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Authorship for scientific papers: the new challenges

*Autoria em artigos científicos: os novos desafios**

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Abstract

The dissemination of the practice of collaborative authorship (co-authorship) in Brazil and in the international scientific community has been accompanied by an increasing occurrence of frauds, manipulations and other deviations in the assignment of responsibility for a scientific paper. This article discusses the criteria for authorship attribution, the reasons for the growing indices of co-authorship and the challenges to determine authorship in electronic journals. Through literature review and case study (bibliographic search in the scientific database), it has been shown ways to avoid that "misbehaviour" deviance regarding the authorship attribution affect the credibility of science.

Descriptors: **Authorship. Periodicals. Scientific communication. Scientific production.**

Resumo

A disseminação da prática de coautoria no Brasil e na comunidade internacional tem sido acompanhada pelo aumento no registro de fraudes, manipulações e outros desvios ao definir a responsabilidade por um trabalho científico. Este artigo discorre sobre os critérios utilizados para atribuição da autoria, as razões para o crescimento dos índices de coautoria e os desafios para estabelecer a autoria em periódicos eletrônicos. Por meio de revisão bibliográfica e estudo de caso (a partir de levantamento de base de dados), aponta caminhos para evitar que "desvios de comportamento" quanto à atribuição de autoria abalem a credibilidade da ciência.

Descritores: **Autoria. Publicações periódicas. Comunicação científica. Produção científica.**

INTRODUCTION

The growth in fraud and other distortions to define who signs a scientific paper has attracted the attention of the academic literature. Martinson et al. [1] interviewed more than 3,000 scientists who were financially supported by the National Institute of Health (NIH), of which 10% admitted having received improperly authorship credit. Mowatt et al. [2] concluded that at least one third of all reviews published in The Cochrane Library, which serve as reference for the Evidence-Based Medicine, have evidence of "ghost authorship" [2].

Despite more frequent than the plagiarism and other attitudes condemned by the scientific community and assigned to a few – "the bad apples of science" – in general the authorship deviances are not punished, because they are considered just "bad behavior", as shown by De Vries Anderson and Martinson [3]. The everyday problems related to the job environment; the way science is organized, and the pressure to publish (the policy of *publish or perish*, which measures the academic success by more scientific productivity) are suggested as possible causes for these deviances. *The pressure to produce – linked to the uncertainties concerning the ownership of ideas, to the*

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most appropriate way to assess scientific output (quantity or quality), to management of competing interests, and to the division of labor in the research – is associated with several behaviors. Although they do not reach the threshold of fabrication, falsification, and plagiarism, they are considered misconduct [3].

Among these bad behaviors, De Vries, Anderson and Martinson include: difficulties in assigning authorship, leaving credits and responsibilities unclear, manipulation of the peer review system, control of research by funders, exploitation of junior colleagues, unreported conflicts of interest, the theft of ideas from conference papers, publishing the same content twice (or more), the withholding of information, and ignoring teaching responsibilities. According to Huth [4], problems concerning authorship rarely interfere with the scientific efficiency or reduce their sources, however, undermine the ethics and honesty.

These data support the need to discuss the assignment of authorship in scientific papers, especially in view of the increasing practice of co-authorship in Brazil, following the trend observed in the international scientific community [5]. This article aims to contribute to this discussion, presenting authorship criteria that have been causing conflicts between scientists, the reasons for the practice of co-authorship, challenges that arose from the dissemination of science by digital means, and approaches to manage the difficulties in order to maintain the reliability in the research.

The Autorship: concepts and importance

The recognition of the author's legal copyright on your text, according to Kant (quoted in Long and Magnolia [6]), is justified because of the intrinsic link that exists between him and his work. More than a legal copyright, the authorship is, above all, a moral right, a "right of personal status" of the author over his work, immaterial (intangible) asset, and the right of economic exploitation by those who produced it. As for Foucault, the author acts as an organizer of knowledge, one that gives it a significant unit and also a new relevance and credibility [6]. According to Foucault, the author acts as an organizer of knowledge, that one who gives it a significant unit and also a new relevance and credibility [6].

