Open science in Italy: lessons learned *en route* to opening scholarship

Rosaria Ciriminna¹ and Mario Pagliaro¹

 1 Affiliation not available

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Abstract

We identify four lessons, selected on a subjective basis following the analysis of the slow uptake of open science in Italy, that may be useful to scholars and research policy makers engaged in promoting the uptake of open science culture and practices in their own countries.

1. Introduction

In contrast to the paradigm of scientific research emerged after World War II (ended in 1945) in which "the majority of publications are behind a paywall, raw data are hidden, methods ill-described, software unreleased and reviews anonymous",^[1] "open science" has emerged in the first two decades of the 21st century as a better way to practice scientific research.

Researchers following the principles of open science make all research outputs and methods openly and freely accessible immediately after completion of research along with interoperable and reusable research data.^[2] This, *inter alia*, enhances the credibility of published research thanks to reproducible results and reproducible methods.^[3]

In closer detail, in open science a research article is first published on the Internet as freely and openly accessible preprint form prior to submission to an academic journal for publication following peer review.^[4] From overly long review (and publication) times through publication behind an expensive "paywall" requiring ever more expensive subscriptions, this liberates the dissemination of new knowledge from all the main problems of conventional publishing of research findings.^[5,6]

Substantially enhancing the quality and impact of research, the practice of open science offers clear benefits also to researchers and to society including for example enhanced opportunities of international collaboration between researchers and faster pace of innovation.^[7,8]

The adoption of open science widely differs amid countries, in both economically developed and developing areas of the world. Italy is amid the most scientifically developed countries in the world. In a list of countries ranked by number of scientific publications in academic journals indexed by a proprietary research database (Scopus) owned by a large scientific publisher (Elsevier), with 154,304 citable documents published in 2021 Italy ranks 6th after China, USA, Great Britain, India and Germany, ahead of Japan and Russia.^[9]

Amid the top ten countries in the aforementioned rank, only articles from British researchers received an higher average number of citations (1.45) to documents published in 2021 when compared to those (1.38) from Italy-based researchers.^[9]

Getting to the performance of Italy-based researchers in the adoption of open sciences, however, in 2017 the head of open science at the University of Milan succinctly described its poor state noting how publishing open access (OA) articles was not yet common, with researchers generally not knowing the foundations and the tools of OA publishing, including widespread confusion between institutional repositories and academic social networks.^[10]

The same scholar was reporting the lack of impactful government policies aimed at promoting open science.^[10] In the subsequent five years, substantial progress has been recorded but not to the extent one could expect from a country where nearly 155,000 research articles are authored and published every year.

This study identifies four main lessons, selected on a subjective basis following the analysis of the slow uptake of open science in Italy, that might be useful to scholars and research policy makers engaged in promoting the uptake of open science culture and practices in their own countries.

2. The uptake of open science in Italy

Aiming at "developing transparent processes, enhancing research activity, its verifiability, the integrity of research results and proper scientific communication",^[11] by June 2022 Italy's government published a National Plan for Open Science. The plan focuses on five areas of intervention including open scientific publications, open research data, and research evaluation.^[11]

Previous policy attempts to promote the adoption of open science practices in Italy included the requirement to make openly accessible the publicly funded research articles submitted to the next evaluation exercise (with an embargo period of 18 or 24 months) by the National Research Evaluation Agency,^[12,13] and a law dating back to 2013 mandating OA for research articles resulting from publicly funded research. ^[14]

It is enough to review the outcomes of one of the first meetings on OA organized by the Conference of Rectors of the Italian Universities (CRUI) in 2016 to learn that out of nearly 100 universities existing in Italy, only 49 had signed the so called "Road Map to Open Access" in 2014. Yet, two years later out of these 49 institutions, only 16 had adopted an OA policy,^[15] and this despite the fact that, as underlined by Giglia at the same meeting, "OA is only 10% of open science".^[16]

In the same year (2016) an Italian Open Science Support Group was established as a voluntary working group of professionals specializing in the areas of research support, libraries, open science, law, and computer science from, amid others, the Universities of Milan, Venice, Turin, Bologna, Trento, Parma, Padua, and Trieste.

The group between 2016 and 2018 organized several meetings and workshops.^[17] One of its main achievements was the development of a policy model on open access that was submitted to the CRUI Library Commission Open Access Working Group group), and eventually approved.^[18]

Previously (in early 2013), "aware of the benefits of Open Access for national research in terms of visibility, promotion and dissemination" the presidents of CRUI and of Italian public research centers had signed an agreement "to act coordinately in order to achieve the success of Open Access in Italy".^[19]

Eventually, in 2015 an Italian Association for Open Science (AISA) was established as a non-profit organization fostering to disseminate in Italy a culture of open science including the need to raise awareness among Italian and European legislators to foster open science in research assessment and intellectual property policies.^[20]

To understand the state of open access perception amid Italy's scholars it is instructive to review an online dialogue between an Italy-based researcher and the head of open science at the University of Milan.

