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### Aims and Scope

IFLA Journal is an international journal publishing peer reviewed articles on library and information services and the social, political and economic issues that impact access to information through libraries. The Journal publishes research, case studies and essays that reflect the broad spectrum of the profession internationally. To submit an article to IFLA Journal please visit: [journals.sagepub.com/home/ifl](http://journals.sagepub.com/home/ifl)

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## IFLA's global vision with local perspectives

**Steven W. Witt**

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The publication of this issue of *IFLA Journal* leads up to the 83rd IFLA General Conference and Assembly 19–25 August 2017 in Wrocław, Poland. The theme of this congress is Libraries, Solidarity, and Society, which is both evocative of Poland's unique political history and IFLA's continued work to support collaboration among information professionals around key issues facing societies across the globe. At the same time, IFLA is hosting a series of meetings focused on formulating a representative global vision that explores how a profession connected globally can meet the challenges of the future as they are expressed on a local level. This issue makes clear that *IFLA Journal* continues to mirror the overarching dialogues within the profession through the publication of research that represents widely held research problems within the profession and a diversity of scholars working to identify and develop applied solutions to issues that range from indigenous knowledge, digitization services, assessment, and the overall value of libraries and knowledge access to societies. This issue of the journal features scholars from Sub-Saharan Africa, the Middle East, South America, the Caribbean, and North America.

Articles such as Ellen Namhilia's 'Predicament of library value' contribute to debates regarding traditional library activities such as collection development, yet Namhilia contributes analysis of this topic through the lens of collection management within the context of developing countries. Looking towards issues of digitization, Katherine Boss and Meredith Broussard address the universal problem of preserving born-digital news applications, exposing the preservation challenges presented by news apps with useful suggestions of how to overcome technical barriers. Another side of digitization is addressed in 'Digitization of indigenous knowledge on forest foods and medicine'. Sraaku-Lartey et al.'s innovative survey of communities in Ghana regarding the interface of the digitization of indigenous knowledge and the

sustainable use of forest resources used for foods and medicine recommends the development of laws and regulations that could help protect communities and natural resources from bio-piracy.

In articles that focus on academic library settings, Harris, Ismael, and Al-Goban focus on library users. Harris' study on the assessment of information literacy instruction for students in science, technology, engineering, and mathematics (STEM) provides an important perspective on the manner by which students perceive the learning of information literacy skills and perceive the instruction itself. This research helps to develop the means to measure and improve the efficacy of instruction programs. Ismael and Al-Goban provide a comparative approach to the user experience, analyzing the use of customer relationship management systems (CRM) in academic libraries in Egypt and Saudi Arabia. With the aim of analyzing the implementation of customer management systems developed for business in the academic environment to achieve the mission of the library, Ismael and Al-Goban strive for answers to widely held concerns regarding the competitive knowledge environment produced by globalization.

The final paper of this issue takes an interdisciplinary and theoretical view of e-science, taking a historical view of information science and of e-science as an informational phenomenon. Again, this article displays the scope of the profession and its necessary interactions and understanding of new methods of knowledge production that may challenge our notions of information and information work.

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As the global library profession gathers in Wrocław in August of 2017, this breadth of topics and diversity of perspectives will be evident amidst a common goal of developing frameworks for understanding our common concerns while implementing practices that respect the contextual nature of work within the information sciences at a local level.

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# The predicament of library value

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## Abstract

This article contributes to the ongoing debate on library ‘value’ in collection management. It is written from the perspective of library practice in a developing country. It focuses on the micro-level of individual library and archival items and comes to the conclusion that value is a multidimensional concept and that one item can have many different values for different individuals, different groups of people, different uses and purposes which are not static but changing over time. This makes de-selection or ‘weeding’ of library and archives material a complex exercise, affecting the benefits from library use in various ways. There may be educational, entertainment, informational, research, evidential (legal), monetary, intrinsic, sentimental and other values inherent to individual library material. Weeding driven by narrowly interpreted criteria of usefulness, curriculum relevance and concerns about storage cost, may not do justice to the educational, social and cultural common good embodied by libraries.

## Keywords

Collections development, de-selection, library value, weeding ethics

Submitted: 2 April 2016; Accepted: 18 October 2016.

## Introduction

The past two decades have seen an assault on physical (paper) library holdings from several fronts, justified amongst others by:

- economic arguments that physical copies occupy expensive storage space;
- educational arguments that learning efficiency requires that students are only confronted with the latest science, and therefore books reflecting earlier stages of knowledge should be removed as outdated, misleading and wasting students’ time;
- technological arguments that digital resources are universally accessible, and make the physical resources redundant;
- the argument that digital resources are easier to mine for information, and therefore preferable;
- the claim that libraries need to prove ‘return on investment’ according to the neoliberal paradigm.

Usually, a random combination of these arguments is used to convince the custodians of libraries of a programme of rigorous weeding to cut the storage

cost of their growing collections, and to free space for more fashionable use. This trend has, however, met with occasional resistance. Protests against well-publicised examples of book destruction going clearly over the top include the Urbana Free Library in Illinois, USA, a public library, where non-fiction books older than 10 years were destroyed with the publication date as primary criterion (Nectoux, 2013). Another salient example concerned the destruction of a rare reprint collection of Chinese classical literature at Augustana College, an academic library (Warmke, 2011). While in these cases undue haste, top-down attitudes by library management and lack of consultation with staff and with the user constituency appear to have been at the core of questionable decision-making, there are also counter-examples of carefully planned and executed weeding exercises, such as the one documented by a blog of Wesleyan University Library (Tully, 2014). Reading

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through various blogs with sometimes heated and controversial discussions about weeding, it is however worrying to see simplistic arguments by academic administrators professing eagerness to follow popular trends instead of analysing the role of the library in education and research. The President of Augustana College defended the make-over of their library: 'We listened more closely, and heard that students preferred access to digital resources over the chance encounter with printed periodicals' (Bahls, 2013). This begs the question whether the library had neither catalogue nor reference staff, leaving the student's encounter with the printed word up to chance? Or are the alleged wishes of the students rather a pretext for a different motivation, namely the reduction of library space?

Value of libraries as institutions of library materials and library services has been an important research topic among the public, academic and special library community for years (Batt, 1996; Feret and Marcinek, 2006; Tenopir, 2011; Whitehall, 1995). A good deal of evidence on how the library can best demonstrate its value, especially to users and to the mother institution, has been collected. Studies using 'return on investment' or other monetary approaches have been criticized on grounds that library value cannot be quantified purely in monetary figures (Calvert and Goulding, 2015; McMenemy, 2007; Mathews, 2015; Missingham, 2005), while Creaser and Spezi (2012: 6) provide that many of these research results are 'evidence of activity rather than evidence of value and impact on teaching and research staff'.

Despite criticism of methodological detail, however, most authors are taking the principal premise for granted, namely that there is a need to justify libraries by measuring an economic impact. This assumption should be met with caution. In a related context, namely in scientific research metrics, Hicks and others (2015: 429) recently stated that: 'Metrics have proliferated: usually well-intentioned, not always well informed, often ill applied'. It is a worrying trend that the idea of libraries as a common good, beautifully expressed by Marcum (2001), is so easily thrown overboard in the race to satisfy short-term profitability demands that may turn out to be just ideologically motivated. The principled discussion – whether the attempts to assign value to the library are nothing but an unwarranted proliferation of neo-liberal ideology, being 'the extension of market logic into previously non-economic realms – in particular into key social, political and cultural institutions' (Bourg, 2014), seems to be relegated to marginalized librarian's blogs.

An almost up-to-date bibliography (American Library Association, 2015) provides a good overview of basic literature on weeding as well as of the ongoing discussion. It seems however that this discussion is mainly based on conditions and experiences in rather affluent countries. Recent experiences in a less-privileged country have prompted me to challenge the unquestioning application of such wisdom under different circumstances.

### Experiences in a developing country

The country in question is Namibia, a large country (825,615 km<sup>2</sup>) with a small population (2.5 m in 2014) classified as an upper middle-income country (GNI per capita 5.210 US\$ in 2015) with high social inequality (Gini co-efficient 61.0 in 2009). The country has a centrally administered country-wide public library network, a national library, the national archives, two public-funded university libraries and several special libraries. The local publishing industry is hampered by economies of scale (small population with high language fragmentation – 13 locally used languages). Despite a modern legal deposit law, funding and staffing constraints have prevented the national library from instituting legal deposit of local web publications, and its international digital access is limited to EBSCO and JSTOR. Staffing constraints have also limited the efficiency of collecting local print publications, and especially audio and audiovisual media. The university libraries are subscribing to aggregated international digital publication services, but the scope of subscriptions is seriously limited by budget constraints. Also, there is no central catalogue, as libraries are operating with different library management systems, and the expertise to create a portal to joint catalogue access is lacking. A digitization programme for the local printed heritage is still in its infancy.

These are conditions under which library weeding becomes a hazardous exercise. This may be illustrated by the experience of an institutional merger. In 2010, four teacher training colleges that had previously been administered directly under the auspices of the Ministry of Education were merged into the University of Namibia, as part of the effort to upgrade the quality of education. The largest of those, the Windhoek College of Education, had a substantial historically grown library taken over from its predecessor institutions that were racially segregated under apartheid rule before Namibian independence in 1990. A large proportion of its holdings was written in Afrikaans which had meanwhile been replaced by English as the official language. Before the merger took place, the

college library had been instructed to weed their collection according to the new curriculum for teachers, with the result that the bulk of the library collection was weeded, with language and immediate relevance to the curriculum being a main criterion.

This action inadvertently destroyed the largest body of literature in the country that would be needed to study the history of apartheid's so-called 'Bantu education', a subject which is not only of academic interest but actually of very practical importance in remedying the destructive effects that the apartheid ideology had on the Namibian education system. Although lists of weeded books were circulated to allow other libraries to take what they considered useful, none of those libraries were serving teacher training institutions, and therefore specifically the main research value of the college library was destroyed. This must be seen against the background that certainly none of this material was digitized; and most of it is not available internationally except possibly in South Africa where 'Bantu education' had also been practised under apartheid.

What had happened? A paradigm change in educational policy, and therefore in educational curriculum, had changed the character and the type of value that this material had. It was no longer of direct educational value for guiding the students to become teachers. The library's management did not realize that these books had nevertheless eminent value to research and overcome the legacy of a racially divided and oppressive education system. And it also did not realize that students would need some exposure to the previous education policy in order to deal with its all-pervasive legacy.

A second round of weeding that threatened, for example, to eliminate the literature on music teaching which was no longer part of the current curriculum, could then be averted – considering that the Department of Arts and Culture in the Ministry of Education is struggling to have the subject re-introduced in all schools. Streamlining the collection according to narrowly interpreted curriculum relevance would have seriously harmed the ability to react speedily to changing needs.

The case highlights the dangers of weeding in a situation in a small country with generally inadequate library resources. Important local material which likely does not exist elsewhere is in danger of getting irretrievably lost.

This incident, as well as experiences in the course of historical research, prompted me to look at what constitutes the value of library and archival material, and how it changes over time.

Many library and archives users are inspired by the unique characteristics and the value of physical documents in the collections. The value of library and archives material is not to be considered only on the basis of the face-value information content, because if this were the case we could just digitize, create virtual libraries and archives, and throw the originals away. The need to retain and preserve analogue originals has been widely recognized: 'Generally, digitization in itself is not a method of preservation of documentary heritage although it does help to protect precious documents from excessive handling' (UNESCO, n.d.). However, while this principle is quite unambiguous where unique archival material is concerned, libraries may feel entitled to weed their analogue literature if digital copies exist, assuming that an original anyway exists somewhere. This is quite in contrast to the digital world, where cooperative schemes to safeguard *several* digital copies in *different locations* have evolved according to the LOCKSS principle (Lots Of Copies Keep Stuff Safe). Cooperative schemes for preserving analogue heritage operate rather on preservation of one 'last copy' repository (Kisling et al., 2000) – which even after successful operation for decades may nevertheless be threatened again by dispersal and destruction because 'with libraries moving toward digital records and access to collections across the globe, the need for a last-copy depository is diminishing' (Benoit, 2011), or on sharing a central storage space for 'little-used material' for several libraries (O'Connor et al., 2002) – which saves on investment and running cost but puts the proverbial 'all eggs into one basket'.

The weeding of digitally available material is also prone to overlook issues like inadequate digital quality. The Wesleyan University example cited above (Tully, 2014) included checking the paper copies for illustrations that might be poorly reproduced in the digital copy, and excluded such periodicals from weeding. But such diligence seems to be rather the exception than the rule.

### Values of library and archives material

The mentioned preservation considerations apart, I would however question the wisdom of 'value' as generally accepted weeding criteria. In an analogy to Pilate's 'What is truth?' (Gospel of John 18: 38) one ought to ask 'What is value?' and come to the conclusion that 'value' can mean very different concepts, and moreover, that in applying those different concepts, their importance changes over time.

Consider the value of obsolete Dewey Decimal Classification (DDC) and Sears Subject Headings

editions. Academic libraries may be tempted to weed out older editions of classification or subject headings guidelines because only the latest ones have the primary reference value in everyday use. But in doing so, they would forget that the older editions have important practical or research uses to fulfil – which are not at all obvious at first glance. Not only that they provide a key for interpreting the classification of older books catalogued with those older editions – one must remember that there have been substantial revisions in numbering, and hardly any library is in a position to continuously re-number according to new editions. Perhaps more importantly, various editions of DDC and Sears become interesting research tools that can be used to trace the emergence of new disciplines, semantic and terminology shifts, and new concepts entering the mainstream. Consider some random examples: The 10th edition (1972) of Sears Subject Headings provided 31 headings starting with ‘Negro’. The 20th edition (2010) has only a ‘use’ reference: ‘Negroes’ use ‘African Americans’, use ‘Blacks’. When did the term become generally unacceptable to be scrapped from the indexing vocabulary? DDC 22nd edition (2003) has a classificatory number ‘306.484 Same-sex marriage’. When did this concept enter public debate and scholarly literature to an extent that it was necessary to give it a classification number? Such questions are not the primary use that DDC or Sears were created for, but by virtue of the regular revision of these tools they can be answered, now and in future – if the tools are kept and not discarded. The initial reference value has transformed into research value.

Consider a legal commentary published in 1901 by a legal scholar about the administration of law in Germany and therefore also in my country Namibia, which was called German South West Africa at the time (Kayser, 1901). When it was published, it was very useful for legal practitioners and had high reference value. Why do we keep this in a Namibian library while none of those colonial laws are valid anymore? We keep it because it still has historical research value, as it was applied and had practical consequences in our country. Identifying and getting it through international interlending from Europe would be costly and time-consuming; nobody knows when it might be digitized; the decision by the National Library of Namibia not to weed the inherited library of the former German colonial administration has already proven useful in many instances.

Take an old edition of the *Encyclopaedia Britannica*. Clearly, much of its information content is outdated. But for historical research, the various editions are an indispensable resource for contemporary

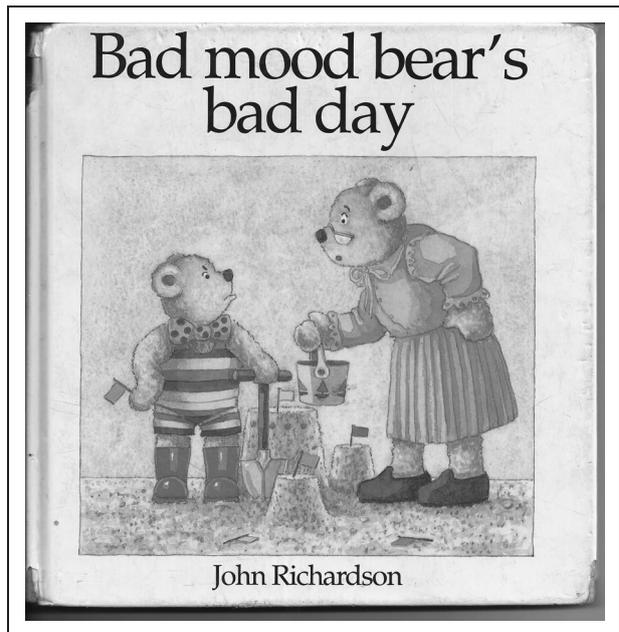


Figure 1. Children's book.

information, with many entries removed in later editions to make space for more current topics. The continued information value of old encyclopaedias is irreplaceable – and that Wikisource has started to put individual OCR'ed articles of the 11th edition of the *Britannica* on the Web illustrates this perception.

Consider a children's picture story book, originally produced with educational and entertainment value in mind (Figure 1). It was bought and served several purposes – entertainment and education for the children, emotional bonding between parents and children in the process of reading and being read to. It acquired stains and dog's ears on the way. After many years, despite its poor condition, it is still retained by the family because it acquired sentimental value for the children who grew up with this book being read to them, and for their parents who read it over and over to their children. It became part and parcel of the individual family history. Sentimental value is very individualistic, but a value nevertheless. And if that book had been owned by JK Rowling, it might some future day be auctioned with a monetary value and end up in a literary archive for its research value as an early influence on the writer, or in a Rowling fan's collection for its intrinsic and collector's value.

The change of the character of value is even more distinct in the case of archival material. Consider an archival document such as a death notice (Figure 2). Death notices are created, and filed in deceased estate files, to provide evidential value, certifying that a natural person has died and that his or her property can therefore be inherited. Once the property has been distributed, this document is still maintained because

N<sup>o</sup> 406, Registered in the Master's Office, Windhoek, 27/5/24  
 M.S.C. 1. UNION OF SOUTH AFRICA.  
 DEATH NOTICE.  
 PURSUANT TO THE PROVISIONS CONTAINED IN "THE ADMINISTRATION OF ESTATES ACT, 1913."

U.D.I. 231  
 HIGH COURT OF SOUTH AFRICA  
 WINDHOEK  
 MAY 27 1924

1. Name of the deceased..... Johannes S. [redacted]

2. Birthplace and Nationality of the deceased..... German - Bismarcksweg

3. Names and addresses of the Parents of the deceased  
 Father..... unknown  
 Mother..... unknown, at present

4. Age of the deceased..... six years eight months

5. Occupation in life of the deceased, or, if a woman, of her husband..... General Agent and Commissioner

6. Ordinary place of residence of the deceased, or, if a woman, of her husband..... Windhoek, South West Africa

7. Married or unmarried, widower or widow } Married

(a) Name of surviving spouse (if any) and whether married in community of property or not } Margarethe S. [redacted] (born Kiehl) married with community of property

(b) Name or names and approximate date of death of predeceased spouse or spouses ...

(c) Place of last marriage..... Maltahöhe, South West Africa  
 22<sup>nd</sup> May 1924

8. The day of the decease: on.....  
 House..... Kaiser Beer  
 Town or Place..... Windhoek

9. Where the person died }  
 District..... Dist. Windhoek, South West Africa

10. Names of children of deceased and whether majors or minors }  
 Margarethe Sophie S. [redacted] (minor) born 13<sup>th</sup> October, 1913  
 Johanna Siphila S. [redacted] (minor) born 17<sup>th</sup> September 1918.

Figure 2. Death notice.

it still has legal value in case of a dispute which may arise later. For example, children born out of wedlock may suddenly turn up to also claim a share of the father's estate. This document served evidential or legal value, many years have passed and there were no disputes, but it is still retained. Why? It acquired another value, which is genealogical, biographical and social science research value. This is a secondary value regarding the information which is contained in the estate file. It shows the family relationship between the deceased and the inheritors; the date of death, it may provide the cause of death; it exposes living and working conditions, such as the prevalent cause of death 'pneumonia' of workers under the colonial contract labour system; and much more.

The same estate file may also contain a cheque printed 90 years ago (Figure 3). Initially this cheque had monetary value at the time it was created; but from the moment it was cashed, its monetary value ceased to exist, and was no longer valid. If the primary value has been served, why has it not been destroyed? It is part of a deceased's estate file and had evidential value to prove this transaction in relation to the

deceased's property. But now, 90 years later, the estate is no longer questioned and this evidence is no longer needed, so why do we not destroy it? Maybe this cheque is worth being preserved because it has illustrative value of what a cheque looked like 90 years ago. To cite an example, a few years ago, one of the local banks in Namibia celebrated their centenary by publishing a commemorative volume, and they were delighted to find in the National Archives of Namibia the beautifully designed cheques illustrating the history of their company which they had not preserved themselves. Apart from an illustrative value, such items can acquire collectors' items value, which in turn again bestows upon them a secondary monetary value. And, although I and many of we librarians have a problem with this issue 'collector's item', being an incentive to theft and mutilation, it is useless to complain about it; it has to be acknowledged as a fact.

Take a school exercise book (Figure 4). At first look, it has no value at all. Why would you keep a school exercise book of a student at an end of a school year when millions of such are thrown away every



Figure 3. Cheque.

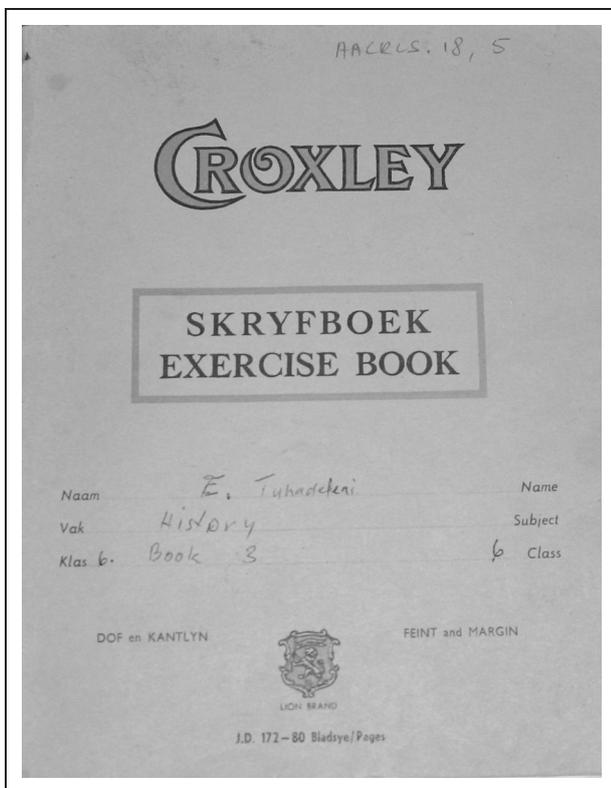


Figure 4. School exercise book.

term? Why do we keep this one? A closer look at this one reveals its intrinsic value. It was used by Noah Eliaser Tuhadeleni, alias Kaxumba kaNdola, who was the Accused No.1. of the 38 Namibians arrested, exiled, tried in Pretoria in 1967–1968 and sentenced to life imprisonment on Robben Island off-shore Cape Town, South Africa. Looking at the content of this exercise book, it seems to have minimal research value, because it does not express Tuhadeleni's own ideas but reproduces what he had to learn to pass a school exam in the apartheid education system. It

certainly had educational value at the time for the late Tuhadeleni, and it might have been kept by him later for sentimental value as a memento of his prison time. But the National Archives of Namibia preserved it for its intrinsic value as one of the few existing handwritten documents by this Namibia liberation struggle icon, and as evidence on how a political prisoner tried against all odds to further his education while serving a life sentence on Robben Island.

