

# Gifts of Openness in Sciences and Higher Education

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This talk is a reflexion on the disruption open access, open data, and other forms of openness are causing in scientific research and higher education. This disruption goes much further than what one would at first expect. This talk's thesis is, that openness has the potential of significantly improving the "making of science" and higher education.

A decade ago, in 2005 on the occasion of the fiftieth anniversary of the death of one of the best-known researchers of modern times, Germany has celebrated scientific research with an "Einstein Year". A problem with this celebration was that it failed to recognize, and therefore did not stress, how scientific research has changed since Einstein's time. Today, science no longer shines thanks to a few stars –like Albert Einstein– but instead through ecosystems capable of attracting both, the considerable funds and the large numbers of researchers of various ages and skills necessary for most scientific and technical endeavours of our time. Think, for example, of genomic or nano-tech research. Think also of what makes Stanford University different from any German university: Its ecosystem, which has given birth to the Silicon Valley. (Nothing illustrates better the potency of Stanford's ecosystem than the name SUN Microsystems, that of an IT company funded in 1982 which developed Unix-workstations and the programming language Java –before being taken over by Oracle in 2010–: SUN is the acronym of Stanford University Network.) Surely, the lone scientist working mostly on her own over several years at solving a conjecture or writing a groundbreaking book will remain a reality. But the lone scientist is a popular figure from the past, not a current standard.

Until approximately half a century ago, scientific research was characterized by a slow pace of communication –that of paper letters–, by individual and local work, and by cheap and few infrastructures. In contrast, the making of science now significantly depends on a very high communication speed –the speed ensured by emails, online

publications, and search engines–, on the collaborative work of scientists from different institutions and countries. More and more, novel infrastructures are built making it possible for distributed scientists to work together. Such infrastructures are developed at the Max Planck Digital Library (MPDL).

As in 1976 the “four colours theorem” was proved (by Kenneth Appel and Wolfgang Haken) by checking with a computer 1,936 basic cases, uneasiness widespread among mathematicians. Would mathematics turn to a science of proofs a single human cannot understand and verify in a lifetime? The uneasiness remains even though it is not much of an issue since the considerable complexity of most of mathematics research leaves enough room for what one might call “single human problems“. However, there are no doubts that, slowly but surely, mathematics is changing. Distributed collaborative work in mathematics is boosted by initiatives such as Polymath, a collaboration among mathematicians to solve important and difficult mathematical problems coordinated by blogs and wikis. Polymath uses software not for solving mathematical problems but instead for bringing together mathematicians distributed over the world. Polymath began in January 2009, as Tim Gowers posted on his blog a request to his readers for ideas toward a problem. Polymath is an example of openness in sciences: It provides an “open access“ through social media –blogs and wikis– not to solutions but to problems. Polymath is to mathematics what platforms like Innocentive are to industrial research and development: A social media targeted at collaborative innovation.

Humanities, too, now rely on software. Recently, an algorithmic data analysis revealed that, during the Terror, the period of violence at the onset of the French Revolution, architects were overrepresented among the tens of thousands victims of mass executions (Sebastian Herrmann: “Long Data - Leuchtspuren der Kulturgeschichte“, *Süddeutsche Zeitung*, 1 August 2014). The fact is puzzling for two reasons: It had so far escaped the attention of historians and, so far it has not been explained. Data analysis will surely not replace traditional work forms in humanities. But, undoubtedly, it will become one method among others. The widespread use of data analysis in humanities is ineluctable. It will raise the issue of open data in humanities. Indeed, without open data,

data analyses are hardly verifiable and unverifiable analyses are not acceptable in scientific research.

