

Cooperative Nonproliferation Controls to Support Research and Security: Risks and Challenges in Research Institutions and Universities Offering STEM Degrees in Argentina

MARIA J. ESPONA AND MAYRA AMENEIROS¹

Abstract

This publication analyzes the current situation in both public and private universities and institutions in Argentina by underscoring the multifaceted approach needed to counter the proliferation of CBRN (Chemical, Biological, Radiological, and Nuclear) weapons, emphasizing collaboration with various stakeholders beyond political, diplomatic, and military realms. The involvement of scientific and engineering communities is crucial. Efforts to increase global awareness regarding CBRN weapons will help reduce the potential misuse of STEM (Science, Technology, Engineering, and Mathematics) research findings. The results presented in this article reveal a significant gap in the curricula of research institutions and universities

¹ **Maria J. Espona** is an expert in the WMD field, especially in the CBW arena and export control. She has several publications on those topics. She teaches in universities in Argentina, Georgia, and Peru on Information Quality, CBRN export controls, and dual-use and responsible use of data. She participates in several Health Security Partners, Coalescion, and CRDF Global projects on biorisk management and export control, among other topics, in Latin America and other regions. She is the EU P2P Regional Coordinator for South America and works with SCK-CEN on an export control-related project. She is a member of the Technical Advisory Group on the Responsible Use of the Life Sciences and Dual-Use Research (TAG-RULS DUR) at the World Health Organization. **Mayra Ameneiros** is a Senior Fellow at the International Biosecurity and Biosafety Initiative for Science. She is a certified professional in biorisk management and biosecurity accredited by the International Federation of Biosafety Associations, where she has also acted as a Mentor of the IFBA Global Mentorship Program. Ameneiros is a member of the WHO Health-Security Interface Technical Advisory Group (HSI-TAG) and serves on the Board of Directors of NextGen, where she is also the liaison to the Global Health Security Agenda Consortium's Steering Committee and APP3 Group on Biosafety and Biosecurity; as well as the NGO working group of the Biological Weapons Convention. She is a Senior Advisor for Sandia National Laboratories, an Affiliated Expert at CRDF Global, and an in-country SME for Health Security Partners.

offering STEM programs. Despite the presence of various advisory committees, none of them currently address crucial topics related to CBRN weapons nonproliferation and disarmament. The absence of such content in academic programs may contribute to a lack of preparedness among scientists and engineers to identify potential dual-use research and address security challenges posed by CBRN weapons. The article demonstrates the importance of reevaluating and enhancing educational strategies within STEM fields to better equip future professionals.

Keywords

Dual-use, CBRN weapons, STEM degree programs, responsible use of science, Argentina, intangible transfer

Introduction

Since 2022, the authors conducted research with the primary objective of acquiring a comprehensive understanding of the landscape surrounding export control measures, intangible knowledge, responsible science, and dual-use research within STEM careers at Argentinian universities.^{2,3,4,5} This pioneering initiative aims to illuminate the situation in a nation dedicated to nonproliferation and export control, delving into a domain that has, until now, been relatively well-explored only in Europe, the United States, and Japan.

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- 2 Responsible science is defined as when “scientists are responsible for conducting and communicating scientific work with integrity, respect, fairness, trustworthiness, and transparency, and for considering the consequences of new knowledge and its application. The maintenance of ethical standards by scientists and their institutions is a prerequisite for trust in science by both policymakers and the broader public.” International Science Council, <<https://council.science/what-we-do/freedoms-and-responsibilities-of-scientists/ethical-responsible-conduct/>>.
 - 3 Dual-use can be defined as “knowledge, information, methods, products, or technologies generated by peaceful and legitimate research that may be appropriated for non-peaceful or harmful purposes.” World Health Organization, “Global Guidance Framework for the Responsible Use of the Life Sciences: Mitigating Biorisks and Governing Dual-Use Research,” Geneva, 2022, ISBN 978-92-4-005610-791 (electronic), <<https://www.who.int/publications/i/item/9789240056107>>.
 - 4 Dual-use research can be defined as “research conducted for peaceful and beneficial purposes that has the potential to produce knowledge, information, methods, products, or technologies that could also be intentionally misused to endanger the health of humans, nonhuman animals, plants and agriculture, and the environment. In the context of this framework, it refers to work in the life sciences, but the principles are also applicable to other scientific fields.” Ibid.
 - 5 Of note: “According to Sanders (2009), the National Science Foundation (NSF) in the 1990’s began to use the acronym SMET, as a “... shorthand, for ‘science, mathematics, engineering, and technology’” (p. 20). SMET was perceived to sound too much like “smut” and STEM, became the acronym of choice.” See William F. McComas, “STEM: Science, Technology, Engineering, and Mathematics,” in: McComas, W.F. (eds) *The Language of Science Education*: Rotterdam, SensePublishers, <https://doi.org/10.1007/978-94-6209-497-0_92>.

Argentina has a solid nonproliferation and export control policy.⁶ Through the authors' ongoing discussions with pertinent stakeholders, it was reaffirmed that there is a need for further enhancement of intangible transfer controls. The identification of this gap was the starting point for this article's research effort, which seeks to understand the current situation to be able to raise awareness among national authorities and help design a plan to address it. It is worth highlighting that individuals within the export control field, such as academics, scientists, engineers, and relevant professionals in STEM careers expressed their support for the proposed research and were enthusiastic about exploring potential individual initiatives to improve the situation within their respective educational institutions.

The primary goal of this article is to enhance awareness regarding local expertise in STEM fields pertaining to CBRN nonproliferation and disarmament. Additionally, it aims to offer recommendations on improving the oversight of intangible transfers and bridging the knowledge gap in this domain. This goal can be approached through diverse strategies; however, a root solution is to incorporate these topics into STEM degree programs. This equips students with knowledge about international Weapons of Mass Destruction (WMD)-related Treaties, Argentina's position in the global security landscape, initiatives undertaken by national and international institutions concerning the nonproliferation and disarmament, as well as fundamental security principles and dual-use terminology necessary for promoting safely and securely research practices. This research was structured to collect publicly accessible information concerning the topic while also incorporating input from key stakeholders to provide insights into their perspectives and potential courses of action. The article begins with an examination of the Argentinean policy concerning CBRN nonproliferation and export controls, offering insights into national commitments, requirements, and obligations. Subsequently, it presents a compilation of STEM degree programs available within the country. The article then delves into the outcomes of a survey conducted to gauge the current level of knowledge and awareness among a diverse array of stakeholders regarding these matters. Finally, the conclusion presents an analysis of these findings and outlines a series of next steps.

