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Information in the Digital Knowledge Ecosystem – Challenges for the Library of the Future

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Abstract:

In the digital society the processes of knowledge generation, dissemination and use are changing dramatically. The distinct knowledge "item" in the form of the "publication" is replaced by the boundless, in principle infinite knowledge space of dynamically networked data stocks. The knowledge management of this data space is the future task of the library, simultaneously requiring a new definition of its role as the steward of the memory of the digital knowledge society.

Keywords: knowledge management, research, dissemination, data stocks

Research – publication – knowledge

Research generates knowledge and knowledge in turn provokes new research. Knowledge – defined as a realization that is regarded as guaranteed and proven at a certain point in time – is expanded, made obsolete, dismissed by research, superseded by new realizations. Sometimes knowledge formations representing the unchallenged research horizon of an entire epoch are completely invalidated by a "change of paradigm". Traditionally, the "publication" plays a central role in this fundamentally infinite process of knowledge generation by research. Firstly, it provides publicity for the results of the realization process by fixating and disseminating the state of research and knowledge reached at the time, usually in textual form. The findings obtained in the laboratory, the results of a field study, the insights of hermeneutics in the field of humanities – all this remains limited to a small circle of those people immediately involved until its publication. Publicity is generated and the process of knowledge distribution and appropriation is started only upon the dissemination in the form of a monograph or a journal article – be it in printed or electronic form. In the cycle of knowledge generation, knowledge dissemination and (productive) knowledge reception, the publication represents the linchpin connecting the research process as the "pre-publication

phase" with the process of its appropriation, scrutiny and becoming part of new research as the "post-publication phase".

The library as knowledge centre and storehouse of knowledge traditionally represents the entity in which the published knowledge is preserved, catalogued and provided, regardless of the form this knowledge takes: a handwritten parchment, a printed article, an electronic journal or a hosted digital object. The library as an information agent consequently provides constant momentum to the process of knowledge generation, dissemination and use by the regulative and preservative curatorship of the published knowledge, in accordance with the well-known dictum "research turns into library, library turns into research". The metaphorical description of the library as the "heart of the university" puts this concept of the library in a nutshell.

The digital age dissolves the boundaries of spaces of knowledge

So far so good. However, are we not dealing with a "model" which, due to the comprehensive digitisation of our entire world of knowledge and living environment, is disintegrating as we speak, which has in fact already become a thing of the past in numerous respects? In the digital world the notion of the "publication" as carrier of knowledge and material field of activity of the library as "storehouse of knowledge" has indeed changed fundamentally. The reason is that the pre-publication phase, i.e. the research process, the post-publication process, i.e. the reception process of the research results, and the publication itself have become completely digital and consequently technically identical, as sequences of bits and bytes. This in turn is the requirement for the classical publication, defined as a self-contained, static and consistent "entity", to "open up" to the production phase and the reception phase of the research process alike. Its seamless linkage with research data and further research results, through the integration of interactive tables, graphics, maps and simulations, videos of laboratory experiments, and finally through networks with blogs and virtual research environments which turn the reported results into the object of further research, contribute to the formation of a continuously evolving ecosystem of contextualized and networked data stocks.

In this system, the "publication", defined as a discretely addressable unit of a distinct object, now only represents a documentary snapshot in a networked, dynamic space of knowledge. The concept of "liquid" documents or "enhanced publications", integrating digital data stocks and data objects from the generation and reception phases of the research project into the "actual" document, thus simultaneously becoming "permeable" to both of these phases, outlines already today the shape of a knowledge landscape in which the traditional notion of the "publication" becomes increasingly opaque.i Long-term, the future concept of knowledge that is adequate to the digital world will come to bear: the linked open data space that is determined by the specific research object and linked with the respectively adjoining research fields on its "edges", thus defining in its entirety the current state of our knowledge.

The library: curator of linked open-data worlds of knowledge

To the same extent as the traditional process chain of research/publication/reception is gradually superseded by the simultaneousness of contextualized, networked data stocks in the digital age, the traditional concept of the library's role as information "agent" is also on trial. As long as one can assume a clear distinction of the process steps of generating, publishing, disseminating and using knowledge – whether in the analogous or in the digital world – the

familiar function of the library as an intermediary, connecting the phase of knowledge generation with the phase of knowledge reception through collecting, providing and preserving all things published, will remain largely "intact".