Whether and when the humanities will join in the quest for open access still seem open issues. The battle for open access in sciences, humanities included, is, however, already won, for a simple reason: Open access is key to a high communication speed and therefore to a scientist's career. In computer science, for example, almost all publications can already be found online for free –thanks to retro-digitalisation, this applies also for older publications. Even though a “wild open access“ in some cases encroaches on publishers' rights, computer science publishers tacitly tolerate it. Indeed, fighting against it like, for example, the movie and music industries do, would alienate them authors and editors. Even though the battle for open access is already won, the debates still goes on, on how to realize it in practice. This debate should not, however, be misunderstood as a debate on whether open access is important for today's making of science. Open access is already a trait of today's scientific research.

I mentioned in the opening of this talk the disruptiveness in sciences not only of open access but also of open data. There are two reasons for mentioning open data. The first one is that openness in all its forms boots distributed collaborative work. An example is the already mentioned mathematics collaborative platform Polymath what makes not only solutions but also problems openly accessible. A second and probably more important reason is that openness in all its forms –among other open review and citizen science– generates invaluable data, namely the footprints lefts by users of an open access server, a collaborative tool like polymath, a crowd-funding platform, a data analysis server, an open review or citizen science platform. This aspect of openness in sciences is worth considering.

Think of a university open access server for the university's research publications that would keep track and analyse its users requests. Data analyses would provide valuable insight on who is interested in what. Correlating such findings with funding programs would give valuable hints at the research interests of competitors and potential partners alike. Such knowledge could be exploited in competing for funds, or even for the

university's research policy. This might sound like science fiction. This kind of "computed consciousness" is precisely what, in the near future, will transform the making of science. Indeed, this is such a "computed consciousness" which has given a cutting edge to retail and service companies. Google's, Amazon's and Expedia's commercial success are based in part on such a "computed consciousness". There are no reasons for scientific research not to adopt similar techniques.

Think also of a university running a crowd-funding platform. Even if the platform would not, especially in its first years of existence, generate much money, it would generate highly valuable information on how the public –parliament members and companies included– perceives research endeavours. Such information would be extremely valuable for better marketing the university's research. Whether it is privately or publicly funded, a research institution is highly dependent on how its activity is perceived by the public –among other by companies and politicians. I do not suggest that the public opinion should decide whether an investment in scientific research is worthwhile. I am arguing that an awareness of the public opinion is useful in the marketing of scientific research and that this awareness can be computed from a crowd-funding platform for research projects.

A positive side effect of running such a platform would be to train researchers to publicize their work. A good publicizing of research goals, as we well know, is key to success in the competitions for research funds. This, too, is a gift of openness. Indeed, openness requires publicizing.

More examples could be given of possibilities to exploit openness in science for collecting valuable data. Instead, it is preferable to consider whether openness is required for the kind of data gathering and data analysis mentioned earlier.

The server of a publisher selling research articles can, indeed, collect exactly the same data and perform the same data analysis as would our hypothetical university open access server do. However, openness is needed for the scheme to properly work for three reasons. The first reason is simply that a publisher's business is not the making,

but the publishing, of science. Similarly, the making of science is not the core business of a bank, or of an agency, that would provide crowdfunding for universities. A second reason is that an entity, company or agency, attending to provide the data gathering analysis services we consider would act for several third parties. One is never so well served as by oneself. The coordination necessary for serving different universities would be significant, if not considerable. And a same service offered to competing universities would hardly provide any of them with a cutting-edge advantage. But the main reasons why openness is needed for the data gathering scheme mentioned lies in the logic of a “gift economy” (David J. Cheal: “The Gift Economy”, Routledge, 1088. pp. 1–19), where valuables are not sold, but instead given without an explicit agreement for immediate or future rewards.