Argentina's CBRN International Commitments and National Implementation

Argentina has actively pursued nonproliferation and disarmament of WMD policies, initiatives, organizations, and agreements since the 1990s. A summary of the general policies and agreements related to biological, chemical, and nuclear weapons in Argentina is shown in Annex 1. Argentina's National Commission for the Control of Sensitive Exports and War Material (CONCESYMB), which includes the Ministries of Defense, Foreign Affairs, and Industry, is the main body responsible for export controls.⁷ Under Decree 603/92, its amending and complementary regulations, the CONCESYMB controls exports of dual-use, sensitive, and war material in compliance with Argentina's international commitments.

6 Strategic trade controls encompass not only tangible goods but also the dissemination of knowledge and technology. This presents a unique challenge, as it includes aspects such as technical assistance, collaborative research and publication of findings and the methods through which this sharing occurs, such as online data sharing.

7 National Commission for the Control of Sensitive Exports and War Material (CONCESYMB), <<https://www.argentina.gob.ar/defensa/comision-nacional-de-control-de-exportaciones-sensitivas-y-material-belico-concesymb>>.

This Commission has several members:

- Ministry of Defense, which is the Executive Secretariat;
- Ministry of Foreign Affairs, International Trade and Worship (specially, DIGAN, the “Directorate of International Security, Nuclear and Space Affairs”);
- Ministry of Economy;
- General Directorate of Customs, as the authority in charge of supervising compliance with export regulations.

For technical advice:

- CONAE (National Commission for Space Activities);
- ARN (Nuclear Regulatory Authority);
- CITEDEF (Institute of Scientific and Technical Research for Defense).

The Commission has a significant role in addressing WMD proliferation and associated technologies.

The CONCESYMB is empowered to grant Prior Export Licenses to transfer elements included in the Annexes of Decree 603/92, grant an “Import Certificate” at the request of an exporting country, authorize producers of war supplies or components to initiate negotiations to export these products abroad, and propose new legal norms that correspond to the guidelines adopted and to be adopted as well as to Argentina’s international commitments.

The purpose of Argentina’s export controls is to prevent any attempt at unauthorized export of sensitive or controlled war material. In addition, there are special registration requirements for companies dealing with controlled chemicals or munitions items.⁸ In 2020, the Permanent Mission of Argentina to the United Nations presented to the Security Council Committee Argentina’s comments to the matrix.⁹ This Committee was established under United Nations Security Council resolution 1540. The matrix shows to what extent Argentina is committed to nonproliferation efforts and how national legislation and other measures adopted reflect this. It is notable that although intangible transfers are included within Decree 603/92 and mentioned in the matrix, the focus remains predominantly on tangible goods. Ongoing efforts are being directed towards the formulation of strategies for managing intangible goods. Regarding intangible transfers and responsible science, the only formal initiative identified in Argentina has been encouraged by the ANCAQ (Chemical Weapons Convention National Authority) and the OPCW (Organization for the Prohibition of Chemical Weapons) and is currently being implemented by the University of Cordoba.

Methodology

To understand the state of STEM degree programs at universities in Argentina, the authors designed an approach that includes a qualitative assessment (survey to key stakeholders)

8 “Argentina Export Control Information,” Bureau of Industry and Security, U.S. Department of Commerce, <<https://www.bis.doc.gov/index.php/enforcement/220-eco-country-pages/1052-argentina-export-control-information#:~:text=Export%20controls%20are%20administered%20by,controlled%20chemicals%20or%20munitions%20items>>.

9 ENAUN N° 327/2020, <<https://www.un.org/en/sc/1540/documents/ArgentinaReport10July2020.pdf>>.

and a quantitative assessment (a structured OSINT search). In addition, the authors included several individual initiatives that were identified, such as the courses given by the University of Cordoba on chemical weapons and dual-use. The objective of this approach is to identify whether universities offering STEM degree programs have courses that include concepts of dual-use research, CBRN nonproliferation, biosafety, biosecurity, chemical and nuclear security. The research also analyzed the opinions of relevant stakeholders.

The authors sent the survey to key stakeholders. The survey included questions about their profession, their area of work, as well as the following:

1. *Responsible conduct of research (RCR) is defined as “the practice of scientific research with integrity.” It involves the knowledge and application of established professional standards and ethical principles in the performance of all activities related to scientific research. 1.A) Did you know this term/definition? What is your opinion about it?*
2. *In politics, diplomacy, science and technology, and export control, dual-use items refer to goods, software, and technology that can be used for both civilian and military applications (or that have both beneficial and malign uses). More broadly, dual-use can also refer to any good or technology that can satisfy more than one purpose at any given time. 2.A) Were you familiar with this term/definition? What is your opinion on this?*
3. *Dual-use research of concern (DURC) is life science research that, based on current knowledge, can reasonably be anticipated to provide knowledge, information, products, or technologies that could be directly misapplied and pose a significant threat with broad potential consequences to public health and safety, crops and other plants, animals, the environment, material, or national security.¹⁰ 3.A) Were you familiar with this term/definition?*
4. *Intangible technology transfer (ITT) involves transferring or making controlled elements available to an entity or individual through intangible means, such as email, verbal communication, training, or visual inspection.¹¹ Did you know this term/definition? What is your opinion on this?*
5. *A) Do you know if there is education on the above topics? If yes, please provide details. [Responsible conduct of research]*

10 Dual-use research of concern can be defined as “research that is conducted for peaceful and beneficial purposes but could easily be misapplied to cause harm with no, or only minor, modification. This term has generally been used for research in the life sciences. DURC encompasses everything from information to specific products that have the potential to create negative consequences for the health of humans, nonhuman animals, plants and agriculture, and the environment.” See World Health Organization, “Global Guidance Framework for the Responsible Use of the Life Sciences: Mitigating Biorisks and Governing Dual-Use Research,” Geneva, 2022, ISBN 978-92-4-005610-791 (electronic), <<https://www.who.int/publications/i/item/9789240056107>>.

11 Intangible technology transfer (ITT) involves transferring or making controlled items available to an entity or individual via intangible means, such as email, verbal communication, training, or visual inspection. See Hyuk Kim, “Intangible Transfer of Technology (ITT): Open-source Information Analysis for the Implementation of Sanctions on North Korea,” James Martin Center for Nonproliferation Studies, March 14, 2023, <<https://nonproliferation.org/intangible-transfer-of-technology-itt-open-source-information-analysis-for-the-implementation-of-sanctions-on-north-korea/>>.

B) Do you know if there is training on the above topics? If yes, please provide details. [Dual-use]

C) Do you know if there is education on the above topics? If yes, please provide details. [Dual-use Research of Concern (DURC)].

