

Cost hurdles to open access publishing: A citizen scientist perspective

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Abstract

Besides offering fun activities for non-scientists to explore the natural world through experiments, simulations or games, the evolving concept of citizen science is increasingly allowing some serious publication quality science to be published by the practitioners (citizen scientists) themselves. The latter is in contrast to the common perception of citizen science, where most citizen science projects such as Foldit are distribution of piecemeal segments of complex projects suitable for solution by individuals, and where the results are pooled together, or used to inform the design and direction of more complex research initiatives. Usually novices in science publishing but nonetheless aware of the importance of journal articles as the primary medium for communicating new research to the wider community (scientific and general public), citizen scientists do encounter significant challenges in science publication. One challenge is in navigating the lengthy and time-consuming peer review process of most journals. But, as benefactors of open access publishing where most journal articles are within pay walls inaccessible to citizen scientists without any research funding, open access publishing is one platform sought after or exist as an option for citizen scientists. Is the option open? Yes, at the preprint level where *figshare*, and *PeerJ Preprints* help provide an avenue for citizen scientists to have a published non peer reviewed article online, but no at the higher end “journal article” level where the manuscript needs to be peer reviewed. Even the biological sciences preprint server, *bioRxiv*, is closed to citizen scientists as publication on the server requires an institution affiliation with either a university or research institute. Most open access publishers (except *eLife*) charge a publication fee (in the thousands of dollars per article) to defray the cost of maintaining an online presence for a peer reviewed manuscript as well as those for copyediting during final stages of journal publication. This is a significant barrier to cost constrained citizen scientists who want to contribute to the scientific discourse. For the scientific enterprise, this represent a loss, whose magnitude or severity cannot be quantified since ideas help seed new research or entirely new fields. Thus, can we as a community provide citizen scientists worldwide a chance to publish open access peer reviewed articles without significant cost through a competitive publication fee subsidy scheme where each application is reviewed by the national science funding agency? If the above is possible, it would open up another area where ideas from citizen scientists could percolate into the scientific mainstream, where, as always, vibrancy and diversity of ideas power science forward.

Keywords: science publishing; open access; publication fee; citizen science; experiment; simulation; theory; citizen scientist;

Subject area: science communication;

Introduction

Science is an understanding of the world gained through careful observation, serendipitous or planned. Its articulation through research is commonly held as an esoteric subject for professional scientists. But who are the professional scientists and how do we define them? We usually associate scientists with those who conduct experiments in a laboratory at a university or a research institute. These may be professors, undergraduate students, graduate researchers or post-doctoral fellows – and they are usually termed professional scientists. However, in recent years, there is an emerging trend towards encouraging the general public to play some role in scientific discovery. This is potentiated, in part, by the generation of large datasets from complex research endeavors organized around consortia, or data discovery research such as astronomy where there is a paucity of manpower to manually annotate data, and more importantly, find meaning in them. Thus, several research groups started the conceptualization of citizen science where common people could contribute to scientific discovery in a continuum of involvement ranging from allowing use of spare idle time on laptops to process some data from a protein folding effort, to playing an education game to discern possible strategies to fold a protein.¹ Fun in nature and generally not requiring much input of time and effort from the general public, these efforts have gradually taken hold in the scientific community – and has expanded into other fields beyond protein folding and astronomy, where one citizen science project (Galaxy Zoo) is a game in which players gain points for correctly identifying a known galaxy or annotating a new galaxy from a large dataset of observations from telescopes (<https://www.galaxyzoo.org/>).

Citizen science as described above is passive, where the public generally contribute to the collection of data or whose game strategy at protein folding help inform the design of future simulation runs by professional scientists.¹ However, there are, or in the future, there will be citizen scientists who traverse the entire gauntlet of challenges from conceiving an idea, reading up on it using the publicly accessible scientific literature (i.e., free or pay walls removed), design an appropriate experiment or simulation to test a hypothesis, collects the data and wish to communicate the results and hard work to the wider scientific community. This has happened in the multitude of projects spurred by the cheap foldable microscope called foldscope.² Developed at Stanford University, foldscope is a paper cardboard based optical microscope capable of imaging microorganisms in various matrixes such as water if it is coupled with a smartphone camera or accessories. Such curiosity driven research projects by citizen scientists may lead to new findings that should be communicated to the scientific community through journal publications.³ While traditional publication avenues in journals with paywalls abound, there is a growing sense, within academia, that open access publishing is the more favorable and equitable means for promulgating science findings obtained using taxpayers' dollars.

However, science publishing, whether online or through printed journals, is a costly process, which the advent of modern semantic web technologies and web-based publication help made cheaper. Taking advantage of web tools and lower cost model of online journal publication,

and the desire to make the scientific literature more accessible to scientists and the general public,⁴ open access publishing was introduced in early 2000s with BioMed Central as one of the first online open access publishing company. To date, all open access publishing companies produce web-only journals with no hardcopy equivalents. Conventional publishers do offer, at a fee, open access option for publication, but most articles published through these publishers remain behind pay walls, which education institutes pay for through volume licensing agreements and individuals pay on a per article basis (tens of dollars per article). More recently, there is a rent an article phenomenon where journal publishers charge a lower fee per article but only grant access to the article for a defined period. All in all, open access publishing is available but it still represents a small proportion of all articles published annually.

