Directions for Developing the Efficiency of Scientific Research

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The article surprises elements of novelty and needs in the activity of scientific research and communication, identifies the needs and their practical settlement.
We identified the needs and behavior of the academic staff involved in research and we analyzed trends in contemporary research. The universities have the opportunity to improve their services for research support in today's information society using new technologies and different avenue for this move into the future. The effect of libraries using the same, shared hardware, services and data, enhances the both library user's experience and library staff workflows.
Connected data, collaboration, digitization and cloud computing will strongly increase the role of library support for academic research.

Keywords: *scientific research; academic staff; scientific communication; information technologies; research data*

The behavior of users involved in research regarding information seeking evolves in parallel with technological developments, sources and policies for access to information, and modern university libraries must keep up with these developments. The directions of developing the efficiency of the research are presented through examples of good practice.

1. Directions for developing the efficiency of scientific research

The directions for developing the efficiency of scientific research are presented by examples of good practice.

a. New channels of communication and support technology

As Abel et al. (2013) say, there are now "new ways to connect entities that were previously considered separated and impossible to connect: people, resources, experiences, various types of content and communities, as well as experts and novices, formal and informal modes, mentors and counsellors". Examples of such connection are the applications for smart device *iResearch* from the American Institute of Physics, *Nature.com* from the Nature Publishing Group, *WorldCat Mobile* from the Online Computer Library Center - OCLC (Online Computer Library Center).

b. Open access to information

OA still faces resistance from publishers and even from some authors, but the benefits of publishing in open access journals (golden open access) and institutional deposits (green open access) for researchers, institutions, the wide public and society, are generally already found.

This motivates the academic and scientific community and governmental forums to find viable and sustainable funding solutions, rethinking the relationship between researchers, the institutions they are part of, publishers, libraries and the public and the role of each of these entities in relation to communicating scientific information and research results.

The transformations in the area in which the universities operate are interconnected and interdependent; advances in data storage and transmission technologies, access to a huge volume of connected data, the possibility to provide open access to information, etc., combining synergistically to help the library successfully serve modern users with specific needs.

c. Multiple channels of communication

Modern users frequently use social media and networks, such as YouTube, Facebook, Twitter, Tumblr, Pinterest, blogs, wiki, etc., both individually and as members of interest groups. The stated purpose of groups such as *Parkinson's Research Interest Group* on Facebook is to provide up-to-date information regarding the research on their area of interest, to facilitate discussions between researchers and to increase participation in research activities in these fields.

d. Intensive usage of data in research

According to the *Merriam-Webster* dictionary, by data we mean "factual information (such as measurements or statistics) used as a basis for reasoning, discussion or calculation".

As Borgman (2007, p. 215) says, data sets represent outputs for the research process and inputs for academic publications and for subsequent research activities, thus forming the basis of research.

e. New methods of interception of data and big volume of data

An alternative to traditional surveys are the applications for mobile devices such as those built on ResearchKit and CareKit software platforms, which allow data collection for the medical field through less traditional methods, such as: using the gyroscope and other features of smart phones to measure dexterity or balance of people, detection of facial expressions when watching a video on the phone to understand the emotional reactions, photographing parts of the body and skin to record and detect changes over time, etc. (Apple 2018). Similar, smartwatches that record body functions and health indicators, in combination with dedicated mobile applications where users can record data on their daily behaviour, diet, emotions and events are an extremely rich source of data for the medical sector.

In addition to the mobile devices we now use regularly, there are more and more equipment connected to the Internet: from video games and sports equipment to *smart homes* in which the environment, security devices and even home appliances can be remotely controlled and up to industrial equipment. They form the so-called *Internet of Things* - IoT (*Internet of Things*), a network of interconnected smart devices that continuously generate data (including locations and data about the equipment owner) and send them over the Internet.

Regarding data as a result of research, Information Science specialists have extensive experience in classifying, documenting and recording metadata and can play an essential role in managing an extensive volume of data and extending the usefulness of data sets beyond their intended purpose for which it was collected. The risks of keeping digital data in time are related to technology and differ from those related to physical collections, and the experience gained in managing material information collections recommends them to help set standards (such as the necessary descriptor sets) to extend the usefulness of research data not only over time, but also across technological platforms, legislations and different fields of research. The libraries thus add to the traditional collections of documents and information, which can only be read and analyzed by people, a new type of resource: *big data*. De Mauro et al. (2018) defines *big data* as information resources which, due to the huge volume, the speed with which they are generated and updated and the variety of format and content, require specific analytical technologies and methods to be enhanced.