I have chosen some archival examples, not only because they illustrate the change of 'value' character more strikingly, but also because the archival discussion on the process of 'appraisal' and (more recently) 're-appraisal' is as controversial as the 'weeding' discussion, and worthy of being considered among librarians.

### The value of the librarian's work

Apart from the value(s) attached to individual library or archives material, one also has to realize that a library is larger than a sum of its parts. Libraries as knowledge institutions do not consist only of books but of the intellectual effort invested in them: a concept upon which the library collection was built; a catalogue interface which makes it retrievable; and librarians who create the catalogue and act as the human interface to the collection. These services are indispensable, and are as important as the physical collection. Unfortunately, the reduction of physical collections driven by a cost-saving mentality is also negating the intellectual labour that had been invested in its acquisition, cataloguing and classification. This might not be a great loss in a standard public library, but can be of serious consequence in an academic or special library that had invested heavily in its discovery tools, and tailored the catalogue record according to its particular mandate.

Citing my own country again, it is instructive to recall the experience of our Namibian National Library's database of national imprints. The database has recently been integrated into a larger collaborative catalogue, without adequate precaution that its records could not be overwritten by other participating libraries. In due course, it was discovered that occasionally records were being replaced by downloaded WorldCat records that had been created abroad by libraries with considerably less insight into the local information base, and therefore either faulty or much deficient in depth of information (Werner Hillebrecht, 2016, personal communication). Being used to consider the international data as superior, and not being trained in original cataloguing to realize the difference, some librarians had assumed they were improving the catalogue but actually achieved the opposite.

The current efforts at automated metadata extraction for indexing and classification are exciting and useful but they will be detrimental if they are used to devalue the intellectual effort and to argue for even further reduction of human intervention in cataloguing and classification, a step that is (again) advocated by cost reduction arguments. CannCasciato (2010: 5) points out: 'A catalogue should assist students to [access] material that they would not have thought of consulting [...] A scarcity of bibliographic information, as with a scarcity of any resource, serves fewer people, meets fewer needs, and has less potential for future development'. The causal connection to weeding is evident: poor discovery tools lead to little resource use, little use leads to weeding 'because the book has not been borrowed for x number of years'.

## Conclusion

This paper attempted to demonstrate the problem with narrow understandings of library 'value'. It discussed the widely different concepts attributed to the term 'value' in relation to the character, form, content and use of documentary material held in library and archival collections and elsewhere. Value has been illustrated as a multi-dimensional concept which in many of its facets is often not recognizable at a first glance and often cannot be expressed in monetary terms or terms of 'return on investment'. In library weeding, just as in archival appraisal, instead of hasty decisions according to formal criteria, careful consideration is required in which factors like enduring research value, intrinsic value due to previous owners or unique materials and technologies, and even

aesthetic criteria and potential illustrative and other uses have to be considered.

These considerations are not meant to negate the need for weeding. The cost of storage space for growing collections is a serious concern that libraries are confronted with, and weeding is one way to address it. But the financial and space constraints of academic libraries should not tempt us to take decisions on the value of collections that are based on short-sighted efficiency considerations, such as:

- making hasty weeding decisions;
- basing decisions on lending records;
- narrowly defining collection development policies;
- acquiring and keeping only subject literature that is directly relevant to the current courses offered;
- keeping only subject literature that conforms to the latest state of knowledge.

These kinds of decisions negate the origin of the word university, which comes from the claim that education and knowledge should be universal. They deny our students the opportunity to look beyond the curriculum, to get ideas and inspiration from other sources and to think outside the box. Imagine an academic library that only stocks the latest textbooks with the latest theories. Imagine an educational concept that students have to be taught 'efficiently' and are not to be burdened and distracted with concepts of yesteryear. How are they to learn and experience that science is a process, that we stand on the shoulders of others, and that any theory might eventually be proven wrong? Academic libraries cannot spoon-feed their users to stifle their critical and creative thinking. The history of science knows many examples of how 'obsolete' theories were resurrected in a paradigm shift and contributed to a new and better understanding.

In short, we may not add value to our students' study and learning experiences if we design our libraries as a learning machine to be streamlined for short-sighted teaching efficiency and measurable return on investment. I agree with the conclusions of the study by Mathews (2015: 229) that 'any attempts to establish the value of library outcomes should recognize that a combination of perspectives – educational, informative, recreational, cultural, and public benefits – will result in more realistic assessment of value'. And finally: librarians in countries that are less privileged in terms of available library resources and costly international digital access, and which experience questionable

preservation of the national imprint, will be well advised to apply extra caution in weeding decisions that affect the diversity of their resources.

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### Author biography

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# Challenges of archiving and preserving born-digital news applications

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## Abstract

Born-digital news content is increasingly becoming the format of the first draft of history. Archiving and preserving this history is of paramount importance to the future of scholarly research, but many technical, legal, financial, and logistical challenges stand in the way of these efforts. This is especially true for news applications, or custom-built websites that comprise some of the most sophisticated journalism stories today, such as the “Dollars for Docs” project by ProPublica. Many news applications are standalone pieces of software that query a database, and this significant subset of apps cannot be archived in the same way as text-based news stories, or fully captured by web archiving tools such as Archive-It. As such, they are currently disappearing. This paper will outline the various challenges facing the archiving and preservation of born-digital news applications, as well as outline suggestions for how to approach this important work.

## Keywords

Born-digital news, news applications, software preservation, web archiving

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## Introduction

Newspapers have been archived in different formats over the centuries, and some of these formats have proved more stable and reliable than others. Libraries recognized long ago that saving physical copies of print newspapers was a failed strategy, as high-acid newsprint quickly yellows, deteriorates, and falls apart. The process of converting print newspapers to microfilm saved many 20th-century newspaper archives (Goho, 2004). Now these collections are being migrated once again, from microfilm reels to digitized PDFs. This process is time consuming and expensive, but is being funded and carried out at archives across the country and around the world to help preserve the first draft of history for the future.

The digital era of media has ushered in a new period of crisis in news archiving. Born-digital news production has exploded in the past decade, with legacy publications like *The New York Times* releasing blogs, videos, and complex interactive and data journalism stories that are not or could not be included

in the print edition. Additionally, the creation of digital-native news websites that began without a print counterpart, such as Salon or The Huffington Post, has also grown exponentially in recent years. Archiving all of this born-digital news presents problems even more ubiquitous and insidious than the fragility of high-acid newsprint. In the United States, initiatives to advance this work are being led by many institutions, including the Internet Archive, the Library of Congress, the National Digital Stewardship Alliance, the Educopia Institute, and the Donald W. Reynolds Journalism Institute at the University of Missouri (Cain, 2003; Hansen and Paul, 2015; Library of Congress, 2015; McCain, 2015; Skinner and Schultz, 2014). However, none of these efforts have

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yet addressed the preservation of some of today's most innovative data journalism projects: artifacts that news developers call a news app, or "interactive news application".

What exactly is a news app? That depends on whom you ask, though clarifying what it *isn't* up front is helpful, as this is not an app that is downloaded to a phone. A news app is a piece of born-digital journalism, or software that has been custom-built to tell a story. "Snow fall" by John Branch (2012) of *The New York Times* is one famous example. This interactive, multimedia story about an avalanche in Washington took a team of more than 15 web developers, designers, and journalists to produce. The project seamlessly weaves interactive graphics, audio and video clips, and data visualizations throughout the story, creating an experience that could not have been built under the constraints of *The New York Times'* content management system.

A more narrow definition of news apps has also been presented by Scott Klein (2012: 185), senior editor for news development at ProPublica, in *The Data Journalism Handbook*: "A news application is a big interactive database that tells a news story. Think of it like you would any other piece of journalism. It just uses software instead of words and pictures". Klein's definition is unique in that it specifically mentions a news app as a story built on a database. This definition accurately describes a large subset of news apps that are data-driven. A good example of this type of news app is ProPublica's "Dollars for Docs" project, which allows users to search a database to see if their own physician has received drug company money, and if so, how much (Groeger et al., 2015). These stories are unique in that they are interactive and exploratory, and it is this particular subset of news apps that is especially difficult to archive and preserve. Because these projects are standalone pieces of software that query a database, they cannot be captured in the same way as text-based or multimedia-based news stories, and they are currently disappearing.

How many news apps are disappearing, and how many others are still in need of preservation? It is not clear. Internet companies and digital media companies are bought, sold, consolidated, and bankrupted at a rapid rate. The media landscape will only get more complicated; the Pew Research Center estimates that there were 438 small digital news organizations in the US in 2013, most of which are digital-first startups (Jurkowitz, 2014). All of these organizations are producing journalism, and some of them are making news apps. This suggests the need for an environmental scan of interactive data

journalism projects, and the development of selection criteria to identify priorities for capture and preservation (Broussard, 2015). Several informal efforts at such a registry have been started and abandoned (Han, 2014); there is a need to build upon these efforts and create a thorough analysis of the nature and number of news apps.

There is also the complicated and time-consuming task of determining best practices for capturing and archiving news apps for long-term access. Most born-digital news preservation efforts are focused on static news objects such as images and text that comprise the vast majority of the born-digital news content being produced today. However, the question of how to archive and preserve dynamic digital news objects such as news apps has not yet been answered (Harris, 2013; Klein and Fisher, 2014). This is due in part to the unique design of these objects, which are built on complex software that is often connected to a database reliant upon various other systems to display and function fully. These software packages may be external and reside on different servers, further complicating matters (Waite, 2013). Preserving a news app is thus a markedly different exercise than archiving and preserving other news content on the Web; it is an exercise in software preservation (Broussard, 2015).

This paper will outline some future projects, initiatives, and research needed for the successful capture, archiving, and preservation of database-reliant news apps. This includes the need for a report on the current status of news apps, consensus on a preservation framework, the establishment of best practices and techniques for approaching the work, metadata standards in describing the content, and more case studies in capturing, archiving, and preserving these data journalism projects.

## **A report on the status of news apps**

The development of news apps is a new and evolving field of data journalism, one that parallels the rapid changes ongoing in web design and development. It is difficult to describe the number of news apps that have already disappeared or to identify those at greatest risk of disappearing, as there is currently no substantive documentation on the number or nature of these projects. An initial environmental and technical analysis would be helpful in this regard, as it would collect information that is currently diffuse, as well as some basic descriptive information on the projects – how they are built and how they operate. This metadata would grant insights into the landscape of what needs to be archived and preserved.

The goals of this analysis are important to consider before beginning the research. One of the primary goals would be for preservation purposes, or to collect information needed by curators and archivists to preserve the works. This would include descriptive information of the news app, the software architecture and environment, its creators, ownership and licensing information, and its archiving status. Such a report would be a useful first step in answering the many questions that follow on how to capture, archive, preserve and make discoverable these works.

### **Significant properties of dynamic digital objects**

News apps are essentially dynamic software objects, so any efforts to save them can be approached by building on the important body of research that has been conducted in software preservation. This research has addressed some of the many challenges related to this work, the first being the fundamental question of what needs to be preserved. Unlike a book or magazine, software packages do not have easily defined boundaries, and it can be difficult to determine just where the digital object begins and ends. Does one preserve just the source code, the binary executable version of the program, or the executable program as well as the software environment (hardware, operating system, programming languages and compilers, software libraries, etc.) on which it was run? Digital archivists frame this dilemma as determining the “significant properties” of the object. In relation to software preservation, this difficulty has been identified in several case studies in preserving virtual worlds and mathematical, scientific, and e-science software (McDonough and Olendorf, 2010; Matthews et al., 2008). Unsurprisingly, there is no standard answer to this question. Instead the answer depends on several important factors and limitations, such as the complexity of the digital object and the human and financial resources available to devote to the project, and is generally determined on a case-by-case basis.

Depending on what boundaries have been established as constituting the significant properties of the news app, and on what curators and digital archivists have determined to be a feasible level of preservation, there are a few options for the preservation technique that might be used. If few resources can be devoted to the cause, then a bare-bones approach to saving news apps might conclude that the database on which the news app is built would suffice as the object for preservation. In such

cases, the boundaries of the digital object would be far more straightforward than if the entire look and feel of the news app were to be captured. The data could be described by the Data Document Initiative (DDI) metadata schema, which could be used to document the data as well as make it discoverable (Data Document Initiative Alliance, 2015).

However, the downsides to this preservation approach are many. To capture and preserve just the data, and none of the interactive features of the news app, would be to sacrifice many of the components that make it desirable for preservation in the first place, including the user interface, data visualizations, and analysis. To supplement the preservation of the data set with web archive snapshots via the Internet Archive or another web archive collection might make up for some of this loss. However, in the case of complex news apps that rely not only on a database but also on an external application programming interface (API) like the Google Maps API, this preservation approach would strip the news app of most of its purpose and functionality. Thus, it does not seem plausible that it would be effective. Given the complexity of these projects and the added value in capturing and preserving their design, display, functionality, and data (not to mention information on each app’s reception and use), there is a strong argument that the significant properties of news apps should encompass their look, feel, content, functionality, and operation. This would require these works to be captured and archived at the most robust level possible.

### **Techniques for digital preservation: emulation vs. migration**

More sophisticated techniques for digital preservation are still being debated in the information science community, and most notably include technical preservation, emulation, migration, and cultivation (Castagné, 2013). While each of these approaches have unique pros and cons, two techniques are common: emulation of the software environment, and migration of the software to current standards. While migration continues to be a successful strategy in providing long-term access to static digital objects, this approach has proved less successful in preserving dynamic digital objects:

Migration – the most widely used digital archiving strategy today – seeks to address this problem by changing the digital object in order to prepare it for access and rendering in future digital environments. Although this strategy applies to static digital objects such as images, text, sound and animation, it is not suitable for dynamic

objects such as educational software or computer games. As a lot of digital material is becoming more advanced, relying solely on migration as a preservation strategy is risky and will certainly result in loss of authenticity and information. (Von Suchodoletz and Van der Hoeven, 2009: 147)

Consensus in the digital preservation community is thus leaning toward emulation as the preferred technique for the highest level of preservation for dynamic digital objects (Granger, 2000; Johnston, 2014; Von Suchodoletz and Van der Hoeven, 2009). With this technique, virtual machines can be utilized to capture the source code, the executable program, the software on which it was run, and other essential significant properties of the news app in order to recreate the app and its environment on any other computer, or in any other software environment. There are many emulators and virtual machines in use and in development that could potentially serve as a technological solution for this strategy. Some recent notable examples have appeared in the field of computational and scientific reproducibility. The open-source reproducibility tool *ReproZip*, for example, which was designed to make computational experiments reproducible across platforms and time, is one possible tool for packing and archiving dynamic digital objects such as news apps (Chirigati et al., 2016). More work in testing such tools and documenting the results is needed.

However, as Anderson et al. (2010) have noted, the debate between emulation and migration is something of a false dichotomy, as emulators are also digital objects which will themselves become obsolete over a long enough period of time. When a hardware paradigm shift occurs, as it inevitably will:

there are just two strategies that an emulation-based digital preservation approach can follow: 1. Produce from scratch a new emulator (or emulators) to run on the latest hardware to provide access to digital objects dependent on previous platforms; or 2. Migrate the existing emulators. (Anderson et al., 2010: 115)

To produce new emulators from scratch would be time consuming and expensive. Anderson et al. recommend a hybrid emulation-migration technique of emulating the software to be preserved on an emulator designed with future migration of itself in mind. Advancements in this technique are being spearheaded by the European Commission's Keeping Emulation Environments Portable (KEEP) project (European Commission, 2014). This hybrid approach seems most promising for long-term

access to complicated software systems. Thus, any long-term technological solution to emulating news apps should take into consideration the migration of the emulation tool itself: what software and hardware dependencies does it rely on, and how complicated would those be to migrate?

Legal issues also present a final, major obstacle in the preservation of news apps (Von Suchodoletz and Van der Hoeven, 2009: 151). Proprietary code, digital rights management, and intellectual property rights must all be taken into account when embarking on any digital preservation project. However, if emulation of the dynamic digital object is chosen as the preservation strategy, this can be advantageous from a legal perspective, as the creation of an emulator is often considered to be a form of reverse engineering. While this has generally been found to be a legal activity, "the ability to create an emulator can be limited by various laws, including copyright law, trade secret law, patent law, the Digital Millennium Copyright Act (DMCA), contract law, and the Electronic Communications Privacy Act" (McDonough and Olendorf, 2010: 54). Further work on establishing a legal pathway to the preservation of news apps is needed.

### **Adopting a framework and metadata schema**

Given that the field of software preservation is still an evolving one, it is also helpful to utilize a preservation framework to provide a broad overview of how to approach the work. Some frameworks are already emerging, most notably the Performance Model Framework for the Preservation of a Software System (Matthews et al., 2010). Developed as a result of a 2008 study launched by JISC to determine the "significant properties" of software, the framework is built on case studies in mathematical, scientific, and e-science software preservation (Matthews et al., 2008). It identifies functionality, software composition, provenance and ownership, user interaction, software environment, software architecture, and operating performance as the general metadata categories needed to properly describe a software object (Matthews et al., 2010: 98–101). This study and its recommendations provide an excellent outline for the needed categories in news app preservation.

A metadata schema should also be considered and adopted before beginning any work on news app preservation. A controlled vocabulary of description of the objects will allow for better discoverability, digital identification, and interoperability with various

hardware and software systems (National Information Standards Organization (US), 2004). Though a definitive schema for describing dynamic digital objects has not yet been agreed upon by the preservation community, there are several accepted standards that should be considered (additionally, complete consensus may not even be required; multiple schemas may be necessary to describe a spectrum of dynamic digital objects). These standards include the ISO Reference Model for an Open Archival Information System (OAIS), the Functional Requirements for Bibliographic Records (FRBR), and Preservation Metadata: Implementation Strategies (PREMIS)

(Consultative Committee for Space Data Systems, 2012; International Federation of Library Associations and Institutions, 1998; Library of Congress and PREMIS Editorial Committee, 2016).

Of these metadata schemas, PREMIS emerges as particularly applicable to news app archiving and preservation for a variety of reasons: it is compliant with the OAIS information model and more inclusive, and the newest release of PREMIS version 3 has been updated with the express goal of accounting for software as a primary object of preservation (Dappert et al., 2013). Additionally, the Performance Model Framework for the Preservation of a Software System maps to OAIS terms, and since PREMIS is compatible with OAIS, the framework can be used and mapped to PREMIS v. 3 equivalent fields. Table 1 shows this relationship between the Performance Model Framework for the Preservation of a Software System, OAIS, PREMIS, and its applicability to news app preservation.

If news apps are to be saved, it will have to be a group effort, with buy in from as many institutions as possible. There are simply too many dynamic digital journalism stories being produced for any single institution to archive and preserve these works in an isolated effort. It is conceivable, then, that this work might be performed by a variety of organizations with a range of resources and goals, including public and private universities, large and small cultural and memory institutions, public, nonprofit, and commercial news content producers, and so on. Thus it is important to identify a variety of preservation levels geared toward different scenarios and stakeholders. The National Digital Stewardship Alliance's description of digital preservation levels is helpful in this regard, as it incorporates considerations for the digital object's safe storage, fixity and data integrity, information security, metadata, and file format compatibility at four levels of increasing preservation status (Phillips et al., 2013). These levels should be consulted and adopted.

## Recommendations and areas for further inquiry

Many terabytes of born-digital news content will inevitably be lost to the black hole of technological obsolescence. News apps, which represent some of the most complex, original, and innovative journalism stories being produced today, should not be among them. In recent years news apps have exploded in production and popularity on websites devoted to data journalism, such as FiveThirtyEight (Silver, 2016), ProPublica (ProPublica Inc., 2016), The UpShot (New York Times Company, 2016), and Vox.com (Vox Media, 2016). Legacy news publications like *The Guardian*, *The Washington Post*, and *The Wall Street Journal* have also dramatically increased publication of data-driven stories over the last five years, and the reach of these projects speaks to their role in shaping our culture (Howard, 2014). It is imperative that a strategy for saving interactive data journalism be established.

A thorough analysis of the nature and landscape of current news apps would be a useful first step in this endeavor. It would centralize some metadata on the projects and provide insights into strategies for capture, archiving, and preservation. The work of saving news apps is a difficult but not insurmountable task, and can benefit from the significant progress being made in the field of software preservation. In particular, newsroom and memory institutions like libraries and archives could investigate emulation as a preservation strategy, and, in selecting an emulator, should choose one that would comply with the findings of the KEEP project to make the emulator itself migratable (European Commission, 2014). The Performance Model Framework for the Preservation of a Software System should be considered as a viable approach in deciding the "significant properties" and boundaries of the digital object to be preserved (Matthews et al., 2010). Furthermore, the PREMIS version 3 metadata schema has the potential to be a fitting schema for thoroughly and accurately describing news apps for the best interoperability and discoverability.

More work in capturing, archiving, and preserving news apps is needed, especially case studies that could test and update these recommendations. Documented case studies could then be used to establish best practices and workflows that could be implemented by other institutions at a broader scale. Such pathways will be the key in preventing these invaluable data journalism stories from being "irretrievably lost to future generations", as Rothenberg (1995: 42) famously warned.