One thing to be remembered about open access is that it is not free to the authors compared to the case for closed access. From another perspective, open access shifts the cost burden of publishing from the readers to the authors;⁵ thus, ensuring all who view the article online to be able to download a full-text, copy edited and typeset version of the article. But, what are the cost components of publishing a scientific article online, and is it the same for both open and closed access? The answer: while the cost components are the same except for the cost of producing hardcopies for publishers who still mail a printed copy of each journal issue to subscribers, the cost components of maintaining an online version of the article, copyediting, adding authors and readers' tools to facilitate broader promulgation of the article etc. are the same for closed and open access publishing.

In general, a publication fee of a few hundred to a few thousand need to be paid to allow a peer reviewed article to be published as an open access article (Table 1). For professional scientists, this fee can be paid for through the research grant if there are provisions for open access publishing in the grant. Indeed, there has been debate and awareness in granting agencies in different countries of the utility of factoring the cost of open access publishing in the research grant. Of more importance is the debate about whether all publicly funded research should be made open access since the general public have the right to access the knowledge and results derived from such research. Making these research findings (which can be encapsulated within the public abstract of the journal article) publicly available could only do good to society since knowledge is a multiplier of economic productivity and development. Specifically, it seeds new ideas in science, and informs or form the basis for debate in other social development issues. Crucially, access to the full-text provides the readers with the evidence to evaluate the claims made in the paper. Knowledge of such importance and utility and obtained using public money should not be kept behind the wall of closed access publishing.

Table 1: Cost of publishing an open access peer reviewed article in specific journals using the Creative Commons Attribution License 4.0, CC-BY 4.0 license, which has the fewest restrictions on reuse of published material

Journal name	Cost per peer reviewed article (\$US)
<i>Nature Communications</i>	5200
<i>Scientific Reports</i>	1495
<i>Scientific Data</i>	1350
<i>Science Advances</i>	4600
<i>PLoS ONE</i>	1495
<i>PLoS Biology</i>	2900
<i>PLoS Medicine</i>	2900
<i>PeerJ</i>	895
<i>Journal of Bacteriology</i>	3000
<i>Applied and Environmental Microbiology</i>	3000

But, what is the situation to open access publishing in general and publication fee in particular for resource starved citizen scientists, who may be alone at work trying to make a tiny contribution to scientific knowledge? The answer is the road to open access publishing is wide open at the preprint level where a multitude of publishers offer free publishing of unlimited number of preprints, which are not peer reviewed. Such publishers include *PeerJ Preprints*, *figshare*, *Social Sciences Research Network (SSRN)*, and others. However, the situation is much tougher at the journal article level, where only *eLife* offers a free open access publishing option.

At the end of the day, society needs to ask itself: what can be done to pave the road, or at least make it less bumpy and torturous for citizen scientist to publish an open access journal article. Because, if the case for publishing a citizen scientist's work as open access articles can be solved, the broader issue of helping professional scientists (i.e., professors at university and group leaders at research institutes) publish taxpayers' funded research in open access journals can also be institutionalized through a funding mechanism for open access publishing built into each research grant awarded. What may be possible for seeding and promoting citizen scientists' research is the provision of an open access publishing help (or fee subsidy), where citizen scientists can submit their peer reviewed manuscript which has been accepted for publication at an open access publisher for competitive review. If found to be of good quality and not accepted at one of the predatory open access publishers, the publishing help from the national granting agency should cover the cost of publishing the open access article at the specified publisher. In reviewing the application, the quality of the science reported should be the main criterion, and the publication grant opportunity should be open to all citizen scientists.

Citizen science as a concept is increasingly being accepted by the profession it is allied to: academia, but it remains a nebulous concept in the eyes of the general public. Introduced to the

concept of contributing to science in the form of processing large datasets that can inform future research, citizen science initiatives and projects in the past couple of years has taken a different turn in endowing individual citizen scientist more freedom to ask their own questions, from which they endeavor to design an experiment or simulation to progressively elucidate details hidden from view. Though not well acquainted with the process of science publishing, many citizen scientists do see the need to communicate their latest research findings as a means for gaining credit for their work, which they obtained by sacrificing time on other aspects of their lives. One option is open access publishing, which will help them disseminate their research ideas to a broader community of scientists and non-scientists at zero cost to the readers. But, without any research funding, it is a significant commitment to publish one's work as open access compared to closed access. Through a competitive review mechanism to assess open access manuscript accepted for publication, this short essay discussed a means that could potentially open the doors to open access publishing option for independent citizen scientists, which helps ensure that fruits of their hard work remains firmly in the arena searchable, and more importantly, accessible to the general public, to which all science seeks to contribute: whether as knowledge for humanity in basic science research or follow-on products or utility in the area of applied research.

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Conflicts of interest

The author declares no conflicts of interest.

Author's contribution

As a citizen scientist, the author experienced difficulty in finding funds to publish his works on open access journals. Thus, he wrote the manuscript to suggest a possible mechanism by which governments around the world can support citizen science activities, which democratize the practice of science. Science is universal and should not be confined to universities and research institutes. In the author's view, a manuscript should be assessed solely based on the importance of the question it is seeking to address as well as the approach used to probe the question, and by default, quality of data obtained. Naturally, the paper must be able to communicate the scientific ideas clearly across to scientists and the scientifically literate. Lack of funds for publication fees should not hinder publication in an open access journal.

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