D) Do you know if there is education on the above topics? If yes, please provide details. [Intangible technology transfer]

6. *Do you have any suggestions on the possibility of education on the abovementioned topics? Please share your ideas.*

In addition, an OSINT search about bioethics and other relevant committees was performed to ascertain the feasibility of utilizing those entities as foundations for the later inclusion of these concepts. Details about the courses developed in the context of the Chemical Weapons Convention were included as well as other personal initiatives related to DURC at the universities.

Results

After an OSINT search about STEM degree programs in Argentina, the authors decided to base their research on analyzing the official national website, called “Guía de Carreras,” which includes all the current available career options in Argentina.¹²

To assess solely the STEM degrees in Argentina, the authors adhered to the criteria outlined in Table 1:

Table 1: Criteria used to conduct OSINT research - types of degrees considered STEM.

<i>Criteria</i>	
Resource:	https://guiadecarreras.siu.edu.ar/carreras_de_pregrado_y_grado.php
Criteria Considered:	
<i>Modality</i>	Classroom (in person) and Distance Learning
<i>State/Private</i>	All
<i>Institution</i>	All
<i>Province</i>	All

12 Guía de Carreras Universitarias, Departamento de Información Universitaria, Secretaría de Políticas Universitarias, <https://guiadecarreras.siu.edu.ar/carreras_de_pregrado_y_grado.php>.

Type of Careers:	<i>Applied Sciences</i>	Astronomy
		Biochemistry and Pharmacy
		Agricultural Sciences
		Soil Science
		Statistics
		Industries
		Informatics
		Engineering
		Meteorology
	<i>Basic Sciences</i>	Biology
		Physics
		Mathematics
		Chemistry
	<i>Health Sciences</i>	Medicine

Note: If the university offers a degree program in both virtual and in-person formats, it is considered as one distinct career in the tables.

The online search was reduced to the analysis of a website. The authors analyzed more than 4,000 results showing that Argentina currently has 115 different universities with at least one STEM career. The Table with the list of universities can be found in Annex 2. The authors then proceeded to research the number of universities that teach each STEM degree program found in Argentina. The results are shown in Annex 3. Annex 4 shows the number of STEM degrees per university.

The universities usually have different committees devoted to ethics, bioethics, research security, hygiene and security, or intellectual property. The committees that already have a structure in place can be used as a starting point to address the concepts of dual-use, responsible science, WMD nonproliferation, and intangible transfers discussed in this article.

There are several types of degree programs at universities in Argentina that are summarized (without any specific order) in *Table 2*.

Table 2. Types of university degree programs in Argentina

Type of Degree
Grado (Undergraduate Degree)
Otros Pregrados (Other Undergraduate Degrees)
Técnico Instrumental (Instrumental Technician)
Título Intermedio (Intermediate Degree)

Ciclo de Complementación (Curricular Complementation Cycle)
Ciclo de Licenciatura (Bachelor's Degree Cycle)
Ciclo Básico Común (Common Basic Cycle)
Postítulo (Postgraduate Degree)
Ciclo de Profesorado (Teacher Training Cycle)

This information allows for the determination of the following:

- How many STEM universities exist;
- The type of courses/degrees;
- How many STEM degrees exist per university;
- Ethics bodies per university.

Argentina has made some progress on the ethical side of biosecurity issues. For example, The National Committee of Ethics in Science and Technology was created in April 2001 according to Resolution 004/2001 and its guidelines were confirmed by Resolutions 031/2002 and 600/2004. The CECTE belongs to the Ministry of Science and Technology and is the Argentinean reference organization for topics related to ethics in science and technology. Members of the CECTE have actively participated in different international organizations where “ethics in science” was a subject of discussion (such as COMEST).¹³

In this context, the Argentine Physical Society has a Code of Ethics that requires scientists to accept their responsibilities while carrying out their functions as researchers and in the management of the resources for scientific research and to acknowledge the existence of possible conflicts of interest while in charge of these tasks.¹⁴

At the University of Cordoba, activities take place that are “...encouraged by the initiatives of the Organization for the Prohibition of Chemical Weapons on education about the prevention of illicit purposes of chemistry” and in this context there is a

“one-day workshop, called the Itinerant Lecture, that covers theoretical aspects combined with activities to promote critical thinking among students. The main topics are presented in an engaging way that is open to discussion and includes activities such as fictional case analyses and role-playing, which allow students to consider the problematic aspects of their roles as scientists. This workshop has been running for the last five years, with apparently very high acceptance by students and teachers in the chemistry field. The use of videos, role-playing, and an active-learning strategy for the topics becomes an excellent approach to introduce chemistry students and teachers to concepts such as professional responsibility and dual-use of knowledge in the sciences and their implications in the production of

13 Bioweapons Monitor, 2014, <<https://www.bwpp.org/documents/BWM%202014%20WEB.pdf>>.

14 “Code of Ethics: Ethical Standards of the Physical Society of Argentina,” Physical Society of Argentina, Virtual Biosecurity Center, March 30, 2011, <http://www.fisica.org.ar/?page_id=104>.

*chemical weapons and other illegal uses...*¹⁵

The authors' survey was answered by 29 individuals, anonymously. The objective was to have experts/professionals who work not only in science but also in the export control system. The first two questions were about their work area and profession, and the results are:

Work Area / Profession	Number of Answers
Chemistry	2
Biology/Microbiology	9
Biochemistry/Pharmacy/Genetics	6
Computer Sciences	1
Political Sciences	1
Engineering	3
International relations	2
Agronomy	1
Physics	2
Medicine	1
Veterinary	1
Total	29

Job titles and roles are:

Job Title / Role	Number of answers
Researcher/Faculty	17
Scientist	3
Public Sector Employee	3
Diplomat	1
Politologist	1
Veterinarian	2
Others (consultant/advisors)	1
Military	1
Total	29

Next, the survey questions and the most relevant answers were listed to understand the thinking of the respondents regarding the topics. An analysis of the answers will be presented in the

15 Integrating Chemical Security into Chemistry Degree Programs in Argentina through an Interactive One-Day Course Addressing Illicit or Harmful Applications of Chemistry Knowledge. <https://pubs.acs.org/doi/10.1021/acs.jchemed.9b00799>

Discussion section of this paper.

1. 1. A) Responsible conduct of research (RCR) is defined as “the practice of scientific research with integrity.” It involves the knowledge and application of established professional standards and ethical principles in the performance of all activities related to scientific research.

Did you know this term/definition?	Number of answers
No	20
Yes	9
Total	29

1. 1 B.) What is your opinion about this?

