The emergence of 'Open Science' to promote research using Open Access Repositories

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The emergence of 'Open Science' to promote research using Open Access Repositories: Experience of University Libraries of Bangladesh

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Abstract

Purpose – The purpose of this paper is to discuss the movement of 'Open Science' to foster research using Open Access Repositories: Perspectives of University Libraries of Bangladesh. OS movement has largely adopted in European countries recently but in low middle income countries like Bangladesh OS activities are moving slowly. Realizing its importance for university and research potentiality, university libraries of Bangladesh permitting OA to their content for internal and external members. This research attempts to explore the extent of OS activities through OA repositories and provides necessary recommendation for future development in Bangladesh.

Design/methodology/approach – This paper begins with an overview of intellectual capital management strategies currently being employed by universities. It moves into a discussion of the impact of open science instruments in research to establish more vibration in open methodology. It closes with a set of recommendation in implementing Open Science in university repositories and plans to ensure that the research output of the university remains accessible over the long term. Data have been collected through survey questionnaire in preparing PhD dissertation in Dhaka University during the year of 2013. Informal interview with the senior professionals in the filed were also conducted and other part of this article has been adapted through intensive literature review and observation.

Findings – The result reveals the fact that most of the public/government and private university libraries have failed to meet the requirement of open science concept. Due to insignificant research and field based educational activities there are huge lacking in generation of sufficient number of electronic content. Existing intellectual capitals are managed with some kind of open sourced library software without maintaining minimum standard and policies country wide. In maximum cases content has been preserved for the internal use rather than ensuring open access to the external users.

Research limitations/implications – Academic libraries in tertiary level of education fall into many categories in Bangladesh. These are degree awarding public/government and private universities and colleges under National Universities and Intuitions and Open University. This research concentrates on public/government and private university libraries leaving all other categories. Strategic sampling has been made from 130 universities though a larger numbers of sample could have been produced better result.

Practical implications – Draws a clear indication for adaptation of open science as an instruments of research development national wide and provides necessary suggestion for

improvement the situation. Hence, policy makers, library professionals, researchers and students might have been getting a better understanding from the findings of this paper.

Originality/value – The paper provides a research result through analysis of data following research methods in library and information science. The part of contents of the research was not published before in any form other than the PhD dissertation.

Keywords – Current Practices, Emerging Trends, University Library, Open Science, Open Access, Repositories, Intellectual Capital, Knowledge Management, Bangladesh

Paper type –Research Paper

Introduction

The advent of the World Wide Web and associated technologies has brought an explosion of free online information, which has had a deep impact on most aspects of our daily lives (Hendriks, 1999; Morrison *et al.*, 2001; Destro-Bisol *et al.*, 2014). Internet has become a common tool for mankind by which information are shared saving procuring cost among the intellectual community to reduce gap between developed and developing countries. Open Science is a social movement in the realm of WWW to exchange knowledge and research advancement around the world. "Open Science (OS) offers researchers tools and workflows for transparency, reproducibility, dissemination and transfer of new knowledge (Grigorov et al, 2015)." OS impart contents in digital, online, free of charge for everyone with an internet connection and free of most copyright and licensing restrictions (Suber, 2003). It includes practices such as: "publishing open research, campaigning for open access, encouraging scientists to practice open notebook science, and generally making it easier to publish and communicate scientific knowledge (Wikipedia)." OS movement has largely adopted in European countries recently but in low middle income countries like Bangladesh OS activities are moving slowly. Realizing its importance for university and research potentiality, university libraries of Bangladesh permitting OA to their content for internal and external members. This research attempts to explore the extent of OS activities through OA repositories and provides necessary recommendation for future development in Bangladesh.

Open science means opening up the research process by making all of its outcomes, and the way in which these outcomes were achieved, publicly available on the World Wide Web (Kraker et al, 2011). Open science is understood as a process, something under construction, that mobilizes different interests and points of view which are, in some respects, antagonistic. It also allows for multiple (and sometimes conflicting) interpretations (Albagli et al, eds., 2015).

Purpose of the study

The purpose of this paper is to discuss 'Open Science' revolution in the digital age, provides an analysis of the current state of the art in Open Access Repositories, its potential in higher education development and research and present situation in the university libraries of Bangladesh.