The role of organizing the knowledge and the link between the author and his/her work makes it highly relevant to the authorship in the academic environment. Acknowledge it means to declare the intellectual effort of the author. More than that, this recognition acts towards the establishment and settling of the researcher's reputation, which becomes legitimized in the academic environment. In addition, it also ensures the continuity of their projects confers prestige and enhances the possibility of aspiring to higher hierarchical positions in their field of study.

The authorship's recognition allows assessing the author's scientific production, which is used as a parameter for granting of financial resources by an independent public foundation with the mission to foster research and the scientific and technological development, as a tool for assessing graduate and post-graduate courses, and as a selection criterion of the faculty members and research team by many institutions.

In other words, publish and having acknowledged its authorship are synonymous with status, legitimacy and credibility in an environment marked by strong competition, in which everything is classified and the production is transformed into indices and impact factors [7].

The competition for status, funding and academic legitimacy translates increased productivity into priority for scientists and researchers, especially in the most crowded areas such as the biomedical area. In an attempt to ensure good levels of scientific production, the union is common to researchers, who start publishing together. The co-author or contributors' image is enhanced, which is considered an exception in the early days of science.

The Authorship: Benefits and Responsibilities

Katz & Martin [8] define co-workers as individuals working together throughout the project or during a considerable part of it. They are researchers, which give frequent and substantial contributions to the study and whose names or job positions appear in the original research project. They are responsible for one or more elements of the research.

According to Vanz [5], co-authorship or collaboration occurs when two or more scientists working together on a research project share intellectual, economic and/or physical resources. The objective of this joint work is the production of new scientific knowledge [8]. However, the scope and type of contribution of each co-worker for this production may be different. The collaboration involves distinctive actions, such as expressing an opinion, sharing ideas and data, working together during a project, or working separately in different parts of a project with the goal of eventual integration [9].

The union and the formation of a network of collaboration among authors not only aim at contributing to the expansion of scientific knowledge, but also carry other reasons such as: (a) increasing scientific popularity, visibility, and recognition of the authors involved and hence the increase of productivity indices, (b) rationalizing the use of scientific labor and time spent researching; (C) reducing the likelihood of error and increase the possibility of an "attack" to the major research problems from increasing discussion of the outcomes and also the collaboration of specialists in various areas through multidisciplinary works, i.e., the juxtaposition and articulation of knowledge, concepts, and theories coming from different disciplines, (d) obtaining and/or increasing

funding, resources, special equipment, and materials, (e) increasing their own experience through exchange of expertise with other scientists, (f) joining forces to avoid competition among research institutions, (g) training of researchers and apprentices, (h) seeking external opinions to confirm or evaluate a problem, (i) promoting wider dissemination of research, (j) maintaining concentration and discipline in work till the delivery of results to the rest of the team, (k) sharing enthusiasm about researching, (l) working alongside other researchers with whom he/she has established ties of friendship [5].

This expansion of reasons contributed to the gradual increase in the number of co-workers by publication observed by several authors [5,10-12]. Some areas of science, such as Physics and Biomedical research have a tradition in publishing articles with multiple authorships. Newman [10] reports that 1681 authors signed a single article in the field of High-Energy Physics. The high number of authors in biomedical research has led to the phenomenon of hyperauthorship, so named when the number of authors may exceed one hundred [11]. In the Humanities' field, the co-authorship is still a recent phenomenon. It is growing, especially in Psychology, Economics, and Social Sciences [12].

Thus, the co-authorship is widely accepted in the scientific world and even stimulated by placing different authors, scientific establishments and institutions in contact to face major problems. However, one must observe certain criteria to avoid these goals to remain in the background and be used only as a resource to increase productivity indices of researchers included in the study by their status or by having legitimacy in the academic environment, not by their actual participation.