In an investigation conducted for Research Libraries UK in 2012, Auckland (2012) mentions the following activities of growing importance in relation to data and information, which librarians carry out in support of researchers: *information management, discovery and management of data used in the research activity, but also the collection and preserving of the data resulting from the research*.

f. High-performance data analysis methods

Here are three examples of how libraries support data analysis:

- University of Guelph Library, Canada provides consulting and technical support for the organization, analysis, interpretation and presentation of different types of data, including geospatial, quantitative and qualitative data (University of Guelph 2018);
- Michigan State University Libraries, USA offer a set of thematic resources for data analysis, which includes contact information for other departments of the university providing data analysis

support, software application recommendations for analysis data in a variety of domains and a list of relevant information resources (Michigan State University 2018);
- *Map and Data Library* of the University of Toronto Libraries offers: software application tutorials; workshops and training sessions; a rich set of thematic resources; dedicated computer rooms with specialized software for accessing and analyzing maps and data sets (University of Toronto Libraries 2018).

g. Connected data

For researchers, using connected data allows virtual collections of objects that are much easier to discover and analyze.

For libraries this concept is relevant from the following points of view (OCLC 2012):

- by including *connected data* in the online description of library resources, users can more easily find library resources on the web; search engines and other information services on the Internet will be better able to send users to these materials directly and quickly;
- by providing library data in granular and better-defined segments, the *connected data* allows programmers to create innovative metadata-based applications obtained from a variety of sources;
- *connected data* gives library specialists the opportunity to rethink cataloguing more efficiently.

h. Collaboration and common access to resources

Library consortium benefit from pooling experience and resources and stimulate creative answers to common problems, have greater purchasing power in transactions with publishers, provide access to richer resources through resource sharing and interlibrary loan agreements, and cooperate on the development of collections (Alison 2013).

i. Interdisciplinarity

According to the report *Facilitating Interdisciplinary Research*, interdisciplinary research is "a way of research by which researchers or teams of researchers integrate information, data, techniques, tools, perspectives, concepts, and / or theories from two or more disciplines or specialized knowledge patrimonies, in order to advance the fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or a single field of practical research" (National Academy of Sciences et al. 2005, p. 26).

Following a study funded by the Andrew W. Mellon Foundation, librarians at the University of Calgary identified six main components of an interdisciplinary research platform: analysis and visualization, analysis services and data sharing, digitization, metadata services, expertise and training, as well as the arrangement of spaces for collaborative activities (Sowa 2017).

j. Digitization of collections

Many university libraries implement projects for the conversion and digital preservation of books, maps, posters and other flat media means, 3D objects, as well as audio and video materials, to support both research and teaching and learning processes. Using specialized equipment, the staff of these institutions digitizes entire collections, including rare or fragile documents, objects and artefacts, for absorption into their own institutional collection or the creation of online galleries, collections and catalogues. For researchers, the existence of these objects and artefacts in digital format also allows new ways to interact with their content and to study them, and even the possibility to analyse and compare a large number of such documents and objects much faster.

k. *Cloud* technologies

Goldner (2010) mentions four key principles of collaborative platforms: openness, extensibility, abundance of resources and opportunities for collaboration.

Libraries can choose from a variety of *cloud* service packages or a combination of them. Among the most relevant are the packages of infrastructure, platform, software, storage space, security and data, laboratory with equipment for visualizing maps and data, such as 3D printers, scanners and virtual reality devices; the services of a specialized librarian who provides consultations and instruction regarding data visualization librarian (data visualization librarian); examples of analyses and visualizations made available by the members of the university's academic

community.

In a report requested by the Minnesota Historical Society from USA, the organization Instrumental Inc. (2013) identifies the following elements that need to be considered in determining the benefits and risks of migrating to a *cloud* solution provided by an external provider for digital storage services, in addition to cost-effectiveness considerations, authentication methods, system requirements, system level necessary expertise of the personnel of the organization and possibilities of extension:

- ownership of files and stored data;
- reliability and integrity of storage type;
- possibility to recover in disaster case through adequate backup;
- portability of files and data when migrating to another provider and retention policies applicable if data and files need to be removed from *cloud*;
- guaranteeing availability regarding the infrastructure, web services and software applications used;
- data and file security;
- scalability of the services offered according to the needs of the library;
- data management and storage functionalities;
- monitoring and processing of stored content for protection against the wear and tear of the technology.

2. Conclusions

The academic environment is evolving rapidly, in parallel with technology and is constantly adapting to the needs of its consumers and today's changes in the information field. Today's user has little in common with the one from a few decades ago, apart from the need for information.

All transformations are interconnected and interdependent. We cannot talk about a large volume of data without talking, for example, about changes in storage methods and *cloud* technology. The need for open access to the data resulting from the research activity and, even more, to existing data in the Internet network, requires the linking of these data and the standardization of their representation to make it accessible to high-power computing machines. Opening the access to information to facilitate the progress of science requires changes to the system of publishing research results and motivates the academic community to collaborate and find viable and sustainable funding solutions, rethinking the relationship between researchers, their institutions, publishers, libraries and public as well as the role of each of these entities.

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