**Table 1.** Mapping the preservation framework to a metadata schema.

Framework category (Matthews, et al., 2010)	Framework description (Matthews, et al., 2010)	Examples (Matthews, et al., 2010)	Equivalent OAIS Terms	Equivalent PREMIS v.3 categories (select examples)
Functionality	Description of the typical characteristics of software. Useful for efficient discovery and accessibility of the software in future	Description of inputs and outputs Description of operation and algorithms Description of the domain addressed	Descriptive Information	Intellectual entities or object entities (significantProperties, objectIdentifier, etc.)
Software composition	Description of the components that constitute software Useful for rebuilding and reusing the software in future	A typical record: binary files, source code, user manuals and tutorials. A more complete record: requirements and design documentation, test cases and harnesses, prototypes, formal proofs.	Representation Information Preservation Description Information (PDI)	Intellectual entities or object entities (environment Function, environment Designation, etc.)
Provenance and ownership	Detailed history of version changes and other significant changes that a software product has undergone facilitates verification of its authenticity Different software components have different and complex licensing conditions.	Software owner and licence information, e.g. Microsoft for MS Word®	Provenance Information category of Preservation Description Information (PDI)	Rights entities (rightsStatement, licenseInformation, etc.)
User interaction	Needs to be included in the preservation planning Description of expected mode of interaction between user and software The 'Look and Feel' and the model of user interaction can play a significant role in the usability of the software and therefore should be considered among its <i>Significant Properties</i> .	The inputs which a user enters through a keyboard, pointing device or other input devices, such as web cameras or speech devices The outputs to screens, plotters, sound processors or other output devices	Not comprehensively addressed in the OAIS – may be categorized as the Significant Properties of software	Agent entities (agentIdentifier, etc.) Event entities (eventDetail, eventOutcome, etc.)
Software environment	Description of the environment that the correct operation of the software depends on Dependencies between software environment related entities and history of changes made to them	Hardware platform, operating system, programming languages and compilers, software libraries, other software products, and access to peripherals. Binaries usually require an exact match of the environment to function	Representation Information	Intellectual entities or object entities (relationshipType, relatedObjectIdentifier, etc.)
Software architecture	Plays a significant part in the reproducibility of the original functionality and features of software	Client/server, peer-to-peer, and grid systems all require different forms of distributed system interaction which would require the configuration of hardware and software to be reproduced to reproduce the correct behavior.	Representation information	Intellectual entities (environmentFunction, etc.)
Operating performance	The performance of the software with respect to its use of resources (as opposed to its performance in replaying its content) Plays a significant part in the reproducible behavior of software. Contributes towards the information needed to measure the overall adequacy of software	Speed of execution, data storage requirements. In some circumstances, we may wish to replay the software at the original operating performance rather than a later improved performance. A notable example of this is games software, which if reproduced at a modern processor's speed would be too fast for a human user to play.	Not comprehensively addressed in the OAIS – may be categorized as the Significant Properties of software	Intellectual entities (environment Designation Note, etc.)

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# Using customer relationship management systems at university libraries: A comparative study between Saudi Arabia and Egypt

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## Abstract

Today, libraries stand in a difficult position that requires exerting efforts to prove their competitive abilities for attracting and satisfying their customers in a virtual environment that has various sources of information. This requires libraries to pay great attention to promoting customer relationship management with their customers for their knowledge development goal plans and strategies to achieve success amidst the current competitive circumstances. The current study aims at surveying the potential implementation of customer relationship management systems in university libraries. This happens through the introduction of the customer relationship management concept to university libraries, the implementation mechanisms of these systems, and the level of the libraries' tendency to adopt them. In addition, the current study surveys the obstacles that confront customer relationship management systems usage in university libraries in Saudi Arabia and Egypt.

## Keywords

CRM, customer relationships, information systems, university libraries

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## Introduction

Today, competitiveness in the world of information institutions is a prominent characteristic. It is imperative for these institutions to look for distinctiveness and points of strength that support them in surviving amidst this competitiveness to closely recognize their customers and their preferences. This is considered one of the most competitive advantages that these institutions can own. The importance and real value of customer relationship management (CRM) systems comes from the fact that they aim at focusing on establishing interdependent relations with customers. CRM helps information specialists to know the types, behaviors and needs of their customers. This is due to the fact that the nature of the information specialist's job is constantly requiring him to deal directly with customers who have different positions, levels and needs. This also aims at continuously meeting

customer expectations, establishing friendly relationships with them, and promoting the greater use of the library which increases its cultural, social, scientific and cognitive role in the society.

## CRM concept

CRM is an administrative scheme that aims at building, organizing and maintaining close relationships with the customers for the longest possible period in order to know their current and projected needs, guarantee their loyalty to the library, and build bridges and interdependent relationships with them.

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CRM is a methodology to understand customers' behavior and influence them through communication in different ways (Munir and Park, 2009). This is done through adoption of an information system that is capable of analyzing and forecasting customer needs and giving suggestions to maintain customers. One example is the simple process of changing a customer's address. The librarian can see:

- If the customer is one of the recurrent visitors to the library during the past year.
- The new address that the customer is moving to and if it is far from the library and close to other competitor libraries.
- If the customer participates in the library's activities.
- The present year is coming to an end, but this visitor did not visit the library frequently, which increases the chance of customer attrition.
- Coefficient of customer loyalty is very weak.
- The system shows a warning message indicating the possibility of losing the library customer by up to 55%.
- The system proposes to the library staff member to make a special offer or additional advantages to the customer to retain him.

The CRM system is an intelligent system that deals with every customer in a different way. It establishes new relationships between database units and elements whenever they are updated or changed. But this does not mean that CRM is only the software application belonging to the Information Technology department or even the Marketing department in the organization, but it is rather a comprehensive strategy for the library that uses and invests in information technology to achieve its objectives. The CRM system starts with deep analysis of customer behavior. It uses information technology to collect data that can be later used to develop the information required for personalized interaction with customers. Hence, CRM systems are tools to organize communications and manage knowledge (Bose, 2002).

### The importance of CRM in libraries

The use of a CRM system in any organization usually aims at achieving profits, but the concept of profit is different from one organization to the other. For example, in commercial institutions and banks, the concept of profit is achieved through increased volumes of sales and savings; while in libraries, the concept of profit is achieved through customer satisfaction which is elucidated in regular visits to the

library. Thus, profitability does not pertain only to financial returns, but extends to the dissemination of science and culture and thus the profitability of the library is shown in its positive impact on the future cultural development of the society in general.

The importance of CRM is manifested in several situations such as increasing rates of customer retention, information provision for marketing information services through studying customers' tendencies and orientations, supposing assumptions about customers' future transactions, and giving a full picture of customers and their needs. This will have a positive impact on affirming the quality of service outputs from the customer's point of view and the library will differentiate itself from competitors and acquire new customers. In addition, this will ensure customers' loyalty to the library; reduce marketing costs through the building of a customer database that facilitates the library's marketing initiatives, increase customers' eagerness to join the library and reduce the number of customers leaving, as well as get some sort of feedback on the library services to reach its customers' satisfaction. CRM focuses not only on how to establish relationships with the customers and keeping them, but rather on establishing the proper relationship with every customer. This will help libraries provide information products on an individual basis in accordance with the requirements of every customer.

### Study problem

The competition today in the virtual world in the area of information access and information services to meet the expected demand is more than a mere competition for meeting the explicit and implicit needs. From this point on, libraries stand in a difficult position that demands exerting greater efforts to know the needs of their users, competing to satisfy them and keeping them from going to competitors.

Customers are the library's real capital and without them the library loses its legitimacy and value. Here CRM comes into play. CRM is an administrative scheme that aims at building, organizing and maintaining a close relationship with the customers for the longest possible period in order to know their current and projected needs, guarantee their loyalty to the library, and build bridges and interdependent relationships with them.

This is in addition to the several challenges that face libraries and other variables that push them to consider new methods to help them survive as one of the information service institutions that seek to continue. The challenges that face libraries can be summarized as follows:

- the current trend towards digital libraries;
- the emergence of a number of institutions and individuals who are producers and marketers of information as an open competition assured by new realities;
- the growing usage of information technology as a strong method for attracting customers in the area of information.

All these factors lead to the need for CRM solutions, where a strong relationship with the customers becomes one of the most competitive advantages of excellence over competitors.

### Study questions

1. What is the CRM concept in libraries?
2. What are the mechanisms of applying CRM in libraries?
3. What are the CRM systems?
4. What is the trend level of the adoption of CRM by Egyptian and Saudi university libraries?
5. What are the obstacles facing CRM in the university libraries?

### Study objectives

1. Identifying the concept of CRM in libraries.
2. Identifying stages and mechanisms of applying CRM in libraries.
3. Identifying different CRM systems.
4. Exposing the studied libraries' adoption level of CRM.
5. Exploring the obstacles facing relevant libraries in adopting an integrated CRM system.
6. Increasing the efficiency and effectiveness of CRM at information organizations.

### Study methodology

The study used the descriptive analytical methodology because it is suitable for the nature of the subject matter of the study which aims at identifying the trend level of Egyptian and Saudi university libraries' adoption of CRM. In addition, this study uses the comparative methodology which helps identifying the similarities and differences between the Egyptian and Saudi university libraries as regards the availability of the requirements of CRM systems. To achieve the objectives of the study, the two researchers designed a questionnaire using CRM-relevant literature. The questionnaire contained three areas: the first area dealt with the characteristics of the study community, while the second area handled CRM in the library, and the third and last area covered the obstacles facing CRM in libraries.

### Study community

The study community consisted of the oldest and largest universities in Saudi Arabia and Egypt, represented by King Saud University in Riyadh and the King Abdul Aziz University in Jeddah, Saudi Arabia. In addition, this also covers Cairo University and the University of Alexandria in Egypt. The total number of personnel who participated in the study was 104 library staff members.

### Literature review

The move toward more customer-centric direction can be traced back to the 1960s when the focus of marketing started to shift from managing products or marketing campaigns to managing the profitability of each individual customer over the entire life of the relationship (Wang, 2007). The paradigm shift has brought lots of discussions on "relationship marketing" since the 1980s (Berry, 1983). Since then, many studies have focused on CRM. Despite several studies that handled CRM in various domains, not enough attention has been given by Arab researchers to CRM in the librarianship and information domain. Reading through the available literature, it became evident to both researchers that no previous Arab studies have addressed this subject area, and it became also obvious that foreign literature in this subject area is also scarce.

Broadly-Preston et al. (2006) analyzed the results of two studies conducted at the Library of Malta University in 2003–2004 and at the Lanchester Library of Coventry University (UK) in 2005–2006 to discover the relationship between library staff and customers through the use of CRM applications. The majority of participants in both survey studies reported that they maintained good personal relationships with library staff. The results of the analysis confirmed that building a CRM system between university college staff members and the library takes a long time. Moreover, the relationship between the customer and the library in this case is much more than a remote personal communication. The study pointed out that to create added value in the service requires the establishment, management and support of ties with customers in the long term.

The results of the analysis also confirmed that university libraries are now working largely in a competitive environment; and in order for them to maintain their clients, they need to strive toward building good and continuing relations with university staff members. The two studies' findings further confirmed that building strong relationships with customers led to

improvements in the quality of service provision in their universities.

A study by Wang (2007) unveils the obstacles that emerged when planning for CRM in a case study of an academic library in Taiwan. The results show that librarians have insufficient experience as regards CRM usage and implementation. They also prove that the biggest challenge facing libraries is raising internal awareness of the functions and capabilities that CRM can provide, and educating library staff on how these functions work. The study confirms that adopting the concept of CRM is one of the possible solutions to ensure customer satisfaction, especially when libraries are facing challenges that arise from increasing number of information service channels, the information explosion, and increasing customer expectations.

Wang (2012) seeks also to extend the resource-based view of the context of CRM. This study is intended to develop a measurement model of CRM capabilities, and to explore the key antecedents and performance consequences of CRM capabilities.

A study by Jamali et al. (2013) developed a valid and reliable method for evaluating and measuring the management relationship level with customers in e-libraries. In addition, the research tries to determine how successful Yazd University Libraries, (Iran) have been in meeting students' expectations, as a guideline to take steps toward improving its services.

In all, the present literature review showed that no studies were undertaken on CRM in Arab libraries, therefore there is a need for conducting such a study to evaluate the situation of Arab libraries. The two researchers hope that this study contributes to filling a major gap in the scarce specialized literature on this subject.

## Mechanisms of applying CRM at libraries

### *First: Knowing library users*

Good knowledge of library users is the starting point for CRM strategy. Acquiring this knowledge happens in two stages:

First stage: the compilation of the largest possible amount of customer data such as (Swift, 2000: 67):

- Demographic data: such as age, gender, position, nationality, etc.
- Contact information: Phone numbers, email, personal website, and favorite means of communication: (SMS, WhatsApp, Line, Skype, etc.)

- Hobbies and interests: reading preferences and needed service requirements.
- Libraries that the customer deals with: library address, favorite services, and the best characteristics of the library.

Second stage: The behavior analysis of the customers' usage of the library through analyzing:

- the behavior of searching for information;
- the method of raising queries and preferred way to submit inquiries;
- the extent of accepting new services introduced by the library;
- the extent of accepting to use information technology;
- the preferred information resources format: print or electronic;
- the analysis of logon files to different library servers such as WebServer and OCLC, etc.

### *Second: Creating data warehouse*

A data warehouse is created to combine all the data available about customers. Generally, the data warehouse contains the following:

- customer's data: personal and demographic data;
- customer's transactional register: includes all the customer's services and activities with the library;
- complaints register: includes complaints submitted by the customer, what happened with them, and the contact person (employee) who deals with the complaints;
- customer's proposals: periodically registers customer's proposals;
- results of previous researches and studies concerning categories of library customers.

### *Third: Setting evaluation criteria*

CRM cannot be effectively applied unless appropriate criteria are used to achieve its demands. Among these criteria lie the rates of customer retention, rates of customer classification according to their frequency in visiting the library, rates of the services and activities in the library during a week, degree of customer satisfaction and degree of customer loyalty.

A distinction must be made between customer satisfaction and its criteria and customer loyalty. Table 1 shows the basic criteria that can be used to measure customer satisfaction

**Table 1.** Criteria for measuring customer satisfaction (Suleiman, 2010).

M	The standard	Its content
1	Sufficiency	How sufficient the service is to the needs of the customer
2	Efficiency	Personnel providing the service possess the skills necessary for service submission
3	Comfort	Availability of comfort means for the customer in the library
4	Communication	The availability of communications between the library and the customers
5	Flexibility	The degree of library flexibility in dealing with its customers
6	Commitment	The degree of library commitment towards the services provided to the customers
7	Assistance	The degree of the librarian's readiness to help customers
8	Tactfulness	The extent of the diplomacy by librarians with the customers
9	Responsiveness	The degree of responsiveness of the librarian to requests from the customers
10	Caring	The degree of librarian's attention to the customers
11	Access	The customer's ease of access to the service
12	Creativity	The extent of the library's attention to provide its services in a creative way

There is no doubt that customer satisfaction would lead to customer loyalty. Loyalty is the deep commitment of the customer to the use of the library in the future, despite the several other alternatives. There are numerous measures of the customer's loyalty, but this can be noticed through the customer's continuous transactions with the library, giving positive opinions towards the library, the ratio of the customer's transactions with the library to the total transactions with other libraries, and the customer's preference to use the library more than any other alternative (Beerli et al., 2004).

#### *Fourth: Classifying customers*

After identifying customers and collecting information about them in the data warehouse and setting evaluation criteria, the next step is to classify customers, depending on their frequency of using the library and leveraging its services. Customers can be classified as follows: top customers, medium customers, small customers, inactive customers and prospective customers.

#### *Fifth: Communicating with customers*

Communication is a key to building relationships. Interaction and communication with customers is the most important factor that leads to increasing the effectiveness of CRM. There are two main ways the CRM system can be used in an attempt to reach and communicate with customers:

1. Human Interaction: where the information specialist here is a mediator between the customer relationships system and the customers themselves. This depends on direct communication with them or through the phone.

2. Automated Interaction: integrated systems and the Internet are used to interact with the customers.

CRM requires a number of important changes to happen in the libraries such as transition from transactions to relationships. This aims at consolidating long-term relationships with customers. Libraries usually consider daily transactions the only ties that link them to customers, and they are rarely keen on transforming these transient transactions to permanent relationships. CRM aims at promoting relationships rather than transactions. A variety of studies proved that establishing relationships with the customers is the best way to increase their loyalty (Swift, 2000: 12–15).

#### **CRM life cycle**

CRM operations can be classified according to the relationship with the service recipient cycle into three stages as follows.

##### *First stage: Identifying and attracting customers*

The library tries at this stage to identify the consumers of its services and activities then tries to attract them through presenting distinguished and innovative services. This is the role of innovation where the aspiration to lead and the search for new competitive advantage are the motive for innovations, not only in delivering services but also in its marketing methodology by creating an integrated marketing mix corresponding to the challenge of other information institutions interested in delivering the library services (Azzawi and Salman, 2009).

### *Second stage: Retaining customers*

Library customers are retained through the identification and response to their current and projected needs in advance, the reduction of response time to provide services, the non-discrimination between customers in getting the services, the commitment to deliver the information resources, the follow-up to improve the service performance and deliver services in a high-quality style, and paying attention to quickly respond and address complaints. This phase increases the customer's trust and loyalty to the library. Simmonds and Andleeb (2001) found that the more frequently the customer visits the library; the more ways the library staff members find to boost familiarity with the customer. The process of measuring customer needs is one of the main pillars to develop services and retain customers. There are multiple methods to measure customer needs, such as:

#### 1. Complaints and suggestions

Through this method, customer complaints about the services provided by the library or complaints from the librarians and customer suggestions for improving the service are identified. Some believe (Barlow and Moller, 2008) that complaints are the customer's gift to the organization and therefore the organization should be grateful to the customer. Customer complaints include expectations of the disappointed customer or customer expectations that have not been satisfied and therefore the customer through complaining gives the library the opportunity to bridge the gap between what the customers want and what happens in reality in the library. Accordingly, complaints are considered a diagnostic tool and neglecting complaints leads to many problems including the failure to develop the service, customer attrition and increasing strength of competitor.

#### 2. Directly asking the customer

This is a traditional way to identify problems that the customer faced during the provision of the service and to make suggestions to resolve these problems.

#### 3. Expectations gap method

Through this method, a comparison between the customer expectations from the service and what has been achieved by the actual library output is performed.

#### 4. Comparison with others method

Through this method, measuring the library service output impact on the customer and comparing it with the same service output by another library is performed; then an improvement in the service based on comparing the results with others is sought.

From the results of the previous modalities, the library can recognize the reality of the service it provides and then work on developing performance. This should help the library retain its customers and secure their continuous communications with the library.

### *Third stage: Recovering lost customers*

In this stage the library tries to identify the inactive customers from the data warehouse and decide upon the main reasons that lead to their dropout by choosing a sample from the customers and contacting them to precisely identify why they left the library. The reasons are regularly the failure of the library to meet customer needs, the library does not perform special studies on customer satisfaction, customers cannot adapt and harmonize with the librarian, library opening times are inadequate for customers, the library does not consider customer complaints, the spread of some negative views of the library in social networks, and not having a digital library in the library.

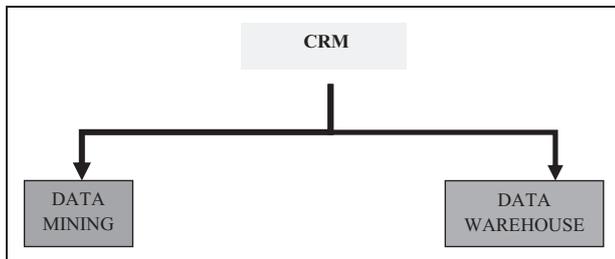
Customer dropout is a serious failure sign and a proof of shrink back in the value level that the library provides to the customer. Therefore, once the library identifies the true reasons that led to a customer's departure, strategies must be developed to obtain their satisfaction again and recover them through the development of a genuine plan that includes the setup of an appropriate program for this purpose, taking the current needs of the customers into consideration.

### **CRM system**

The CRM system is used to create accounts for the library users, follow up all of their activities, track all necessary communications with them, register all the events which occur daily, submit various reports and take the necessary actions for the improving customer services. Therefore, this system represents the electronic process that handles the relationship between the library and its users.

The management of a library's customer relationship in software industry is called a "CRM system". The CRM software products create an integrative climate between the users and the library in order to enhance and strengthen the relationship between the library and its users, despite the different nature and categories of users, to achieve better service for the customer through analysis of various types of communications with him. This is done through the compilation of data from these communications, whether they are audibly recorded via the phone or read from written scripts, and then placing them in an advanced electronic environment that reserves and categorizes them accordingly. This allows communications to be analyzed, studied and understood in an easy and useful

way for decision makers in institutions in order to formulate smarter service strategies and become closer to the real needs of the library users. These software products are 'intelligent' information systems that allow the organization to possess the data warehouse that is full of the library users' data (Kamal, 2002). Figure 1 shows the basic components of the CRM system.



**Figure 1.** Components of the CRM system.

The functions which CRM systems perform are divided into operational tasks carried out by the Operations Department. Operations is responsible for collecting users' information and it handles the data warehouse and analytical functions that analyzes this stored information through the use of data mining technology to make this information useful. The analytical side devises several relations from this information to extract new user-related knowledge that is useful in the development of the service provided to the user or in the provision of additional services related to the user (Fouad, 2013: 53–54). Thus, the CRM software is an intelligent and advanced tool that contributes to improving the performance of the enterprise and upgrading its services (Kamal, 2002). Figure 1 shows the basic components of the CRM system.

There are several options for libraries to adopt a CRM system, (Fouad, 2013: 53–56).

1. Building a local system.
2. Purchasing ready-made software package.
3. Using cloud computing applications.
4. Open source CRM software applications.

There are several open source CRM solutions that can be downloaded from the Internet, and such programs allow any library the possibility to amend the source code according to the library requirements. For example, Sugar CRM Community Edition software program (<http://www.sugarcrm.com>) and the open source software SourceForge (<http://sourceforge.net>) include a number of CRM solutions (Arnold, 2013).

It can be said that the library automation system and the CRM system are complementary, since the first focuses on maximizing operational efficiency

and effectiveness in managing library source; while the second aims at adding value to the relationship between the library and the customer (Wang, 2007).

Numerous libraries used CRM systems for sustaining customer satisfaction, including Alsom Malta University library and Coventry University's Lanchester library (UK) (Wang, 2008).

### Competitive advantages of library's adoption of CRM system

Numerous competitive advantages emerge when the library adopts a CRM system, as follows:

- an increase in customer satisfaction ratings due to customers' feeling that the library is more capable of understanding their needs and that it is quickly and efficiently responding to them (Swift, 2000: 12–15);
- the development and improvement of the service through the data that has been collected in a data warehouse then accurately and objectively analyzed and used as inputs in directing decisions related to improving the service;
- improving and developing communication ways with the customer and increasing the effectiveness of self services provided to the customer;
- an increase in the customer retention percentage.