However, the more the sequentiality of the pre-publication phase, the publication and the post-publication phase "merge" in favour of contextualized, linked, dynamic data stocks – which will surely take place at substantial time offsets in the different cultures of research and knowledge of the humanities and the sciences – the more the core mission of the library will also change: Instead of being responsible for only one part of the value chain of knowledge, it must now support the complete network, the complete "flow" of knowledge. In short: The future mission of the library as research infrastructure is the curatorship of the fundamentally infinite linked open data space as it is described above. Or even more succinctly: the field of action of the library is knowledge streams instead of knowledge items.

It is a service which is determined primarily technologically: In addition to the provision of collaboration and communication tools in the form of virtual research environments, digital long-term archiving and long-term availability of complex, increasingly also multimedia-based data stocks, this service supports processing of digital mass data for quantitative analyses ("big data"), primarily semantic structuring, linking and visualisation of the knowledge networks with the goal of making them navigable comfortably – all of which is an exercise which is literally never-ending in view of the high dynamics of modern research processes.

In this scenario, an essential category of librarian work will probably lose much of its importance: It is the classical notion of "collection", understood as a systematically arranged body of knowledge with a subject- or topic-oriented structure. Aside from access limitations due to copyright and licensing, all available data stocks, materials and documents are simply "there" in the digital space. Using intelligent search algorithms, the user himself structures this data space as desired, arranging his "collection" secondarily and continually anew. Particularly for large, universally-oriented libraries, this situation is almost paradox: With the digitisation of each work from their rich and frequently unique collections, they pull this work out from its original collection context, releasing it for user-determined re-contextualisation within the digital knowledge space.

Knowledge design: mobile, situational, natural

The use of this digital knowledge space, encompassing all forms of handling digital data stocks and information, will be increasingly determined in the future by mobile usage scenarios. This represents a further challenge for the library of the future. The currently rapidly accelerating transition from the stationary to the mobile Internet is more than a mere technology change regarding the utilisation of digital information. It marks the transition to the omnipresent Internet which permeates the entire living environment and is wholly integrated in our everyday actions. Digital knowledge is no longer something that is retrieved by the user at an Internet workstation, but surrounds the user wherever he goes and is available everywhere. The Internet will become as individual as the life of its users, being their constant companion. Twenty-five percent of all US teenagers already refer to themselves as "cell mostly" Internet users: They use the Internet primarily via "mobile devices", such as smart phones and tablets, hardly using desktop PCs or laptops any longer.ii

The relevant criterion according to which information and data stocks in the mobile Internet are structured, filtered and processed is their "situational adaptation". Digital knowledge is "designed" to be adapted as exactly as possible to the situation in which I am as a user, and with reference to the specific interest of utilisation that I have in my current situation. Concise examples of such applications are location-dependent services and augmented reality apps making available information with reference to the respective current location of the user, in the case of augmented reality directly integrated into the camera image of the real world. The change in handling the information is determined by the type of device employed. The mobile technologies require a new paradigm of digital knowledge structuring, dissemination and use: personalised, situation-focused, "on the spot". The processing of digital knowledge is strictly oriented on the paradigm of mobile devices that can be operated completely by means of touch screens and gesture-based navigation. The conventional "graphic user interfaces" are replaced by "natural user interfaces", designing the behaviour of digital knowledge objects in reaction to language, gesture and touch.iii

Libraries can play a future-oriented role in the realisation of the vision of the mobile Internet – the ability to use digital contents and services at any time, in any place, in a situation adapted to the individual situation and user – only if they detach themselves at least somewhat from the web as primary digital place of action. Already today, Internet users in the USA spend 70 minutes daily on the web, but already 127 minutes using apps on mobile devices. "With unlimited information," writes Jeff Stibel, "there is a greater need to filter out irrelevant information and go directly to what you need, download the app, and never search again. ... As tablets and phones replace computers, the web will be relegated to a position no higher than that of a 'super app'."iv

The more firmly this trend takes hold, the more the libraries will have to design their infrastructure services in the form of personalised and specialised applications adapted to specific situations to meet their users' expectations. "Individualised" provision of the desired information in the respective current use scenario, for example with a focus on specific research situations, will become equally important as the semantic structuring of comprehensive search spaces and highly aggregated content clusters. An essential requirement for this, among other things, is to achieve an as comprehensive as possible georeferencing of the knowledge stocks curated by libraries.

