovation (SINACTI, 2021) in order to disseminate science, technology or innovation to the non-specialized public, through activities and strategies that enable the transfer of knowledge, as established in Article 5
Promotion of projects, activities and indicators	To promote scientific culture in Peruvian society, in addition to the National Institute of Health in Peru. This is achieved through media such as social networks and platforms. The aim is to exchange professional and scientific knowledge among different audiences.
Scientific dissemination through social networks and web platforms	Inserted in the Science, Technology and Innovation Popularization Program, the National Institute of Health and Supported by the National Science and Technology Policy, information related to progress is socialized.

logical Innovation (CONCYTEC, 2017), attached to the Presidency of the Council of Ministers, which is responsible for the direction, promotion, coordination, as well as supervision and evaluation of state actions promoted in the country in science, technology and technological innovation; in addition to guiding the actions of the private sector; and implementing support actions that promote the scientific and technological development of the country.

Investment in Science, Technology and Innovation in Peru and trends

The United Nations Organization (2018), quoted by the Ibero-American and Inter-American Network of Science and Technology Indicators, RICyT (2023) points out that Latin America and Ibero-America are regions worldwide in which there is evidence of a sustained decrease in investment in science, technology and innovation, which has a negative impact on global scientific production.The low investment by the State in this area is due to the low investment of private organizations in scientific and/or technological activities, little encouragement for the promotion and preparation of professionals dedicated to research or the high cost of scientific equipment and materials (Chinchilla et al., 2015; Bonilla, et al., 2015; Guerrero-Casado, 2017).

Despite the alarming nature of these data, since 2014 there is evidence of a positive trend in the growth of scientific production in four areas of the world: Africa (36.5%), Middle East (28.1%), Asia (24.3%) and finally Latin America (17.69%), this growth is based on scientific documents indexed in Scopus by Scimago Journal & Country Rank (SJR) between the period 2010-2014 (Alvarez and Perez, 2016). In the region, according to data from UNESCO and RICyT, Mexico and Brazil are part of the 40 leading countries in scientific production, with the Brazilian nation investing 1% of GDP in research, innovation and development activities.

Specifically, in the Peruvian reality, according to CONCYTEC's resolutions published on its website, in the last five years, 2022 is the year in which the agency in charge of formulating, promoting and managing public policies that guarantee and transfer scientific knowledge to society received the lowest budget (Table 3).

In this regard, CONCYTEC conducted a study of Peruvian public spending in which it was observed that some ministries theoretically propose a percentage of their annual budget to programs related to science, technology and innovation. Among these portfolios are Education, Defense, Energy and Mines, Environment, Production, Tourism, Agriculture, Health, Housing, Foreign Trade, Agriculture, Foreign Affairs and Health.
When reviewing the use made of these resources, it is evident that they are not destined to research activities; for example, in the Ministry of Education, they are used for student scholarships that are not related to research programs. Excluding this item, the Ministry of Education invests only 7% of its annual budget in science. Table 5 shows the budget allocated by CONCYTEC to research:

Table 5.
Budget allocated in soles by CONCYTEC for 2018

Year	Budget allocated in soles
2018	150 494 858
2019	147 335 960
2020	213 529 124
2021	165 909 869
2022	127 096 501

Note: CONCYTEC (2020).

The amount that Peru currently allocates to STI is insufficient to promote scientific activity, technology and innovation, which undoubtedly hinders the nation's development. According to CONCYTEC estimates (2021), for every dollar invested in R&D, the return obtained is an average of 2.2 to 3.1 dollars. Investing in science is the main step to achieve significant changes and sustained growth in a country (Griliches, 1998; Guellec and Pottelsberghe, 2001). Investment in science, technology and innovation (STI) is an important issue for a country's development and growth.

In the case of Peru, efforts have been made to increase investment in this area in recent years. According to the CONCYTEC report (2020), in Peru, there has been a sustained growth in STI investment in recent years. Between 2010 and 2017, investment in research and experimental development (R&D) in Peru increased by 174%, from S/ 710 million to S/ 1,948 million. This increase demonstrates the country's commitment to strengthening the STI sector.

In addition, the report highlights that investment in STI in Peru has been driven mainly by the business sector. In 2017, private companies accounted for 65% of total R&D investment, followed by the public sector with 31% and universities with 4%. This shows the active participation of the private sector in promoting research and innovation in the country.

Invest in science, technology and innovation 0.13% of gross domestic product (GDP), is very far from the investment made by developed countries where this number is 2% and in the case of South Korea and Israel is 4%, according to World Bank data published in 2018. In Annex 5 of the Public Sector Budget Law for fiscal year 2022, the amount allocated to CONCYTEC is 127 096 501 soles. That represents a decrease of 23.4 % compared to the amount it received in 2021, which was 165 909 869 soles.