### Reasons for CRM systems implementation failure

There are different reasons that lead to the failure of CRM systems implementation in information institutions such as the following:

- the prevailing belief that purchasing the best CRM software will guarantee the efficiency of library outputs;
- staff resistance to change, especially veterans, which negatively affects the implementation of the CRM. The solution is often the training programs that help staff absorb the aim of CRM and how the system can help them provide better service to customers;
- the rush towards the implementation of CRM solution in one shot, while this should be divided into phases and every phase should be accurately completed;
- the decreased level of awareness of the concept of CRM since the Arabic region is in fact far from possessing a real idea and understanding of the nature of work of the CRM applications. (Kamal, 2002)

## Field study and results

### First axis: Backgrounds of the respondents

This includes characteristics of the participants who filled in the survey in Saudi and Egyptian university libraries.

**Table 2.** Analytical results of variable type.

Country	Saudi Arabia		Egypt		Total
	Male	Female	Male	Female	
Type					
No. of staff members	25	28	16	35	104
Percentage	47.2	52.8	31.4	68.6	100

Total number of personnel according to Table 2 who participated in the study is 104 people working in university libraries of Saudi Arabia and Egypt. The larger percentage of workers in the university libraries are females.

It is evident from Table 3 that the ages of study participants vary from (20–40 years).

It is evident from Table 4 that scientific levels of library staff members vary. Only in Saudi university libraries are there staff members who hold public high school qualification with a rate of (8.6%), while the greater percentage of workers in both Egyptian and Saudi university libraries (73.04% of the total participants in the study) have a Bachelor's qualification.

Table 5 shows that most of the participating employees from university libraries in Saudi Arabia and Egypt work in the Services department, the Organization department and the Computer & Databases department.

### Second axis: Customer relationships in the library

This axis addresses to what extent librarians perceive the concept of CRM and mechanisms of implementing CRM systems in libraries and the libraries' adoption level of CRM systems.

Table 6 shows the CRM concept from the point of view of the participants in the study. It also shows that the workers in Saudi university libraries think that providing distinguished services to customers is the most important concept that expresses CRM systems; while (64.7%) of the personnel involved in the study from Egyptian university libraries see that the CRM concept is embodied in the marketing of the library services and products to the customers. We can deduce from the answers of the participants in the study from both Saudi Arabia and Egypt that the CRM concept is leaning towards the services provided by the library as a final product.

Table 7 shows that the great majority of study participants (98.1%) see the importance of the CRM system at the library. The high percentage represents almost all the participants of the study except for one participant from one Saudi Arabian university.

Table 8 is one of the most important pivots of the current study because it shows the degree to which CRM system basics in libraries participating in the study vary from the point of view of participants. By calculating the standard deviation of the degree of availability of these basics in Saudi and Egyptian university libraries, it becomes clear that the element of "Using information technologies to interact and communicate with customers" is the most available element in the Saudi university libraries with a standard deviation of 11.8; while the element of "Adopting statistical indicators for measuring library usage and percentage of customer growth, etc. and using them in developing library plans" is the most

**Table 3.** Analytical results according to age variable.

Age	Between 20–25	Between 25–30	Between 30–35	Between 35–40	More than 40	Total
Saudi Arabia	3	9	16	8	17	53
Egypt	6	20	17	5	3	51
No. of staff members	9	29	33	13	20	104
Percentage	8.7	27.9	31.7	12.5	19.2	100

**Table 4.** Analytical results of Scientific Level Variable.

Age	Secondary education	University level	Master's degree	Doctorate degree	Total
Saudi Arabia	9	36	7	1	53
Egypt	-	40	11	-	51
Total	9	76	18	1	104
Percentage	8.6	73.04	17.4	0.96	100

**Table 5.** Analytical results of employee's department variable.

	Administration	Services Department	Organization Department	Acquisition Department	Computer & Databases	Other	Total
Saudi Arabia	10	20	7	3	4	9	53
Egypt	2	16	14	2	15	2	51
Total	12	36	21	5	19	11	104
Percentage	11.5	34.6	20.23	4.8	18.3	10.6	100

**Table 6.** Analytical results of librarians' perception of (CRM).

The CRM concept	Saudi Arabia	Saudi Arabia	Egypt	%
Providing distinguished services to customers	42	79.2	29	56.8
Marketing library services, resources and products to the customers	22	41.5	33	64.7
The electronic process that handles the relationship between the customer and the library	12	22.6	13	25.4
The process that strengthens the customers' loyalty to the library	17	32.1	18	35.2
Building a close relationship with customers to retain them	17	32.1	27	52.9
Other opinions	2	3.7	1	1.9

**Table 7.** Analytical results of significance of applying CRM in libraries.

Significance of adopting CRM	Saudi Arabia		Egypt	
	Egypt	%	Yes	%
Yes	52	98.1	51	100
No	98.1	1.8	0	0
Total	53	100	51	100%

available element in Egyptian university libraries with a standard deviation of 11.8.

The weakest basis for building a CRM system in both the Saudi Arabian and Egyptian university libraries is the element of "Storing all customer inquiries in a repository" with a standard deviation of 6.2 in the Saudi university libraries and a standard deviation in the Egyptian university libraries of 2.2, which refers to the insufficient interest in the university libraries in Egypt and Saudi Arabia to collect and store customer inquiries.

We also find a decrease in the value of the element "Identifying and monitoring inactive customers" in the Egyptian university libraries with a standard deviation of 2.1, in contrast to the Saudi university libraries, where the value of this element has a standard deviation of 8.5, which refers to a weakness in the monitoring of customers at the Egyptian university libraries.

There is also a decrease in the standard deviation value in the element of "Comparing library services

with services provided by other libraries to improve and develop the quality of provided services" in both Egyptian and Saudi university libraries which refers to the participants' poor understanding of the concept of competitiveness. Understanding the concept of competitive behavior has an important role in the comparison with others.

### *Third axis: Obstacle facing the application of CRM systems in university libraries*

This axis discusses possible obstacles in applying CRM systems in the Egyptian and Saudi university libraries and reveals these obstacles.

Based on (Table 9) frequency data shows that 82.3% of workers in the Egyptian university libraries and 45.3% of workers in the Saudi Arabian university libraries have obstacles that hinder the implementation of CRM systems. Table 10 reveals these obstacles.

Table 10 shows that there are a number of constraints that prevent the application of CRM systems at Saudi and Egyptian university libraries. The most important obstacles at Saudi Arabian university libraries, according to the standard deviation order, are the following:

1. resistance of involved staff members to CRM;
2. lack of awareness of the importance of CRM;
3. shortage of financial allocations needed for CRM;
4. lack of trained personnel to manage CRM.

**Table 8.** Availability of customer relationships management basics in the participating libraries.

	Kingdom of Saudi Arabia										Arab Republic of Egypt									
	Strongly Agree					Disagree					Strongly Agree					Disagree				
	T	%	T	%	T	%	T	%	T	%	T	%	T	%	T	%	T	%	T	%
	Standard Deviation					Standard Deviation					Standard Deviation					Standard Deviation				
Basics of CRM in libraries																				
1	21	39.6	27	50.9	3	5.7	2	3.8			24	47.1	10	19.6	8	15.7	9	17.9	6.8	
2	10	18.9	32	60.4	7	13.1	4	7.5			16	31.4	16	31.4	13	2	6	11.8	4.1	
3	15	28.3	26	49	10	18.9	2	3.7			15	29.4	21	41.2	7	13.7	8	15.7	5.6	
4	11	20.7	26	49	9	16.9	7	13.2			16	31.4	6	11.7	18	35.8	11	21.5	4.6	
5	17	32	26	49	7	13.2	3	5.6			20	39.2	16	31.4	7	13.7	8	15.7	4.9	
6	10	18.9	29	54.7	12	22.6	2	3.7			17	33.3	6	11.7	10	19.6	18	35.2	4.9	
7	13	24.5	26	49	11	20.7	3	5.6			19	37.2	21	41.1	7	13.7	4	7.8	6.2	
8	7	13.2	26	49	14	26.4	6	11.3			17	33.3	14	27.4	9	17.6	11	21.5	3.1	
9	15	28.3	27	50.9	7	13.2	4	7.5			21	41.1	21	41.1	7	13.7	2	3.9	8.4	
10	10	18.9	23	43.3	14	26.4	6	11.3			13	25.4	15	29.4	9	17.6	14	27.4	2.2	
11	4	7.5	16	30	26	49	7	13.2			16	31.3	12	23.5	13	25.4	10	19.6	2.1	
12	20	37.7	25	47.1	7	16.9	1	1.8			25	49	15	29.4	6	11.7	5	9.8	8.1	
13	24	45.2	21	39.6	7	13.2	1	1.8			21	41.1	14	27.4	9	17.6	7	13.7	5.4	
14	20	37.7	19	35.8	12	22.6	2	3.7			15	29.4	17	33.3	9	17.6	10	19.6	3.3	
15	22	41.5	22	41.5	7	13.2	2	3.7			32	62.7	13	25.4	4	7.8	2	3.9	11.8	
16	23	43.3	27	50.9	2	7.5	1	1.8			28	54.9	14	27.4	3	5.8	6	11.8	9.6	
17	24	45.2	22	41.5	4	7.5	3	5.6			24	47.1	10	19.6	11	21.5	6	11.8	6.7	
18	23	43.3	26	52.8	3	7.5	1	1.8			13	25.4	19	37.2	9	17.6	10	19.6	3.8	
19	11	20.7	25	47.2	14	26.4	4	7.5			5	9.8	9	17.6	19	37.2	18	35.2	5.9	
20	6	11.3	22	41.5	20	37.7	5	9.4			12	23.5	25	49	9	17.6	5	9.8	7.4	



6. Marketing of library services.
  7. Systematic and frequent measurement of user satisfaction.
- The study demonstrated that a large percentage of participants believe that there are obstacles to the application of CRM systems in university libraries. Obstacles in the Egyptian university libraries (83.3% per survey) mainly include the lack of financial resources allocated to the CRM and the lack of technology and software solutions due to high price of CRM software that can help in the management of customer relationships. Obstacles in the Saudi university libraries (45.3% per survey) center on relevant staff resistance of CRM
  - The study has shown that a large percentage of participants believe that there are obstacles to the application of CRM at university libraries since 45.3% of the participants at the Saudi Arabian university libraries confirmed this; while the majority of participants from the Egyptian universities reported a number of obstacles by the rate of 82.3%. Obstacles in the Egyptian university libraries centered around the shortage of financial resources needed for CRM and the lack of software and technologies that help in the management of CRM. Obstacles in the Saudi Arabian university libraries **centrated** around the resistance of relevant staff members to CRM.

### Recommendations

The study recommends the following:

- The CRM concept and its applications are promising and information institutions are expected to succeed when adopting an integrated CRM system. The system's success depends on the ability of workers to absorb its concepts and find unconventional forms of application when using the system for customer communication.
- University libraries should adopt the CRM system as an integrated strategy that has a vision, mission statement and objectives to achieve with the support of the highest university senior level. Staff members should get training on the system in order to strengthen and support the Arab universities' positions.
- A department or unit for the CRM should be established in the library to collect and analyze customers' data and transactions and link the

analysis output with other departments to find integration between various units of the library then provide a better service that achieves the highest levels of customer satisfaction and loyalty.

- A database that contains detailed and accurate data about current prospective customers of university libraries should be created. New services suitable to customer interests and needs should be developed to ensure the correct orientation of the CRM in the present and the future.
- Library staff members should be encouraged to forge connections with the customers and should be motivated to create initiatives to strengthen relationships between the library and its customers because technology alone cannot do so.
- Criteria for measuring and evaluating performance of CRM systems in university libraries should be accredited.
- CRM is a new concept, particularly in the Arabic libraries; therefore, there is an urgent need for further research studies in various types of information institutions.

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# Undergraduates' assessment of Science, Technology, Engineering and Mathematics (STEM) information literacy instruction

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## Abstract

Information literacy instruction is of value to the educational process and is an important contributor to the academic library's efforts to communicate its value. Similarly, Science, Technology, Engineering and Mathematics (STEM) is an important contributor to development. Recognizing the value in information literacy instruction and STEM, the University of the West Indies Mona, Science Branch Library delivers embedded STEM information literacy instruction to students. An assessment of this is instructive on many levels; consequently, this paper seeks to determine undergraduates' perception of (a) the curriculum delivered and the extent to which it provided the opportunity to learn new information and skills and (b) the facilitators' performance. A self-reported measure (survey) was used to capture these perceptions. A direct testing measure (test) was administered to add value to students' reported perception. This paper reveals students have a positive perception of the facilitators' performance, the STEM information literacy instruction curriculum and the opportunities it provided for learning new information and skills. The findings also provide recommendations for improvement. The paper does not seek to measure the effectiveness of STEM information literacy instruction nor does it seek to measure whether learning has occurred. This paper is of value as assessment provides useful information for monitoring the effectiveness of what is being taught, how it is being delivered, for improving performance and providing benchmarking. Given STEM's and information literacy instruction's importance to higher education, its assessment can direct the success of future sessions and ultimately impact the quality of higher education. Additionally, given STEM is a burgeoning concept in Jamaica and that the resultant literature on STEM in Jamaica is in a developing stage, any documented work on STEM-related activities has value and this paper is the first of its kind in Jamaica.

## Keywords

Information literacy instruction, Science, Technology, Engineering and Mathematics, STEM

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## Introduction

“Embedding information literacy into the curriculum is essential because of the information explosion and the need to access electronic sources of information. This has made it critical that evaluation of resources, computer literacy and use of electronic sources be integrated into the curriculum” (Crebert et al., 2011: 6). While embedding information literacy instruction (ILI) in the curriculum is important, an assessment of ILI is also important. “Assessment in institutions of higher education is being driven by demands for accountability from legislators, trustees, and

accrediting agencies. These assessment efforts are now expanding to library instruction programs” (Pausch and Popp, 2015: 3); which is not surprising given libraries are a critical component of the institutional complement. Therefore, “the assessment of ILI is of increasing importance, as institutions seek to improve the effectiveness of their ILI programs and

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as they are required to provide evidence of this effectiveness both internally and to external agencies and the public” (Pausch and Popp, 2015: 3). Amidst the need for ILI in the curriculum and the need for the assessment of ILI, is the growing importance of the concept Science, Technology, Engineering and Mathematics (STEM), its nexus with development and the role of the academic library in enhancing awareness of STEM. However, the literature on STEM in academic libraries in Jamaica is extremely limited and Jamaican libraries’ activities in STEM need to be strengthened. Harris (2013) (who has authored the only work on academic libraries and STEM in Jamaica) notes that while STEM has been given a renewed focus in Jamaica, more emphasis on the acronym ‘STEM’ is needed. In this regard she notes there is the need to re-brand courses, activities and organizations to give accent to this concept and that given librarians’ role as information gatekeepers they must activate awareness of STEM resources and they must re-evaluate and strengthen the library’s place in STEM education. It is against this background that the University of the West Indies (UWI) Mona, Science Branch Library (SBL) has re-branded its ILI sessions as STEM ILI to give accent to the STEM concept, activate awareness of STEM resources and in doing so simultaneously strengthen the library’s place in STEM, give focus to ILI, which has become essential because of the information explosion and give attention to the assessment of ILI, which has become important because of the need for accountability. Accordingly, this paper seeks to describe and analyse undergraduates’ assessment of these STEM ILI sessions, particularly with respect to their perception regarding: the facilitators’ performance, the STEM ILI curriculum delivered and the extent to which it provided the opportunity to learn new information and skills. This therefore informed this paper’s research questions: (1a) How do undergraduates perceive the STEM ILI curriculum delivered? (1b) To what extent does the STEM ILI curriculum provide opportunities to learn new information and skills? (2) How do undergraduates perceive the facilitators’ performance? This paper sought to respond to these questions through a survey of the perceptions of undergraduates from the Faculty of Science and Technology (FST), UWI Mona, who completed a two-hour embedded STEM ILI session. The survey was administered by the librarian at the end of the STEM ILI session, which solicited responses regarding students’ perceptions about the STEM ILI curriculum delivered, and the extent to which it provided the opportunity to learn new information and skills as well as regarding the facilitators’

performance. To enhance the validity of the responses, particularly with respect to the extent to which the curriculum provided the opportunity to learn new information and skills, a 30-minute multiple choice question (MCQ) test was administered by the librarian, at the end of the session and under examination conditions, which contributed to 5% of the students’ grade for the course in which the STEM ILI was embedded.

This paper is of value as assessment and in this instance, students’ perception, provides useful information to monitor the effectiveness of STEM ILI and for the overall improvement of the STEM ILI. Given ILI’s importance to higher education, an assessment of STEM ILI is not only integral to the success of the instructional program but also ultimately impacts the quality of higher education in the FST at the UWI Mona. This paper also provides useful information to the UWI Mona library as well as to other STEM libraries in Jamaica and the Caribbean who are yet to introduce or who have already introduced STEM ILI within their parent institution. Additionally, given that STEM is a burgeoning concept in Jamaica and that the resultant literature on STEM in Jamaica is in a developing stage; any documented work on STEM-related activities has value.

This paper does not seek to measure the effectiveness of STEM ILI, nor does it seek to measure whether learning has occurred. As per title, this study seeks to describe and analyse students’ assessment (perception) of the STEM ILI curriculum with respect to its delivery, the opportunities it provided for learning new information and skills, and the facilitators’ performance. However, in doing so, the responses students give allude to the value and effectiveness of the STEM ILI through their lens and one can draw inferences from these responses about the value/effectiveness of the STEM ILI; however, these should be read within the context that these are based on students’ perception of the STEM ILI. The MCQ test seeks only to add value to students’ reported perception; it does not seek to measure whether learning has occurred. Therefore, all inferences and conclusions should be read against this background. There is certainly room for assessing the extent to which perception is consistent with demonstrated skills, which could be the basis for a follow-up study. In this regard this research and the resultant paper may be regarded as representing a useful start.

### **The UWI Mona library system and information literacy instruction**

The UWI Mona library system comprises five libraries: the Main Library, the Science, Medical and

Law Branch Libraries as well as the Western Jamaica Campus Library. ILI is a recurrent strategic objective of the UWI Mona library. The library believes IL competencies have the potential to assist faculty and students to become critical thinkers and lifelong learners. The library therefore collaborates with faculty to ensure students receive the requisite training to develop these competencies and ultimately produce better research papers. The training aims to empower students to: locate scholarly resources efficiently, acquire or improve their research skills, improve the quality of academic assignment and reference work correctly to avoid plagiarism.

In 2001, the Mona Information Literacy Unit (MILU) was set up in the Main Library to coordinate all the ILI of the UWI Mona library. Consequently, although MILU is physically located within the Main Library, its services are delivered throughout all the libraries within the UWI Mona library system. The unit seeks to ensure all students are equipped with the necessary IL competencies to empower them to become lifelong learners, as articulated by the university's administration. Consistent with this objective each library within the UWI Mona library system seeks to modify the delivery of ILI to their respective faculty. By way of example, the Science Branch Library (SBL) modifies its ILI to meet the needs of STEM information seeking students within the Faculty of Science and Technology (FST). Table 1 shows the number of FST students reached during the last five years.

**Table 1.** Number of students reached in STEM IL sessions.

Academic years	No. of students reached in STEM IL sessions	Faculty of Science & Technology (new & returning students)
2011–2012	301	2503
2012–2013	341	2561
2013–2014	396	2663
2014–2015	404	2789
2015–2016	247	2723

## Literature review

The literature on academic libraries and STEM is generally limited and this is an observation underscored by Subramaniam et al. (2012: 163) who note “despite the tremendous interest surrounding young people and STEM education, the role of school libraries in these initiatives is rarely examined”. This is also true of the Jamaican situation. STEM is a burgeoning concept in Jamaica and perhaps

consequently, the literature on STEM and Jamaican academic librarianship is limited; there is only one paper written on STEM and Jamaican academic librarianship and this is a paper authored by Sasekea Harris (2013) on “Enhancing awareness of STEM in academic libraries: A Jamaican case study”. Similarly, although ILI has been around for sometime, the literature on STEM ILI in Jamaica is non-existent. Also, although STEM has been given a renewed focus in Jamaica as is evident in a number of initiatives, namely: the establishment of organizations such as the National Commission on Science and Technology (NCST), which is an advisory body to the government on policies and strategies relating to STEM; the strengthening of the Scientific and Technical Information Network (STIN) that increased access to STEM resources; the launch of the National Innovation Awards for Science and Technology in November 2005; the conference held at the University of the West Indies (UWI) Mona Campus, 5 February 2013, under the theme: “Science, Technology, Engineering and Mathematics (STEM): For Innovation and Economic Prosperity”; and the re-branding of the UWI's Faculty of Pure and Applied Sciences at the Mona Campus as the Faculty of Science and Technology, more emphasis on the acronym STEM is needed in a number of areas, one of which is ILI. Given (a) ILI's importance in academic libraries' efforts to communicate their value, as observed by (Pausch and Popp, 2015); (b) the nexus between science, technology and development as per works of National Commission on Science and Technology et al. (2004: 9) and Ventura (2005: 4); and (c) ILI's impact on higher education as per works of Jarson (2010) and Kasowitz-Scheer and Pasqualoni (2002), more emphasis is needed on STEM ILI, particularly in Jamaica. This provided the basis for the development of the particular research questions for this paper. Further, given these gaps in the literature, this section focuses on a general assessment of ILI, the observations of which were used to inform this paper's assessment of STEM ILI – the results of which will provide the first attempt at filling the gap, although incremental, in the literature on STEM ILI in Jamaican academic librarianship.

## Options for assessment of information literacy instruction sessions

There are a number of assessment options and librarians will need to investigate these and decide on which to implement. A review of the literature reveals options for the assessment of ILI are no different from regular methods employed in the assessment of general teaching. Based on the review of the literature,

this paper has categorized the options for assessment of ILI into the following: traditional vs. non-traditional; traditional vs. authentic; classroom assessment vs. non-classroom assessment; qualitative vs. quantitative; non-measures vs. indirect measures vs. direct measures; diagnostic vs. formative vs. summative; and self-assessment vs. artefact/expert assessment. It is worth noting that these categories are not necessarily mutually exclusive and therefore there are overlaps.