It is important to highlight the fact that the name included in an article implies responsibilities. For Montenegro & Alves [13], to be an author means to ensure its integrity and be able to defend it publicly. "The inclusion as co-author of an article implies significant involvement in its development, knowledge of content and participation in its writing. In other words, the co-author is co-responsible for the work and accounts for it ".

Miller et al. [7] raise questions about how to divide the legal responsibilities and the financial profits from a co-authored work, once economic and legal rights are intrinsic to the concept of authorship. According to them, the criteria for defining authorship, intellectual property, and patent law are based on similar principles: substantial contribution to conception and "design".

Nevertheless, would the real authors be willing to share any possible royalties obtained from patents of their publications with all the coauthors? Even those who were invited? This question leads us to discuss the criteria that must be taken into account to define what is actually written and who can sign a paper as a coauthor.

Authorship Criteria

Not all contributions qualify a researcher to be considered an author of a study. According to Vanz [5], in the list of co-workers should be present only those responsible for a key step in the study, whether it is an original idea, hypothesis or theoretical interpretations, besides the scientist who proposed the original project, which one plays the role of the research leader. On the other side, the list should exclude those who have done only a small part of the research or those who are not exactly researchers, as in the case of technicians, assistants, and even undergraduate and master's students included in the project.

Although in general these recommendations are accepted, in practice, they cause many debates. Authorship criteria are far from a consensus among scientists. The discussion is so strong in the academic environment that groups, such as the journal editors in the field of biomedical sciences [14] and the Committee on Publication Ethics (COPE) [15] have established their own criteria to designate who should or should not sign a paper.

In 1978, the International Committee of Medical Journal Editors (ICMJE), popularly known as the Vancouver Group, established some criteria and guidelines on ethical principles, editorial policies, and other guidelines in favor of the quality of scientific publications. The updated occurred in 2008. To receive the authorship credit, a researcher must fulfill three conditions: (1) substantial contribution to conception and design, or data acquisition, or data analysis and interpretation, (2) writing and drafting the article, or revising it critically for its important intellectual content, or (3) approval of the final version to be published [14].

The ICMJE has set other recommendations for the publication of multicenter studies (among several institutions) with a large number of researchers. They are as follows: (A) the group should identify the individuals that accept direct responsibility for the manuscript, (b) obtaining funding, data collection, or general supervision of a research group are not of their own accord criteria of authorship, (c) all persons assigned as authors should qualify (identifying who he/she is, what he/she did in the study, and what he/she is accounted for), and all the qualified persons should be listed, (d) Each author should have participated sufficiently in the work to take responsibility for content specific segments, (e) some journals also required that one or more authors, referred to as "warrantors" be identified as the people who will take responsibility for the integrity of the study as a whole, (f) the group as a whole must decide about the co-workers and authors before submitting a manuscript for publication. It is out of the editor's role to take decisions concerning authorship, or mediate disputes relating to the subject, (g) the corresponding author should be prepared to explain the presence and order of these individuals [14]. All co-

workers that do not meet the criteria for authorship, according to the ICMJE report, should be listed in the acknowledgments' section with their specific contributions to the study (study design, data collection, data analysis or manuscript preparation, etc.). Once the readers may conclude that the people listed in the acknowledgments' section endorse data and conclusions, these people must provide written consent to be thanked [14].

COPE, a forum created by editors of scientific journals to discuss issues related to the integrity of papers published in these journals instituted the following recommendations: (a) although recognizing that there is not a definition of consensus universally valid for authoring, COPE requires at least that the authors take responsibility for a portion of the study. When the authors only may be responsible for specific contributions to their discipline, this should be specified; (b) the researchers must remain "alert" in order to ensure that their names not be added to the article just to add credibility, (c) the co-authors are expected to reach an agreement on what is expected of each co-worker and how this reflects in decisions about authorship, and (d) in light of current uncertainties and the differences between the guidelines, the authors should pay attention to the rules followed by the journal to which they wish to submit their article [15].