Gift economies build communities of interest, while economies where valuables are sold, do not or might even be harmful to the building of communities of interest (David Bollier: “The Stubborn Vitality of the Gift Economy. Silent Theft: The Private Plunder of Our Common Wealth”, Routledge, 2002. pp. 38–39, 2002). Researchers getting for free research articles or research data from a research institution are more likely to unrestrictedly use the service, thus yielding more and better footprints, to accept the data gathering and the analysis the institution performs from their footprints, and to collaborate with this research institution. The gift economy is the principle of the open source movement (Eric S. Raymond: “Homesteading the Noosphere – The Cathedral and the Bazaar”, O'Reilly, 1999) which has been so hugely beneficial to the software industry. The gift economy “oils” many services such as Google search and Amazon’s recommendations even though both companies are profit conscious. The gift economy holds considerable promises for the making of science. These promises are based on openness, that is, first and foremost, open access and open data.

The gifts of openness in sciences could be further discussed. Instead, I would like to turn to higher education. I argue that openness is disrupting higher education as much as scientific research.

While researchers still are discovering the gifts of openness, students are in a different situation. They have grown up in the gift economy, what most of us have not. They are, for example, used to, and therefore expect, the free software, free media, and free services of the gift economy: First and foremost for search and recommendations, that are free services –products found on Amazon can be, and in some cases are, bought elsewhere–, but also in combination with services for fees. One does not pay, for example, for the app of a railway company, an airline, a public transportation system, or a music seller. One pays for the ticket or the music, not for the app their use may require. The socio-economical model students and, as a matter of fact, all of us, are nowadays used to is as follows: One subscribes for a fee to a service –a railways or airline ticket, a piece of music, a newspaper, or a book– and then gets without additional costs the software, and possibly additional media, ensuring a good use of the service. In spite of the fees, the principle is that of a gift economy. There are good reasons for this model: It fits perfectly with cloud storage what binds customers to providers –a benefit for the providers– and ensure the permanent and ubiquitous access to up-to-date versions of media and software –a benefit for the customers. The same principle makes sense in sciences and higher education, too.

But should universities follow a commercial fashion? Should they not, instead, either beware what they are, or establish their own new models regardless of what commerce and society might practice or favour? It is tempting to answer in the positive. But doing so, we would follow a fashion of the past, keep with a university model of a forever gone time.

The city of Vienna, in Austria, perfectly illustrates what European universities have been and still are perceived to be by many. Along the Ring, a boulevard around the middle age city where the city walls have been, one finds the one after the other all places –should I say temples?– of the high culture of the long 19th century (the period beginning with the French revolution and ending with the First World War): a public park, an opera house, natural history and art history museums, a square –the Heldenplatz– where military parades took place, a parliament house, a city hall, a theatre –the Burgtheater–, a university, a church –the Votivkirche celebrating the alliance of church and empire

which, interestingly, lies slightly behind the line–, and a stock exchange. Vienna University on the Schottenring has been build as a palace at a time higher education was only accessible to a privileged few –very few, in fact. In the preface of his book “Fractured Time“ (Abacus, 2013), Eric Hobsbawm estimates the number of university students at the eve of the First World War to “one tenth of 1 percent of the joint population of Germany, France and Britain“. In 2012, university students amounted to 3% of Germany’s population –Thirty times more but still a smaller proportion than in many other European countries.

Today’s universities are no longer temples of a high culture for a few they have been in the 19th century. Each time I give a lecture in the main building of the University of Munich, I am physically confronted with the discrepancy of what the university has been and what it now is: I enter a Byzantine church-like building the holly of holies of which is the auditorium maximum –where all professors and all students could gather together and celebrate– and I am almost overrun, or flooded, by the falling tide, I mean, the masses of students leaving the building. Professors, research assistant, and students –a population of over 50.000– no longer gather together for celebrations. Their work is clockwork-regulated leaving no time for celebrations the university anyway has no room for. Universities are no longer adornments of a small social class. They are places for the reproduction of, and social promotion into, the large and still widening middle class of the post-industrial society –which, rightly, is also called “information society“. Universities are no longer temples of the high culture of a few but instead agoras of a mass culture. The gift economy students nowadays expect to find at universities perfectly suits today’s universities. The gift economy gives universities a unique chance to adjust to the information society and doing so, to re-invent themselves.