Literature review
For the purpose of the present study this researcher reviewed relevant articles and found no research has yet been done focusing on the main theme of the present study in Bangladesh. Relatively a certain number of books and research articles have been found related to the automation and application of ICT and digitization of library resources.

Rahman *et al* (2015) conducted a survey on "Digital Resources Management in Libraries: Step Towards Digital Bangladesh" and found that libraries in Bangladesh are giving priority to born digital materials than digitally converted objects, and their main concern is to journals, e-books, and thesis databases. The university libraries emphasize on digitizing thesis, reports, and newspaper articles. In all these cases, there is an attitude to provide access to the resources freely (no direct cost) available in the internet and linked those to the either ILS, or library website or in the DRM system. The majority of the libraries has less materials to digitize, whereas, Old public universities, National library, National Archives, National Museum, and Public library preserve a huge collection of archival materials, historical documents, cultural documents, 100 or more years old books, pamphlets, manuscripts that are in the urgent need of digitization.

Das *et al* (2015) conducted a survey on ETDs in agriculture: status and way forward with case studies from India and Bangladesh and found that due to growing global awareness and interests about free and open accessibility and knowledge sharing (Open Access) among the researchers and research managers, till date about 100 research repositories have been established in India and 10 in Bangladesh respectively. However, when compared to the amount of research taking place in agriculture, very few online ETDs have been established in India and Bangladesh the only popular ETDs in agriculture in India is KrishiPrabha (now part of KrishiKosh) and in Bangladesh, Digital Archive on Agricultural Theses and Journal (DAATJ). These repositories are now primarily being made available online for the academicians and research community (Das et al, 2015). A survey conducted by Rahman (2013) among 20 public and private universities of Bangladesh and found that 65% of libraries have no digital archives or repositories. One of the important findings of the study was that the extensive use of open source software in the university libraries of Bangladesh. The study reveals that 40% of university libraries use open source software. Due to the availability of Internet and communication technologies university libraries are extensively using open source and free software rather than using customized or purchased software packages. Open source software is user friendly and may be customized with minimum effort.

Bangladesh entered into IR activities in different university libraries in 2007 when BRAC University for the first time introduced IR project supported with fund from INASP using Dspace Software. Subsequently some private universities started IR project in their libraries. Chowdhury, Uddin, Afroz, & Sameni (2011) carried out a study on IR activities in Bangladesh funded by ICDDR'B and found that 'ICDDR,B and BRAC University, a leading private university in Bangladesh, are now working on IR using Dspace software supported with fund from INASP. Alam & Islam (2011) conducted a study on "Digital library initiatives in Bangladesh", twenty public and private university libraries were selected as sample and found that libraries hold some electronic literature on CD-ROMs and DVDs. 15% of libraries reported that they preserve their research output in electronic format. The study also

revealed that digitization activities have been hampered for the cause of dual expertise particularly in prefect OCR level scanning, metadata extraction, subject analysis, searching and retrieval.

A massive works have been started under Higher Education Quality Enhancement Project (HEQEP) of Bangladesh assisted by the World Bank since independence in 1971. The project has been launched in May 2009 and include in the Government's Annual Development Program (ADP). A total number of 18 public and private university libraries and one Information Science & Library Management Department of Rajshahi University got this project from 1st Round AIF to 3rd Round AIF since the project tenure from 2009 to 2015 (UGC, 2015).

Methodology
This paper begins with an overview of intellectual capital management strategies currently being employed by universities. It moves into a discussion of the impact of open science instruments in research to establish more vibration in open methodology. It closes with a set of recommendation in implementing Open Science in university repositories and plans to ensure that the research output of the university remains accessible over the long term. Data have been collected through survey questionnaire in preparing of PhD dissertation in Dhaka University during the year of 2013. Informal interview with the senior professionals in the filed were also conducted and other part of this article has been adapted through intensive literature review and observation of the writer of the article.