Although ICMJE and COPE have ratified criteria or recommendations for co-authoring, surveys show that, because they are not mandatory in most cases, they are not followed.

In 2004, Miller et al. [7] analyzed the guidelines of 40 Brazilian journals in the Health Area which are in the Scientific Electronic Library Online (SciELO). They found that only 20, or 50% of the journals, followed the standards of ICMJE.

To restrain abuses, seven publications (17.5%) used the policy of restricting the number of authors allowed per article - which are also controversial, once dozens of authors might actually have taken part in the studies - and other seven explicit in the guidelines the criteria defining authorship.

In 2007, Pellizzon et al. [16] analyzed the instructions of another 20 national journals, now in the Area of Surgery. The study concluded that 75% of the publications followed the Vancouver System requirements, but 17 (85%) journals did not define the criteria relating to the authorship of articles, and none of the journals asked for any type of declaration of the participation of each author in the study.

In 2008, Ivan et al. [17] performed an analysis of 181 manuscripts with more than one author (a total of 865 authors) published in Croatian Medical Journal between January and July 2005. They found that 60% of the authors did not meet ICMJE criteria. They concluded that the "article final approval" is a different category and should not be considered a criterion of authorship, but an administrative demand similar to the declaration of conflict of interest.

In 2010, Street et al. [18] interviewed 17 researchers in the Science Area of two Australian universities to investigate behaviors adopted in the assignment of authorship. They found that there is a mismatch between the standards set by scientific journals and the regulatory agencies. The institutions are reluctant to take action in prosecuting those deviances, once they are not considered fraud or errors and just researchers' misbehaviour that include or exclude names based on political, cultural, or financial interests. For example, the U.S. Office of Research Integrity does not investigate complaints about the author, unless they meet the criteria of plagiarism.

This same article also describes the criteria used in practice to include names on the list of authors. Writing the text, developing the methodology and helping with statistical analysis, interpretation of results and solving problems are the most common ones.

Sometimes, however, researchers with small contributions to the idea or those who provide a reagent have their names included. Likewise, political reasons related to labor relations at the institution are also relevant: divide the authorship may serve to give a present to some researcher to avoid conflicts and ensure a good neighbourhood, even if the person does not offer a specific contribution to the article.

Another important factor refers to the credibility of the study, once the inclusion of well-known, respected academician increases the chances of publication in a journal with high impact factor. By the way, the practice is quite common, especially among scientists and junior researchers and yet with no legitimacy among peers. Thus, the list of authors may reflect "a complex set of parameters, including cultural and social pressures."

The criteria are adopted according to the disciplines. While in Social Sciences, particularly Anthropology, Sociology and Communication in which unique authorship is common, once the tutors/supervisors are rarely included in the authorship, in the Medical Sciences they are always listed as authors.

The hierarchical position played an important role in assigning authorship in medical articles; in the Social Sciences, there is a more even distribution and the coauthors work in turns to determine who takes the lead in each publication.

In most disciplines, the most important position falls to the first author. Nevertheless, the latter has a distinct role. In the medical disciplines, the place is reserved for the research project supervisor, while in the Social Sciences shows minor contribution in general. Occupying the places in-between suggests minor importance in both areas.

The misbehaviors in relation to Authorship

Due to the amount of problems and policies that influence the decision on the attribution of authorship, Monteiro et al. [7] have established some patterns of irregular authorship and co-authorship. They are as follows:

- "Guest" authorship and/or co-authorship (*guest authors*) are people who have their names included in studies, which they did not participate. The practice is used to please top professionals in the hierarchy, increasing the chances of publishing the paper with the inclusion of names already sanctioned and well-known, or even increase the scientific production through "reciprocity agreements" or exchange favors among researchers

- "Pressed" authorship and/or co-authorship: when the group leader requires the inclusion of his name on all the studies carried out by the team members. The origin of this practice can be a "departmental tradition" so deep-rooted that does not need to be explicit; all members know it and follow it automatically.

