Opening science: New publication forms in science

Opening Science: Neue Publikationsformen in der Wissenschaft

Abstract

Digital technologies change how scientists access and process information and consequently impact publication forms in science. Even though the core of scientific publications has remained the same, established publication formats, such as the scientific paper or book, are succumbing to the transitions caused by digital technologies. At the same time, new online tools enable new publication forms, such as blogs, microblogs or wikis, to emerge. This article explores the changing and emerging publications forms in science and also reflects upon the changing role of libraries. The transformations of publishing forms are discussed in the context of open science.

Keywords: scholarly publishing, digital scholarship, science 2.0, open science, internet studies

Zusammenfassung

Digitale Technologien ändern die Art und Weise wie Wissenschaftler mit Informationen umgehen und beeinflussen dadurch Publikationsformen in der Wissenschaft. Auch wenn der Kern von wissenschaftlichen Publikationen gleichbleibt, unterliegen etablierte Formate, wie zum Beispiel der wissenschaftliche Artikel oder das Buch, einem durch digitale Technologien hervorgerufenen Wandel. Gleichzeitig, ermöglichen online Werkzeuge neue Publikationsformen, wie beispielsweise Blogs, Mircoblogs oder Wikis. Dieser Artikel untersucht die sich wandelnden und neu entstehenden Publikationsformate in der Wissenschaft und reflektiert auch die sich wandelnde Rolle der Bibliotheken. Diese Transformationen der Publikationsformen werden im Kontext von Open Science diskutiert.

Schlüsselwörter: wissenschaftliches Publizieren, digitale Wissenschaft, Science 2.0, Open Science

Kaja Scheliga[1]

1 Alexander von Humboldt Institute for Internet and Society, Berlin, Germany

Introduction

Information is the raw material for publications and is recorded in various publication forms. The act of recording information is what determines how knowledge is preserved and how history is written. 'No records, no history, so history is actually synonymous with the information age, since prehistory is that age in human development that precedes the availability of recording systems' [1]. Furthermore, according to Floridi, we are currently witnessing a shift from a historical society, which relies on information and communication technologies (ICTs) to record and transmit data, to a hyperhistorical society, which is dependent on ICTs to record, transmit and process data, and where information is a fundamental resource [2]. In light of this transition from a historical to a hyperhistorical state, I want to explore the way digital technologies affect established publication formats and how they enable the emergence of new publication forms in science.

Today, the internet is having a similar effect on how we create, access and process information as the printing press had on society in the 15th century. Yet, interestingly, in spite of the new opportunities opened up by the advancement of digital technologies, the essence of publications remains the same. Many digital publication formats have retained the static characteristics of their analogue ancestors; especially in scientific publications the format has been transferred from page to screen. The mere digitisation of a paper utilises the possibilities of digital technologies to a limited extent.

At the same time, the impact ICTs have on society on a macroscopic level is also reflected in the transitions that can be observed on the microscopic level in the realm of publications. It is important to note here, however, that

in many cases new publication formats are not replacing traditional ones; they rather play a complementary role.

Open(ing) Science

From a historical point of view, an interesting shift is happening in the relation between publication and openness. When the scientific journal system emerged in the 17*th* century it was an excellent example of open science. Scientific insights were no longer encrypted in anagrams, as was common practice in the days of Galileo and Kepler, but published in scientific papers in journals. The accessibility of scientific discoveries enhanced the exchange of knowledge between scientists. As time progressed, more scientific journals were established and subscription fees increased, culminating in paywalls. The financial barrier that stands between the interested individual and the scientific publication triggered the open access movement: its aim is to provide free access to scientific publications. While open access is a crucial element of open science, the idea of open science encompasses more than access to scientific publications.

The informal definition of open science is 'the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process' [3]. The important aspect of this approach to open science is that it refers not only to the final publication of research insights but also to the steps that lead to those insights, thereby making the whole research process more transparent. Against this background, sharable fragments of knowledge are particularly interesting as they constitute the material that goes into new publication formats. Analogous to Cory Doctorow's remark that 'if you are making art that is not intended to be shared, you are not making contemporary art' [4], one could argue that if you are producing science that is not intended to be shared, you are not producing contemporary science.