*Traditional vs. non-traditional assessment.* “In today’s universities and colleges, library instruction encompasses a variety of methods, especially the traditional single-class instruction session, credit courses or parts of credit courses, workbooks, and handouts” (Pausch and Popp, 2015: 3). In-class exercises, which were found to be a common method used in the library system at the University of Pittsburgh can be placed in this category. Non-traditional options for assessment included the use of the World Wide Web (WWW) and games. According to Pausch and Popp (2015) the WWW is being increasingly used to present information and tutorials particularly because academic libraries are increasingly involved in distance education. Tewell and Angell (2015) found students who played online games improved significantly more from pre-test to post-test than students who received a lecture in lieu of playing online games, suggesting that participating in games related to the instruction they received resulted in an improved ability to select appropriate keywords and ascertain citation formats.

*Traditional assessment vs. authentic assessment.* Authentic assessment refers to a learner-centred model of evaluation where a ‘holistic’ impression of assessment is gathered using authentic student work (Carbery and Leahy, 2015: 76); it includes asking students to perform real world applications (Mueller, 2014). Carbery and Leahy (2015), Mueller (2014), Booth et al. (2014) and Biggs and Tang (2011) [order] highlight authentic assessment as a viable ILI assessment option. Carbery and Leahy (2015) and Rinto (2013) cite rubrics and annotated bibliographies as examples of authentic assessment. Mueller (2014) also cites rubrics and adds scoring scales and portfolios as further examples; Bennett and Brothen (2010) note citation analyses as an option as well. Carbery and Leahy (2015: 79) rubric however consists of five criteria: presence of a thesis, variety of sources, quality of citations, completeness of annotations, and holistic impression and they also used a citation analysis checklist to assess ILI. The citation analysis checklist

was designed as a metric tool to help understand how students find information for their academic research; for example they were able to track students’ item-level citations and review them for evidence of library collections usage and for the types of resources used: scholarly vs. popular sources (Carbery and Leahy, 2015: 80). Mueller (2014), however, notes the use of authentic assessment is not meant to suggest you have to choose between traditional assessments such as tests and more authentic or performance assessments.

*Classroom assessment vs. non-classroom assessment.* Instructional efforts also focus on non-classroom activities such as: computer-based learning (especially in the case of distance education), WWW tutorials, videos, non-credit workshops, and handouts (Pausch and Popp, 2015). Discussions with faculty as done by the University of Pittsburgh could also be viewed as an example of non-classroom assessment; a survey carried out revealed it was one of the most common assessment methods used campus wide within the University of Pittsburgh library system (University of Pittsburgh, 2014).

*Qualitative vs. quantitative.* Schilling and Applegate’s (2007: 206) work reveals ILI assessment includes both qualitative and quantitative options. They used data from survey, written test and a practical literature searching exercise to examine the extent to which students’ perceptions about their skills matched their demonstrated skills. Satisfaction surveys, as used within the ILI assessment within the University of Pittsburgh library system provides examples of qualitative and quantitative options and these surveys were found to be one of the most popular method used within the library system (University of Pittsburgh, 2014). Williams’ (2013) paper also outlines a number of qualitative and quantitative tools for the measurement of data for ILI assessment. Dunaway and Orblych’s (2011) paper addresses the need for quantitative measures of the impact of formative assessment on students’ information literacy skills.

*Non-measures, indirect measures and direct measures.* According to Schilling and Applegate’s (2007: 206) work, non-measures would include an assessment of attitudes; indirect measures would include student self-assessment of skills; and direct measures would include tests. Walsh (2009) noted self-assessment method is used in ILI assessment; therefore, this option could be included in this category as well. Schilling and Applegate (2007: 207) recommended the incorporation of “direct” testing measures such

as: objective tests or expert reviews of performances, artifacts or portfolios to complement the use of other measures. Scharf et al. (2007) and Walsh's (2009) paper indicate that portfolios can be used as well, and study by Scharf et al. (2007) captures the strengths of using these. According to Schilling and Applegate (2007: 207) self-reported measures are considered "indirect": informative, but not specific nor as useful as direct measures. Therefore, direct measures are preferred.

*Diagnostic, formative and summative.* Together, the works of Northern Illinois University (2016), Williams (2013) and Dunaway and Orblych (2011) provide useful details on these options. Diagnostic assessment identifies students' current knowledge of a subject, their skill sets and capabilities, and clarifies misconceptions before teaching takes place (Northern Illinois University, 2016). Examples include: pre-tests (on content and abilities); self-assessments (identifying skills and competencies); discussion board responses (on content-specific prompts); interviews (brief, private, 10-minute interview of each student) (Northern Illinois University, 2016).

Formative assessment provides feedback and information during the instructional process while learning is taking place. These include: observations during in-class activities; homework exercises; reflection journals that are reviewed periodically during the semester; question and answer sessions; conferences between the instructor and student at various points in the semester; in-class activities where students informally present their results; student feedback collected by periodically answering specific questions about the instruction and their self-evaluation of performance and progress (Northern Illinois University, 2016). Dunaway and Orblych (2011) provide an example of the implementation of formative assessment of the ILI. They note the use of formative assessment creates effective ILI by acknowledging variation in IL skills among students (Dunaway and Orblych, 2011: 24).

Summative assessment is another option. Summative assessment takes place after the learning has been completed and provides information and feedback which sums up the teaching and learning process (Northern Illinois University, 2016). Summative assessment include: examinations (major, high-stakes exams); term papers (drafts submitted throughout the semester would be a formative assessment); projects (project phases submitted at various completion points could be formatively assessed); portfolios (could also be assessed during its development as a formative assessment); performances; student

evaluation of the course (teaching effectiveness); instructor self-evaluation. Additionally, the use of report cards and consultations with professors, as per Williams' (2013: 121) paper, could be included in this category as well.

*Self-assessment vs. artefact/expert assessment.* According to Schilling and Applegate (2007: 208) this option would include: citation patterns, course grade, paper grade, task/speed and accuracy, task/think aloud, knowledge test, survey (name a database), survey (confidence), quiz, and narrative reflections. Schilling and Applegate (2007: 207) warn, however, that while librarians may accept students are excellent self-judges, data analysis has often demonstrated otherwise, revealing three important findings: (1) students believed themselves to be more information literate than actual test scores would indicate; (2) students were not aware of important quality-filtered resources; (3) students did not know what information resources to use in support of their coursework. Previous research demonstrated that students assume they possess a higher level of information-literacy skills than they actually have. This suggests it may be useful to incorporate a combination of assessment methods.

In addition to the foregoing assessment categories, the works of Mueller (2014), Blevens (2012) and Jarson (2010) reveal whichever options are chosen, there are a wealth of resources that are readily available from both commercially and institutionally developed and administered products to support the various assessment options and these include the very popular SAILS (Standardized Assessment of Information Literacy Skills) amongst others.

The options for assessment of ILI, as per the literature reviewed, indicate a range of possibilities; these include: one shot vs. longitudinal, pre-test or during test or post-test, skills testing vs. attitudes testing vs. performance testing, holistic vs. non-holistic, independent assessment (library only) vs. collaborative assessment (faculty & library), and instructor testing vs. instruction testing vs. students' testing. Each option has its strengths and weaknesses as some of the aforementioned authors have highlighted. Oakleaf (2008) work provides added evaluation of these assessment options, particularly their respective strengths and weaknesses. Given the assessment categories overlap and that each comes with its own strengths and limitations, there is the indication that one should try to use a combination of methods. Further, the papers reviewed revealed each of the methods can yield positive or negative results about students' performance as well as about the

instructor's performance and the ILI itself. Therefore, depending on what is needed, what is valued, the focus and the perspectives regarding what students should really know and do, should determine the choice of assessment.

## Methodology

The STEM ILI curriculum delivered included segments on: the organization of STEM resources in the library, general use of the library to find STEM resources, use of the library's portal (UWILINC) to find STEM resources, use of subject specific databases to find STEM resources, general search strategies, evaluating and selecting online resources, plagiarism and referencing. To facilitate a hands-on approach and the completion of practical activities using the computers, the library's computer lab was the venue for these sessions. According to Schilling and Applegate (2007: 207), as per the literature reviewed: "Academic assessment protocols strongly urge the incorporation of 'direct' testing measures, such as objective tests or expert reviews of performances, artifacts or portfolios. Self-reported measures are considered 'indirect': informative, but not specific nor as useful as direct measures". Accordingly, this study implemented a mixed approach to STEM ILI assessment. The data collection instruments therefore included a questionnaire, which is an informative self-reported measure and also a graded MCQ test, which is a direct useful testing measure to add value to the survey.

### The questionnaire

The author created the questionnaire which comprised seven items consisting of open and closed-ended options. These seven items were informed by the following research questions: (1a) How do undergraduates perceive the STEM ILI curriculum delivered? (1b) To what extent did the STEM ILI curriculum provide the opportunity for undergraduates to learn new information and skills? (2) How do undergraduates perceive the facilitators' performance? Research Question (1a) was addressed by items 1–4 on the questionnaire which solicited students' response to the content and delivery of the curriculum. Research Question (1b) was answered through item 5, which asked students to comment on the new information and skills exposed to. Research Question (2) was addressed via item 6 on the questionnaire, which asked for a response to the facilitators' performance. Item 7 provided an opportunity for students to give open/free response to provide added information on areas possibly omitted by the researcher. Prior to

administering this questionnaire, a researcher checked the items, paying attention to clarity of language, content, and the extent to which the items addressed the research questions; the researcher made a few suggestions for improvement, which were incorporated. Accordingly, Questions 1 and 2 were modified to improve clarity. The questionnaire was piloted on 32 students during Semester I of 2015 and two items were modified after this pilot study. The questionnaire was then distributed to a total sample size of 173 students. The questionnaire was administered at the end of the STEM ILI session, under examination condition and invigilated by a librarian in order to protect the integrity of the findings. This resulted in a return rate of 100%, which enhances the validity of the research results. A student assistant entered the data into Excel. In an effort to achieve interrater reliability the author cross checked the data entered by the research assistant to ensure representativeness of the information on the questionnaire. For the open-ended items, Strauss' (1987) in vivo coding was used to categorize the open-ended responses from the questionnaire. Accordingly, the responses were reviewed and analysed with the objective of identifying themes/categories emerging from the responses; these were then used as "buckets" that the responses could be placed in. The findings of the questionnaire were presented by research question and question by question.

### Graded multiple choice question test

A MCQ test was administered to the groups where the STEM ILI accounted for a percentage of the coursework grade. A total of 76 students comprised the sample. The test sought to enhance the validity and reliability of the results for Research Question 1b (To what extent did the STEM ILI curriculum provide the opportunity for undergraduates to learn new information and skills?). It is important to note that the focus is on '*the opportunity*' provided to learn new information and skills rather than on whether '*new information and skills were actuality learnt*'. Consequently, the purpose of the test was to support students' perception about opportunities the STEM ILI provided to learn new information and skills (as reported on the questionnaire); and not to verify or test whether learning had occurred. In this regard, the items on the test sought a demonstration of information and skills with respect to the curriculum, specifically: the library's portal (UWILINC), search strategies, STEM databases and general use of the SBL to find STEM resources. Prior to administering the test, the former coordinator of MILU assessed the test structure and made suggestions for modifications.

It was suggested that all items be transformed from an open-ended structure to a MCQ structure, which was done. The completed MCQ items were then reviewed by said coordinator, who made further suggestions regarding the questions and the response items, which were incorporated. The test was then administered under exam conditions and invigilated by a librarian, at the end of the STEM ILI session, which reduced the possibility of contamination, thereby enhancing validity. Students were given 30 minutes to complete the paper. A library assistant graded the MCQ scripts and the author checked the scores to ensure that the test scores were reliable. The scores were sent to the lecturer of the course as the test contributed to 5% of students' coursework grade.

The data from the questionnaire is presented first by research question, and question by question, followed by the data (scores) from the MCQ test administered. This is followed by a section which discusses the findings of both the questionnaire and the test scores. The discussion is organized and presented by research question and question by question.

**Presentation of findings from the questionnaire**

*Research Question 1a: How do undergraduates perceive the STEM (ILI) curriculum delivered?*

Question 1: Library instruction was:

For Question 1, students were asked to answer yes or no to five options relating to library instruction. They were also provided with a sixth option called "other", in which they could provide additional responses not included in the response options given. Table 2 presents students' responses to Question 1.

**Table 2.** Students' assessment of the instruction.

Assessment of library instruction	Yes	No	No response
a. Organized	89%	7%	4%
b. Clear	91%	4%	4%
c. Helpful for my research assignment or course of study	97%	2%	1%
d. Activities were practical	94.8%	4.6%	.6%
e. Resources relevant to my assignment were demonstrated	84%	5%	11%
f. Other: She's cool Very comprehensive Very knowledgeable			

Question 2: What did you find most valuable about the library instruction session?

Table 3 captures students' assessment (perception) of the particular segments of the library instruction they found most valuable.

Question 3: What would you have liked to learn that was not covered in this session?

Table 4 details the areas students would have liked to be covered in the STEM ILI but which were not covered.

Question 4: Should library instruction continue to be included as part of this class in future semesters?

Table 5 reveals students' perception regarding the continuation of STEM ILI.

*Research Question 1b: To what extent did the STEM ILI curriculum provide the opportunity for undergraduates to learn new information and skills?*

Question 5: I learned new information/new skills in the following areas.

Table 6 highlights the ILI opportunities to learn new skills and new information.

*Research Question 2: How do undergraduates perceive the facilitators' performance?*

Question 6: The library instructor:

Table 7 shows the results of students' assessment (perception) of the instructor.

**Other comments**

Question 7: Any other comments?

Question 7 facilitated remarks that may not have been raised on the questionnaire. Table 8 captures the additional comments students made regarding STEM ILI. Only 33% of the students made additional comments.

**Findings of the test administered**

This section presents the findings and analysis of the MCQ test administered at the end of the session. Figure 1 shows the test scores. Of the 76 students who sat the test, 47 (62%) scored 100%, 14 (18%) scored 90%, 7 (9%) scored 80%, 3 (4%) scored 70%, 4 (5%) scored 60% and 1 (1%) scored 40%. With the pass mark being 50% only one student failed; 99% of the students passed the test with an average score of 90%.

**Table 3.** The most valuable aspects of the STEM ILI.

Most valuable aspects of the instruction	Responses
Clarification and new information	<p>It certified things I didn't understand            It clarified things I didn't understand            The information            The fact that there were past papers online for practice            It exposed me to aspects of UWILINC that were previously unknown            Learning about a new site that coordinates with my major            I am now better able to understand UWILINC            How to complete forms            Item loans            Learning that UWI has a library website            Learning how the library works            How to prepare my literature review and annotated bibliography            Everything            The amount of information available to us            How to better research assignments            I gained better understanding of how the library operates</p>
Access to resources	<p>The introduction to Scifinder            Learned how Scifinder can help to find molecules' name that are foreign to me            Scifinder chemistry database            Access to resources online            New resources for my research are available            Access to the computers            The number of chemistry database I was introduced to            How to access materials physically and online            Locating past papers effectively            Learning how to use the library website correctly and efficiently            The online printing account            How to find books without leaving home</p>
Selecting and evaluating resources	<p>The approach to finding large amounts of data            How to access information that is relevant            The ways and means of carrying out researches            Providing different sources and places to find material and how to get around finding work for research purposes            Ways to access different types of materials            Knowledge about the availability to use academic resources</p>
Search & discovery strategies	<p>Advanced ways to search UWILINC            How to search for e-journals            How to use Scifinder            How to use UWILINC            Use of the online databases            Finding how to use the library resources            I learned how to find credible resources for my research assignment            How to properly search articles            Finding resources            How to use the various databases; finding e-journals on database            How to find resources for my area of research            How to search for books            How to find sources for information            How to use the library's website            Got more quality on how to search for materials            Using search all and find e-journals feature            How to search for books online            Different ways I could search for books and articles            Boolean operators and quotations            Learning how to find the articles on the databases</p>

(continued)

**Table 3.** (continued)

Most valuable aspects of the instruction	Responses
Structure of the sessions	The hands-on practice It was informative It was straightforward The pragmatic approach that was taken The step by step guide The practical exercises allowed familiarity with the interface Instructor was quite clear and stuck to the field (science) The thorough details with the instructor working/interacting with the students Practical demonstration
Referencing	Learning to reference Not to plagiarize Citation How to cite using Chicago It was actually clear with regards to the referencing style It gave an overview of the citation style required for the course

**Table 4.** Areas students would have liked to be included but which were not included in the STEM ILI.

Responses	%
Everything was covered	10
Nothing	8
No response	39
N/A	9
Other responses:	34
How to actually find books	
Expectations met somewhat	
Nothing specifically	
How to cite for each sources	
How to get 100% on the test	
EndNote Program	
More about citation	
How to use the entire UWILINC	
How to do ACS referencing	
More on ACS	
How to properly referencing documents	
How to publish your own article	
Referencing popular books like the Koran & Bible	
I learned all I believe was relevant	
Virtual referencing	
For now what I needed was covered	
How to summarize journal articles	
How to write field reports	
Details of plagiarism	
How to cite pictures and diagrams	
How to complete annotated bibliographies	
Session was comprehensive	
Proper citation relating to my field	

**Table 5.** The future of STEM ILI – to be continued or discontinued.

Should embedded library instruction continue:	Responses
Yes	72%
Yes: conditional/comments/implied	19%
Definitely	2.9%
Strongly agree	.5%
No	1.7%
Uncertain	1%
No response	2.9%

**Discussion of findings from the survey (Questionnaire) and MCQ test**

*Undergraduates' perception of STEM ILI/curriculum (Research Question 1a)*

*Survey Question 1.* Undergraduates perceive the delivery of the STEM ILI as organized, clear, practical and helpful for their research assignment or course of study; they also perceive the STEM resources introduced as relevant to their assignment. This is perhaps attributed to the hands-on nature of the sessions, which largely comprised search and discovery activities using various search strategies. This perception indicates the value of STEM ILI to higher education, particularly with respect to students' course of study. This underscores the works of Jarson (2010) and Kasowitz-Scheer and Pasqualoni (2002) who noted the positive impact of ILI on higher education.

**Table 6.** Opportunities for new skills and information development.

I learned new information/skills in the following areas	Yes	No	No response
a. How to use the Science Branch Library in general	93%	3%	4%
b. Using the library's portal (UWILINC)	89%	7.5%	3.5%
c. How to find resources (books, journals, etc.)	91.3%	5.2%	3.5%
d. Search strategies	94%	4%	2%
e. Identifying plagiarism	61%	29%	10%
f. Minimizing plagiarism	58%	29%	13%
g. Proper referencing	66.5%	14.5%	19%
h. Other	Identifying plagiarism and minimizing plagiarism could have been expounded on How to use call numbers to identify books How to read references of journals Citing references		

**Table 7.** Assessment of the instructor.

The library instructor was:	Yes	No	No response
a. Knowledgeable about the library resources and systems	92%	2%	6%
b. Helpful	91.3%	2.3%	6.4%
c. Explained clearly	85%	7%	8%
d. Answered questions adequately	83%	12%	5%
e. Other	There were no "other" comments		

*Survey Question 2.* Students perceived the segments of the STEM ILI curriculum offering clarification and new information, access to resources, selecting and evaluating resources, search and discovery and referencing as most valuable. These segments reflect the full content of the STEM ILI curriculum and would therefore suggest students perceive the whole STEM ILI curriculum delivered as valuable. This is particularly instructive for Caribbean libraries interested in offering STEM ILI as it highlights content areas of value. The responses provide detailed and specific examples of the value in each segment. While these segments focus on curriculum content, students also reported their perception of the structure of the STEM ILI as being one of the most valuable aspects. For example, students noted that they liked the straightforward approach to delivery, the pragmatic approach taken, the step-by-step guide and the practical exercises. This indicates that while content is valued, the delivery of the content is also important; and a process-based delivery is preferred.

*Survey Question 3.* The majority of the students (66%) expressed outrightly their satisfaction with the content of the STEM ILI curriculum by noting either of the following: everything was covered, nothing, and not applicable; additionally, the absence of a response could be interpreted as satisfaction. The perception of the remaining 34%, as per comments, was a mix

of: (a) expressed satisfaction with what was delivered; (b) the desire for greater depth with regard to what was delivered (c) and the perceived need for additional segments to be integrated into the STEM ILI curriculum; regarding the expressed desire for greater depth of what was delivered, it is instructive to note that the majority of the statements pointed to referencing; comments included: "how to cite for each sources", "Endnote program", "more about citation", "how to do [American Chemical Society](ACS) referencing", "more on ACS", "how to properly reference documents", "referencing popular books", "how to cite pictures and diagrams", "proper citation relating to my field", and "how to complete annotated bibliographies". The comments: "how to summarize journal articles" and "details of plagiarism" are somewhat related to referencing as well. The referencing segment was largely demonstration and there were no practical student activities, unlike the other segments of the ILI. Additionally, it covered only the Chicago author/date referencing style, which is one of two of the most popular styles used within the Faculty. Students' responses therefore indicate the need for the library to consider revising the curriculum to include a separate session on referencing, which could include the American Chemical Society (ACS) referencing style, the use of Endnote software and practical student exercises on citing the various sources using the

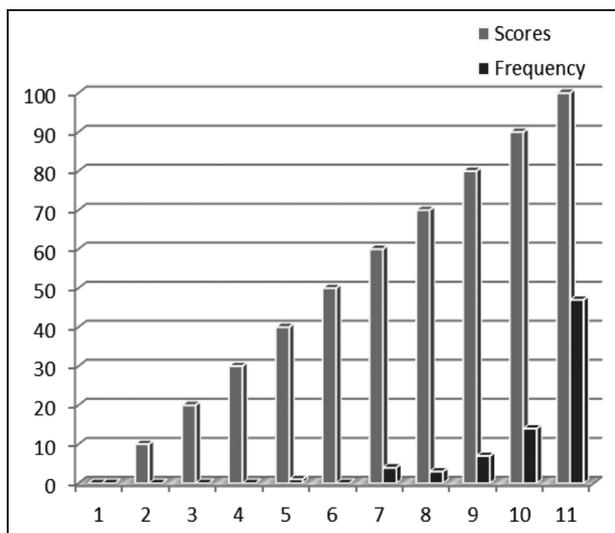
**Table 8.** Additional comments re STEM ILI.