- "Ghost" authorship and/or co-authorship: it is the non-inclusion of individuals that participated in important stages of the study. In general, the excluded ones are students or professionals responsible for statistics. Other explanations for this authorship pattern are disagreements and disputes for positions between researchers and the scientists fear to have his name listed when the results are not favorable to the funders of current and future projects. The "ghost" authorship may also conceal hidden motives. For example, an employee of a company writes a review article with the aim of promoting a product, but invites a respected researcher to take the responsibility for the authoring and the submission for publication in exchange for a fee and without revealing any conflict of interest [7].

The practice of these irregular patterns, even considered misbehaviour or slight deviance, generates consequences such as: (a) the questioning of the research integrity, in case the authors are not able to certify the veracity of the results; (b) the acceptance of practices that exploit the junior researchers or involve falseness, diminishing the respect and the value of academic research; (c) injustice or harm in disputes for academic promotion or grant funding, (d) influence on the newcomers who by seeing experienced researchers using tricks ethically questionable and still receiving institutional recognition and rewards, began to consider the practice acceptable and worthy of being followed; (e) the difficulty in keeping balance between the requirements of personal ethical standards, the regulatory standards, and the inspiration of mentors with the requirements of a perverse system of rewards; the increasingly competitiveness and the successful example of researchers that ignore the rules. That is, the integrity of the research does not always take priority to this clash between the ethical, the acceptable, and the patterns of misconduct, which often provide benefits and almost no punishment to the researcher [18].

Scenery of Brazilian Co-Authorship

In 2009, Samil Vanz, a researcher from the Federal University of Rio Grande do Sul (UFRGS) examined in his doctoral dissertation a total of 49,046 Brazilian articles published in journals indexed by the *Web of Science* between 2004 and 2006. He concluded that at least 95 % of these studies were based on collaboration [5]. The researcher calculated the rates of co-authorship and participation of Brazilian institutions in general and by discipline as well, as shown in Tables 1 and 2.

Table 1. Summary of main results - extracted from Vanz [5].

		2004	2005	2006
Averages by articles	Authors	5.9	6.4	6.5
	Institutions	2.3	2.4	2.4
	Countries	2.6	2.6	2.6
Articles	International co-authorship	30.8%	30.1%	29.9%
	Co-authorship among Brazilian Institutions	41.4%	43.4%	44.3%
	Co-authorship among individuals	95.7%	95.8%	96.7%

Table 2. Averages of authors, institutions and countries by areas, 2004-2006 - extracted from Vanz [5].

	Averages by articles		
	Authors	Institutions	Countries
Geosciences	8.8	3.4	2
Bimoedical Research	5.6	2	1.3
Chemistry	4.6	1.9	1.3
Experimental and Internal Medicine I	7	2.7	1.7
Experimental and Internal Medicine II	5.6	2.2	1.4
Neurosciences	5.3	1.9	1.3
Biosciences	5.5	2.1	1.4
Engineering	4.1	1.9	1.4
Biology	4.7	2.1	1.4
Mathematics	2.5	1.9	1.5
Agriculture and Environment	4.6	2	1.3
Physics	13.3	3.6	1.9
General	6.3	2.4	1.5

Vanz [5] concluded that the form of interaction among scientists varies by area of knowledge and came to the following considerations: in the area of Agriculture and Environment, scientists gather in networks, which reflect their invisible colleges (interest groups formed by researchers that, by knowing each other and keeping good relationships, favor each other at the time to accept articles).

In Physics predominates large groups of co-authoring and Mathematics presented researchers divided into sub networks that not reflected in groups by institution [5].

In relation to the analysis of the web of internal collaborations from 16 Brazilian institutions with greater scientific productivity, she noted the formation of several regional networks. The institutions of the São Paulo State, USP, UNICAMP, and UNESP clearly constitute a network. In the South, the Federal University of Santa Catarina (UFSC) and the Federal University of Paraná (UFPR) constitute a group that tends to work with the Federal University of São Carlos (UFSCar) in countryside of São Paulo State. Another partnership team is constituted by the Federal University of Rio de Janeiro (UFRJ), Federal University of Minas Gerais (UFMG), and the Fundação Oswaldo Cruz (Fiocruz).

