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Supervision of Scientific Integrity by Postgraduate Academics

Supervisión de la integridad científica por académicos de posgrado

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Abstract

The purpose of the article is to develop a better understanding of how postgraduate academics from a Mexican university supervise the integrity of their research work. A qualitative inquiry was carried out with 291 postgraduate professors and researchers, who answered the question, "In your academic work, how is integrity in research supervised?" The analysis was conducted using grounded theory procedures. The results were organized in two categories: "Supervision of scientific integrity based on collective work," which involves the participation of a variety of actors, and "Epistemic vigilance in the supervision of scientific integrity," associated with an attitude of caution throughout project development. The conclusion highlights the relevance attributed by the professors and researchers to basic aspects of ethics in the generation of knowledge and in training processes.

Keywords: scientific researchers, ethics of science, research, postgraduate education, university professors

Resumen

El artículo tiene por objetivo desarrollar una mejor comprensión de las acciones que implementan académicos de posgrado de una universidad mexicana para supervisar la integridad en su trabajo de investigación. Se realizó una indagación cualitativa con 291 profesores e investigadores de dicho nivel que contestaron la pregunta, "En su trabajo académico, ¿cómo se supervisa la integridad en la investigación?" El análisis se desarrolló con base en los procedimientos de la teoría fundamentada. Los resultados se organizaron en dos categorías: "Supervisión de la integridad científica con base en el trabajo colectivo", que involucra la participación de diversos actores, y "Vigilancia epistemológica en la supervisión de la integridad científica" asociada con una actitud de cautela a lo largo del desarrollo de los proyectos. La conclusión destaca la relevancia que dan los profesores e investigadores a los aspectos básicos de la ética en la generación del conocimiento y en los procesos formativos.

Palabras clave: investigadores científicos, ética de la ciencia, educación de posgrado, profesores universitarios

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I. Introduction

Research ethics is an important part of the scientific process. Some studies employ ethically unacceptable or questionable conduct, while other projects adopt good ethical conduct in their scientific development and training processes. We work from the view that there are several obstacles to understanding this concept, one of which is the difficulty of establishing a distinction between similar terms, such as research integrity (RI), scientific integrity, and academic integrity.

This diversity shows the need to develop research that provides insight into the thinking of academics and, from their conceptions and experiences, contributes to the construction of a conceptual framework that favors the quality of research processes. From this perspective, the study of scientific integrity is pertinent. In this regard, Silva et al. (2021) point out that there is no universally accepted definition of scientific integrity.

Problems arise in the various titles given to supervisors of scientific integrity, including tutors, mentors, professors and researchers, since they all perform similar functions in higher education institutions.

In our Research Ethics Project Questionnaire, we included the open question, "In your academic work, how is research integrity supervised?" The idea is to develop a better understanding of this research problem based on the empirical evidence provided by postgraduate academics from a Mexican university.

Interest in this topic dates from 2006 with the development of the Interuniversity Project on Professional Ethics (Hirsch, 2009). This work clearly highlighted the relevance of values, competences, and ethical aspects for postgraduate professors in the tasks they performed, especially in research. After that, we began a new project on applied ethics in relation to research ethics, with the purpose of advancing in the construction of theoretical and empirical work with university postgraduate academics. We expect to share the advances in this field with professors and researchers from other higher education institutions.

The article is organized into the following sections: A literature review; the methodology, based on the procedures of grounded theory (Corbin & Strauss, 2015) and the use of 'ATLAS.ti' (Friese, 2019); and the results, presented according to two emerging categories: "The supervision of scientific integrity based on collective work," and "Epistemic vigilance in the supervision of scientific integrity."

1.1 Literature review

A search was performed for indexed articles in English on a) Supervision of scientific integrity, and b) Responsible supervision. We selected nine publications from different countries – Belgium, China, Croatia, Denmark, Finland, Greece, Hungary, Kenya, the Netherlands, Norway, and the United States of America – from 2018 to 2022, and from different international journals, such as the American Journal of Tropical Medicine and Hygiene; the International Journal of Teaching and Learning in Higher Education; Accountability in Research; Responsible Research, Science and Public Policy; the Journal of Academic Ethics; Science and Engineering Ethics; and BM Medical Ethics. The database is from ERIC, Scimago, Sage Journals, Springer, the National Library of Medicine, and Taylor & Francis Online.

