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Beyond Trivialization: Targeted Nuclear Education for Professional Opinion Leaders and Strategic Segments

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1. Introduction

The rapid expansion of digital media has led to a paradoxical phenomenon: the trivialization of scientific discourse. We are currently facing a "disengagement crisis" where unqualified actors—ranging from widely recognized digital influencers considered leading authorities [1] and reputable popular science magazines [2] — disseminate inaccurate information without scientific accountability or peer review. Simultaneously, a significant portion of the scientific community conflates "dissemination" with the mere digital reproduction of content, contributing to an informational overload that lacks pedagogical depth. In the nuclear field, where radiophobia and technical complexity persist, providing raw data is insufficient. This paper argues that effective public perception requires Science Education—a process demanding specific pedagogical credentials, solid theoretical foundations, and the professional expertise necessary to transform information into meaningful knowledge.

2. Methodology

The strategies developed at the Nuclear and Energy Research Institute (IPEN-CNEN) move beyond unstructured dissemination into a rigorous educational framework based on two pillars:

1. Direct engagement: The organization of specialized technical events (seminars and workshops) tailored to the specific professional lexicon and interests of distinct socio-professional niches.
2. Specialized literature: The development of the "IPEN Explica" series — open-access, scientifically rigorous books designed through a pedagogical lens to bridge the gap between nuclear experts and professional society.

3. Results and Discussion

3.1. Case Study 1: Engineering and Industry

Industrial radiography is a vital Non-Destructive Testing (NDT) tool. However, due to radiophobia, some industries have replaced it with less sensitive techniques, compromising quality.

- Action: IPEN-CNEN hosted the Seminar on Safe Operations in Industrial Radiography for engineers and corporate decision-makers. The event focused on advanced inspection techniques, occupational safety, environmental protection, and emerging market trends. The primary goal was to provide high-level technical knowledge to ensure the safety of industrial structures and operations, emphasizing risk reduction and strict regulatory compliance [3].
- Outcome: Participant feedback highlighted a critical void of reliable, high-level technical materials. This led to the publication of "IPEN Explica: Radiografia Industrial", serving as a technical-pedagogical bridge for the industrial sector. The book addresses complex topics such as the

miscommunication of risk, radiological protection, and the technical specificities of X-rays, gamma radiography, and industrial tomography, including their strategic applications in public safety and security [4].

3.2. Case Study 2: Basic Education and the National Curriculum (BNCC)

The 2019 BNCC update mandated the inclusion of peaceful nuclear applications in school curricula, yet educators were not provided with the necessary training or resources [5]. Furthermore, students are often confronted with an informational overload that proves ineffective in constructing meaningful knowledge applicable to real-life contexts [6].

- Action: Annual workshops for educators focusing on Food Irradiation—a critical issue for Brazil. This theme is approached as a multidimensional solution, encompassing the stability of the national food supply chain, food safety (ensuring food is free from pathogens), public health, and the urgent global challenge of reducing post-harvest waste.
- Outcome: To meet the demand for classroom-ready content, IPEN authors developed illustrated, curriculum-aligned books for free distribution. Reflecting the international impact of this initiative, these works were translated into Spanish through a partnership with a professor from the Balseiro Institute (Argentina). Edited by the Brazilian Society of Radiation Protection (SBPR), these versions are now distributed throughout Latin America, establishing a cross-border network for nuclear literacy [7].

3.3. Methodological Expansion: The Medical Sector (2026)

Building upon this successful methodology, a specialized seminar for medical professionals was conducted in May 2026. This initiative addressed clinical applications and radiation protection for non-nuclear medical specialists. To consolidate this action, a new open-access volume dedicated to the healthcare sector is currently in development and scheduled for publication in the second half of 2026, further institutionalizing the link between nuclear science and medical practice.

4. Conclusions

The current informational landscape demonstrates that an overload of unstructured content often results in a vacuum of comprehension. The era of amateur scientific dissemination must be superseded by Professional Science Education. Successful engagement in the nuclear sector is not a matter of content volume, but targeted actions focusing on corporate education and pedagogical alignment. By focusing on professional multipliers—engineers, educators, physicians and soon environmentalists, journalists and policy makers,— the authors propose a new paradigm for the popularization of scientific knowledge: one that is professional, assertive, and socially transformative. It is a paradigm where scientific authority and educational rigor effectively transform public perception and social confidence in nuclear technology across all strategic sectors of society.

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