Open Science what does it mean?
This new data-rich era of instantaneous communication creates novel challenges and opportunities for research, one that researchers cannot avoid confronting. The process of doing so is vigorously underway in many research fields that are making scientific knowledge and underlying data available to the whole scientific community and the public, owing to the combined efforts of researchers, science communicators and other stakeholders (Neylon & Wu, 2009; Boulton *et al.*, 2012; Destro-Bisol *et al.*, 2014).Within a view to share scholarly publication, open science movement has started with the advent of academic journal since 17th Century (Wikipedia). Though the importance of Open Science initiatives felt long back, the term gaining popularity in last two decades during the booming of internet and www. The topic of "open science" is gaining ground not only within institutional environments for science, technology and innovation, but also in other contexts that, until now, were kept apart from these activities. As a result, it is mobilizing other social groups as interlocutors of scientific practices. In turn, the resulting transformations in the relations between science, technology and society integrate the new dynamics of production and circulation of knowledge as well as the new role played by these dynamics in contemporary processes of social participation and change (The Open Science and Research Handbook, 2014).

There is now a growing international movement for "open science", by which is meant making publication of scientific concepts and the data on which they are based readily accessible to all, together with procedures for sharing important data sets. This trend is not only limited to technical and IT aspects, but extends to epistemological, sociological and political issues (Destro-Bisol et al., 2014; Fecher & Friesike, 2013; Mauthner & Parry, 2013;

Velden, 2013) and to governmental initiatives to open official data both to citizens and to entrepreneurs able to offer new data-based services.

"Open science" is a very broad concept that encompasses several different practices and tools linked to the use of collaborative digital technologies and alternative intellectual property tools. Some inclusive definitions propose that open science embraces practices as different as open access to scientific literature, digitally-mediated forms of open collaboration, as well as the use of copy left licenses to foster reuse of scientific results and protocols (Delfanti e Nico Pitrelli, *2015)*. For example, FOSTER (2015), a project recently funded by the European Commission to set in place sustainable mechanisms for EU researchers to embrace open science practices, defines open science as "the conduction of science in a way that others can collaborate and contribute, where research data, lab notes and other research processes are freely available, with terms that allow reuse, redistribution and reproduction of the research." The taxonomy tree of this concept branches into several directions (see also Fecher; Friesike 2014).

Instruments of open science

Open Science encompasses several instruments that have been extracted from several definition of Open Science. These are:

1. open access as a way to make research results available
2. open data as a way to publish the raw data
3. open source as a way to give access to research prototypes
4. open methodology [1-3 already well-known and 4, Kraker et al, 2011]
5. open Reproducible Research
6. open Science Evaluation
7. open Science Policies [5-7, Delfanti e Nico Pitrelli, *2015]*
8. open peer review
9. post publication peer review
10. open notebook science
11. citizen science
12. aspects of open source software and
13. crowd funded research projects [8-13, Amsen, n.d]
14. promoting open access publishing
15. open access publishing itself
16. harnessing open-source software and open standards, and
17. public documentation of research processes with 'memoing' [14-17, The Open Science and Research Handbook, 2014]

Each of these themes can be subdivided in many other subtopics that represent the whole spectrum of difficulties face in an open science framework. Not to consider Research Data Management, and finally Ethics and Legal Issues (Delfanti e Nico Pitrelli, *2015)*.

To focus the main theme of study this researcher attempts to discuss only Open Access Repositories that encompasses in enhancement research at the tertiary level of education in Bangladesh.

Open Access Repositories

The serials pricing crisis is now in its fourth decade. We're long past the point of damage control and into the era of damage. Prices limit access, and intolerable prices limit access intolerably. Every research institution in the world suffers from intolerable access limitations, no matter how wealthy. Not only must libraries cope by cancelling subscriptions and cutting into their book budgets, but researchers must do without access to some of the journals critical to their research (Suber, 2003). Suber (2003) argued that pricing and permission crisis may be solved by open access. The impact of digital technologies is not restricted to science, but creates challenges for the whole range of research and scholarship. In the "digital humanities" for example, research often entails new methodologies and intellectual strategies that are nonetheless grounded in traditional humanistic areas of focus (the nature of authorship, continuity of concepts over time, the social context of artistic expression). The challenges not only apply to data that are born digitally, but also across large corpora of text, as well as visual, aural, audiovisual, sensory, neurological and even kinesthetic forms of information (Destro-Bisol *et al.*, 2014).

The term open access was coined by the Budapest open access initiative (BOAI, 2002): "By 'Open Access' to this literature, we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself."