In the Northeast, there are frequent collaborations between the Federal University of Ceará (UFCE) and the Federal University of Pernambuco (UFPE). Another point that drew the attention of the researcher was the fall in the rate of international co-authorship, precisely in the period that coincides with the growth of national academic literature, which corresponds to 2% of what is produced worldwide and 45% of what is produced in Latin America [5].

Regarding the interaction among countries, a study by Meneghini et al. [19] examined the citations received by 1,244 articles published in 2004 and 2005 by authors from four Latin American countries (Argentina, Brazil, Chile and Mexico) in seven international journals. They were compared with citations by authors from five rich countries (Germany, United States, France, Japan and UK). The study also found that areas with the highest levels of partnerships are the Geoscience fields with more than 50% of articles in international collaboration, followed by Mathematics and Physics with approximately 40% each.

The United States is the most common Brazilian partner in the number of articles with 22% of the co-authorships. Then, come France (8.2%), Germany and Britain (7.3%), Italy (4.3%), Canada (4%), Spain and Argentina (3.8%). However, relative indexes show that the U.S. and Argentina are the main partners.

The authorship division with the researchers from major international centers brings more visibility to the science produced in Brazil and other emerging countries, as pointed by Marcelo Leite, in an article published by Folha de Sao Paulo [20]: *Statistically, it makes no difference for the authors in developed countries to publish with or without foreign co-workers – they will be quoted at a similar proportion and very close to the impact factor of publication. In Latin America, the downside is enormous. Articles without support from colleagues have developed impact factors 34% lower than the average. With the international collaboration, they get closer of the common use in the publication. It remains to be established whether the studies of Latin Americans are less cited only because they are poor, which is unlikely, or if the researchers from rich countries do not bother to read them. Many Latin Americans have already concluded, the "rocky road to professional growth" requires the favour of a nice co-author.*

The effect of the partnership with scientists from rich countries has been depicted in studies conducted between 1996 and 2009. Meneghini [21] concluded that articles resulting from international collaborations have on average four times more citations compared with those involving national collaborations, and the impact is 60% higher than the one signed by a single author.

Outlining a scenery of the Brazilian science in the ISI database (Web of Science), between 1999 and 2003, an article published in the journal of Scientometrics, in 2006, signed jointly by a Hungarian, a Brazilian, and a Belgian, Wolfgang Glänzel, Jacqueline Leta, and Bart Thijs, respectively, showed that Brazil boasted the lowest percentage of publications with at least one international partner when compared to Latin American countries like Argentina, Chile, Mexico, and Venezuela [22].

Over the same year, Meneghini & Packer [23] found that 84.3% of the Brazilian articles with more than 100 citations in the Web of Science database, between 1994 and 2003 were the result of partnership with other countries. All these studies present sufficient evidence to reinforce the need for both North/South partnerships and co-authorships, so that our scientific production is made itself known and valued internationally. For the current rules of the game, the signature of an author from a developed country is worth more than the study of our scientists, however much it is solid, well-reasoned and fruit of years of research and dedication.

CASE STUDY

In order to evaluate the increase in the number of co-workers per article published in scientific journals over a period longer than that presented by Samil Vanz [5], in his doctoral dissertation, it was conducted a survey in the database of a high impact journal on the Health Sciences field (Endocrinology).

The journal chosen was the Journal of Clinical Endocrinology and Metabolism (ISSN 021-972X; impact factor of 6.325 in 2008), one of the official publications of the Endocrine Society, an American Association which congregates medical experts in the field of Endocrinology. This journal has been published since 1912 and became a monthly publication from 1941. The information was obtained on the journal homepage on the Internet (http://jcem.endojournals.org/). It was complemented by a research on the site Web of Science, a database with information

from scientific publications worldwide, available for free only for academic institutions.