1. Muthanna and Alduais (2021) provide an account, based on a qualitative study and the review of 66 publications, of the linkages between scientific integrity and the supervision of research. The results emphasize the fact that responsibility for maintaining integrity falls mainly upon instructors and supervisors, highlighting cases in which these procedures are at risk and providing messages of guidance for decision makers, administrators, instructors, and trainees. According to the authors, supervision helps students to develop critical and creative thinking, research skills, and knowledge. It is based on an adequate relationship between supervisors and supervisees, and considers the ethical codes of research, as well as the different cultures and norms of the subjects being taught. They point out that there were complaints from learners who were dissatisfied with the process and reported cases of abuse. A lack of attention by supervisors to ethical aspects can cause conflicts, in the same way as having too many students and not enough time to cater to them.

2. Löfström and Pyhältö (2018) point out that research integrity is learned by way of supervision. They believe that monitoring degree exams is central to the socialization of young researchers, as doctoral students ask ethical questions and learn the phases and procedures of research, along with the principles and practices of the scientific community. Priority is given to honesty, care and precision, respect for the research participants, the promotion of well-being, and the avoidance of harm.

Serious cases of ethical misconduct arise in relation to principles and values. These include issues such as exploitation, abuse, inadequate treatment, bullying, and conflicts regarding the roles carried out by supervisors, limiting the autonomy of the students. There will be problems that the supervisor can resolve alone, but there are others in which the scientific community must intervene. Although the responsibility to promote ethical and sustainable models lies with all participants, tutors are in a key position to perform this work.

3. Bukusi et al. (2018) also agree that tackling ethical aspects through supervision is key to promoting scientific integrity and the ability to carry out research. They refer to the need to support learners in their understanding of the normative aspects of this substantive role, to ensure that both the processes and results are reliable. They report that each generation of students continues to face problems with the various facets of research, from design to implementation, as well as with the analysis and dissemination of results. They perceive a high prevalence of unethical conduct, due to shortcomings in institutional structures and in the systems that support and promote scientific integrity. Despite improvements in teaching and tutoring, and in programs that regulate research, they believe that better education about responsible behavior is required. In their review of specialized literature from several countries, they selected four common areas of unethical conduct: plagiarism, unjustified authorship, inappropriate use of responsible conduct in research, and power inequality, especially in terms of gender.

4. Pizzolato and Dierickx (2022) explain that supervisors play an important role in understanding what doctoral students learn during their sessions on research integrity. They interviewed 22 subjects from Europe to find out how they perceive their role as trainers and their supervision practices. They found differences in relation to academic field, seniority, country of work and gender. They also noted that institutions are relevant for supervision efforts and practices, and that research integrity is associated with responsible practices and high professional, methodological and ethical standards. The authors used a qualitative methodology, with semi-structured interviews (from October 2021 to January 2022) and two main research questions, about "exploring how supervisors' behavior and different practices can influence supervisees' research practices and related behavior" and "how research institutions can support supervisors and responsible supervision to help them to promote

RI and responsible research" (p. 6). Participants were also asked to choose explicit and implicit supervision practices and indicate which virtues they thought were important to a good supervisor. They agreed that the main role was to supervise doctoral candidates, especially in their communication skills and their ability to work in teams.

5. Haven et al. (2022) wrote about training supervisors to work with doctoral candidates. They believed they should be familiar with responsible research practices and possess interpersonal skills. To this end they developed a three-day pilot training course, and sent the Research Supervision Quality Evaluation Survey to the PhD supervisors and the candidates before and after training. They also conducted a focus group.