This development is almost inevitably accompanied by the loss in importance of the large Internet portals and institutional websites oriented towards "full service". They will likely be replaced by applications that are custom-tailored for specific purposes and services and adapt to the diverse, heterogeneous use environments of mobile digital knowledge spaces with an individual focus. This will also have far-reaching consequences for the large (meta)data aggregators of digital objects, such as the "Deutsche Digitale Bibliothek" and the "Europeana". They will only be able to play a successful role forming part of future research infrastructures if they do not understand themselves as portals, thus as "display windows" of digital objects, but as platforms. As platforms, they prepare digital data stocks for use, interlink them, enrich them (in the sense of the knowledge stream described above), and making them available via open interfaces for use and processing in external work environments and applications.

"Competency" in digital knowledge spaces

The dynamic digital knowledge spaces as field of action of the future library simultaneously "demand" new forms of "knowledge work", in particular within the framework of study, teaching and learning. It can be predicted that the fast, associative comprehension of networked structures, the agile handling of multimedia-enriched, multiply linked data stocks as well as the ability to consciously limit oneself to what is, pragmatically speaking, "necessary to know" in the light of a fundamentally endlessly networked knowledge space, will become more important. Conversely, it is possible that the dissolution of the classical notion of "publication" in the sense of the self-contained, primarily textually determined knowledge "item" also puts the existential importance of classical cultural techniques into perspective, such as the concentrated, linear reception of sequential argumentation structures: "The essential skills", writes Jonathan Grudin, "will be those of rapidly searching, browsing, assessing quality, and synthesizing the vast quantities of information. In contrast, the ability to read one thing and think hard about it for hours will not be of no consequence, but it will be of far less consequence for most people."v

The cultural philosopher Michel Serres takes this even a step further in his new book "Petite poucette" (English title: “Petite Poucette: The Culture and Technology of Millenials) interpreting the omni-availability of knowledge that is possible in the digital world as an indication of a change of the forms of perception and awareness themselves: "We do not have an urgent necessity for concepts. We can dwell on the narratives, the examples and singularities, on the things themselves, as long as we need. Practically as well as theoretically, this renewal retrieves the honour of those philosophers of knowledge who are committed to description and committed to the individual."vi These considerations offer multifarious possible approaches to libraries to redefine the teachings of "information literacy". This field, which is currently very strongly technically determined as the conveyance of skills of researching, selecting and evaluating information, could remain important for the library work in the future when interpreted somewhat more broadly: as the conveyance of "knowledge literacy" in the sense of successful "knowledge work" in data spaces whose boundaries have been dissolved by the digital age.

"Libraries": an open future

The considerations of this article admittedly depict a still rather unfamiliar scenario of a completely digitally composed knowledge landscape in which the libraries, too, must stake out their future. The dissolution of the traditional notion of "publication" (knowledge item) in favour of the concept of a boundless, continually newly networking and dynamically evolving knowledge stream requires that many of the currently discussed questions of a research-adequate design of information infrastructures must be asked differently and anew. For example, the current open access discussion and its essential components (green versus golden road, subscription model versus article processing charges, secondary publication right versus publication "obligation" etc.) are almost inextricably connected with the traditional concept of a "monolithic", textual electronic publication, and will probably become a question of the degrees of "openness" of linked-data knowledge spaces in the "new world", also with respect to innovative business models which involve the interplay between authors, publishers, libraries and commercial IT providers.

Given the speed of change and innovation in the digital society, statements about the future profile of the library as research infrastructure must necessarily remain vague. In particular, it must remain open whether the new structures will complement the current knowledge landscape, or whether they will transform and finally replace it. The Bayerische Staatsbibliothek for example adds around 130,000 printed volumes (i.e. "real books") to its collections every year, with this practice even following an upward trend.

Technologically, the future scenarios described here can already now be almost fully implemented. In contrast, the question to what extent the transition of our understanding of knowledge towards a liquid, networked data stream represents a desirable target perspective is a matter of the cultural self-conception of the digital society. The question why this flow must be "stopped" at certain points at all, and made the subject of a closed "publication" fixating a state of knowledge, can be answered plausibly in the digital realm only with a view to the traditional role of the library as a steward of memory: In terms of fixating a certain state of knowledge, we publish what we wish to preserve permanently, what we consider to be sufficiently important to "keep available long term" – even if superseded by new findings in the near future. Finally, the question arises to what extent a society with a notion of knowledge as a data network that is infinitely connected and reconnected, reinventing itself, still needs the safe ground of a reinsurance in the form of handed-down knowledge stocks that can be called upon at all times (even if rarely made use of in practice). The answer to this question would clarify at the same time whether and to what extent the library is in fact more than an institution of the "information infrastructure".

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