Interestingly, the contemporary gift economy is not at all foreign to universities. Indeed, the gift economy has been introduced at universities with the internet, email, the open source movement, and the World Wide Web which, although created at CERN, has been fully developed at universities –admittedly, more in the US than in Europe.

The gift economy is not foreign to universities for a further reason: education is never for sale; education is always a gift. One learns by associating oneself with, and helping, others already possessing the knowledge or mastering the skills one wishes to acquire. This is, I think, one reason why Humboldt's model of higher education consisting in the socialization of students among researchers is so much mourned over in Germany: The service, and therefore consumption, model subjacent to the recent, neo-liberally inspired, educational Bologna reform is out of touch with educational reality. Evidence for the view that education is not for sell can be found in the private schools giving grants to a few meriting students who cannot afford their tuition fees. Are other institutions for the well-offs, for examples hotels, doing the same? Of course, not. Indeed, in contrast to schools, hotels and other institutions can very well be perceived as selling their services.

The gifts of openness are a tremendous chance for higher education. These gifts are "learning analytics" enabling an "evidence-based teaching", that is, detecting what form of teaching works well for whom in what context. Up till the Second World War and the 50es of the 20th century, higher education did not need learning analytics and evidence-based teaching because it was for very few and it had a canon. Now, higher education dramatically needs them. Teaching to several hundred students without statistics on their performances is like driving without visibility: it often badly ends. And indeed, teaching and learning often badly ends: in my field, computer science, Germany-wide about a third of Bachelor students leave without a Bachelor degree in computing.

A further gift of openness is personalisation, which is as promising for mass education as it is successful in online-commerce. The time of "one size fits all" in higher education is over because this kind of education requires a normative educational model which is only possible with an agreed upon cultural and educational canon. The normative high cultures of the long 19th century had educational canons. Educational canons are no longer compatible with today's global village, today's knowledge explosion, and most importantly today's distrust of ideologies. Today, the *raison d'être* of universities is to convey a variety of skills and cultures to huge and heterogeneous audiences.



Yet other gift of openness among others are to assist, of course using algorithms, the huge and heterogeneous communities of students attending some lectures in building “communities of practice”, that is, small groups for collaborative and peer learning (Etienne Wenger: “Communities of Practice: Learning, Meaning, and Identity”, Cambridge University Press, 1998) or to achieve self-regulated learning (Deborah L. Butler and Philip H. Winne: “Feedback and self-regulated learning: A theoretical synthesis”, *Review of Educational Research*, Fall 1995, Vol. 65, No. 3, pp. 245–281).

More examples of the gifts of openness in higher education could be given. Let us instead consider what these gifts, and therefore openness, enable. Openness makes possible to detect and attract those students for whom a teaching offer best makes sense. Openness makes it possible for students to better choose their universities and for universities to better choose their students –an obvious reason why leading US universities are investing in MOOCs (Massive Online Open Courses). The gifts of openness make it possible to steer masses of students still letting them freely choose or, using a phrase of Richard H. Thaler, the gifts of openness give rise to a “libertarian paternalism“ (Richard H. Thaler: “Nudge: Improving Decisions About Health, Wealth and Happiness”, Thaler & Sunstein, 2009). The phrase “libertarian paternalism“ has been coined for expressing how findings of psychology on the behaviour of humans, especially of human in large communities, can be exploited for a renewing economic theory in a behavioural economics. I am convinced that the times are ripe for a “behavioural pedagogy” addressing “mass education”.

Two more remarks before concluding:

- Among the gifts of openness are those we have so far not thought of and “observational data analyses” will unveil.
- Exploiting the gifts of openness raise ethical issues that are far from being trivial.

We can conclude that the concern of librarians for open access, open data, open courses, and other form of openness is more than the concern of a profession. It is a concern essential to the re-thinking of scientific research and higher education; a re-thinking which, especially in continental Europe, is urgently needed.