One of several aspects described was that the relationship between supervision and research integrity is bidirectional, because poor supervision may increase research misconduct and responsible supervisors help to develop research integrity among doctoral candidates. Several authors pointed to a need to develop research integrity training in relation to good interpersonal skills and promote an open atmosphere where failures could be discussed. They recruited PhD supervisors in three different academic institutions. Interactive training was conducted following a learning-by-doing approach. The focus group interview was about three aspects: the perception of training, the combination of interpersonal skill development and research integrity, and supervisors' thoughts about making supervision training compulsory.

6. Cornér et al. (2019), explored doctoral supervisors' perceptions of the factors that contribute to doctoral studies. They applied 15 semi-structured interviews with professors that act as supervisors in economics, medicine, natural sciences, engineering, the humanities, and social sciences in three universities. Supervisors identified a variety of resources that were associated with social aspects of work, and challenges related to structural elements within the research community. The findings highlighted the importance of different supervisory resources such as a good supervisor-student relationship, research team support, and international contacts. The objective of the study was to identify the main factors that contribute to the successful completion of doctoral studies and achieve a broader understanding of doctoral supervision. The authors used the job demands-resources (JD-R) model to explore the supervisors' perceptions of key regulators such as necessary resources and challenges in completing doctoral studies.

The results show variation in the perceptions of supervisors, which relate to structures, the organization of doctoral education, the scholarly community, supervisory relationships, and individual competence.

7. Noting the importance of education for fostering research integrity, Labib et al. (2021) followed a constructivist approach and reviewed experiences regarding how research institutions can develop and implement research integrity and training policies. Thirty focus groups were conducted with 147 participants from Europe. Five themes were identified: RI education should be available to all, education and training approaches and goals should be tailored, motivating trainees is essential, both formal and informal education formats are necessary, and institutions should consider various individual, institutional, and system-of-science factors in implementing RI education, tailoring training to discipline-specific contexts. Researchers of various ranks were included.

The results of the analysis showed few differences in perspectives between participants from different disciplines and ranks. In addition, education is unlikely to be successful if implemented without sufficient attention to other research integrity responsibilities and the

multitude of existing approaches used in training programs. Implementation was also found to be highly dependent on various individual, institutional and system factors.

8. Armond et al. (2021) performed a systematic review in PubMed, Web of Science, SCOPUS, JSTOR, Ovid, and Science Direct. Their goal was to identify cases of bad practices related to research ethics and research integrity, from which they intended to analyze the characteristics of these practices and how these problems are represented in the scientific literature. From 14,719 records, they identified 238 cases. They found four prevalent forms of ethical misconduct: fabrication and falsification of data (44.9%), violation of codes or procedures (15.7%), participant safety issues (11.1%), and plagiarism (6.9%). Most cases were from the medical and health sciences (80.8%). Sanctions included the retraction of publications and the limitation of funding.

9. Roje et al. (2022) applied the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist. The authors selected 236 publications from different areas: biomedical, social, and natural sciences and the humanities. They found a prevalence of publications that studied negative impacts. They also highlighted the importance of coordinating efforts to promote integrity at three levels – researchers, institutions, and the system – and favor pertinent training processes tailored to the characteristics of research in different disciplines and to the needs of students. The authors concluded that it was necessary to apply a range of strategies to facilitate knowledge of the different codes and policy development together with academics.

The nine articles we chose showcase the diverse range of methodologies that can be used to address research integrity, and they served as a reference framework for the present study. It was widely acknowledged that it is important to recognize training and supervision processes as essential building blocks to achieve ethical attitudes.

II. Methodology

2.1 Participants

Interpretive qualitative research was used for this article (Sánchez et al., 2020). Maxwell (2019) indicates that these types of studies are characterized by their flexibility. Participants were selected through purposive sampling (Marte & Peña, 2020), and we specifically requested the participation of academics with postgraduate experience.

The participants were located using the official web pages of the university and we prepared an extensive list of graduate professors and researchers who were asked to take part. In total, 3,874 messages were sent requesting their input and 291 responses were received (7.51%). Although a small percentage answered the questionnaire, we believe it is relevant that they represented all 41 postgraduate programs.