	Themes that emerged	Other comments
Limitations	Planning/organization	Did this session in another course already Refreshments would have been nice It was informative but a bit hard to focus after such a long day
	Content of ILI	The skills of proper referencing should be introduced The presentation was speedy but I believe it's because we were pressed for time
	Delivery of ILI	Not worth comments, need improvement Could be longer and more interactive The time given to the presenter was too short Nothing was presented on plagiarism The presentation should have been more detailed
Benefits	Planning/organization	This was a good library session Thank you It was great; definitely not a waste of time Well organized and resourceful session It was ok
	Content of ILI	Very well planned and organized; would have been useful to first year students as well Very useful information was presented; it was wise to include this session in the course The topic on plagiarism was explained clearly I was enlightened to the knowledge of plagiarism Session was helping. Adequate information was provided The presentation was informative and pertinent to areas of research The session was very informative Insightful presentation
	Delivery of ILI	Very formal and interactive Please give a printed copy of the PowerPoint or allow students to view it on their computer Thanks for such interactive and informative session The session was adequately interesting and informative Good presentation, was informative, clear, interactive and vibrant The session was interactive and fun
	Themes that emerged	Other comments
	Planning/organization	Did this session in another course already Refreshments would have been nice It was informative but a bit hard to focus after such a long day
	Content of ILI	The skills of proper referencing should be introduced The presentation was speedy but I believe it's because we were pressed for time
	Delivery of ILI	Not worth comments, need improvement Could be longer and more interactive The time given to the presenter was too short Nothing was presented on plagiarism The presentation should have been more detailed
	Planning/organization	This was a good library session Thank you It was great; definitely not a waste of time Well organized and resourceful session It was ok
	Content of ILI	Very well planned and organized; would have been useful to first year students as well Very useful information was presented; it was wise to include this session in the course The topic on plagiarism was explained clearly I was enlightened to the knowledge of plagiarism Session was helping. Adequate information was provided

(continued)

**Table 8.** (continued)

Themes that emerged	Other comments
Delivery of ILI	<p>The presentation was informative and pertinent to areas of research</p> <p>The session was very informative</p> <p>Insightful presentation</p> <p>Very formal and interactive</p> <p>Please give a printed copy of the PowerPoint or allow students to view it on their computer</p> <p>Thanks for such interactive and informative session</p> <p>The session was adequately interesting and informative</p> <p>Good presentation, was informative, clear, interactive and vibrant</p> <p>The session was interactive and fun</p>

**Figure 1.** Test scores.

two most used styles in the Faculty (ACS and Chicago). Citation analysis as advocated by Bennett and Brothen (2010) and Carbery and Leahy (2015) could be considered as an authentic assessment option that could be included in the revised component. Regarding the perceived need for additional segments to be integrated into the STEM ILI curriculum, the comments (“how to get 100% on the test”, how to publish your own article” and “how to write field reports”) indicate the need for complementary/stand-alone open sessions on writing, study skills and publishing.

**Survey Question 4.** Of the students 94% supported the continuation of embedded STEM ILI; of this number, 19% of the responses had an associated comment or a condition associated with the positive affirmation. The comments and conditional requirements focused on: the benefits of the ILI, structure of the ILI, planning/delivery of the ILI and miscellany (see Table 9). The responses emphasize the need for STEM ILI, citing in particular the belief that fellow schoolmates are unaware and that they do not know how to search for and

access the library’s resources. The responses also point to areas for improvement, namely: it should be more organized, it should be more in-depth, it should be more relevant to the course and topics being covered, it should be better advertised, it should include two more sessions per semester, the session time should be longer to allow for further going through of the areas, the ILI should be delivered over two sessions instead of one, the ILI should be introduced earlier, for example during the first semester, and that updates should be made to the library’s portal. These responses reiterate how students perceive the STEM ILI curriculum content and delivery. The responses suggest students see the sessions as important and of value, particularly when one considers the recommendations regarding extending the session time and number of sessions as well as introducing the sessions to students earlier, that is, during their first year of study instead of their second year of study. This reiterates the value of STEM ILI to higher education and also the value of the STEM library to the academic enterprise.

#### *The extent to which the STEM ILI/curriculum provided opportunities for new information and skills (Research Question 1b)*

**Survey Question 5.** The responses indicate that the STEM ILI provided students with opportunities to learn how to use the SBL, how to use the library’s portal (UWILINC), how to find resources (books, journals, etc.), how to search, how to identify and minimize plagiarism, and how to properly reference sources. The “other” comments spoke to the general use of the library, plagiarism and referencing, which strengthen the point that students were exposed to opportunities to learn new skills or information relating to the general use of the library, plagiarism and referencing and that more could have been done in the area of plagiarism. The responses which indicated that students did not learn how to use the SBL, how to use

**Table 9.** Positive affirmations (direct & indirect and/or with comments & conditions) regarding the continuation of STEM ILI.

Themes that emerged	Responses
Benefits of the sessions	<p>Yes, I believe it should. It is very informative and helpful</p> <p>Yes it should. The more exposed we are to looking for scholarly articles for research, the better our research paper</p> <p>Yes as it helps in conducting meaningful research</p> <p>Not mandatory but can be used as a guide</p> <p>Yes I am sure many people do not know how to access the many resources offered</p> <p>Yes because it will help students in their research</p> <p>Yes it is very helpful</p> <p>Yes it provides a vast amount of research knowledge</p> <p>Yes for research purposes</p> <p>Yes. A lot of students are not aware of the library process</p> <p>Yes I think so. It's very informative</p> <p>Yes it should because sometimes instruction may not be remembered</p> <p>Yes it should as it acts as a guide to access resources</p> <p>Yes it should, not many students know how to access and use UWILINC</p> <p>Yes it should as most students are not aware of the considerable resources they have access to</p> <p>Yes it should continue to be included</p> <p>It should, it is very useful and now I feel like I want to write a journal article based on how interactive and informative it was</p> <p>Yes it is very helpful and enlightening</p>
Structure of the sessions	<p>Yes, but should be more organized</p> <p>Yes, if reviewed to be more in-depth</p> <p>Yes but it should be more relevant to the course and topics being covered</p> <p>Yes she explains it very clear</p> <p>Yes but it needs to be more relevant to much obvious things</p>
Planning & delivery of sessions	<p>Yes, plus advertise better</p> <p>Yes and in first year</p> <p>Yes please give a printed copy of the PowerPoint or allow students to view it on their computer</p> <p>Yes two more each semester if possible</p> <p>Yes it should be a 2-hour session to allow more go through in UWI</p> <p>Yes but either over two classes as this class was a bit too tedious</p> <p>Yes but just earlier like in the first year courses or the first class</p>
Other	<p>I think it should be continued however, it was quite quick and I had to catch up on my own</p> <p>Not unless some update or improvements have been made for the library's portal</p> <p>I guess so if it's really necessary</p>

the library's portal, how to find resources, how to search, how to identify and minimize plagiarism, and how to reference properly – could suggest that the students either knew before the session how to identify, execute or find same or that even after the session they still did not know how to identify, execute or find same. The latter would suggest the need for further work in the area of STEM ILI and for the continuation of the STEM ILI curriculum but with a focus on enhancing these areas and perhaps testing to see whether learning has occurred.

**Test scores.** The test scores revealed a past rate of 99% and an average score of 90%. This adds value to students' reported perception about the opportunities for new information and skills (as reported via the

survey); however, this should not be interpreted as hard evidence that learning has occurred as this paper did not seek to measure same. The seemingly high pass rate and the average test score could be the result of administering the test so soon after the STEM ILI session, when the information was fresh in students' minds. Although the study's objective was not to test whether learning had occurred or whether students' perception matched reality, consideration could be given to this as a further line of enquiry.

*Undergraduates' perception of the facilitators' performance (Research Question 2)*

**Survey Question 6.** The findings revealed that students perceive the instructors as generally knowledgeable,

helpful, and as responding clearly and adequately to questions. This is consistent with the responses provided to survey question 1, where students reported that the STEM ILI was organized and clear; “she’s cool”, and “very knowledgeable”, which highlights the place of the librarian in the delivery of the STEM ILI curriculum. These responses reveal a positive image of librarians and highlight the important role of librarians as teachers in this current information age.

### *Additional comments re STEM ILI*

*Survey Question 7.* Only 33% of the students made additional comments. The comments highlighted the limitations and strengths of the STEM ILI with regards to planning and organization, the content of the STEM ILI curriculum and its delivery. The comments reiterated most of what was reported in previous sections. The planning and organization of the ILI: serving refreshments and reviewing the time of day the session is delivered could be a subject for conversation between the library and Faculty. Additionally, the re-occurrence of the issue of referencing highlights that this is an area to which attention should be given in the future planning and delivery of STEM ILI. Additionally, the time allotted for the delivery of STEM ILI should be reviewed as it was felt that the session may have been rushed and that the time was not adequate. Notwithstanding these limitations there were positive comments regarding the planning/organization as well as the content and delivery of the ILI. Students reiterated the session was: “pertinent”, “well organized”, “interactive”, “informative” and “definitely not a waste of time”. This survey no doubt provided useful information on STEM ILI within the Jamaican context and therefore confirms Schilling and Applegate’s (2007: 207) assertion that self-reported measures are informative.

### **Conclusion and recommendations**

Students perceive embedded STEM ILI as valuable. Students have a positive perception of the STEM ILI curriculum and the opportunities it provided for learning new information and skills. Students perceive the STEM ILI as organized, clear, practical, helpful and relevant. Students perceive the segments of the STEM ILI curriculum offering opportunities for clarification and new information, access to STEM resources, selecting and evaluating STEM resources, search and discovery and referencing as most valuable. Students perceive the delivery of the content as mostly adequate and there was the general feeling that what was covered was what was needed; however,

consideration should be given to expanding the number of sessions, introducing the ILI earlier in the students’ academic life, for example during the first year of study, and increasing the time allotted to the referencing segment.

Overall, students perceive the STEM ILI provide opportunities to learn how to use the SBL and the library’s portal (UWILINC); how to find resources (books, journals, etc.); how to search; how to identify and minimize plagiarism; and how to properly reference sources. The students were generally pleased with the instructors; they perceived the instructors as knowledgeable, helpful, and providing clear and adequate responses, which highlights the important role of the librarian as a teacher and their place in higher education.

Students offered additional comments relating to the limitations and strengths of the ILI with respect to: planning and organization, the content of the ILI and its delivery. Students supported the continuation of STEM ILI and its being embedded in a course, which reiterates their recognition of the relevance of STEM ILI. Students’ performance on the test adds some value to their perception of the STEM ILI but should not be interpreted as evidence that learning has occurred or as evidence that there is a correlation between students’ perception and performance. There is definitely a need to develop a holistic authentic assessment, perhaps tracking students’ performance from the start of the program through to graduation. Also, while the findings are positive, it would be instructive to see the outcome of a “process implementation evaluation”, which surveys faculty’s feedback on training “success”. A pre-test and a post-test could also be useful as well as a yearly assessment or a longitudinal assessment to measure learning. It is submitted however that customers’ perceptions (students’ perceptions) are of value in this service culture; consequently, this study’s findings represent a useful starting point and make a noteworthy contribution to the non-existent literature on STEM ILI in Jamaica.

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# Digitization of indigenous knowledge on forest foods and medicines

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## Abstract

This paper discusses the digitization of indigenous knowledge on forest foods and medicine for the effective management of Ghana's forest resources. The paper is based on a survey conducted in nine communities in Ghana where primary data were obtained from 606 respondents using in-depth face-to-face interviews. The aim of the study was to assess what knowledge local communities had about products of the forest especially indigenous forest foods and medicine. The findings reveal that local communities have an in-depth knowledge of indigenous forest foods and medicines. They are conversant with what foods and medicines are available in the forests, how they are consumed and when they mature. The study reveals that consumption of indigenous forest foods is on the decline, while the use of traditional medicine is on the ascendancy. The study recommends the promulgation of laws and legal instruments to protect communities from bio-piracy.

## Keywords

Digitization, forest foods, indigenous knowledge, indigenous knowledge systems, traditional medicine

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## Introduction

Indigenous knowledge (IK) refers to the knowledge belonging to a specific ethnic group that is unique to that ethnic group, society or culture (Boven and Morohashi, 2002: 12). According to Grenier (1998: 6), indigenous knowledge is understood to be the traditional knowledge of indigenous peoples which is oral in nature, usually transmitted from one generation to the other and exists mostly in the minds of local people. The medium of transmission is usually through personal communication and demonstration and can be from tutor to the pupil, or to the apprentice and/or from parents to children (Christian, 2009: 3).

IK is an essential resource for the developmental process. Its application plays an essential role in

the lifestyle of members of the local community (Christian, 2009: 6). Christian (2009: 9) reports in his study on digitization of traditional medicine in Nigeria that IK is predominantly tacit and is embedded in the practices and experiences of its holders. He explains further that within the local environment, IK forms the basis for decisions pertaining to food security, human and animal health, education, natural resource management and other vital activities. In Ghana very little attempt has been made to

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collect, process and digitize indigenous knowledge by libraries. Ghana therefore stands the risk of losing its traditional indigenous knowledge if no effort is made to preserve it.

This paper reports on a study undertaken by some researchers of CSIR-Forestry Research Institute of Ghana (CSIR-FORIG) to assess the level of knowledge of local people on forest foods and medicines in some local communities in Ghana and discusses the digitization of the foods and medicines identified. The aim of identifying this knowledge was to document and digitize it in order to preserve and make this valuable local knowledge accessible to all. The study was undertaken in forest fringe locations where most of the populations depend on the forests for their livelihoods and general well-being.

### **Digitization of indigenous knowledge**

Because IK is the knowledge of an indigenous community that has accumulated over generations of living in a particular environment (Gorjestani, 2000), it is important for researchers to pay attention to its preservation for posterity. This becomes more critical when one considers the fact that this knowledge includes all kinds of scientific, agricultural, technical and ecological knowledge, including cultigens, medicines and the rational use of flora and fauna (Daes, 1993).

Battiste (2005: 5) in a study on aboriginal life and education in Canada, reported that indigenous knowledge of the environment was being lost in communities around the world, giving rise to the urgent need to conserve and help develop mechanisms to protect the earth's biological diversity. The need to protect IK was also recognized by the United Nations Convention on Biological Diversity. This UN agency recognizes IK as a valuable contributor to the sustainable development of local communities which needs to be preserved (Clarkson et al, 1992: 77).

The rapid loss of IK within communities is therefore a cause for concern and failure to find solutions to this could actually compound the problem of knowledge loss. Reasons adduced for the rapid loss of knowledge within communities are that IK is always passed on by word of mouth from one generation to the other and disappears once the older generation passes away (Grenier, 1998: 6). Also, IK is being lost as a result of changes in taste that are being introduced from other cultures (Mohamedbhai, 2013). For these reasons, it is imperative for IK Systems in Africa and elsewhere to be studied, collected, documented, and protected where necessary and then widely disseminated to promote development (Mohamedbhai, 2013).

In recent times, there has been a growing tendency for governments in the Sub-Saharan Africa region to pay close attention to indigenous knowledge systems and to develop mechanisms to incorporate them into sustainable development initiatives (Jaya, 2006: 2). For these programmes to be effective and provide the necessary impact, there is the need to develop a framework within which these digital initiatives are implemented (Jaya, 2006). According to Swanepoel, (2008) digitization initiatives are driven by a variety of motives, two of the most common being for preservation and enhanced access. The digitization of indigenous knowledge on forest foods and medicines which is the key focus of this study is situated within the framework of digital preservation of local knowledge (Parry, 2014:3–4) with the aim of preserving the knowledge and enhancing its access. Within this framework, the scope, standards and responsibilities for creating and maintaining the digital collection has been defined.

### *Scope*

The collections to be digitized consist of knowledge residing in the minds of local people and do not include any other resource from any other source. In addition the digitized knowledge is limited to IK gathered from the selected communities only and covers only plant foods and medicines.

### *Standards*

The digitization process takes cognizance of digital standards available such as metadata, database architecture and software standards.

### *Responsibilities*

The database group which is part of the research team has oversight responsibilities of the digitization process and endeavours to follow all rules and regulations that may be developed to manage the process.

### *Knowledge exchange*

Contribution of knowledge by researchers is encouraged but all local knowledge contributed must be validated.

Libraries are currently faced with the difficult task of managing IK material, storing them and making them available to users (Parry, 2014: 2). It is important for libraries to consider the use of digitization to preserve IK in order to prevent it from becoming extinct. This study considers digitization as an option for the preservation of traditional knowledge on forest foods and medicine which is considered to be a global

Intellectual Property (IP) issue (WIPO International Bureau, 1999: 2). IK can only be protected intellectually if it has been identified, collected, documented and preserved.

Digitization is the process used to capture an analogue signal into a digital form (Bandi et al., 2015: 333). It involves the making of an electronic version of a 'real world' object or event, enabling the object to be stored, displayed and manipulated on a computer and disseminated over networks and/or the World Wide Web (Bandi et al., 2015: 333).

According to Akinwale (2012: 4), digitization processes are often based on two main perspectives which are library-oriented and cultural heritage-oriented approaches. He espouses that the first perspective portrays digitization in terms of the system of knowledge in relation to digital libraries, while the second perspective is primarily based on communication of memory. No matter the perspective selected, IK is still treated as a literary material, even though it differs greatly from western knowledge (Anyira et al. 2010). The processing of IK as a literary material within library and information circles especially in Africa is almost a new phenomenon. In Ghana, the processing of IK as a literary material is almost non-existent. However in some countries such as Australia, major efforts have been made to preserve IK in accessible forms through the recording and documentation of the knowledge, so as to assist in its easy retrieval (Nakata and Langton, 2006: 10). With advancement in the use of information and communication technologies (ICT), a range of new opportunities is now available for processing this unique form of knowledge. The major challenge for library and information professionals is usually with the ability to recognize traditional knowledge as a distinct system of knowledge that requires handling and management regimes for its materials that are different from those applied by the western system of knowledge management (Nakata and Langton, 2006: 7).

There are many types of IK systems, but one of the most familiar systems is typically referred to as the Indigenous Ecological Knowledge (IEK) system. In this system of knowledge, locals have an intricate understanding of their environment which includes the land, its plants and animals. The local people live off the resources of the land, many of which are located in forests. The importance of forests to these people can therefore not be undervalued.

Forests worldwide are storehouses of ecological treasures (Arnold et al., 2011: 259) and in Ghana local people living in forest fringed communities depend on the treasures stored in these forests for their survival. The World Bank Group (2013: 2) reports that an

estimated 1.6 billion people around the globe depend on the forests to some degree for their livelihoods. In Ghana, forests provide livelihoods to 15% of the population (3.6m people out of 20m people in 2012) (Kpelle, 2012: 5) who depend on them for food, medicines, fuel wood, snails, mushrooms, local building materials and many others. Indeed out of 3725 higher plants known to grow in Ghana, about 2300 are found in the high forest zone, including 730 tree species (Ministry of Lands and Natural Resources, Ghana, 2012: 3). This rich biodiversity has a wide variety of uses including foods and medicines. Forest foods are important in the diets of people because they are rich in micronutrients and fibre but low in fats and sugars (Arnold et al., 2011: 259). Their consumption according to Arnold et al. (2011) can play a major role in food security and human health. The forests also harbour medicinal species that are used in treating various ailments by local people. In fact many companies exploit the knowledge communities have on medicinal properties of forest species for economic benefit. Forests and tree-based agricultural systems also provide direct and indirect ecosystem services that make essential contributions to human livelihoods and well-being (Knowledge and Learning Group, 2004). Many of the people who depend on these forests for their well-being live in rural communities.

### **Benefits of documenting and digitizing forest foods and medicine**

Several benefits of digitization have been identified worldwide (Holmes, 2015; Sabbagh et al., 2013). One major advantage of documenting, digitizing and preserving this delicate knowledge is that through digitization, wider dissemination of the knowledge is ensured (Christian, 2009: 11). More people can therefore gain access to this knowledge than previously. Also, it is easier to search through digitized content than it is to search through print media thereby reducing the time used in conducting such searches. Documentation and digitization of IK is also an effective tool for defensive protection from bio-piracy as well as the reduction in the misappropriation of indigenous knowledge without compensation by multi-national entities (Christian, 2009: 11; Nakata and Langton, 2006: 48). Several examples exist on the bio-piracy of indigenous knowledge by multinational entities worldwide in India, South America and South Africa (Avantika et al., 2015: 80; Bhattacharya, 2014: 50;).

Documentation provides evidence that a particular knowledge has developed in a particular local community, thereby vesting the community with claim

over such knowledge as well as the right to share in any profit resulting from the commercialization of the knowledge (Christian, 2009: 11). Other benefits include the long-term preservation of the resource, reduced costs of handling and storing the digitized material, and the ability to index and store the material in a document retrieval system.

## Research problem

IK has caught the attention of policy makers and governments as well as international agencies worldwide due to its valuable contribution to rural development. IK is the knowledge base of any community and harnessing it is essential in the developmental process (Akinwale, 2012: 5). Ghana's forests are storehouses of valuable plant species that can be used for food, medicines and timber, just to name a few. However, in Ghana, the knowledge accumulated by local communities over many years is beginning to dwindle. So despite the value attached to IK, it risks becoming extinct in Ghana due to a lack of policy on it and inadequate methods of preservation in a complex and dynamic world. Policy makers, scientists and local communities in Ghana have made very little effort at comprehensively documenting indigenous knowledge, especially on indigenous foods and medicines. Neither has there been any comprehensive policy or attempts at digitizing this knowledge using ICTs. Some documentation has however been made on some herbal drugs in Ghana (Ministry of Health, n.d.). In order to prevent the extinction of IK in Ghana, it is important to assess the knowledge that local people have on indigenous forest foods and medicines, collect, document, digitize and store them appropriately. We can learn from countries such as Venezuela, India and China that have compiled digital databases, inventories or registries of traditional knowledge over many years (Nair, 2006: 3; Swanepoel, 2008: 7).

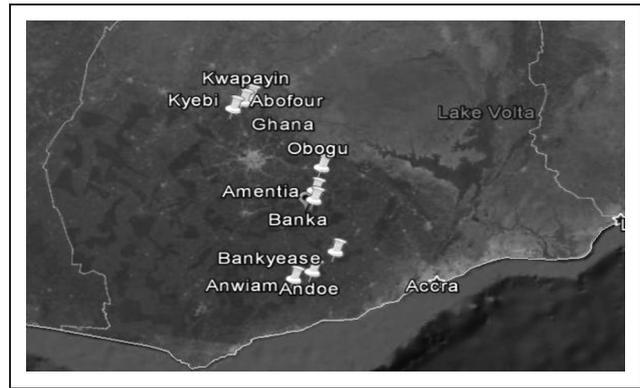
## Objectives of study

The main objective of the study was to assess what knowledge local communities had about products of the forest especially indigenous forest foods and medicines. The specific objective was to identify, capture, document and digitize indigenous knowledge on forest foods and medicines in nine communities in Ghana.