Elements that are shared through Open Access these are:
1. Open access journals,
2. e-print archives and
3. e-theses repositories are covered with an emphasis on the sciences including the physical sciences, mathematics and the biomedical sciences (Fernandez, 2006).

Institutional Repositories

The archiving of electronic documents is a hot topic in many institutional communities, including universities, libraries and archives, museums, private businesses, and the records management industry (Teper and Kraemer, 2002). In Bangladesh repositories basically started as a subset of institution's digital repository which is "[…] a digital archive of the intellectual product created by the faculty, research staff, and students of an institution and accessible to end-users both within and outside of the institution, with few if any barriers to access (Essential elements section) (Crow, 2002; Rahman, 2015). University libraries usually host the institution's local repository within their digital library in implementing IR project as a subset of digital process of the university library. Over the last 20 years, open access repositories have been implemented around the world and are now fairly widespread across all regions. Repositories provide open access (OA) to research publications and other materials and enable the local management and preservation of research outputs. They are a key infrastructure component supporting the growing number of open access policies and laws, the majority of which recommend or require deposit of articles into an OA repository (European Commission, 2015).

Open access repositories play a variety of roles in the scholarly communication system, and these roles continue to expand and evolve. To date, their primary functions have been to provide visibility and open access to research outputs, with a focus on the journal literature, as well as to ensure archiving of this material over the long term. Much of the journal literature is currently only available through subscription and/or pay per view fees, creating a significant barrier to the widespread dissemination and use of this research knowledge. To improve the visibility and impact of their research, many funders have adopted policies that require open access to journal articles. Repositories are a key infrastructure component to support these policies. Indeed, the vast majority of open access policies and laws requiring or requesting authors to deposit articles into an open access repository (European Commission, 2015). In the area of e-journals, the economics of publishing is based on the print subscription model. The incremental costs of going online are low enough so as not to affect journal viability. Open access has distinct advantages in providing more visibility and widening the geographical distribution of both readers and authors. However, promotion of these journals continues to be challenging as only some of these journals are indexed by well-known abstracting and indexing services. Moreover if they are not OAI compliant they cannot be searched by search engines as part of a universal archive (Fernandez, 2006).

Findings of the Study

Open access to Bangladeshi research is still in its infancy. A few of Bangladeshi premier university are providing open access to their research. For example: Digital Archive on Agricultural Theses and Journal (DAATJ) particularly at the Agriculture disciplines and a2i project at the government level. Many universities in Bangladesh are at present lacking in infrastructure for establishing institutional repositories. Basic resource sharing and networking among the universities did not establish since 1971. A few initiatives were found but did not sustain due to non-cooperation of the participating institutions and proper policy at the national level. Core research activates in the field of applied science and sciences are still inadequate at the tertiary level of education. Universities which have established institutional repositories under the support of HEQEP and government funding do not maintain the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). Basically they are providing access for the institutional members only.

Open Access E-Journals

There is no forum which produces e-journal to enhance research at the university level. A few public and private universities are publishing print journal on various disciples as well as electronic version of the same copy and upload full-text at the university websites. Sometimes appeared full-text publicly accessible documents. "In Bangladesh, e-journal databases first appeared in 2002. Currently, 47 libraries are subscribing 37 databases (including 13 free of cost databases) through BIPC and providing access to the users. It is evident that libraries welcome e-journal databases immediately after its availability in Bangladesh (Rahman et al, 2015)."

Open Access ETDs

There are two types of Higher Educational Sectors in Bangladesh: a) Government b) Private. Private sector emerged after the Private Universities Act in 1992 and Government Universities started after the Dhaka University Ordinance in 1921. All the government/public universities have right to give MPhil as well as PhD degree on various disciplines but no

Private University has such kind of permission. As a result, only public universities produce Theses and Dissertations (TDs) as a partial fulfillment of MPhil and PhD degrees (Rahman, 2015).

In private universities mandatory Internship Report (IR) has to be completed for the fulfillment of Bachelor Degrees during an Industrial attachment for a maximum period of 6 months. Other sources of TDs are voluntary submission by a PhD or MPhil degree holder faculty members after completing his/her degree in abroad and a link of Electronic copy where he/she has completed degrees. They usually submit theses in a form of print thesis (Rahman, 2015). Theses and dissertations from all academic departments become part of the university's library collection. ETD has a great impact on thousands of graduate students in many universities as well as diverse researchers countrywide. Proper initiatives have not taken by any university yet (Rahman, 2015).