We took into consideration the four knowledge areas within the university and added a special category that we named “cross-disciplinary,” which includes academics that work in different postgraduate programs. The relative frequency of each is as follows:

1. Physical, mathematical, and engineering sciences: 21.5%
2. Biological, chemical, and health sciences: 30.5%
3. Social sciences: 11.6%
4. Humanities and the arts: 17.8%, and

5. Cross-disciplinary: 19%

The participants had served in the institution for between 2 and 63 years. In total, 77% are members of the National System of Researchers and 86% are part of the Academic Staff Performance Stimulus Program. The gender data showed that 54.9% identified themselves as male, 44.3% as female, and 0.6% preferred not to answer.

2.2 Instrument

A questionnaire was designed with three sections. The first one included the research project, the academics responsible and an informed consent form. The second section concerned the area of work and years of service, and the last one included twelve open questions, previously validated by a group of experts to ensure their pertinence and quality. It was decided to administer the questionnaire online using Google Forms, thus facilitating the authors' participation (Packer, 2018).

2.3 Procedure

The information was gathered online. Once the instrument was validated, it was transcribed into Google Forms and the request was sent by inserting the corresponding link in an email message. The process lasted six months between 2021 and 2022.

Responses were checked daily and we continued to search for email addresses, send more questionnaires, and deal with concerns raised by the participants. Tables were also designed to record the information from the questions asked. For this article, attention was paid to the information derived from the question, "In your academic work, how is integrity in research supervised?"

A Word document was created with the information from each knowledge area, a preliminary reading was carried out to correct possible transcription errors, and later this information was used to create a hermeneutic unit. All responses were incorporated into the ATLAS.ti program (Friese, 2019), which was used to support the organization of data.

2.4 Analysis

The information was analyzed and interpreted following the postulates of grounded theory (Corbin & Strauss, 2015), to generate theory based on the application of our questionnaire. Subsequently, a microanalysis process was started that consisted of reading each document repeatedly, line by line, with the purpose of identifying initial concepts and their characteristics and assigning labels or names to fragments of information (codes), while comparing and regrouping the data.

The process of elaborating categories was essential. It is a detailed and meticulous procedure from which a conceptual construction susceptible to permanent analysis emerges, until, according to Corbin and Strauss (2015), a point is reached at which new significant concepts no longer arise that could trigger the need for other categories, while the existing ones contain the necessary dimensions and properties. In Table 1 we identified 29 codes, seven dimensions and two characteristics. They emerged from the data analysis (and not from previous categories).

Table 1. System of Codes, Dimensions and Categories

Categories	Dimensions	Codes
Supervision of scientific integrity based on collective work	External evaluation	Evaluation Ethics committees Accountability
	Work dynamics	Peers Publication Committees Events
	Open science	Consensus Good service to society Open science Social Social pressure
	Integrity as part of the training process	Constant supervision Training Authorship Corrective action
Epistemic vigilance in the supervision of scientific integrity	Research development	Methodology Reproduction – confirmation Plagiarism Literature review Originality Ethical considerations of the project
	Personal attributes of researchers	Qualities Leadership Critical thinking
	External references	Absence Codes – Treaties Principles Institutional policies

III. Results

3.1 Supervision of scientific integrity based on collective work

The professors and researchers who participated in the study relating to the open question "How is research integrity supervised in your academic work?" considered that research integrity was based on exchanging points of view with other people who are capable of assessing quality, relevance, and adequacy for the type of research work performed, or it is achieved through the training process and by guiding the work of students. Underlying this category is the idea that research integrity is based on the collective work of the postgraduate professors and researchers involved, together with their peers, students, project participants, and authorities, amongst others.