All the exact answers to the survey can be found in **Annex 5**. It is interesting to highlight that even when most of the respondents declare that they do not know the definition proposed, they still understand the concept and its implications for the academic community. Also, many agreed that they were educated to work responsibly but clearly there is a lack of formal education.

2. In politics, diplomacy, science and technology, and export control, dual-use items refer to goods, software, and technology that can be used for both civilian and military applications (or that have both beneficial and malign uses). More broadly, dual-use can also refer to any good or technology that can satisfy more than one purpose at any given time. What is your opinion on this?

<i>Were you familiar with this term/definition?</i>	Number of answers
No	8
Yes	21
Total	29

3. 3.A) Dual-use research of concern (DURC) is life science research that, based on current knowledge, can reasonably be anticipated to provide knowledge, information, products, or technologies that could be directly misapplied and pose a significant threat with broad potential consequences to public health and safety, crops and other plants, animals, the environment, material, or national security.

Were you familiar with this term/definition?	Number of answers
No	21
Yes	8

Total	29
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3.B) What is your opinion about this?

All the exact answers are shown in **Annex 6** but generally the replies were similar to those for question 1A. Some of the respondents showed a clear preference for having a top-down approach with different institutions providing guidance and training to have a structured, coordinated approach and less personal initiatives that depend on individuals and not on organizations.

4. 4.A) Intangible technology transfer (ITT) involves transferring or making controlled elements available to an entity or individual through intangible means, such as email, verbal communication, training, or visual inspection.

Did you know this term/definition?	Number of answers
No	22
Yes	7
Total	29

4.B) What is your opinion about this?

All the exact answers are shown in **Annex 7**, and as in previous open questions, the respondents have a lack of knowledge or understanding of the meaning and implications of this term. This is one of the most complicated topics, since the Web is considered a tool to facilitate research and not a means to negatively affect the work.

5. 5.A) Do you know if there is education on the above topics? If yes, please provide details. [Responsible conduct of research]

No	8
Yes	14
<i>I don't know</i>	7
Total	29

5. B) Do you know if there is training on the above topics? If yes, please provide details. [Dual-use]

No	12
Yes	12
I don't know	5

Total	29
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5. C) Do you know if there is education on the above topics? If yes, please provide details. [Dual-use Research of Concern (DURC)].

No	15
Yes	4
I don't know	10
Total	29

5. D) Do you know if there is education on the above topics? If yes, please provide details. [Intangible technology transfer]

No	13
yes	8
I don't know	8
Total	29

6. Do you have any suggestions on the possibility of education on the abovementioned topics? Please share your ideas.

The exact answers to these questions are shown in **Annex 8**. In summary, the respondents want to know more about dual-use and the other topics included in this survey and to implement different educational strategies to have not only students but also graduates and researchers aware of these concepts.

Discussion

To understand the current situation in Argentina, the authors' starting point was to consider the legal scaffolding in terms of export control of dual-use goods and other nonproliferation initiatives. The analysis shows that Argentina is the only country in the region that is engaged in all relevant export control regimes, agreements, treaties, and other initiatives, such as the Proliferation Security Initiative (PSI) and Container Security Initiative (CSI). The international commitments and national enforcement structure provide the umbrella to go deeper in the work with universities to implement the strongest ITT controls.

The research conducted for this article can support the government's formation and strengthening of its ITT policy. The survey and discussions with experts in the area shows that there are gaps regarding intangible transfers, particularly for universities and research centers. However, most of the survey respondents showed a positive attitude towards working together to implement university education in ITT and responsible use of sciences. This openness is an incentive to look for opportunities to help add these new concepts into their courses (formally or informally), add

new courses, or create special activities to discuss them. Over the past few years, the concept of responsible conduct of research has become a synonym for performing research following nonproliferation principles, being aware of the dual-use or potential misuse of research results, as well as acknowledgment of the vulnerabilities that arise from cyberspace. The respondents to the survey were mostly not aware of the term and many considered it related to ethical behavior. Nevertheless, many respondents replied that when they work, they do follow these parameters even when there is potential confusion about the terms, highlighting the importance of showing interest. This situation demonstrates the value of formal education on responsible science and ITT, as it would create coherence between the legal frameworks and what experts do and why. It would also provide formal guidance on how to perform their work safely and securely and encourage compliance. The lack of knowledge about the existence of certain concepts is a key insight of this research.

It is interesting to note that most of the respondents declared to be familiar with the term dual-use but were nevertheless aware of its definition. However, respondents are supportive of understanding the potential negative impacts of research, even when considering this a difficult task due to the related unpredictability of the research and innovation.

ITT is again a term not well known by the respondents, considering that they would like to know more. Some consider that due to how research takes place and the role of virtuality and future of AI developments, it would be difficult to implement any sort of control.

When asked about their knowledge of education on the mentioned topics, the majority responded that they do not know or that there is no education on them. Those who answered yes did not provide much information, except that:

- At The National Technological University (UTN) there is a Sensitive Technologies Network (RITS) that deals with dual-use technologies and scientific research (nuclear, space, cybersecurity).
- In Argentina, the CIME course (Training in the Identification of Strategic Goods) has been implemented, which provides instruction on existing strategic export controls and the international commitments assumed by the country in the matter and is training for the recognition of goods that could contribute to the development of WMD.^{16,17}

In this context, the chemical weapons and dual-use course delivered at the University of Cordoba is attended by several students from different universities. Its modality makes it more accessible for all to attend. Even when this is a top-down initiative, professors work to pass their knowledge to students, constantly communicate with the ANCAQ, and inform the OPCW.

In other cases, some professors decide to discuss the topics of responsible science, dual-use and nonproliferation with their students on their own initiative. This demonstrates the interest of some members of the academic community to raise awareness about these topics. The authors consider that further research is necessary to identify these initiatives and how they can be strengthened.

16 “El Ministerio de Defensa llevó Adelante una Nueva Jornada del Taller de Capacitación Para la Identificación de Mercaderías Estratégicas,” Argentina Ministry of Defense, July 4, 2023, <<https://www.argentina.gob.ar/noticias/el-ministerio-de-defensa-llevo-adelante-una-nueva-jornada-del-taller-de-capacitacion-para>>.

17 This course’s attendance includes Customs and military and security personnel.

The survey respondents strongly supported the implementation of courses with different formats to cover the topics mentioned, both at the undergraduate and graduate levels. Having workshops is another possibility together with creating MOOCs. It also highlighted the importance of having a multidisciplinary approach, which will be a mirror of how nonproliferation and export control are enforced.