The indices selected included: articles/volume, authors/articles, countries/articles, and institutions/articles. The index of articles/volume was obtained by the ratio between the total number of articles published in each period and the number of volumes (six). The index of authors/article was found by dividing the total number of authors by the total number of articles in each period. The calculations of the indexes countries/articles and institutions/article were made upon the total amount of countries and institutions divided by the number of articles in different periods.

To assess the endogeny (publications preferably the country of origin) it was calculated the percentage of articles that had the U.S.A. as a participating country (alone or jointly with other countries). This percentage was obtained by dividing the number of articles with the U.S.A. participation by the total number of articles in the period.

All indexes were calculated based on the original articles published in the first six volumes of each year (January to June) with an interval of ten years beginning in 1968. Thus, this sample is composed of articles from 1968, 1978, 1988, 1998 and 2008, corresponding to a 40-year period.

For presentation purposes, information concerning the average number of publications/year and authors/publication through all the years has been provided. Information relating to the average of countries/publication, institutions/publication, and participation of the U.S.A. (country of origin of publications) is shown only in the first and last years (1968 and 2008). The results are presented in Table 3.

Table 3. Distribution of indices by period.

	Period				
Indices	1968	1978	1988	1998	2008
Articles/fascicule (average)	23	26	36	55	50
Authors/articles (average)	3.1	4.5	5.1	6.2	7.9
Countries/articles (average)	1.1	...	...	...	1.4
Institutions/articles (average)	1.6	...	...	...	3.9
USA participation	76.6%	...	...	...	31.0%

There was a significant increase in the number of authors/article (3.1 in 1968 versus 7.9 in 2008) and institutions/article (1.6 in 1968 versus 3.9 in 2008) in these four decades. The endogeny decreases from 76.6% of the articles with the U.S.A. participation to only 31% four decades later.

Current Trends and Future Perspectives

With the improvement in communication technology and the new tools provided by the Internet, the discussion about authorship acquires other contours, especially with the Web 2.0 interactive platforms. New ways to publish, share and modify information referring to research (Science 2.0), in particular, the possibility of collective knowledge construction tends to complicate the attribution of authorship.

The growth of electronic journals (on-line journals) with open access should modify the process of publishing scientific journals, as announced Regina Castro [24]: "*Changes in the flow of scientific communication after the advent of the Internet reflect a thorough review of cultural, social, and economic values still in a process. Besides requiring the actors' adaptation to the new technologies, they require overcoming resistances to the transience and reliability of the electronic (on-line) versions and to the established patterns of academic communication.*"

In Castros' evaluation, who at the time was coordinating the Health Scientific Communication at BIREME, the Latin American and Caribbean Center on Health Sciences, better known by the acronym taken from its original name (Regional Library of Medicine), the challenge is to utilize the full potential of electronic media by enhancing the positive aspects and the quality standards of the traditional flow of scientific communication and defining policies to support the new structure, in order to ensure the preservation and distribution of information as a public asset. Free access to the Internet, says the author contribute to the democratization and the equitable access to scientific information.

By the definition of open access, the authors are the copyright holders and can decide how they want the document to be used [16]. In the RoMEO Project (Rights MEtadata for Open archiving - http://www.sherpa.ac.uk/romeo.php), the author determines the type of authorized access to academic articles available online.

In February 2010, the RoMEO already covered 700 publications around the world. Special licenses also appeared for copyright protection of electronic documents offered by *Creative Commons* (http://creativecommons.org) and Science Commons (http://sciencecommons.org). The novelty in these cases is the dismissal of the traditional copyright ("all rights reserved") and the adoption of a new beginning ("some rights reserved"), as stated by Miranda et al. [25].

These modifications are interpreted by some studies as signs that the authorship is an institution in crisis and that the concepts of author and copyright need to be reformulated. According to Long & Magnoli [6], in science, the author's reputation is considered a criterion for social selection of information. Nevertheless, in the face of the new context of production and distribution of knowledge, this idea becomes obsolete and must be replaced by innovative mechanisms of information selection and processing.