In accordance with this vision, scientific integrity is supervised at various times in the research process, from the preparation of projects, when they are submitted for review and approval by the respective ethics committees or corresponding university departments; during project execution, based on reports that researchers carry out periodically; or at the end, when authors must report back (especially in funded projects). In these circumstances, their work is subject to external evaluation by academics outside the research project itself (inside or outside the institution), who bear responsibility for ensuring quality in the generation of knowledge. In this regard, the study participants stated:

> The projects must be approved by the Ethics Committee of the Neurobiology Institute. (Sciences: neurobiology; biomedical sciences; biological sciences; and medical sciences, deontological sciences, and health).
>
> There would be two aspects, one external and the other internal to the institute or university. The external participation is carried out by project sponsors (entities such as the National Council for Science and Technology, or private individuals) to whom they report through accountability mechanisms. (Earth sciences).

Although academics recognize the importance of external evaluation, they also express concerns regarding this form of supervision, insofar as it can be understood as a bureaucratic review that pays more attention to productivity than to the quality of work. In contrast to this idea, participation in activities directly linked to the development of research, such as tutorial committees, was considered positive and highly valued. A further activity recognized was involvement in conferences (national and international) since this promotes direct dialogue with other specialists. In the same vein, they also mention the preparation of publications, on the basis that the evaluation process enables a direct appraisal of the quality of their work. Some of the ideas expressed in response to the questionnaire are listed below:

> Also of importance are comments received by way of participation in international conferences, which is where one addresses the community. (Physical sciences).
>
> Through presentation in discussion and evaluation forums that allow input on the various implications of the research (Industrial design).
>
> Peer review is the central part of the revision process (Mesoamerican studies).

The "decision process on the work" (prior to publication) was one of the codes with the highest density in the hermeneutic unit (36 mentions); therefore, it is assumed that a significant share of the study participants interpret this matter as especially relevant to achieve scientific integrity. In some cases, it is even the only action cited to this end. This is shown in opinions such as the following:

> The main products of our research are articles published in international journals that undergo a strict peer review. This is a very useful mechanism to prevent fraud. (Physical sciences).
>
> One of the ways in which integrity in research is supervised is through peer review, that is, prior to publication it must first be examined by other academics; since they are similarly qualified, they can review it, complement it, or provide constructive criticism on the work, thereby serving as a research analysis filter. (Law).

Within the category "Supervision of scientific integrity based on collective work," answers were also found related to the concept of open science, understood as a movement that seeks to open up scientific research (including methods, instruments, and data) for the benefit of society as a whole (Becerril-García & Córdoba, 2021). In this sense, they mention a need for the communities where the studies are carried out to be the beneficiaries of their results, and to develop discussions about the research process with peer groups and supervision within these professional groups, as well as a need to act transparently in all phases of work. These opinions are presented below:

> …find ways to return the results and products of the study to the communities where the research took place. (Pedagogy and law).
>
> Discussing the research results, whenever possible, with the actors involved and with their academic peers (Sustainability sciences).
>
> Since theoretical physics is a relatively small community, it is difficult to hide and/or disguise behavior that could be classified as "lacking integrity." (Physical sciences and astronomy).

The view that integrity in research is supervised through collective work, including the relationship of academics with their peers and communities, is reflected with greatest relevance in the bond established with students.

The most prevalent code of the hermeneutic unit is “Constant supervision” (63 mentions in total), which refers precisely to the view of teachers that it is their responsibility to contribute to training their students in research ethics, and that this is achieved by reviewing their progress and through support in seminars and the tutoring processes. Specific extracts from these reflections include:

> I keep an eye on the experiments and review the calculations and analysis with the students. (Engineering).
>
> Working closely with students; reviewing their progress (Library and information studies).
>
> The procedures for the treatment of experimental data and how these data are communicated in reports, theses, article manuscripts, etc., are reviewed in detail with the students. (Postgraduate program: biochemical sciences).

The link with the students implies recognition of the importance of addressing integrity as an integral part of the training process in postgraduate studies. The importance of preventing unethical behavior is also mentioned, since they specifically refer to the inadequate handling of data and plagiarism, insisting on the need to acknowledge the authorship of all subjects who participate. Below are examples:

> For years I have given talks on the subject to new students at my institute, since I see it as crucial both for the development of science and for its perception and advancement. (Biomedical sciences, biochemical sciences, and biological sciences).
>
> If an abnormality is observed, I seek to understand where, and if there may be any type of data manipulation or fabrication. (Biomedical sciences, marine sciences and limnology, and biochemical sciences).
>
> In terms of plagiarism, academic quality, and scientific rigor, I carry out the initial filter on my students. (Earth sciences, and chemical sciences).