"Open Access is a business model identified by publishers, generally commercial companies, in response to computerization and the consequent ease of obtaining scientific articles for free, without having to bear the cost (without entering into secularism or not). Fewer subscriptions, less turnover. More Open Access, more turnover. It is therefore not surprising that the governments of some states support Open Access, which is usually paid for at a high price by research funds. In fact, some major publishers have tax offices in the Netherlands, Germany, the UK and bill several billions a year. The maximization of their turnover is therefore in the interest of their governments, which will be able to collect more direct tax revenues both on companies and on the work of employees, as well as on related activities, and from indirect taxation on employee consumption. Therefore, why the Ministry of University and Research should squander resources to benefit the tax authorities of other states, instead of using the limited resources of Italian taxpayers to benefit the taxpayers of others?".^[21]

To whom Galimberti responded:

"None of the reasons you cited are reflected in the history of open access that arises precisely as a reaction of scientists to the closure and marketing of the contents they produce and freely sold to publishers... When I noticed that in Italy there are few and totally confused ideas, I was referring to interventions like this."^[22]

Regardless of the delays highlighted by Galimberti,^[10,22] one of the most relevant and practically useful books on open science in Europe was published in Italian in 2017 as freely and openly accessible book.^[23] One of the main needs identified therein by Giglia is the need to develop both a new culture of open science and new tools such as the preprint platforms and online repositories to self-archive and make openly accessible research articles and other scientific documents, including books.^[24]

With EU funds made available, a European Open Science Cloud (EOSC) was established in 2015 as an international non-profit organization under Belgian law with national branches, that officially launched in late 2018 starting to provide access to their to services via the EOSC portal at the URL www.eosc-hub.eu. In Italy a Competence Centre on Open Science was thus created within the Italian Computing and Data Infrastructure, a forum of major Italian research and internet infrastructures. The Competence Centre organizes a number of activities including new seminars such as the "Open Science Café" monthly interactive online presentations focusing on a specific theme of open science.

The series debuted on March 2021 with a seminar on Open Research Europe (the new publication platform of the European Commission for which a 5.8 million EUR, four-year contract was signed on March 2020 with a open research publishing platform owned by a large scientific publisher) held by an Italian scholar based at the University of Göttingen.^[25]

Similarly, by late 2021, a website focusing on open science was launched at the URL www.open-science.it. Managed by professionals of the aforementioned Competence Centre and experts of an Italy's Research Council (CNR) institute, the website includes information (in Italian) on many aspects of open science and its ongoing uptake.

Finally, following similar "networks" already existing in other countries including Australia, an Italian Reproducibility Network was established in 2021 which also organizes seminars on open science inaugurated in the same year by a seminar of Nosek on the culture change required for a "more open, rigorous and reproducible research".^[26]

Along with several other researchers,^[27,28] one of us has suggested that enhancing the uptake of open science requires to undertake new and practically oriented educational activities aimed at young and senior researchers.^[4] Similarly, in 2017 a European Commission publication of the Working Group on Education and Skills under Open Science was reporting a widespread lack of training opportunities for open science in Europe.^[29] It is therefore relevant to review selected examples of pioneering education in open science activities held in Italy.

Pievatolo, a political philosophy scholar, gives a three-lesson course on "Open science and research data management" at the University of Pisa, whose presentation slides and handout text in English are freely and openly accessible under a Creative Commons "ShareAlike" license (for which users are free to share, copy and redistribute the material in any medium or format, as well as adapt, remix, transform, and build upon the material or any purpose, even commercially).^[30]

The three lessons focus on open science ("Scholarly communication and research evaluation: the Open Science Revolution"), research evaluation ("Irresistible proxies? Peer review and (mainstream or alternative) bibliometric"), and academic copyright ("Copyright: taking authors' rights seriously"). The video of a similarly relevant conference lecture held by the same scholar at the University of Rome in 2015 is still available online.^[31]

A course on open science in the earth sciences was given by researchers of Italy's Institute of geophysics and volcanology by late 2020 in collaboration with CNR, OpenAIR, and EPOS experts as a series of four lectures held online, again with a strong orientation to practice so as to enable the attendees to learn the tools to practice open science.^[32]

Six months later, another jointly organized online course, this time aimed to CNR scholars and researchers in humanistic and cultural heritage sciences, was organized again as a series of online lectures,^[33] including specific lectures on the main EU-based research infrastructures and research projects for open science in those disciplines (Clarin Eric for language resources and technologies, Operas for human and social sciences, Dariah for data in human sciences, E-rihs for interdisciplinary data in cultural heritage sciences, and Ariadne+ and Parthenos for archeology).