Conclusion

The research conducted by the authors showed an incipient understanding of the concepts of dual-use, responsible research, and ITT as well as a clear interest in improving this level of understanding through educating scientists and researchers. The survey also confirmed the gap in formal education on the topics mentioned above, but surprisingly, the respondents were open not only to knowing more but also to contributing to the development of courses and materials to increase the competencies of students and researchers. The research findings have enabled the identification of educators responsible for delivering lectures or courses on the subject and opens pathways for increasing networking and collaboration with these trainers.

Recognizing the identified need from the research, there is a plan to develop a series of modules addressing these topics, incorporating the expertise of international experts and programs. Notably, there are existing initiatives worldwide focusing on CBRN nonproliferation and export control education, and efforts are underway to bring this valuable knowledge to Argentina. The modules will be developed in such a way that they can be used in other Latin American countries to improve overall capacity in the region. Upon the creation of the modules, a train-the-trainer course will be established for professors interested in delivering them. This creates a cycle for maintaining these efforts. Additionally, there is a strategy to approach university authorities for a more structured implementation of these modules within the academic framework. Engaging relevant stakeholders, including CONCESYMB, is deemed essential, and the plan includes informing them about the research results, as well as updating them on the subsequent steps and progress.

Annex

Annex 1: Policies and Agreements on Biological and Toxin, Chemical, and Nuclear Weapons in Argentina

Policies/ Initiatives/ Agreements	Date	Summary	Source
Biological			
<i>The Declaration of Mendoza</i>	Was signed in 1991 by Argentina, Brazil, and Chile. Later, it opened to most Latin American countries, and four signed the Declaration: Bolivia, Ecuador, Paraguay, and Uruguay.	Its parties will not use, develop, produce, acquire, stockpile, retain, or transfer, directly or indirectly, chemical or biological weapons.	Link
<i>Biological Weapons Convention (BWC)</i>	It is a state party of the Biological and Toxin Weapons Convention (BWC), having ratified it in November 1979	The Biological Weapons Convention (BWC) effectively prohibits the development, production, acquisition, transfer, stockpiling, and use of biological and toxin weapons. It was the first multilateral disarmament treaty banning an entire category of weapons of mass destruction (WMD).	Link
<i>The Geneva Protocol</i>	Argentina acceded to the Geneva Protocol on May 12, 1969	Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare	Link
<i>Australia Group</i>	Argentina joined in 1993.	The Australia Group is an informal forum of countries that, through the harmonization of export controls, seeks to ensure that exports do not contribute to the development of chemical or biological weapons.	Link

Nuclear			
<i>Treaty on the Nonproliferation of Nuclear Weapons (NPT)</i>	On February 10, 1995, in Washington, Argentina acceded to the Nonproliferation Treaty as a non-nuclear weapon state.	International treaty whose objective is to prevent the spread of nuclear weapons and weapons technology, to promote cooperation in the peaceful uses of nuclear energy, and to further the goal of achieving nuclear disarmament and general and complete disarmament.	Link
<i>“International Partnership for Nuclear Disarmament Verification” (IPNDV)</i>	Argentina joined the initiative.	The country reaffirms its commitment to the nonproliferation of nuclear weapons and its efforts to advance toward complete nuclear disarmament in a verifiable, transparent, and irreversible way.	Link
<i>Agency for Accounting and Control of Nuclear Materials (ABACC)</i>	In the early 1990s, Argentina and Brazil, established a bilateral inspection agency (ABACC). In 1991 the National Congresses of Argentina and Brazil ratified the bilateral agreement.	The Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) was created to verify both countries’ pledges to use nuclear energy only for peaceful purposes and signed the Quadripartite Agreement with the International Atomic Energy Agency (IAEA).	Link
<i>Latin America Nuclear Weapons Free Zone Treaty (Treaty of Tlatelolco)</i>	Argentina opened for signature the 27 September 1967 and on January 18, 1994, for Ratification	The Treaty of Tlatelolco established a nuclear-weapon-free zone in Latin America	Link

<i>The NSG (Nuclear Suppliers Group)</i>	Argentina joined in 1994	The Nuclear Suppliers Group (NSG) is a group of nuclear supplier countries that seeks to contribute to the nonproliferation of nuclear weapons through the implementation of two sets of Guidelines for nuclear exports and nuclear-related exports.	Link
<i>“International Partnership for Nuclear Disarmament Verification” (IPNDV)</i>	Argentina joined in 2015, reaffirming its commitment to nuclear nonproliferation.	The IPNDV brings together more than 30 states with and without nuclear weapons under a cooperative framework to promote further understanding of the complex challenges involved in the verification of nuclear disarmament and to identify potential solutions to overcome those challenges.	Link
Chemical			
<i>Chemical Weapons Convention (CWC)</i>	Ratifying the Chemical Weapons Convention on October 2, 1995.	The Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and their Destruction.	Link
<i>The Declaration of Mendoza</i>	Signed in 1991 by Argentina, Brazil, and Chile. Later opened to most Latin American countries, and four signed the Declaration: Bolivia, Ecuador, Paraguay, and Uruguay.	Its parties will not use, develop, produce, acquire, stockpile, retain, or transfer, directly or indirectly, chemical or biological weapons.	Link
<i>The Geneva Protocol</i>	Argentina acceded to the Geneva Protocol on May 12, 1969	Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare	Link

<i>Australia Group</i>	Argentina joined in 1993.	The Australia Group is an informal forum of countries that, through the harmonization of export controls, seeks to ensure that exports do not contribute to the development of chemical or biological weapons.	Link
General WMD			
<i>Political Declaration of MERCOSUR.</i>	Argentina, Bolivia, and Chile signed a zone of peace in Ushuaia on the 29th of July 1998.	The Southern Common Market Market (MERCUSOR), of which Argentina is a member, declared its geographic region and Bolivia and Chile free of weapons of mass destruction (WMD) and a “zone of peace” in July 1998 through the Declaration of MERCOSUR, signed in Ushuaia, Argentina.	Link
<i>MTCR (Missile Technology Control Regime)</i>	Argentina also joined the MTCR in 1993.	The Missile Technology Control Regime (MTCR) is an informal political understanding among states that seeks to limit the proliferation of missiles and missile technology.	Link Link
<i>Security Council Resolution 1540</i>	Argentina firmly and vigorously supports the terms of the resolution 1540.	In resolution 1540 (2004), the Security Council decided that all States shall refrain from providing any form of support to non-state actors that attempt to develop, acquire, manufacture, possess, transport, transfer or use nuclear, chemical or biological weapons and their means of delivery, in particular for terrorist purposes.	Link

Annex 2: Complete List of Universities with STEM Careers:

University
Universidad de Buenos Aires
Universidad Nacional de Córdoba
Universidad Nacional de La Plata
Universidad Nacional de Tucumán
Universidad Nacional del Litoral
Universidad Nacional de Salta
Universidad Nacional de San Luis
Universidad Nacional de Cuyo
Universidad Nacional del Sur
Universidad Nacional de Rosario
Universidad Nacional de San Juan
Universidad Nacional de Mar del Plata
Universidad Nacional del Comahue
Universidad Nacional de Misiones
Universidad Nacional del Nordeste
Universidad Nacional de Santiago del Estero
Universidad Nacional de Catamarca
Universidad Nacional de la Patagonia San Juan Bosco
Universidad Nacional de Entre Ríos
Universidad Nacional de Río Negro
Universidad Nacional del Centro de la Provincia de Buenos Aires
Universidad Nacional del Chaco Austral
Universidad Nacional de La Pampa
Pontificia Universidad Católica Argentina Santa María de los Buenos Aires
Universidad de Morón
Universidad Nacional de La Rioja
Universidad Autónoma de Entre Ríos
Universidad Nacional de Río Cuarto
Universidad Juan Agustín Maza
Universidad Nacional de Jujuy
Universidad Nacional de Formosa
Universidad Católica de Córdoba
Universidad de Belgrano
Universidad Nacional de General Sarmiento
Universidad del Norte Santo Tomás de Aquino
Universidad Nacional de Luján
Universidad Empresarial Siglo 21
Universidad Tecnológica Nacional
Universidad Nacional Arturo Jauretche
Universidad Nacional de San Martín

Universidad Católica de Salta
Universidad Nacional de Villa María
Universidad Nacional de Hurlingham
Universidad Nacional de La Matanza
Universidad Nacional de la Patagonia Austral
Universidad Católica de Santiago del Estero
Universidad Argentina de la Empresa
Universidad Nacional del Noroeste de la Provincia de Buenos Aires
Universidad Nacional de Chilecito
Universidad Católica de Santa Fe
Universidad Austral
Universidad Nacional de San Antonio de Areco
Universidad de la Defensa Nacional
Universidad Nacional de Tres de Febrero
Universidad CAECE
Universidad Nacional de Villa Mercedes
Universidad Nacional de Lomas de Zamora
Universidad de la Fraternidad de Agrupaciones Santo Tomás de Aquino
Universidad Nacional de Quilmes
Universidad Nacional de Rafaela
Universidad Católica de Cuyo
Universidad Provincial del Sudoeste
Universidad Nacional del Oeste
Universidad Maimónides
Universidad Argentina John F. Kennedy
Universidad Nacional Guillermo Brown
Universidad del Aconcagua
Universidad Nacional de Tierra del Fuego, Antártida e Islas del Atlántico Sur
Universidad Blas Pascal
Universidad Nacional de Avellaneda
Universidad Nacional de Lanús
Universidad de la Marina Mercante
Universidad Nacional de los Comechingones
Universidad Pedagógica Nacional
Universidad Favaloro
Universidad de Mendoza
Universidad del Gran Rosario
Universidad del Chubut
Instituto Universitario Escuela de Medicina del Hospital Italiano
Instituto Universitario de Ciencias Biomédicas de Córdoba
Universidad del Centro Educativo Latinoamericano
Universidad Católica de La Plata
Universidad de Palermo

Universidad de Concepción del Uruguay
Universidad del Salvador
Universidad Metropolitana para la Educación y el Trabajo
Universidad Nacional José C. Paz
Instituto Tecnológico de Buenos Aires
Universidad de Ciencias Empresariales y Sociales
Universidad de Flores
Universidad Abierta Interamericana
Universidad Nacional de Moreno
Universidad de la Cuenca del Plata
Universidad Atlántida Argentina
Instituto Universitario de Seguridad Marítima
Universidad Provincial de Ezeiza
Universidad Adventista del Plata
Universidad de San Pablo - T
Universidad Nacional del Alto Uruguay
Universidad Gastón Dachary
Instituto Universitario de Ciencias de la Salud de la Fundación Barceló
Universidad Torcuato Di Tella
Universidad Champagnat
Instituto Universitario para el Desarrollo Productivo y Tecnológico Empresarial de la Argentina
Universidad Católica de las Misiones
Instituto Universitario CEMIC
Universidad Nacional Raúl Scalabrini Ortiz
Universidad del Este
Universidad Provincial de Córdoba
Universidad del CEMA
Universidad de Congreso
Instituto Universitario Escuela Argentina de Negocios
Universidad de San Andrés
Instituto Universitario Italiano de Rosario
Instituto Universitario de Gendarmería Nacional

Annex 3: Number of Universities Covering STEM Degree Programs

STEM Degree	Count of universities that teach each career
Médico (Physician)	45
Ingeniero Industrial (Industrial Engineer)	42
Ingeniero Agrónomo (Agricultural engineer)	32
Ingeniero en Informática (Informatics Engineer)	27
Ingeniero Químico (Chemical engineer)	25
Ingeniero Electrónico (Electronic Engineer)	25

Ingeniero Civil (Civil engineer)	22
Farmacéutico (Pharmacist)	20
Ingeniero en Alimentos (Food engineer)	20
Bioquímico (Biochemist)	20
Ingeniero Mecánico (Mechanical engineer)	19
Ingeniero Electromecánico (Electromechanical engineer)	18
Profesor en Matemática (Mathematics professor)	18
Licenciado en Ciencias Biológicas (Degree in life sciences)	17
Licenciado en Matemática (Degree in Mathematics)	17
Profesor en Física (Professor in Physics)	15
Profesor en Química (Chemistry Professor)	15
Licenciado en Química (Degree in Chemistry)	14
Ingeniero Agrimensor (Surveying Engineer)	13
Licenciado en Gestión Ambiental (Degree in Environmental Management)	13
Licenciado en Sistemas (Degree on Systems)	12
Licenciado en Sistemas de Información (Degree on Information Systems)	12
Licenciado en Biotecnología (Degree in Biotechnology)	12
Licenciado en Física (Degree in physics)	12
Ingeniero en Telecomunicaciones (Telecommunications Engineer)	11
Profesor en Ciencias Biológicas (Professor in Biological Sciences)	11
Analista de Sistemas (Systems analyst)	10
Licenciado en Informática (Degree in computer science)	10
Ingeniero Ambiental (Environmental engineer)	10

Annex 4: Number of STEM Careers per University

Universidad Nacional de La Plata	55
Universidad de Buenos Aires	50
Universidad Nacional del Litoral	50
Universidad Nacional de San Luis	46
Universidad Nacional del Sur	42
Universidad Nacional de Córdoba	41
Universidad Nacional de Rosario	37
Universidad Nacional de Cuyo	36
Universidad Nacional del Centro de la Provincia de Buenos Aires	36