## Research methodology

### Study area

The forest area of Ghana is estimated at 9.17m ha accounting for about 40% of the total national land



**Figure 1.** Map of Southern Ghana showing the study communities (Source: Google Earth, 2015).

(Agyarko, 2001: 6). The forests have been classified on the basis of ecological conditions which put the Closed Forest Zone area at 8.1342m ha, Transitional Forests at 1.036m and the Savannah Forest Zone at 14.66m ha (Agyarko, 2001: 6). The original closed forest cover of approximately 8.2m ha which the country had at the beginning of the 20th century, has due to several factors including unsustainable agricultural practices, illegal logging, illegal mining and deforestation among many others dwindled and only an estimated 1.5m ha of 'intact' closed forest now remain (Agyarko, 2001: 6). The vegetation is divided into the high forest zone in the south, which accounts for roughly 30% of the land area and the savannah zone in the north, accounting for the remaining 70%. The high forest zone is well known for the high value of wood species and non-timber forest products of commercial importance that it stores (Agyarko, 2001: 6). To ensure that the research team would have access to information on as many species as possible, the study was confined to the southern sector of the country where a greater majority of the forest reserves are located.

The study was conducted in one municipality and two districts of Ghana, namely Offinso Municipal, Asante Akim South District and Assin South District respectively. The municipality and districts were purposively selected to represent different ecological zones. The ecological zones represented were the dry semi-deciduous, moist semi-deciduous and the moist evergreen vegetation zones in the southern sector of the country. A total of nine communities, three in each forest zone, were randomly selected and surveyed (Figure 1). The communities studied were Kwapanin, Kyebi and Abofour in the Offinso Municipality; Amantia, Obogu and Banka in the Asante Akim South District and Bankyease, Anwiam and Andoe in the Assin South District.

### *Data collection methods*

Data for this study was collected by conducting in-depth interviews through the administration of questionnaires. In addition to this, three validation workshops were organized in the three ecological zones studied, while the observation method was used during all stages of the study.

### *In-depth interviews*

Primary data were obtained from in-depth face-to-face interviews conducted among 606 respondents resident in the nine communities using questionnaires. Bio-data of respondents were collected in addition to information on forest foods and medicines they were familiar with. The questions posed were open ended and sought their knowledge on the type of forest foods and medicines available in their locality. Other information sought included the phenology of the plants, quantities available, period of availability, uses of the species, parts used and ways of preparing the different species for food or medicine. After collection, the data were processed in the office and validated using published literature and expert knowledge from researchers at CSIR-FORIG. After that the processed and partially validated data were sent back to the communities where very knowledgeable members of the nine communities participated in a validation process.

### *Validation workshops*

Three validation workshops were organized for key informants and knowledgeable participants in the three selected districts/municipality. One workshop was organized in each zone and consisted of participants from all three communities studied within each zone. The aim of the workshops was to validate the data that had been collected by bringing the key informants from each zone together so that collectively they could certify if the data that had been collected were correct.

In the Asante Akim South District, a total of 42 participants participated in the workshop whilst 28 participated in the Offinso Municipality and, finally, in the Assin South district 34 participants were selected from the three communities.

A PowerPoint presentation which included all the species named, their uses, parts used either for food or medicine and their images was shown to participants. Participants in these communities were asked to confirm whether the uses that had been listed for each of the different species were correct and to certify whether the images captured duly represented the species. Feedback from participants indicated that the

project was on course as over 95% of information we had gathered was correct. Additions and omissions were noted and corrected at a later date. The whole process proved to be a learning process for both the researchers and participants. Participants attended the workshops out of their own free will and spent the greater part of the day responding to queries and making valuable suggestions to improve the data. The workshops were cordial and relaxed, full of goodwill and camaraderie from both participants and researchers.

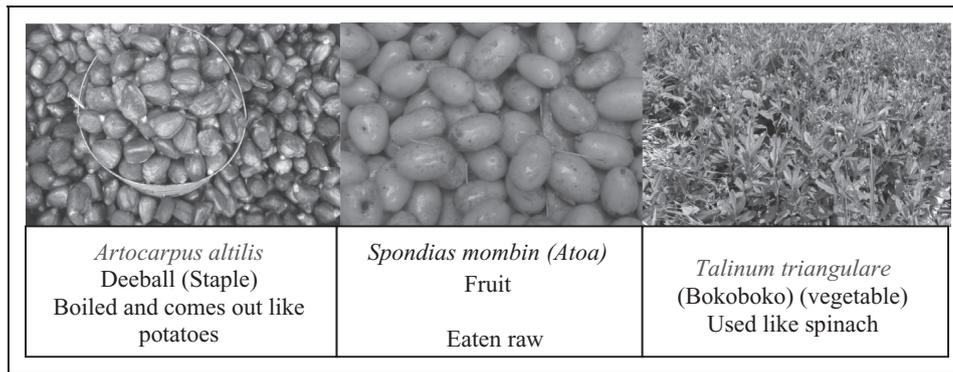
### **Findings of the study**

The findings reveal that 25% of respondents consume forest foods on a regular basis, being a significant component of their diets, while 34% use them less regularly and about 41% consume them occasionally. These figures represent a gradual decline in consumption in the communities because many of the trees that yield these foods have been cut down by illegal timber operators, and are therefore not available for collection. The few that are available are also located so far away that respondents have to walk long distances in order to gain access to them. Also the decline in consumption could be attributed to the changing culinary tastes of local people, especially the younger generation. The opposite is however true of medicinal plants where the percentage of those who use traditional medicines is higher than those who do not. About 60% of respondents use it regularly, 30% use it occasionally, and only 10% use it sparingly.

### *Species identified*

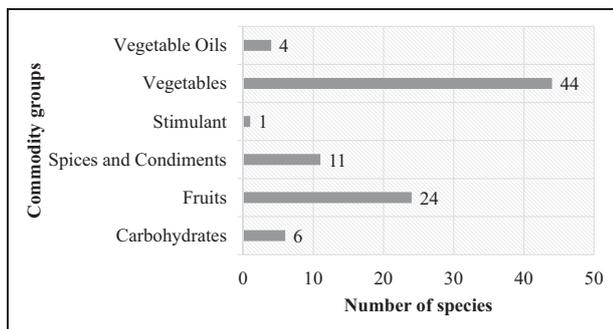
A total of 289 different species were identified in the study. Of these 90 species were identified as forest foods and 199 as medicinal plants. However, the scientific names of seven out of the 90 species could not be identified in the laboratory. Of these 90 species 43 were identified as food products only, while 47 species were identified as foods that had medicinal properties. There were some differences in knowledge and use of forest foods among the study communities with respondents from Asante Akim mentioning the highest number of species of 73, followed by Offinso Municipal with 63 species and Assin South District which had the least number of 61 species. Images of some species are shown in Plate 1.

Though 90 species were identified in the nine communities as forest foods, it is possible that more species may have been overlooked, forgotten or unavailable at the time of the survey. Inadequate time and finances were some reasons why more communities could not be surveyed to unearth more species.



**Plate I.** Images of some food species.

Source: Field survey.



**Figure 2.** Categorization of forest food species into commodity groups using Plant Resources of Tropical Africa categorization (PROTA).

The plant commodity group categorization used by Plant Resources of Tropical Africa (PROTA) together with the FAO food categorization was adapted and used to group the forest foods. The adapted groups used were ‘fruits’, carbohydrates, vegetables, vegetable oils, spices and condiments and stimulants (Figure 2). The results show that the forests of Ghana harbour valuable resources that need to be assessed and promoted for livelihood development.

An impressive 199 species were identified as medicinal plants (Figure 3). Information received from the respondents revealed that these medicinal plants can be used to treat 121 different types of ailments ranging from skin diseases, snake bites, malaria, coughs and headaches just to mention a few.

#### Creation of an online database

An online database has been created using DRUPAL a free, open-source web content management platform. The database is online and can be found at <http://csir-forig.org.gh/tikfom/>. The site is still under construction but will be fully published in the shortest possible time. The database presents valuable information on the species identified. All the food

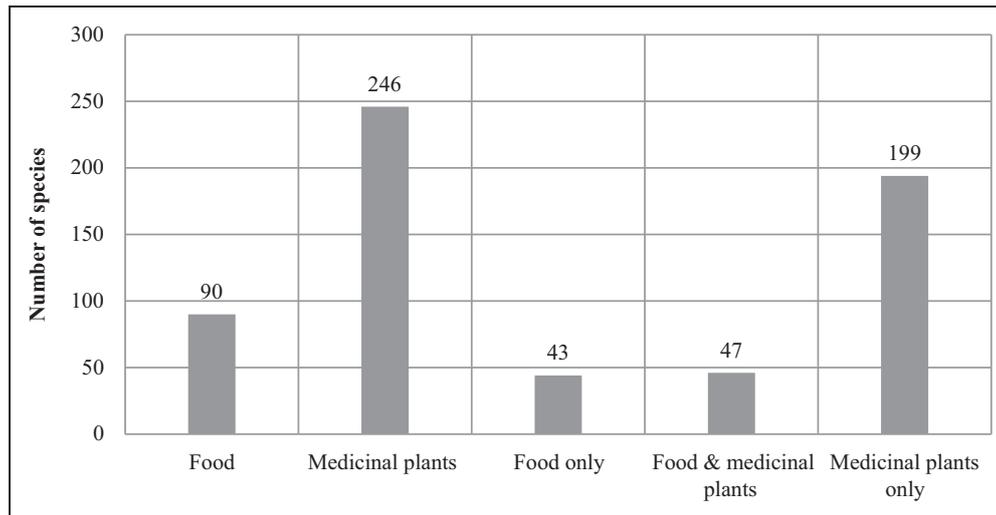
categorization groups are duly represented in the database. In essence, users will be able to find those species that are fruits or those that produce fats and oils, carbohydrates, spices and condiments. For each record on a species, the following fields are included: local/traditional name(s), scientific name, family name, and uses of species, as well as brief information on the seasons when they are available. A digital image of each species is also included in the database. Users can search for particular species in the database by querying the scientific or local name. Alternatively users can browse through the listed species and click on the species of interest. See Plate 2 for a screenshot of the database.

#### Challenges in preserving indigenous knowledge

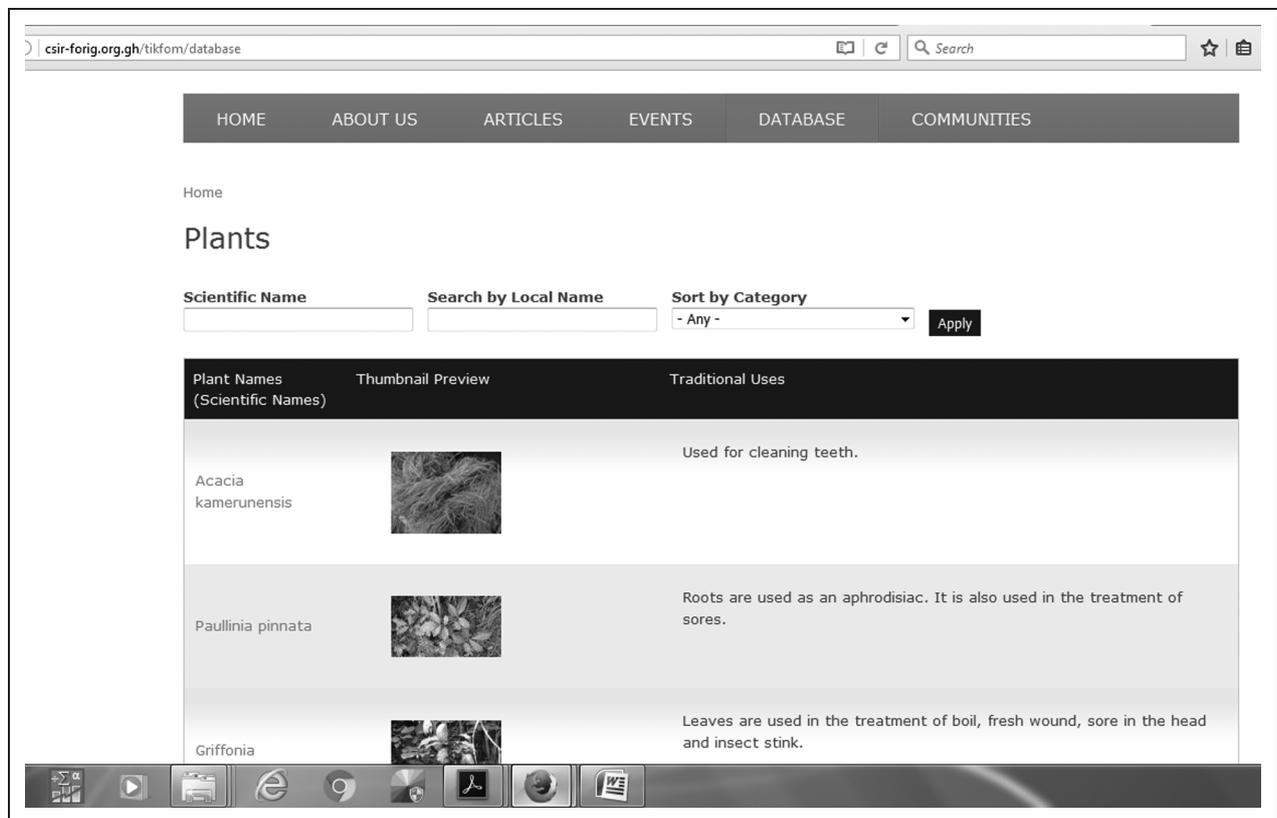
Challenges identified by the research team in the collection and management of IK include language barriers, funding, technological challenges, and intellectual property rights.

#### Language

Language is a major factor in the collection and preservation of IK (Settee, 2008: 2). It is at the heart of culture and knowledge retention and can either be a barrier or a unifier depending on how it is used. In this study, though all the communities visited were Akan (a local language in Ghana) speaking communities, differences existed in dialect resulting in specific plant species having different local names in different localities. Gathering or collecting indigenous local knowledge is an expensive enterprise but it is more expensive when translation from a local language into English or identifying the appropriate scientific names for the local plant species to enable preservation has to take place. It becomes even more costly when errors occur during the translation process and also when considerable time and effort have



**Figure 3.** Number of species that can be used for forest foods and medicinal plants.



**Plate 2.** Screen shot of indigenous knowledge database.

to be used to correct it. Language is the most fundamental way that cultural information is communicated and preserved so getting enumerators who understand the local language is an important factor that needs to be determined. When using the local language to transmit IK, it may be helpful to manually record it in order to avoid adulteration of the original information. Some interactions with the local community (focus group discussions) were recorded. The research team in this study did not

come across any documented evidence aimed at preserving IK in any of the nine communities.

### Funding

Funding is a significant factor in the collection, processing, digitization and storage of indigenous knowledge. The major hurdle encountered and which was partially overcome during this study was the ability to fund the survey in all nine communities. Costs

incurred included but were not limited to transportation, accommodation and development of research instruments. This project fortunately had the financial support of Elsevier Foundation thereby reducing the financial burden. Funding is also an important factor in the recruitment and training of required staff. In fact, it is important for staff to be well trained when executing a digitization project such as this and for them to have access to the right equipment which comes at a high cost. The research team agreed on the creation of a database which would be made available online – also at a cost, since there was the need to pay for the services of a web/database developer, pay for Internet hosting and also subscribe to high speed internet access.

### *Technological challenges*

Recent advances in technology have transformed the way information is managed and made accessible to relevant stakeholders. Digitization which is one option in the preservation of IK is the process of capturing analogue signals into a digital form (Bandi et al., 2015: 333). It is often used when diverse forms of information, such as text, sound, image and video need to be converted into a single binary code (Plockey, 2014: 28). Attempting to digitize IK is basically an attempt to create digital collections of oral knowledge that resides in the memories of elders, healers, midwives, farmers, fishermen and hunters throughout the world (Plockey, 2014: 27). Several challenges have been identified in the use of information and communication technologies for the management of information in general and IK in particular. The use of modern technologies comprising hardware, software and data formats used to create and store these digital collections are expensive due to the fast rate at which they become outdated. It is difficult therefore to keep up to date with the technological changes. There is the need to have up-to-date equipment – good scanners and cameras for image capture, fast and reliable Internet access and a registered domain for hosting the site. Also, human capacity to execute the project needs to be developed. Different categories of staff working on the project needed to be well trained so that they could operate professionally and competently. In line with this therefore, a three-day training workshop was organized for 13 librarians and information managers as part of capacity building.

### *Intellectual property and ethical rights*

The preservation of IK comes with challenges such as intellectual property rights (IPR) and the ethics governing their use. IPR are mechanisms that are used to

protect individual and industrial “inventions” and which give patent-holders exclusive monopoly over their invention for a specified period of time (Grenier, 1998). IK on biodiversity however does not necessarily fall within the category of inventions described above. Thus communities are often on the losing side when it comes to the use of their biodiversity. Communities that live with and depend on biodiversity for their survival often do not have much choice in the appropriation of their IK. They often feel cheated and therefore refuse to co-operate with researchers when they approach them for support in their research endeavours. This study has shown that local people are vulnerable when it comes to the appropriation of their rich biodiversity. They have very little knowledge on how to protect their knowledge from exploitation neither do they have the resources to do so. It has also revealed that communities are losing their knowledge due to lifestyle changes and the inability to transmit information from the elders to the younger generation. In spite of the importance attached to IK worldwide, there is still no international consensus about how indigenous peoples’ rights on the protection of their cultural knowledge systems can be secured legally, promoted ethically and used resourcefully (Anderson, 2010: i). In spite of the considerable interest shown and concerns about the use of IK by external groups, there is still no consensus about how indigenous people’s rights to the protection of their knowledge systems can be secured, either within an intellectual property regime or through some other legislative or policy framework at the international or local level (Anderson, 2010). In Ghana, no legislation has been passed or developed to protect indigenous local knowledge. Local people must therefore be involved in developing appropriate frameworks for access and use of local knowledge in Ghana (Anderson, 2010: ii).

### **Conclusions and recommendations**

This study has opened up significant gaps in the collection, processing and storage of indigenous knowledge in Ghana with special reference to forest foods and medicines. It is envisaged that indigenous local knowledge will be preserved digitally so that it does not become extinct. It is expected that the database will be consulted as the first point of call in the design and execution of relevant research work. It will be a useful tool in identifying and selecting forest species to be worked on by researchers, students, lecturers and civil society.

In countries like Canada and other developed economies, IK is being applied in such complex areas

as scientific, genetic and medical research and natural resource management in managing forests, coastlines and water bodies (Brascoupe and Mann, 2001; Grenier, 1998). This can also be done in Ghana, but only when the knowledge has been collected, processed and stored in an appropriate format.

This study has unearthed various valuable species that are beneficial to local people in particular and the wider community in general. However, knowledge on the uses of these plants resides in the memory of local people who disappear with this huge knowledge when they die. To prevent this from happening the following recommendations are being made.

1. It is important to harness the local IK within communities in Ghana and ensure their continuous existence through digitization. Indeed, apart from forest foods and medicines, there are a host of other benefits that can be derived from the forests of Ghana and so the necessary attention needs to be placed on other disciplines such as traditional building materials, traditional art and craft. The Ghana Government must systematically task relevant institutions to develop similar databases that would preserve the knowledge in the various disciplines for posterity.
2. The process of collection, processing, and digitization and storage of IK also comes along with some challenges. Some of these include funding. This study covered only nine communities in three ecological zones but was done at considerable cost. It is recommended that other communities be studied in ecological regions that were not covered in this study. Government must commit funding for any future study.
3. It is also important to be assured of the cooperation of local people when conducting the study. Once one has their confidence and they are certain the research is not for personal enrichment, they will open up on the knowledge they have. This can be done by establishing a working relationship with them, sensitizing them on the importance of the knowledge and educating them on the importance of negotiating with entities who may approach them for their information.
4. There are prospects for the development of livelihood activities based on natural resource development in Ghana. Future studies should therefore concentrate on the categorization of these natural resources in the various regions of the country and assess their potential for

development into livelihood activities. The livelihoods of local people can actually be improved if local resource that is prevalent in that local community is harnessed for development.

5. It is also important to bring out issues that need to be addressed by central government in the execution of such projects. So far, no legislative instrument has been identified in Ghana's laws concerning the management of IK. This research therefore recommends that the Government of Ghana should develop a policy document on IK usage and preservation that would address issues such as how local people can be protected from the exploitation of their knowledge and resources; what measures to put in place to ensure that local people are compensated for the information they provide; and how IK should be preserved and stored so that all stakeholders can have access to and benefit from it (Brascoupe and Mann, 2001: 6). The development of such a policy document should include but not be limited to government representatives, members of parliament, researchers, university lecturers and traditional people.

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The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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# E-science: An epistemological analysis based on the philosophy of technology

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## Abstract

The purpose of this essay is to formulate historical-descriptive and epistemological premises for information science, using some elements from the philosophy of technology, and presenting e-science as a contemporary information phenomenon. As a field of studies, information science needs to be dedicated to technological questions that enable the creation of a new class of epistemology based on philosophy: techno-epistemology. This can be justified by the usefulness of information science in reviewing how the frontiers of its field of knowledge are delineated and looking into the possibilities of interdisciplinary collaboration. This essay also emphasizes the limitations that an epistemology grounded on historical-descriptive narratives would impose on the progress of information science as it approaches a new informational phenomenon, in this case, e-science.

## Keywords

E-science, epistemology, information, information science, philosophy of technology

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## Introduction

The new investigation methods used by researchers for collaboration, based on the use of hardware infrastructure and scientific software, have allowed the emergence of new techniques to organize and exchange information for science: this is known as e-science. In the 1990s, John Taylor, the Director General of the United Kingdom's Office of Science and Technology, created this term to refer to the use of technology to conduct scientific investigations (Yang et al., 2009: 353). In a lecture in 2007, Microsoft CEO Jim Gray described the principles of e-science and highlighted how it is interconnected with others fields of knowledge, while explaining that it is a new way of doing science: he believes that e-science is the fourth paradigm<sup>1</sup> scientific discipline (Hey et al., 2009).