In 2019 Giglia, head of the Open Science Unit at the University of Turin, held a one-day course aimed at PhD students, librarians and research evaluators of the University of Messina.^[34] To understand the demand of education in open science in Italy (and in Europe) it is enough to review the seminars (all linked to the self-archived presentation slides) given by Dr Giglia since 2015 to date.^[35]

Only in 2021, the scholar gave 26 seminars starting in early January with a *lectio magistralis* inaugurating the Doctorate Schools again at Messina's University ("Open science, il valore della scienza per tutti"), and ending with a seminar ("Open Science A to Z) given at the University of Girona, in Spain, on mid December.

3. Why Italian scholars ignored open science?

According to Vianello, a work and organizational psychology professor at the University of Padova, the two main barriers to embracing open science practices in Italy would be culture and the extra effort needed to disseminate knowledge according to the open science principles. "Our burden is already heavy, pressure to publish is ridiculously high" he wrote in 2021, so that "one really needs to be extremely motivated to follow open science practices".^[36]

One remarkable point explaining a certain *naiveté* surrounding the open science discourse has been raised by Henry commenting a 2017 study of Masuzzo and Martens focusing on the need for researchers to learn the new language of open science:^[37]

"When you write 'One of the basic premises of science is that it should be based on a global, collaborative effort, building on open communication of published methods, data, and results' you only account for an idealistic view of science. In reality, Open science has an enormous opportunity cost for 1. researchers themselves (hence the importance of credit and citation) 2. institutions 3. countries (somehow secrecy is believed to be a competitive advantage). In the past (and still today to a large extent), science was done for the benefit (prestige, economic or power advantage) of researchers, but also benefactors, universities, nations, etc. not the whole community. I love the idea that we need to insist on the 'communism' dimension of research, but we should not ignore the obstacles to Open Science and the fact that funders are mostly national agencies supporting national interests".^[38]

We agree with Henry's preach for realism. It is precisely the little (and even negative) relevance of open science to the academic career that led Italian scholars to delay the uptake of open science practices for nearly two decades. Italy's researchers were (and most of them still are) unaware that by simply self-archiving their research articles published in paywalled journals in personal or institutional websites (granting to anyone "green" open access) they would substantially increase the number of citations, and therefore the impact of their research, on which they are supposed to be evaluated.^[39]

This reluctance, in brief, has been due to a widespread lack of education on open science,^[4,29] resulting in a similarly widespread ignorance of its benefits for the academic career.^[40]

One might object that since Italian universities do *not* recruit professors according to their h-index or other bibliometric indicators,^[41] Italian researchers would not be interested in rising their citation-based metrics.

This, however, is not the case because at least the National Scientific Qualification (ASN) necessary to take part into recruitment and promotion process (from researcher to associate professor, and from associate to full professor) is based on citation-based metrics of publications in indexed academic journals.^[42]

It is relevant here to notice that only in 2018 and 2019 Italy has lost about 14,000 Italian researchers who emigrated mainly towards other European countries and the USA, where they "find a faster career progression and are more confident in their future than Italian researchers in Italy".^[43]

Along with higher salaries, the shift to merit-based recruitment and promotion processes is the solution that has long been identified to end the emigration of Italian researchers and attract talented foreign researchers.^[43,44,45]

This is possible by expanding the research evaluation process to include all three areas of scholarly activity (research, teaching and mentoring, and service to society) and improving the evaluation criteria.^[7,8] Noticeably, the improvement of the research evaluation system in the third intervention area of Italy's Open Science Plan (Table 1).

Intervention area	Intervention plan
Scientific publications	Open access to publications Non-commercial forms of publication European framework on copyright
	Monitoring system Open educational resources
Research data	Enabling findable, accessible, interoperable and
	reusable (FAIR) research data Integration in
	European Open Science Cloud (EOSC)
	Collaborative data production Shaping open
	research data professionals
Research evaluation	Evaluation processes and criteria Collaboration
	between research institutions and researchers Open
	access publishing Open peer review National
	infrastructure
Open science, scientific community and European	Organic path towards open science European-level
participation	coordination
Opening research data concerning COVID-19	National portal for FAIR data and texts concerning COVID19 Models of public health data

 Table 1
 Italy's Open Science Plan. Interventions areas and intervention plans [Adapted from Ref.11]

The Plan includes seven recommendations to improve research evaluation,^[10] explicitly calling universities and research centres to adhere to principles of the Declaration on Research Assessment (DORA, 2012).^[46] Amid them, one principle calls to reduce the weight of bibliometric indicators such as the journal impact factor and the candidate's h-index) to include service to society ("third mission") and contributions to advance open science. Developed in 2012 during the Annual Meeting of the American Society for Cell Biology held that year in San Francisco, the DORA declaration has become a worldwide initiative all scholarly disciplines signed so far (late 2022) by 19,531 individuals and 2636 organizations including research funders, universities, research institutes, professional societies, and scholarly publishers.