3.2 Epistemic vigilance in the supervision of scientific integrity

The second category that emerged from the questionnaire analysis refers to the importance

of maintaining some form of epistemic vigilance, based on the application, throughout the research project, of different references that may be external to the researcher – for example, respect for autonomy, beneficence, non-maleficence and justice, as principles inherent to research ethics (Beauchamp & Childress, 2019) – or internal, as part of the set of values that academics apply in their professional activity.

In this case, another of the most frequently mentioned codes in the hermeneutic unit was "Absence" (45 mentions), which applied whenever professors and postgraduate researchers stated that they did not undertake any type of special action to supervise scientific integrity. However, they also pointed out that they considered it unnecessary, since it is associated with ethical principles or with the design of the various research protocols. This is illustrated by the following examples:

> As such, there is no oversight (or commission) that reviews the integrity of the research. There is an ethics body in our institute. I believe that the integrity of the research we carry out falls mostly on ourselves, those who generate knowledge. (Biochemical sciences, and biomedical sciences).

> There is no supervision as such. Researchers generally apply their own criteria about honesty, ethics, and responsibility, and up to now my department has worked well without any conflict or problem. (Mathematical sciences).

In line with this vision, some criticism was identified regarding research integrity procedures within several university departments. In addition, participants mentioned not being aware of any type of action taken by the institution in this regard, as well as the absence of defined criteria. For example:

> I don't feel there is any supervision per se. Only when an academic clearly violates the basic principles of coexistence, perhaps in that case, perhaps some measure would be taken in this regard. (Earth sciences).

> In the humanities, if a problem does appear that falls outside the scope of the research team, appeals are made to committees such as the gender violence or ethics committees, with all the implications of their characteristic shortcomings and operational difficulties. (Philosophy, pedagogy, philosophy of science, and teaching for upper secondary education).

By contrast, explicit recognition of the existence of institutional policies and the participation of authorities in the supervision of research integrity is evidence of a diversity of opinions on the subject:

> The university has very clear criteria for research, teaching, and the dissemination of culture. There is an active collegiate dynamic with a sense of collaboration that has historically allowed our university to be an important example for many public and private universities. (Pedagogy, and teaching for upper secondary education).

> The supervision of integrity is carried out by management: the academic secretary, the academic managers, and the coordinators of the center, who must apply the governing protocols both at the level of the university and in each institution. (Literature).

In addition to institutional policies, the measures established in research ethics codes and regulations were also repeatedly cited. Integrity is considered one element of applied ethics, and therefore, for the research participants, there is no need for differentiation. The following examples illustrate this:

> I ensure the protocols comply with national and university regulations, international guidelines, and institutional protocols. (Law).

> Following the ethics treatises for both humans and animals (Medical, dental and health sciences; chemical sciences; biomedical sciences; and biological sciences). The application of the document "Ethical Principles for Research," produced by the National School of Nursing and Obstetrics, and Official Mexican Standard NOM-012-SSA3-2012 on the criteria for the execution of research projects regarding health in human beings (Nursing).

In line with the above, responses also made direct reference to the issue of principles, both in the discipline itself and in relation to scientific research. They have been identified together with expressions that indicate a lack of knowledge specifically on research integrity, while others place integrity within ethical discourse. Specific examples include:

> Fundamentally, it is being carried out in accordance with the scientific principles that apply to the topic being investigated. (Engineering).

> I begin with the basic principles by which information must be gathered from the people from the communities in which I work, along with their consent (Biological sciences and sustainability sciences).

In addition to these references, which include codes, principles, and regulations, academics recognize the importance of their personal attributes in their ability to perform work that promotes the generation of knowledge, and in which integrity is the principal guide. Within this dimension is the idea of critical thinking, which refers to the need to analyze actions that will be carried out. The following quotes illustrate this premise:

> Through a critical review of the generated texts (Latin American studies, and Mesoamerican studies).