Miranda et al. [25] emphasize that the collective authorship in science differs from collective authorship in other areas, such as music and literature, just by playing the role of certifying the knowledge: "*The recognition of the value of the scientific contribution occurs with the publication and holds on the citation to the text published by other researchers.*" Nevertheless, not in the least the scientific world is immune to the changes triggered by the so-called ICTs (Information and Communication technologies), which are generating a "reengineering of the production activities of social organization based on more comprehensive networks and connections."

According to these authors, "the collective knowledge is constructed via ICT on inter- and transdisciplinary basis, a multivocality of authorship." Thus, a text can be worked up from contributions arising from various agents from different areas, which not even need to share experiences or relationships. What counts is the complement of their ideas.

Thus, new doubts begin surrounding the concept of authorship. Simultaneously, the complaints of fraud reveal how fragile and susceptible to deviance of behaviours the co-authorship is. For that very reason, the recognition of credits to co-workers has become more discussed in literature.

According to Pellizzon et al. [16], the interest in the topic because they favor the elucidation of the ethical issues surrounding the inclusion of names and the order of authors in the articles often defined more by issues of power and hierarchy than for their effective collaboration in research or in writing the paper.

A proposal to eliminate the subjectivity implicit in the definition of co-authorship is the score criterion. Through this criterion, each task performed during the development of the study would receive a different score: the study design and the formulation of hypotheses, study methodology framework, manuscript writing, literature review, data collection, financial grants, workplace leadership, referral of patients, or study material supply, and statistical analysis, among others.

Through this system, the co-workers that would be entitled to authorship were those who after the summation of the points for each task performed have obtained a minimum value previously set. Thereafter, the sequence of authors would be determined in decreasing order of score [26]. The question is whether such a proposal, which adds an additional step to the researcher's study, will be welcomed and will even be able to avoid distortion.

FINAL CONSIDERATIONS

The competition imposed by a semi-industrial science, in which the productivity is measured by the number of scientific articles and their impact factors combined with new technologies that promote a more open and participatory science, strengthen the co-authorship as a way to survival of the scientist and his legitimacy in the academic environment.

Cooperating, sharing, and establishing partnerships become key words in science, which needs that researcher, institutions, and even countries join forces to "attack" the today's major problems.

Working in partnership reduces costs, saves time, optimizes human and financial resources, promotes a multicenter and multidisciplinary vision, and provides an important exchange of experiences to come to new solutions. Thus, the number of authors by studies has increased in recent decades, and the trend is to keep on the rise.

However, in order to the collaboration really exists, a scientific paper should be the result of a team effort, each one performing its function to produce the final product.

Only those who actually participated in the study should have their name included in the study. The lack of a consensus and pattern gives rise to conflicts and distortions. Therefore, it is necessary to recognize the need to discuss the criteria of authorship attribution to shed light upon the doubts and at the same time to preserve the (moral, legal and economic) rights of the author. New standards should be proposed and considered to make this process more transparent and less political.

Widespread practices as the guest, pressed, or ghost authors must be resisted - although not being considered serious offenses, just misbehaviour. These practices harm the credibility of both the science and the scientist who commits such deviances to benefit at the time of getting financial grants, legitimacy, or to ascend hierarchically in his/her career at the expense of the colleagues who have guided their conduct by the ethics.

If the co-authorship is the pathway to the future of science - and everything indicates that it is! - That future unfolds like a question mark. It is not yet possible to estimate the impact of changes brought about by the expansion of Science 2.0. Today we discussed who should sign a study. Maybe ten years henceforth, it no longer exists the concept of authorship as we know it, or the controversial indices that measure the acceptance of a scientific finding.

Who knows whether we find new ways to conduct a collaborative study with the "multivocality of authorships", and at the same time be able to ensure the legitimacy of scientific production? Meanwhile, the authorship is a discussion to be leaved open, as well as the very own development of science.

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