Universidad Nacional del Comahue	35
Universidad Nacional de San Juan	35
Universidad Nacional del Nordeste	34
Universidad Nacional de Catamarca	34
Universidad Nacional de Tucumán	33
Universidad Nacional de Misiones	32
Universidad Nacional de Salta	32
Universidad Nacional de Santiago del Estero	31
Universidad Nacional de la Patagonia San Juan Bosco	30
Universidad de Morón	29
Universidad Nacional de Río Negro	28
Universidad Nacional de Mar del Plata	26
Universidad Nacional de La Rioja	26
Pontificia Universidad Católica Argentina Santa María de los Buenos Aires	26
Universidad Nacional de Entre Ríos	24
Universidad Autónoma de Entre Ríos	22
Universidad Nacional de Río Cuarto	20
Universidad Nacional de La Pampa	18
Universidad Nacional del Chaco Austral	15
Universidad Juan Agustín Maza	11

Annex 5: Responses to Survey Question: Responsible Conduct of Research

Responsible conduct of research (RCR) is defined as “the practice of scientific research with integrity”. It involves the knowledge and application of established professional standards and ethical principles in the performance of all activities related to scientific research. 1A) What is your opinion about this? Intangible technology transfer (ITT) involves transferring or making controlled elements available to an entity or individual through intangible means, such as email, verbal communication, training, or visual inspection. What is your opinion?

I didn't know those concepts. They are only addressed in the academy, very tangentially and always in good faith, ignoring bad or illegal uses.

Yes, I knew the concept. I consider that RCR is something that should be included in the curricula of different careers as spaces that give rise to reflection, on the analysis of the social scope of the discipline itself in different scenarios of professional conduct concerning research activities.

I didn't know it, but it is almost obvious that any investigation should be carried out honestly, without cherry-picking data and getting the answers that emerge, not the ones you want.

No. I think it is extremely important to talk about this.

I knew the concept, although not the textual definition. I believe that it is a fundamental basis on which we should perform as scientists.

I had heard it. I think it is necessary to advance clear rules/responsibilities like doctors or architects have.

No, it is important to spread it.

I didn't know it as such, but I did know the concept of good research practices. They must be framed within the scope of scientific research and protected by aesthetic standards.

I did not know this term, however, I apply the concept in my work area

I don't know it as such, but I practice it daily, working in health involves adhering to the rules, applying the principles of ethics, but mainly a high degree of empathy and respect is required for those who need our service.

I did not know the term exactly, but they have trained me since my graduation, instilling in me ethical and responsible conduct for the performance of my professional duties.

I did not know this term, but that of responsible research and the code of public ethics, which make one as a researcher use the funds received exclusively for what they were given. I think it is good to include integrity in the definition since it is comprehensive, but the scientific population should be educated about it.

No, I find it interesting, as long as it is not a way of restricting diversity and only lowering the line of one way of doing things (research)

I didn't know the term, although I did know the practice. Interesting

Yeah. It is very good but although it is tacitly recognized, I do not think it is put into practice.

I did not know that term and it is good that before carrying out research work it is approved, in my case by the Luis Pasteur Zoonoses Institute, all research work must be approved by the CEI (ethics and research committee).

I didn't know the term, but in my practice, I try to be governed by this same principle of integrity.

Yes. It is a topic in which not only the researcher but also the institution where the research is carried out must be committed. Transparency must be achieved in the work carried out by researchers.

Yes, I knew her, and I agree.

If you knew similar expressions. In my area of expertise it is called bioethics

Yes, I knew it. It is essential i) to have ethical standards, ii) that they are widely disseminated, iii) that these principles be discussed as a way of reflecting on the topic, iv) Transmit and teach these concepts in the classroom and when working with students.

I didn't know it. I consider it essential for the development of science in any field.

Yes, I know the definition, and I think that dissemination and awareness about this is of utmost importance.

I didn't know it but it seems like a correct definition to me. I would add that these activities must have a justified purpose, a clear hypothesis, and an adequate development.

I did not know the term but I did know the concept, it is how I have managed to carry out research during my doctorate.

I didn't know the term. Courses on ethical performance standards and principles are not usually offered in my areas of performance.

Annex 6: Responses to Survey Question: Dual-Use Research of Concern

Dual-use research of concern (DURC) is life science research that, based on current knowledge, can reasonably be anticipated to provide knowledge, information, products, or technologies that could be directly misapplied and pose a significant threat with broad potential consequences to public health and safety, crops and other plants, animals, the environment, material, or national security. What is your opinion?

I did not know it was defined that way, but it is generally taught in Ethics and legislation in biotechnology

I did not know the term as such, but I did know the concept that when doing research, even if not all possibilities can be foreseen, it is vital to start thinking about what can go wrong, so as in the previous question, try to look for actions that can prevent/reverse/mitigate Negative effects.

Yeah. I consider it dangerous and ethically reprehensible.

If some technology is very easy to take to fields where it can cause harm, its use must be controlled. But the opportunity should not be lost to the benefits that can be achieved

No. I find it interesting to learn more about the subject. It seems essential to me to advance with this line of research

Related to the previous question. I think this topic should be discussed more.

I knew the definition. Professional guidelines/responsibilities must be established as with some professions

Not without knowledge of the term

I didn't know. It would be necessary to analyze what makes something dangerous. Let's think about a simple knife, the use we give it is what makes it such. Just today they killed a person with a Tramontina. Whoever manufactured it did not violate any ethics. This indirectly brings me to Napoleon... Bayonets are useful for anything except sitting on top

I do not know that terminology, however, each professional must know the scope and potential uses of their products, therefore they must take precautions for their proper use.

I know the term but again I believe that my environment does not know it and this is worrying since it is necessary to become aware of the danger of the incorrect use of knowledge, information, products and/or technologies, even more so that mental illnesses are becoming more frequent in people. people.

I did not know this term, I have been away from areas of biological research for more than 6 years. I think, like the previous answer, we must focus on the control bodies so that with state policies, regulations and measures, scientific research is not stopped due to a possible problem that may or may not develop for certain. The education of researchers is key, it is the first tool that gives us guarantees of their work, but a good supervision system helps avoid “detours in research”

I didn't know it, and he seems very good to me.

I didn't know it. Although in many fields it is difficult to predict consequences (thalidomide...) having a method can be useful

I do not know that term, and I believe that in each case the purposes of the research must be established with approved protocols and the objectives of said project clear, and the conditions of biosafety and consent if required.

I didn't know the term. It is essential to categorize these goods as dual and for this this type of research is required.

Yes. Awareness of the risks that exist due to dual-use must be created, especially in the research area so that scientists keep this concept in mind when discovering or developing new technologies.