> The application of critical appraisal is necessary. (Engineering, and sustainability sciences).

Another element linked to the above is the idea of taking leadership and personally verifying each of the actions carried out in research projects. Some accounts by participants show that the supervision of integrity is a task that cannot be delegated, since it is related to the leadership that must be exercised in the laboratory or in front of the various work teams that are participating, especially when working with postgraduate students, and in accordance with the characteristics of each academic discipline. This is reflected in the statements below:

> Being personally the main voice responsible for how the research is carried out (Engineering, and computer science).

> Verifying the work in both the field and the laboratory, participating directly in all

> activities (Animal production and health sciences).

The idea that personal verification of each stage of the research process ensures integrity is also linked to trust in one's personal qualities, which serves to ensure ethical development. It is believed that if a teacher is honest in his personal life, he will also be honest when generating knowledge, and therefore will act autonomously and will be unwilling to plagiarize, falsify data, or engage in any type of behavior that undermines his honest character. Evidence of this is given below:

> It all depends on the code of honor. In other words, we believe that what they tell us is true. (Astrophysics, and earth sciences).

> Both academic and research integrity are directly linked to levels of commitment and a sense of co-responsibility between myself and the institute I am affiliated with, along with the information provided in the annual reports and annual work plan. (Pedagogy and teaching for upper secondary education).

> It is largely self-regulated, based on ethical principles. (Biological sciences, and sustainability sciences).

Specifically, autonomy is understood as acting free from external influences and as an exercise in self-control, which is inherent to the identity of the participating researchers.

> Do not allow political determinations to influence the scientific content of research (Law).

> The way I supervise integrity in my research work is a form of self-control, like any other social behavior. (Latin American studies).

> Although I also believe that research integrity is a more personal endeavor, integrity, responsibility, and ethical practices must be part of our identity as researchers. (Sustainability sciences).

On an epistemological level, it is evident that confidence in the adequate development of the methodological processes inherent to each discipline ensures integrity in research, from the moment of its conception to the presentation of results. From this perspective, any project must offer the necessary information required to enable replication with the aim of confirming the information obtained. The stability of the results is associated with the quality of the work carried out, which is also linked to the use of standardized procedures that can be followed by other researchers and put into practice. Below is a selection of pertinent quotes:

> In engineering and in applied sciences in general, demonstrating the reproducibility of research is a fundamental factor. (Engineering).

> The work should provide sufficient information to enable replication. (Linguistics).

The importance of knowing and applying the methodological procedures is highly valued, along with "publication," which is the fourth highest ranked code based on the number of mentions in the answers to the questionnaire. It is important to highlight the affinity between these ideas and the epistemological principles of positivism, in terms of confidence in the

method per se, and an aspiration to the axiological neutrality of science in general, along with the processes of knowledge generation. This premise is supported by opinions such as:

> The use of standardized methods supported by scientific literature, tested and approved by world-renowned scientific associations, with a sampling design, a strict use of standard (or reference) samples, and sufficient observations and repetitions based on the variability that the variables to be measured may provide (Earth sciences, and geography).

> I adhere to the outlined methodology. This always has an order and system which allows consistency as a guide and in what is conducted. (Law).

Also, ethical considerations in the methodological process are mentioned in general terms, but also more specifically in relation to procedures that are usually accepted as inherent to ethics in the research process, for example the guarantee of confidentiality or the clarification of any possible conflicts of interest. The issue of integrity is once again addressed within the context of applied ethics. Below are examples:

> We submit a protocol that covers all bioethical aspects, and we have a quality management system that complies with ISO9001. (Biological sciences, and biomedical sciences).

> Conflicts of interest are disclosed and dealt with a priori. Confidentiality agreements are signed at the beginning of the collaboration. (Engineering, and sustainability sciences).