In relation to current trends in scientific dissemination in Peru, we assume the development of new strategies for scientific dissemination in the field of public health, the implementation of public policies such as the National Science and Technology Policy and the Science, Technology and Innovation Popularization Program, and the dissemination of scientific research through social networks and web platforms.

It is important to note that Peru has also sought to strengthen collaboration between the public sector, the private sector and academic institutions to boost investment in STI. Alliances and cooperation programs have been established between universities, companies and research centers to promote the transfer of knowledge and technology, and foster innovation in the business sphere.

The next step in this process is that each researcher will plan from the beginning of their work how they will disclose the progress and results of their work. A good example of this is the competitive call for research model (Rodriguez et al., 2019).

In summary, the triad of science, technology and innovation becomes a fundamental pillar for the sustainable development of a country as diverse as Peru, which according to experts is constantly in search of public policies that promote an economic, social, cultural and political system. All interconnected and interdependent (Marticorena, 2013).

Conclusions

In Peru, public policies direct the design and programmed and structured execution of all those initiatives adopted to address a series of needs (Sobhani et al., 2018). Peruvian science outreach policy, is aimed at broadening individual understanding of the world in which we live, can stimulate public participation in choices and directives regarding science and technology, can contribute to the inclusion of the interests of social groups that have traditionally been excluded from the benefits that scientific and technological development can bring (Paz, 2022), so that actions to promote science outreach are promoted can also be understood as strategies to stimulate social inclusion.

Public policy on science, technology and innovation in Peru often aims to have greater visibility of science as a way to promote and increase the collection of knowledge in journals and universities (Álvarez and Pérez, 2016 and Rodríguez et al., 2022). This type of law usually forces researchers to expand their scientific knowledge, which may even limit the advancement of research, science and technology. Public policies on science and technology are implemented by government ministries and institutions in each nation (Mejía, 2020). These policies govern the production and dissemination of science, technology and knowledge. They establish channels and means through which science, technology and knowledge can be socialized. However, there are determinants external to the national ones that condition the production of knowledge.

In Peru, funds and financing programs have been established to encourage scientific publication. These funds can be used by researchers and academics to cover the costs associated with publishing scientific articles in open access journals, such as Article Processing Charges (APC).

It should be noted that Peru has implemented public policies to promote scientific culture, such as the National Science and Technology Policy and the Science, Technology and Innovation Popularization Program. In addition, scientific dissemination policies have been implemented in the field of public health and studies have been carried out on the dissemination of scientific research in Peru.

Scientific communities play a determining role in the development and implementation of public policies (Monfredini, 2016), they require for their development bibliographic sources, communication channels and resources for research. The instruments and means of editorial policies in science, technology and innovation are composed of documentary typologies that refer to sources of character. In order to analyze the public policies of scientific popularization in Peru, it is important to understand some conceptual models and relationships that involve the problem of the so-called public communication of science, understood as a fundamental aspect of popularization.

The models of scientific and technological policy in Peru are promoted by different international organizations, based on the experience of the most industrialized countries. The tendency to homogenize public policies in science, technology and innovation has a long tradition. International institutions such as the Organization of American States (OAS), the Inter-American Development Bank (IDB) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2018), promote common science, technology and innovation policies in Latin America (Gómez, 2015; Foladori, 2016).

In this perspective, public policy in the field of Peruvian science and technology is usually carried out by government departments and agencies. Which establish regulations that regulate the production and dissemination of science, technology and information. They create channels and media where it can be integrated. In Peru, there is a public policy aimed at promoting and strengthening scientific publication. This policy aims to encourage the production and dissemination of quality research, as well as to promote the visibility and impact of Peruvian scientific production at the national and international level.
It has been verified that one of the key initiatives in this policy is the National Digital Repository of Science, Tech-

nology and Innovation of Peru (ALICIA), an online platform that collects and disseminates Peruvian scientific and technological production. Through this repository, researchers and academics can publish their research papers, theses, projects and other open access scientific documents. This allows scientific knowledge generated in Peru to be freely available to the scientific community and the general public. In other words, public policy in Peru has also promoted the creation of Peruvian scientific journals and has established criteria and standards for their quality and indexing. The adoption of good editorial practices is promoted and technical and financial support is provided to improve the infrastructure of scientific journals and their visibility in indexed databases.

Author contributions:

Kerwin Chávez Vera: conceptualization, methodology, analysis, curation, project development, initial writing, final writing.

África Calanchez: conceptualization, methodology, analysis, curation, project development, initial writing, final writing.

Mariby Boscán: analysis, curation, supervision, validation, initial writing, final writing.

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