Openness as interaction

A piece of knowledge that is shared can be interacted with. Thus, I want to interpret openness not simply as access to the publication but also as interaction with the content of the publication. This interaction can happen before or after the publication.

Pre-publication interaction takes place when author(s) share their text with other people before it is published. This can take the form of asking colleagues for feedback on a first draft of a text, which is a standard procedure among scientists. Opening up further can mean sharing a text with a wider audience by making it available online for feedback and discussion. A more radical form of this idea is to make the process of writing transparent so that the entire creation process of a text can be witnessed. For collaboratively written texts having a shared document that can be simultaneously accessed and edited by all co-authors is a new feature enabled by digital technologies (for example Google Docs or EtherPad). For scientists who are working together on a shared text this functionality potentially opens up new ways of collaborating. While technologically supported transparency by means of online tools among a research group can be beneficial for collaboration, it is not always feasible to have a radically transparent writing process, particularly in the medical sciences, and thus needs to be treated with caution. It can be fascinating to watch an artist paint or to hear a musician practice, but using online tools as a digital peephole to observe the writing process may seem rather like opening up the doors of the operating theatre for everyone to watch the surgery. Not everything has to be seen; in some cases the intimate space and full concentration behind closed doors is needed in order to produce the best results – a healed patient or a whole text.

An example of pre-publication interaction is the "Handbuch CoScience – Gemeinsam forschen und publizieren mit dem Netz" [5] created during a booksprint [6]. Several scientists gathered at the Technische Informationsbibliothek (TIB) in Hannover in order to collaboratively write the first version of the book within a few days. They subsequently continued to improve it during the CeBit 2014 in Hannover inviting everyone who was interested to contribute.

Post-publication interaction takes place when the author(s) share their text after they have published it, with the intention of integrating the feedback they receive into the next published version. This can take the form of comments from the scientific community or the interested public. In the current publishing system, the insights of a scientific publication should ideally trigger some discussion leading to further research and subsequently to new publications. In this case the idea is to improve the existing publication instead of producing a new one on the same topic. To some extent this is happening with some journals incorporating 'research supplements' which is a short publication form that complements an existing publication. But here again it can be argued that a 'research supplement' is the enhanced digital version of a paper-based journal supplement.

What is interesting about post-publication interaction is on the one hand that it makes the discussion around a scientific text more visible and on the other hand that it applies the notion of incremental improvements to written materials by means of harnessing collective intelligence. An example of post-publication interaction is the book "Opening Science: The Evolving Guide on How the Internet is Changing Research, Collaboration and Scholarly Publishing" [7]. It has been published as a book and is simultaneously available online for free. In addition, the content of the book is uploaded on GitHub where it can be edited. Anyone who is interested can comment on the existing content as well as submit suggestions on how it could be improved and extended.

Blurred lines

Interaction with text is not limited to either pre-publication or post-publication interaction, it takes place during the whole publication process and involves varying degrees openness. Giving and receiving feedback is an integral part of the scientific process. While in the past these discussions took place within the scientific community, among scientists who knew each other through their publications and from conferences, today a scientist can potentially reach an unprecedented global audience, including citizen scientists. Digital technologies add a new dimension to scientific discussions around publications by expanding the potential outreach. As a research infrastructure developer stated in an interview on open science, 'the vision that all of Europe is a huge playground for scientists where there are no borders anymore, no barriers to work together, that is indeed a great vision' [8].

Informal discussions of texts do not leave a trail behind. An idea voiced by a colleague or a friend which is integrated into a text cannot be traced back in the same way as a written record, for example, a comment in the raw version of the text document can be traced. It is also digital technologies that expand the possibilities of recording scientific conversations thereby making the creation process of a publication more comprehensible and if opted for, more transparent. As Carolina Ödman-Govender, an astrophysicist, elucidates 'when you use [online tools], the conversation you have gets recorded, and you can follow it, you can remember the conversations you had with your colleagues just because you have a Google plus community where you had these conversations' [9].