4. Outlook and Conclusions

The history of the uptake of open science practices in Italy in the first two decades of the 21th century has several lessons to teach to scholars based in other countries where the transition to "more open, rigorous and reproducible research"^[26] is also taking place.

First, the case of Italy shows that the adoption of open science can be actually driven by a small group of pioneering scholars and researchers. In practice, an active minority comprised of Italy-based scholars and researchers active in both natural and social and humanistic science have actively engaged in open science, adopting its practices and disseminating its value. Examples span from chemistry^[47] and law^[48]through the earth^[49] and life^[50] sciences, and include virtually all disciplines.

Furthermore, the public discourse on open science in Italy has seen and continues to see important and creative contributions such as those of Caso,^[48] Aliprandi,^[23]Giglia,^[24] Morriello,^[51]Töttössy,^[52] Gargiulo,^[19]Galimberti,^[10]Pievatoli,^[53] and many others.

Second, the case of Italy where for many years no financial resources nor personal incentives were actually provided to practitioners of open science, shows that the uptake of open science can smoothly take place also in economically developing countries, where financial resources invested in research and education are a small fraction of those available in economically developed countries like Italy.

Third, the slow uptake of open science practices in Italy was also due to a prolonged lack of training to researchers potentially interested in the shift to opening their scholarship activity. Hence, universities and research policy makers interested in promoting the adoption of open science might wish to shape educators capable to effectively educate undergraduate students and researchers on the principles and tools of open science.

Fourth, also in Italy researchers owning personal academic websites were amid the first to use the World Wide Web to openly share the outcomes of their research and educational work with colleagues from across the world and with their students. In other words, the delay of Italy's researchers to embrace the shift first to OA and then to open science has been partly due also to the limited use of the World Wide Web by Italy's researchers to autonomously disseminate their research, educational and service to society activities.

As the practice of open science increases, to paraphrase Watson,^[1] all publications will be freely and openly accessible, raw data and methods well described and reproducible, software released and peer reviews openly published and no longer anonymous. The objective of open access, indeed, is to maximize research impact by maximizing research access,^[39] but the objective of open science is to enhance science credibility by improving all steps of the scientific research process including the final dissemination step. This, *inter alia*, requires to rediscover intellectual humility in which the limitations of any research work are explicitly presented by the authors and their consequences incorporated into the conclusions.^[54]

Remarkably, the latter study including five important recommendations on how to practically increase humility in scientific articles,^[54] is self-archived and openly accessible at the repository of the University of Groningen^[55] (whereas single access to the article published in the paywalled journal in which it was published currently costs \$32).

The present succinct analysis of the adoption of open science in Italy also shows evidence that, as it happens at the CNR where researchers rely on self-determination to outclass a shrinking research budget,^[56] a small group of researchers and librarians self-determined to practice and disseminate research carried out according to the principles of open science, advocated its value for nearly two decades within a research community showing a prolonged lack of interest.

Eventually, by late 2022 Italian scholars and researchers may access increasingly numerous informative and educational resources on open science. Many universities and research centers have created open science offices. A national open science plan has been published, and an intense intellectual debate on open science is taking place in the specialized literature. Every year, furthermore, the aforementioned associations and "networks" organize in Italy conferences and meetings on open science no longer attended solely by open science advocates, but by researchers finally interested to learn how to adopt the principles of open science in their research activities.

Much remains to be done in Italy concerning the uptake of open science in education, especially undergraduate education, that goes much beyond open educational resources to include a new relationship between educational and research work,^[57] and new evaluation of scholarship.^[7]

Author Information

Rosaria Ciriminna - Istituto per lo Studio dei Materiali Nanostrutturati, CNR, via U. La Malfa 153, 90146 Palermo, Italy; orcid.org/0000-0001-6596-1572; E-mail: rosaria.ciriminna@cnr.it

Mario Pagliaro - Istituto per lo Studio dei Materiali Nanostrutturati, CNR, via U. La Malfa 153, 90146 Palermo, Italy; orcid.org/0000-0002-5096-329X; E-mail: mario.pagliaro@cnr.it

Conflict of interest

The Authors declare no conflict of interest.

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