E-Resource Consortium
University Grants Commission (UGC) of Bangladesh has set up an e-resources consortium called the UGC Digital Library (UDL) as a sub-component of Higher Education Quality Enhancement Project (HEQEP) in 2012 (Ahmed, 2014). Currently, 41 universities have joined the consortium (UGC, 2015). The UDL provides access to subscribed e-journal databases only (Rahman et al, 2015).

BanglaJOl
Some initiatives have also been taken by BanglaJOL (www.banglajol.info) with the help of International Network for the Availability of Scientific Publications (INASP) to digitize all journal articles published in Bangladesh. BanglaJOL is a database of Bangladeshi journals, covering the full range of academic disciplines. The objective of BanglaJOL is to improve the visibility of the participating journals and the research findings they carry. All the materials available on BanglaJOL are free to search, view and browse. Copyright of all included matters is retained by the journals or authors of respective journals. Permission is required for any use or reuse of the content that falls outside the concept of fair use (Chowdhury et al, 2011).

Open Source Software
University libraries preferred Open source software for institutional repositories and completing digital library platform. Among the open source software DSpace is used in almost all the private and public university library repositories. 'Libraries took the advantages of open source software for digitization within two years of its appearance (public version of DSpace released in November 2002). The library professionals played the key role for these accomplishments. It is an enormous achievement in the last decade, while computerization and digitization got momentum in Bangladeshi libraries (Rahman et al, 2015).' Other preferred software are SLiMs, EPrints, FEDORA, GreenStone, and Evergreen.

Recommendation
Lack of national level policy and poor infrastructure hindered the extensive implementation of institutional repositories at universities in Bangladesh. Basic infrastructure like making a common platform for sharing knowledge and research experience should be build up to foster the open access initiatives in the country. A common policy should be adopted to

make harmony in creation and preservation of research output in the university libraries of Bangladesh. The problem of erratic power supply should be solved to facilitate consistent communication among the participating universities. Improvement of computer networking as well as data transfer facilities and bandwidth should be increased for smooth transaction and handling big data.

Appointment of library position by improving infrastructure is an urgent issue in the country now. Most of the university library are suffering due to lack of trained librarian and occupying the position by a nonprofessional staff. Professional recruitment should be increased as well as existing staff should be trained with modern tools and technologies. Bangladesh library professionals are lack in technical expertise for software implementation especially when additional programming is necessary. So, training on programming and software is necessary.

Library budget should be increased to a logical standard so that adoption of modern equipment, tools and techniques become easy. Mentality of the higher authority and internal management should be changed to adopt refurbishment as well as for new establishment. University Grants Commission (UGC) of Bangladesh may frame a regulations on the submission of theses and dissertations in electronic format for proliferation of institutional repositories in the country. National professional groups like LAB and BALID may come forward to take a leadership role in framing polices and guiding policy makers at the government level.

Conclusion
Amsen described that open access has been growing steadily over the past decade, and open peer review is becoming more popular. Many major funding organizations are asking for not just publications, but also the underlying data to be shared openly, and crowd funded researchers are also often incentivized to share their work with their funders. Meanwhile, citizen science has been around for over a century, and is only growing with novel web applications that enable everyone to participate in scientific research and drug discovery. Online post publication peer review is still quite new, and open notebook science has not spread very far yet, but both of these are steadily growing as well. So despite researchers' fear of competition, and a reward system that still favors publication in exclusive journals (where openness is not a main concern), scientific research is gradually moving towards an open science system.

Despite various limitations the university libraries are building institutional repositories though maximum of these are close access in nature. Though there is huge lacking in setting up research laboratories and holding national conferences, symposium and workshop at the government science and technology department and expected that the situation will improve day by day. The universities of Bangladesh can learn a few lessons from our neighboring countries if research to be promoted. To specify the role of librarian in accelerating promotion of the benefits of open access Fernandez specified some important factors and mentioned that faculty could help publicize the issues involved. Fernandez also mentioned that 'subject librarians could participate to a larger extent in these efforts as part of their liaison activities. Mediated deposit can be utilized where faculty non-compliance is

an issue. Sharing of best practices among institutions could help generate more interest in developing research repositories.'

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