Interactions with publications, especially when they take on unconventional forms, come with a series of challenges. Since publications and citations are critical values in the contemporary scientific system they force scientists who are playing by the rules of the system to work in certain ways. Thus opening up science is often met with scepticism based on the fear that someone else could free-ride on one's work or that by sharing research insights one might lose out on competitive advantage and potentially patents [8].

From the perspective of an individual scientist it is strategically more advantageous to produce a new publication than to expand an existing one. Thus, one question is how updating existing publications, instead of withholding new insights until they have accumulated sufficiently to form a substantial basis for a new publication on the same topic, can be integrated into the scientific publication system. Linked to this is the question how to maintain an overview over version control. Here the challenge is both on the side of the author and the reader to be up to date and to refer to the same version of the publication in a scientific discussion.

Dynamic publication formats integrating input from people who are not authors of the previously released version pose interesting questions with regards to authorship. At what point does a contribution become substantial enough to include the person as a co-author? Assuming the publication has been considerably expanded by other authors, is there a point where the first author loses their position?

New publication forms

As already mentioned above, while the core of publication formats remains the same, digital technologies have contributed to the emergence of new publication forms as well as to the transformation of established formats. In the following section I explore some of them.

Books in their printed form continue to play a crucial role. With the growing adoption of various forms of e-readers, however, book content is increasingly shifting from page to screen. While until now, this transition is only minimally affecting the essence of the reading experience, it is possible that in the future multimedia will be increasingly integrated into books, possibly leading to books being read (consumed) rather like websites.

Papers, similarly to books, tend to be static rather than dynamic. Even though it is increasingly common to embed links to referenced publications in the text and particularly in the references, the main body of the text remains static in most papers. There are some efforts, however, to make scientific papers more dynamic. For online papers, an area where the potential of digital technologies can be made the most of, is integrating graphs that go beyond statically representing a fragment of the dataset. If the dataset is linked, it allows the reader to manipulate the parameters and to explore the data more fully. Similarly, instead of integrating an image to illustrate a particular issue, especially in cases where progress in time is relevant, a sequence of images or even a short film can be included. Even though there are some examples of enhanced or executable papers, it is generally rare to see papers that are harnessing the potential of digital technologies in order to present the findings holistically.

Data have long been considered as supplementary material to scientific papers, not as publications in their own right. The open data movement is a step towards making scientific findings more replicable by not only providing the summary of research in words, illustrated by graphs, but by also publishing the data that form the basis of the findings. Publishing data, however, entails numerous challenges. Often the rules and regulations concerning data, especially when it comes to data gathered as part of international collaborations, are not clear [8]. Moreover, it can be difficult to find an appropriate repository in which to publish the data so that it is findable by those who might be interested in re-using it. While there are certain conventions that determine the structure of scientific papers, there is a lack of standards when it comes to putting data into a publishable format, especially one that is meaningful to someone who was not involved in the data collection process. It the future, however, it is likely that we will see an increase of data repositories,

an integration of publishing datasets into the scientific publishing cycle, and possibly even scientists whose expertise will be solely based around collecting and maintaining datasets.

Code can also be seen as a publication. Repositories, such as GitHub, provide coding scientists with a platform to share their code and to re-use the code of others. In many scientific disciplines that work with code but where coding is not inherently part of the discipline, a piece of code is not respected as a publication that gets a scientist credit. With increasingly more disciplines relying on computer-aided data processing it is only a matter of time before citation standards for code will develop and for the sharing of code to be rewarded in the scientific publishing system.

*Blog*s provide a platform for writing about a topic in a more informal way than in a scientific paper. Moreover, a scientist has full control over the content and is solely responsible for its quality. The content can be published in a timely manner and independently of a publisher. Blogs can be used for various forms of scientific communication such as summing up the essence of a scientific paper, formulating ideas about a topic that are not ripe for a paper yet, reporting reflections from a conference and so on. It allows scientists to disseminate knowledge to a potentially wide audience. As Martin Fenner, technical lead of the PLoS Article Level Metrics project, stated in an interview on open science: 'if I need only twenty minutes to set up some blog where I can publish my whole science then that is disruptive, even if it is only a technological change' [10].