I didn't know about it (I would translate it as Concern about Dual-use of Research). It is essential to take this into account and make it known.

Yes, I know it, although it falls outside my scope of professional responsibility.

I didn't know it. It should be spread more in non-specialized areas.

I didn't know it. I believe that it is difficult to prevent this research from occurring and eventually being used for harmful purposes.

I didn't know the term. It is a more precise definition than “dual-use.”

Annex 7: Responses to Survey Question: Intangible Technology Transfer

Intangible technology transfer (ITT) involves transferring or making controlled elements available to an entity or individual through intangible means, such as email, verbal communication, training, or visual inspection. What is your opinion?

I think it would only be useful to be accompanied by inspections, otherwise the evasion, errors and falsification of information are not detected.

I was not aware of this term as such, but about confidentiality agreements that establish that any disclosure of information that is part of the agreement includes any means. In the case of verbal communications, I consider them to be the most difficult to prove that they occurred.

I did not know the term, but the use of intangibles, whether goods or services, is increasingly necessary.

No. I find it interesting to learn more about the subject.

I didn't know him. I think it is part of the consulting/technology transfer.

I know the term. More international elaboration required

I didn't know the term but I did know the concept. Regarding intangible transfer through emails, I believe that sometimes data vulnerability situations can arise.
Not as such, diagnostic methods and health technology are transferred through training frequently and are done within current regulations for their proper use.
I did not know this term, but in practice, I have done it, without becoming very aware of the act itself. In any case, there are situations in which this must be done mandatory by institutional provisions.
I know this topic well, it is today a big black hole. Since the researcher's career implies the preparation of papers, participation in conferences and the exchange of information with colleagues. If a researcher does not carry out these activities, he never grows professionally and that affects not only his academic career but also his pocketbook. Today this discussion is still open and the truth is that I do not see a quick solution. I think that as a basis we should have two qualification systems for scientists, one open and public and the other closed, but the issue is so broad that a very firm state policy is needed to carry it forward.
I didn't know about it and I find the possibility of being attentive to that vulnerability interesting.
Yeah. Care and regulations must be taken with the transfer of knowledge through these channels, and especially if they are for dual-use.
I didn't know that term, it is very difficult to control this information management nowadays.
Yes. It is a difficult area to control. All research works are found on the web; there is an exchange of personnel between the different institutes in different countries; Programs can be sent remotely or on small devices that go unnoticed by customs controls. It is a challenge for all countries.
I didn't know it. I think it should be controlled
I didn't know it. It's scary
Yes, they are procedures that must be paid attention to and that researchers should be aware of.
I learned it recently through a class given by a guest expert in the university environment. Again I suggest dissemination in directly or indirectly linked sectors.
Undoubtedly, the current ease of movement of information and people means that the transfer of knowledge and technology has a diffusion that is in some cases impossible to estimate.
I didn't know the term. I think it would be incorrect to use the word "elements" for the type of technology that can be transferred through the aforementioned means; "information" or "knowledge" would be more appropriate terms.

Annex 8: Responses to Survey Question: Education

Do you have any suggestions on the possibility of education on the abovementioned topics? Please share your ideas.

It is necessary to incorporate these concepts into the curriculum
Workshops, MOOC courses.

They could be incorporated into introductory subjects of stem careers and through scientific dissemination.

Most of these issues show how important it is for each individual to take responsibility for their consumption and actions.

I think it is very important to advance with the training of professionals but also among students in biology and related careers.

In the same way that careers such as medicine have legal subjects in their curricula, the same should occur in some engineering, biology, physics, etc.

It is important to implement biological-scientific careers in the curriculum at different educational levels.

Research ethics should be part of subjects such as research methodology

I believe that they are concepts and topics that should begin to be widely disseminated, both in postgraduate courses and in undergraduate subjects.

I imagine that there must be organizations that train on these topics, I don't know who or which ones.

Education in these topics should already begin at graduation and then should be reinforced in post-graduation.

Yes, specifically point 4, TIT is today, in my opinion, the big problem, and I find that decision makers always try to be "politically correct" then since the academic world is involved and public opinion is behind it, no one ever sits down to plan. alternatives in this regard to be able to ensure the information produced in our research centers. Be careful, I am not judging the researchers, this is an institutional and educational problem for each of the research centers.

There are several ideas and they would all be valid, I believe that first there must be a state policy that defines the guidelines and based on that, develops a plan.

I believe that whenever sensitive topics with dual abilities are being investigated, education should be generated about it.

These are fairly general topics of application, they should be part of a combined strategy. Presentation of the topic at conferences or meetings, notes in the media, etc.

At UTN there is a Sensitive Technologies Network (RITS) that deals with dual-use technologies and scientific research (nuclear, space, cybersecurity).

Each institution that handles this type of bioinformatic biological material must have these protocols and make them known to the staff, and not find out that they exist when one wants to carry out research.

It would be interesting to incorporate this approach during undergraduate courses, although I recognize that it would require a subject designed with a view related to the current of science, technology and society. With a much smaller scope, it would be possible to carry out postgraduate courses in this regard, thinking about them applied in a particular field to generate the interest of experts in different specific areas.

In our country, the CIME course (Training in the Identification of Strategic Goods) has been implemented, which provides instruction on the existing strategic export controls and the international commitments assumed by the country in the matter, and is training for the recognition of goods that could contribute to the development of nuclear, biological and chemical weapons, or their delivery systems, such as missiles and rockets. Also, this year, training in intangible technology transfer was received from the United States and a workshop was held with Brazil.

I consider that they are important topics to be incorporated into the curricula of the corresponding careers.

General and professional ethics must occupy more space in the training and management of science

My previous answer is focused on my university, I don't know what it is like at others, although I have the impression that education on these topics is not very widespread and is necessary.

Linkage between specialists in these fields with students and educational settings. Seminars and dissemination tasks in sectors such as diplomacy, intelligence, armed forces and security. Possibility of participation in seminars/scholarships for university students and teachers to generate a multiplier effect in the dissemination of this type of knowledge and work on it from a multidimensional approach.

The issue of education about scientific research is not seen in undergraduate courses (or it was not seen when I was studying a few years ago). I received this

It does not begin to be seen in master's or postgraduate courses and empirically when one begins to actively participate in this type of activities and begins to question methodologies and results from reading papers and publications.

They seem very specific terms to think about an education that involves a subject in undergraduate courses. Perhaps it should be considered as knowledge to be taught transversally in various subjects. Mandatory virtual courses can be implemented for teachers, researchers and/or professionals who work on projects with possible DURC (from public institutions at least), similar to those taught within the framework of the Yolanda law, for example.