In designing research projects, the relevance of reviewing specialized literature must not be overlooked. This activity is considered to constitute "integrity," since it enables researchers to establish the theoretical foundations and develop a frame of reference, whilst guaranteeing original research that will be conceived as a genuine contribution to the generation of knowledge and provide an impact.

> A frame of reference is established based on the "state of the art" in the specialized literature, along with a timely and pertinent research design. (Medical, dental, and health sciences).

> Verifying the authenticity of the information that is written and presented, as well as verifying the originality of the projects and ensuring there is no repetition or plagiarism (Medical, dental, and health sciences; and biological sciences).

> That it be a novel study that contributes to the generation of knowledge and provides social impact (Pedagogy, and Law).

The interest in developing original work is directly related to the concern regarding plagiarism. In the previous category, this issue was pointed out by teachers and researchers alike with respect to preventing this practice among their students, but in this case they are referring to the assessment of their own work, once it has been completed but prior to submission. In this context, the use of anti-plagiarism programs is especially valued as a guarantee of originality and scientific integrity:

I check for plagiarism throughout the whole project, whether from bibliographical references or work conducted by colleagues/researchers or specialists in figures, text, tables, data, and attitudes. (Earth sciences).

I obsessively check my texts and presentations to ensure that I am citing correctly and giving the corresponding credit to each pertinent colleague. (History of art).

The only point on which action is being taken is the issue of plagiarism, using specialized software. (Astrophysics).

IV. Discussion and conclusions

Research integrity is a significant part of research ethics and depends on involvement from various actors. Steneck (2006) relates it to the idea of acting according to the highest professional standards to achieve adequate scientific work. The results show that for ideal performance, support processes are needed that can be implemented in two ways: direct supervision and training activities. Through direct supervision, it is possible to identify and correct weaknesses and problems in research projects, in relation, for example, to originality and adequate use of the methodology.

We found consensus in the literature, in works by Muthanna and Alduais (2021), Löfström and Pyhältö (2018), Bukusi et al. (2018), Pizzolato and Dierickx (2022), and Cornér et al. (2019) on research integrity. Haven et al. (2022) expressed a need to consider the attributes of supervisors. Our research shows that, in the opinion of the postgraduate academics, formative processes are essential to promote integrity in research. We discuss the need to use multiple strategies to achieve this.

Works by Roje et al. (2022), Labib et al. (2021), Muthanna and Alduais (2021), and Bukusi et al. (2018) point to the relevance of international, national, and institutional principles, norms, ethical codes, and treaties.

In our empirical work with postgraduate academics from a Mexican university, we found interesting ideas in relation to the concept of open science, implying a need to conduct research with the intention of benefiting society in general and sharing data, methods, analyses, procedures, and results.

Löfström and Pyhältö (2018) introduced recommendations from the Finnish National Board on Research Integrity (TENK) and Universities Finland that also emphasize the participation of the scientific community. Similarly, Roje et al. (2022) identified the need to address this issue with researchers, institutions, and the system.

Epistemic vigilance implies an attitude of caution during the research process with respect to ethical issues, such as conflicts of interest, and careful development of methodologies to ensure quality and originality in knowledge. Pizzolato and Dierickx (2022) recognize the role of institutions in this process.

Roje et al. (2022) identified concern about several tasks required of academics and which may affect their performance. This situation has been observed for several decades without a satisfactory solution and has been confirmed by the experiences of academics in this study, who also raise concerns about how their work is influenced by the multiple demands they find themselves under. We agree with Labib et al. (2021), Haven et al. (2022), and

Armond et al. (2021) on the need to consider specific procedures to supervise scientific activity within each area of knowledge.

We think that it would be interesting to generate comparative studies to be able, for example, to verify the specific mechanisms used by academic communities to promote research integrity. It is also important to highlight that the reported results can provide insight into this issue as a social phenomenon. Any such analysis should consider, in addition to the epistemological dimension, the importance of collective work and the value of researchers' experience.

Contribution of each author:

Ana Hirsch Adler: conception; investigation; formal analysis; methodology; writing - review and editing.
Douglas A. Izarra: conception; investigation; formal analysis; methodology; writing - review and editing.

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