*Microblog*s such as Twitter invite scientists to engage in global discussions on currently important issues in science. For instance, it can be used to highlight key points during a conference. Moreover, it is a tool that scientists can employ to keep the scientific community up to date about their conference contributions, recent publications, intermediate insights and work in progress. While in the case of Twitter the information has to be compressed into 140 characters, shortened urls can be used to complement the distilled essence.

*Wiki*s can be regarded as a hybrid publishing platform. On the one hand it provides scientists with an online space in which they can collaboratively work on projects and apply various degrees of openness. They can share work in progress with collaborators only or with a wider audience while maintaining shared responsibility over the content. On the other hand, wikis are used to document completed research projects. It is technically easy to switch from closed access during an ongoing research project to open access once the work is finished.

An imaginary example of using new publication formats to open up science could look as follows. A scientist sets up a blog on which she documents her research project; she briefly describes her topic, her research question and her method. By continuously posting fragments of her research insights as updates she puts a timestamp on her progress. Since her research is not based on human subjects she is not constrained by the challenges posed by anonymisation and data privacy. In addition to her blog, she uses Twitter to post mico-updates about her research such as for example pictures. She gathers and analyses the data. She starts writing a paper when she receives a message from a scientist who has read her blog and happens to work on a similar topic. He shares some interesting ideas with her and they decide to collaborate on the paper. They send the first draft of their paper to some of their colleagues, who are also experts in this field, to collect feedback. Together with her co-author she integrates the feedback into the text. The paper goes through the peer-review process and is finally published in an online open access journal. At the same time, the underlying data and the code used to analyse the data are also published. Again, the scientist uses her blog to post a summary of her paper and uses Twitter to disseminate the information about its publication. The publication is discussed in the scientific community and this conversation is 'recorded' online.

Changing role of libraries

With the increasing shift from paper-based content to electronic resources the role of the library is also changing. Online search engines cannot be relied upon as the only resource to finding the relevant publication among a multitude of publications. Providing access to resources and facilitating the search is still a crucial element of library services. What is likely to change, especially in the medical sciences where it is vital for publications to be up to date, is a decrease in physical resources and an increase in digital resources. This means knowledge actually becomes an unreplenishable common good that can be accessed by an unlimited number of scientists simultaneously. In addition, digital resources can easily be updated. Furthermore, a possible development is the inclusion of apps as educational resources which can be a valuable learning tool in areas such as anatomy for example.

In addition to silent areas, libraries are using their spaces for hands-on learning formats. There are seminars on various topics related to the library resources for instance, but there are already some libraries that are exploring more unconventional learning experiences by providing access to 3D printers [11]. Considering the convergence between medicine and (digital) technologies, 3D printing could be a great resource for students to learn about the structure of organisms by programming and subsequently printing them.

Conclusion

As illustrated by the examples above, digital technologies are transforming established publication formats in science and leading to the emergence of new publication forms. Even though at large, scientific publications have retained their analogue characteristics in digital formats,

the possibilities of digital technologies to enhance existing formats are present and likely to be increasingly applied in the future. Ultimately, however, it is up to the individual scientists as to how they can harness the power of digital technologies to present their research findings in the best light.

Note

Competing interests

The author declares that she has no competing interests.

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Corresponding author:
Kaja Scheliga
Alexander von Humboldt Institut für Internet und Gesellschaft, Humboldt Universität zu Berlin, Juristische Fakultät, Bebelplatz 2, 10117 Berlin, Germany
scheliga@hiig.de

Please cite as
Scheliga K. Opening science: New publication forms in science . GMS Med Bibl Inf. 2014;14(3):Doc28.
DOI: 10.3205/mbi000325, URN: urn:nbn:de:0183-mbi0003253

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Published: *2014-12-19*

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