Scientific investigation methodologies have changed as a result of new technological infrastructures. The traditional models of scientific investigation, such as empirical observation/exploration, theorization, and the latest studies on simulation, are amplified when mediated by a computer, thus leading to different methodologies and data collection techniques. In other words, this has led to a new way of doing science based on technical tools and devices that have been built by contemporary technology, creating a new dimension for scientists.

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The e-science phenomenon is responsible for the generation and use of data in large quantities. Labeled the “data deluge” by Hey et al. (2009) the data universe and related technologies have become indispensable for modern scientific procedures, creating a *locus* where the data can be collected, curated, analyzed and displayed in all places. In the Big Data<sup>2</sup> era, technology and information are pervasive. This is the context in which this essay seeks to build a dialogue between information science (IS) and the philosophy of technology, based on the relationship between the concepts of information and technology and its implications for the term “e-science.”

This is an investigative justification for understanding technology’s influence on the new concepts and practices of contemporary science. We discuss the classical state of the field of IS, focusing on the philosophy of technology to explain e-science. To do this, we go back to the historical origins of IS, and we explore the connection between IS and the emergence of information technologies, and consequently its social-cultural characteristics, which are connected to the techno-epistemology that is currently embedded in our society’s way of being.

To do this we need to understand the idea of the philosophy of technology and place it at the core of IS investigations. Luciano Floridi developed a philosophical discourse on technology, roughly categorizing it into three areas: the social, cultural, and political impacts of technological developments; the epistemological status of technological knowledge, especially in relation to scientific knowledge; and the ontological status of the products of technology, i.e. technological artifacts (Demir, 2012).

In his paper “Computational epistemology and e-science: A new way of thinking”, Jordi Vallverdú (2009: 557) states: “e-Science offer us the opportunity to think about the specific epistemological changes created by computational empowerment in scientific practices, to the Spanish researcher the principal concept for e-Science is Information”. This research takes Vallverdú’s hypothesis as a starting point.

IS is a field of study where interdisciplinary issues circulate. It considers all forms of interaction between people and information. According to Bates (1999), IS is a multidisciplinary field of study, involving several forms of knowledge, given coherence by its focus on the central concept of human-recorded information.

When such issues are mediated by technology, they can reveal the complexity of new ways of scientific investigation, and therefore the principles of e-science. Our aim here is not to report on something new but instead to establish the relationship between

IS and information. We intend to portray a historical narrative of facts, and one of our goals is to conduct a reflection on IS that discards the single-minded, deterministic view of technology as a catalyzing agent in our society.

Based on the dialogue between the philosophy of technology and IS, we seek to synthesize definitions and ideas in order to develop a concept of e-science that is free from positivist and determinist issues. We wish to create something that truly describes the importance of the interaction between man, information, and technology, thus proposing the basis of a techno-epistemology. The individuals representing the first category, i.e. scientists, are heavily influenced by the constant evolution of techniques that help their concepts materialize through the technological hardware and scientific software that they create to turn the natural world’s objects into information.

Hence, we first need to establish certain assumptions in order to understand our object of study. These are reflected in basic questions such as: What is technology? What is information? What is e-science? The complexity of the problem lies in trying to delve into the concept of information that is based on e-science, and to establish the nature of the relationship between information and technology. These questions are the object of fluid, flexible, and rigid fields of studies and depend on the context in which they are used, or on their epistemological meaning. They can be open and/or closed questions, depending on the type of study to which they refer. This context poses one of the greatest challenges, considering that technology and information are not the privilege of any particular fields of study but are instead a type of energy that rouses questions in several fields of knowledge.

According to Floridi (2002), the field of philosophical information concerns the critical investigation of the conceptual nature and basic principles of information. The current author has argued that fashionable terminology such as cyberphilosophy, digital philosophy, and computational philosophy, normally expresses specific theoretical orientations, such as the philosophy of computer science, the philosophy of computing, or computation. This essay will adopt the philosophy of technology as a foundation for a techno-epistemology, using these terms synonymously.

The theoretical argument of this essay will take place mostly through the dialogue between classic IS texts such as “Information science: What is it?” by Harold Borko (1968); “Information science: Origin, evolution and relations” (Ciência da informação: origem, evolução e relações) (Saracevic, 1996), and the recent edition of the *Encyclopedia of Library and*

*Information Sciences* by Tefko Saracevic (2010); it will also use papers by major Latin American authors such as “Campo interdisciplinar da Ciência da Informação: Fronteiras remotas e recentes” by Lena Vânia Pinheiro (1998) and “O conceito de informação” by Rafael Capurro (2007). To expand the essay discussions, it will also use “Information as thing” by Michael Buckland (1991), *Ambient Findability: What We Find Changes Who We Become*, written by Peter Morville (2014), and *Introduction to Information Science*, written by David Bawden and Lyn Robinson (2012).

Next, we will explore the theoretical angle of Scharff and Dusek’s (2006) writings on the philosophy of technology in their book *Philosophy of Technology: The Technological Condition: An Anthology*, texts compiled by David Kaplan (2009) in *Readings in the Philosophy of Technology*, Luciano Floridi’s *Philosophy of Technology: Critical Reflections*, edited by Hilmi Demir (2012), and *The Philosophy of Information*, written by Luciano Floridi (2010). This examination aims to discuss technology and the philosophy of information (PI) and to examine the impact of technology on scientific knowledge and information concepts, i.e. research activities, the discourse about scientific culture, and its influence on the processes of interaction between people, information, and technology.

Finally, we will explore the issues related to e-science brought up in the book *The Fourth Paradigm: Data-intensive Scientific Discovery*, edited by Tony Hey, Stewart Tansley, and Kristin Tolle (2009). This book is used because it considers all aspects of e-science, including those related to scientific and technological progress, communication and collaboration regarding the recording of scientific information, and the intensive use of data obtained from technological sensors. It also considers computational science as a third type of IS aiding the various domains of knowledge, for example the hard sciences such as astronomy, physics, and medicine, among others sciences. In this sense, IS is concerned with investigating all aspects of recording information and the communication cycle in networks such as the Web.

### **Aspects of epistemology relative to information science**

Epistemology, or the theory of knowledge, is concerned with the scope and limits of what and how we know something. Its theoretical sources seek to answer how we justify knowledge. It deals with skeptical arguments: that is, the denial that we can have

knowledge of something, be it scientific or common sense. From Plato’s philosophy in the *Theaetetus* up until the present day, questions have emerged in the scientific community that have essentially led it to look into the nature, origins, and validity of scientific knowledge (Greco, 2008). According to Demir (2012) philosophical reflection on technology is as old as philosophy itself, dating back to the Ancient Greek philosophers.

Another angle of epistemology as a philosophical branch is to consider the possible types of definition to which we can give knowledge. For instance, defining something means establishing the epistemological place at which we want to arrive. In that sense, defining any object is already a problem for those wishing to think about knowledge. Therefore, one way of defining things is to base a concept on real things: that is, a *real* definition. This standpoint assumes that our words can only refer to a structure within the real world. Our words correspond to the real nature of things. An analogous, albeit contrasting, type of definition is the stipulative definition, which is a definition based on words instead of natural things (Scharff and Dusek, 2006).

The notion of natural classes of things dissolves in a theoretical definition. It also brings to light another way of defining something: a reportative definition, which refers to how people use the words that make up the object that is to be conceptualized. Finally, a fourth type of definition is the *précising* definition. This approach retains the core meaning of the world. It is neither stipulative nor arbitrary, nor does it simply describe how words are used. Instead, it is an application concerned with the boundaries between the key concepts in which a definition becomes a point of view used by a conceptual application of an object that is being studied (Scharff and Dusek, 2006).

When related to the field of information science, the theory of knowledge examines basic questions about its conceptual core and definitions. In order to define the field, simple questions can be asked, such as: What is information science? What are its origins? What are the basic concepts? Who created them? What do we need to know in order to understand and/or explain information science? Considering epistemology and philosophy applied to the field of IS, in this essay we propose to review the concepts that have been widely adopted by the community of information scientists, while using this review to situate the discussion and challenges surrounding the questions about the word “information”. Meanwhile, we will also consider the skeptic’s rationale, with its challenges and criticism, which, as philosophy

explains, should not be disregarded but learned from: in this way, we will explore how IS can be justified.

Some narratives about IS can hypothetically be considered classic and precise, leading toward a précising definition of IS. We agree with the authors of the City University London definition, David Bawden and Lyn Robinson (2012): for them, Harold Borko coined the first definition of IS in 1968:

[...] that discipline that investigates the properties and behavior of information, the forces governing the flow of information, and the means of processing information for optimum accessibility and usability. It is concerned with that body of knowledge relating to the origination, collection, organization, storage, retrieval, interpretation, transmission, transformation, and utilization of information. This includes the investigation of information representations in both natural and artificial systems, the use of codes for efficient message transmission, and the study of information processing devices and techniques such as computers and their programming systems. It is an interdisciplinary science derived from and related to such fields as mathematics, logic, linguistics, psychology, computer technology, operations research, the graphic arts, communications, library science, management, and other similar fields. It has both a pure science component, which inquires into the subject without regard to its application, and an applied science component, which develops services and products. (Borko, 1968: 3)

Years later, Tefko Saracevic revived Borko's definition and explains that IS can be defined as:

[...] the science and practice dealing with the effective collection, storage, retrieval and use of information. It is concerned with recordable information and knowledge, and the technologies and related services that facilitate their management and use. (Saracevic, 2010: 2570)

In this context, the conceptual core of IS investigates theoretical-practical questions connected to the behavior of information. We can say that it is concerned with the interactions taking place between people and information. Globally, it has developed under the tradition and practices of document-based record-keeping and the birth of contemporary computer science. Its transmutation from the organic to the digital/electronic has revealed IS as a complex objective field of study. Conventional, practical disciplines such as documentation/bibliography, information retrieval, theory of information, and cybernetics are clearly described in Borko's words and reveal themselves to be at the origins of the concept of IS.

For another origin of IS, we can turn to Europe some years earlier, in 1934, at the origins of documentation: specifically Paul Otlet's (1934) experiences in his *Treaty on Documentation and Statistical Bibliography*, where we see a few traces of the concept of IS emerging, and the focus changing from the conventional document to multifaceted ways of recording information. Otlet's contributions were important for the emergence of IS in the US in 1968. According to the authors David Bawden and Lyn Robinson (2012: 10):

The establishment of a new discipline or profession has typically been recognized, since the 19th century, by the setting up of a professional body to represent it. The first such body in the area that was to spawn information science was an international body for the co-ordination of the activities of the documentation movement. The *Institut International de Bibliographie* (IIB), later renamed as the *International Federation for Information and Documentation* (FID), was established by the two Belgian pioneers of documentation, Paul Otlet and Henri La Fontaine, in 1895. Lasting until the new millennium, it can claim to be the first recognizable information science association.

IS was a subsequent breakthrough by US documentalists, who from then on started calling themselves information scientists. For instance, Borko (1968) chose to coin the new term of IS to represent his scientific activities: leaving behind the concept of documents, focusing his efforts on the description and emergence of information itself as the new object of study.

Information was a major issue in the 1950s. This is clear from Vannevar Bush's (1945) influential Memex concept of personal information management with access to the world's information, combined with Shannon and Weaver's (1949) *Mathematical Theory of Communication*, and the new "informetrics" laws, such as Bradford's law of scattering, held out the prospect of a genuinely scientific approach to information management.

These worldviews drove the emergence of information retrieval (IR) and metrics to assess information's relevance in the IR processes—Precision and Revocation—were coined by Allen Kent (between 1951 and 1955) and developed at Cranfield University (Cleverdon, 1960). These ideas remain popular, vital objects of study among information scientists to this day.

In that sense, these schools of thought also assume a relevant character in the précising definition of IS and are based on practices related to the information. When Calvin Mooers decided to coin the term IR, and

Cranfield University carried out its retrieval experiences using punch cards, they enabled the first IR practices.

It has been noted by Silva and Ribeiro (2012) that IS was a new field of study developing alongside the traditional areas—archivistics and librarianship—which had emerged as scientific disciplines in the mid-19th century, in the framework of historicism and positivism. In this way, they led to a sort of pragmatic attitude based on the probability of transmission of information and discarded its meaning. The paper “The information paradox”, describes the historical background of IS as follows:

Shannon’s ‘Information theory’ is actually the theory of the transmission of signals, independent of their possible meaning; ‘Information retrieval’, coined by Calvin Mooers was judged by Robert Fairthorne to be ‘Reference retrieval’ (and even today Google retrieves web-sites); the ‘Information revolution’ is actually the ‘Communications revolution’, and so on. (Gilchrist, 2014: 13)

Another point of view on IS is offered by Tefko Saracevic, a theorist who introduced the first bibliometric studies in Brazil. He compares this field to disciplines such as librarianship, communication, and computer science. This author believes that IS encompasses professional practice and scientific inquiry, addressing the problems of the effective communication of knowledge and knowledge records among humans in the context of social, organizational, and individual needs for and use of information (Saracevic, 1996).

Tefko Saracevic offered this scenario in the 1990s in an effort to answer questions about the field’s epistemological theoretical evolution. This classic definition of IS provides the basis for the goal of connecting IS and the philosophy of technology, considering the amalgam of the two fields as the basis of an investigation into the processes of interaction between information and technology.

When addressing these issues, IS has a particular interest in making use of modern technologies, so it is linked to studies about information technologies. Harold Borko (1968), Tefko Saracevic (1996) and Marcia Bates (1999) agree with this, and also identify interdisciplinarity as one of the main epistemological characteristics of IS. Although Borko does not focus on looking into discipline specialization issues, he approaches IS as something that is multifaceted and seeks to understand the reality of information-related issues as the basis for studying the behavior and interactions between people and information.

This international panorama influences Brazilian researchers like Lena Vânia Pinheiro, who believes that the set of disciplines making up IS can only be perceived based on interdisciplinarity and epistemology. In other words, the author seeks her answers from the same angle as Saracevic and aims to understand how other fields of knowledge contribute to IS by looking into concepts, principles, techniques, methods, and theories that influence it, such as the theory of information, cybernetics, and general systems theory (Pinheiro and Loureiro, 1998).

Grounded on the descriptive historic evolution of information and communication technologies, in Brazil and across the world the field of IS often reveals itself as a branch of study based on technological determinism, despite challenging this concept and considering itself a post-modern applied social science. Lena Vânia Pinheiro develops the idea that IS has its own scientific by-laws as an interdisciplinary social science and stems from the communication and information processes carried out in different territories: scientific, technological, educational, social, artistic, and cultural: in short, multiple backdrops and experimental conditions.

Pinheiro describes events ranging from the ideas of Vannevar Bush (1945) and the system associated with him (the Memex) to the creation of the Brazilian Institute of Science and Technology (IBICT) and graduate IS programs in Brazil, which are always based on interdisciplinarity and the influence of technology on information studies. In this way, she ratifies the link between IS and technologies and connects it to Tefko Saracevic’s ideas about the interconnection with IS and the information society’s developments (Pinheiro and Loureiro, 1998).

From another standpoint, Gernot Wersig (1993) sees IS as a prototype of a post-modern science. He seeks to describe its communicative, cognitive, and technological processes in order to understand people’s interaction with information. Based on the social-technical-cultural study of IS, he brings to light the debate about the various discourses between the sciences, philosophy, and practices and technology. Through this, perhaps it becomes possible to think of IS as a post-modern, interdisciplinary science like ecology.

There are other review papers about the theoretical, epistemological, and methodological purposes of IS, but most of the time they repeat one another and focus on technological innovations. Therefore, it becomes necessary to define the concept of information so we can understand IS better.

In that regard, we have searched the writings of Rafael Capurro, Luciano Floridi, Michael Buckland,

Armando Malheiro da Silva, and Peter Morville for a definition of information in the context of philosophy.

### The concept of information

In the book *Luciano Floridi's Philosophy of Technology*, the authors Silva and Ribeiro (2012) discussed the technological revolution of the last decades and society's involvement in the information phenomenon, which is today completely linked to digital media, provoking profound changes in the field of IS. The authors assume that IS as a unitary yet trans-disciplinary field of knowledge, included in the overarching area of the human and social sciences, which gives theoretical support to some applied disciplines such as librarianship, archivistics, documentation, and some aspects of technological information systems.

Silva and Ribeiro (2012: 176) propose that information is a: "Structured set of codified mental and emotional representations (signs and symbols), modelled with/by social interaction, and capable of being recorded on any material medium and, therefore, communicated in an asynchronous and multidirectional way".

Another point of view is suggested by the Uruguan Rafael Capurro (2007), who examines the notion of the term from the etymology of the word *informatio* (to give form to) up until the uses made of it in the current approaches that employ technologies. This author believes that what makes information especially significant at present is its digital nature, and that interpreting its basic aspects is extremely relevant. According to this hermeneutical philosopher, IS reflects the concept of information and requires two-way investigative approaches, i.e. both objective and subjective. The concept of information depends on interpretation, which may be considered a bridge between these two poles.

From a constructionist perspective, truths are ultimately designed, so some semantic information **p** can be more or less close to its referent **w** only metaphorically, when discussing the foundations of our knowledge of the world in the deepest sense, or secondarily, when talking about the approximation between different pieces of information among themselves (Floridi, 2012: 305).

In this context, for Luciano Floridi (2002, 2004), PI is concerned with (a) the critical investigation of the conceptual nature and basic principles of information, including its dynamics, utilization, and sciences, and (b) the elaboration and application of information-theoretic and computational methodologies to philosophical problems.

Building on this assertion to give the concept of IS meaning, Floridi (2010) sees information as knowledge communicated, knowledge that needs to be uttered, explained, and understood. Additionally, he states that we should not consider information in isolation, but see it in relation to other concepts and objects. He even suggests that seeing information as a thing means seeing it as a subjective concept, or as a sign, i.e. as an object depending on the interpretation of a cognitive agent. From my point of view, the most important of Capurro's (2007) arguments is the distinction between information as an object or thing (e.g. the number of parts) and as a subjective concept or sign, i.e. as depending on the interpretation of a cognitive agent. The meaning of information is determined in social and cultural contexts (Capurro, 2007).

Another author looking to unveil the concept of information in IS is Michael Buckland, who has developed the following approach to understand the concept of information: (a) *Information-as-process* happens when someone is informed and what they know has changed: this is the very act of informing; (b) *Information-as-knowledge*, which is used to denote that which is perceived in information-as-process, i.e. the knowledge that is communicated concerning some particular fact, subject, or event; (c) *Information-as-thing* is attributed to objects, such as data and documents, which are referred to as information because they are regarded as being informative, as having the quality of imparting knowledge or communicating information, or instructive.

The purpose of thinking about information as thing is to: (a) clarify its meaning in relation to other uses of the term; (b) affirm the fundamental rule of information in information systems; and (c) bring theoretical order to heterogeneous fields associated with information science (Buckland, 1991).

At its core, IS looks into theoretical-practical issues related to the behaviors and flows of information when we add technology-mediated hybrid media such as e-science. Hence, we need to go back to Tefko Saracevic, a theorist who coined some of the field's main characteristics, such as interdisciplinarity, its strong connection with information technology, and the developments of the Information Society. The ubiquitous technology that drives the pervasive behavior of digital information has changed our existence, which has been increasingly mediated by technology. This is not limited to the sciences but encompasses all domains of knowledge.

In his book *Ambient Findability*, Morville (2014) describes information as communication. It involves the exchange of symbols, ideas, messages, and meaning between people. As such, it is characterized by

ambiguity, redundancy, inefficiency, error, and indescribable beauty. Communication is the backbone of all human society from ancient tribes to modern nations. Information is the principal ingredient that enables cooperation to scale from clans with a few dozen members to an interconnected global economy of billions. Information allows us to communicate across time and space (Morville, 2014: 959–964).

Next, this paper is going to describe the relationship between e-science and its uses through technology. Based on the constructivist notion of technology, the issues that contextualize the possible uses of e-science will be discussed.

### The e-science phenomenon

Recently, philosophers have followed historians and social scientists when it comes to the game rules of science. Those who follow this path are called technoscientists. They oppose and reverse the view that technology is the concrete manifestation of abstract scientific principles (Kaplan, 2009).

Instead, they claim that science is made possible by technological instruments and devices. The theoretical understanding of these studies is based on appreciating that the nature of scientific things depends on the materiality of technical devices. Therefore, scientific instruments are the key to contemporary scientific practice. This conclusion makes science less about knowledge than about a practice that involves using machines and technical devices (Kaplan, 2009).

A second consequence of tying science to instruments is that it highlights the social and political dimensions of technoscience. The authors examine the role that instruments play in scientific knowledge; the role of laboratories and the scientific community; the role of moral theory in scientific expertise; and the relationships between scientists, policy makers, and the public. Philosophers of technoscience take a more realistic, less idealized, approach to science, although they do not let go of the constructivist view of technology (Kaplan, 2009).

In this backdrop, e-science must be practiced by technoscientists and is meant to allow scientists to conduct their research in a more efficient, collaborative manner. The use of new information technologies and scientific collaboration is the basis of e-science. Digital technologies are believed to have revolutionized scientific methods and sprung new scientific methodologies that have changed how scientific studies are done. According to Jankowski (2007: 549), we believe that e-Science: “[...] is not limited to the natural sciences, where e-Science has become, in some countries and disciplines, the *modus operandi*,

but is also penetrating the domains of the social sciences and humanities”. E-science has become a multidisciplinary field that may be of interest to studies conducted by researchers from the field of IS.

In the words of Jankowski (2007: 552) e-science includes:

- [...] (a) International collaboration among researchers;
- (b) Increasing use of high-speed interconnected computers, applying Grid architecture;
- (c) Visualization of data;
- (d) Development of Internet-based tools and procedures;
- (e) Construction of virtual organizational structures for conducting research;
- (f) Electronic distribution and publication of Findings.

These technologies include resources that are used for data modeling and analysis, electronic/digitized laboratory notebooks, raw and fitted data sets, preliminary project versions (manuscripts, preprints and/or electronic publications), and handling the very information in digital format.

One component of the infrastructure required for e-science is that it allows researchers to safely set up their own virtual organizations that connect to other research centers with which the researchers wish to share their resources. A second component is, naturally, the underlying investigation network that makes up network-based academic research. Another component is access to research results—both to publications and to the replication of original research data (Hey et al., 2009).

The procedures for observing natural phenomena under controlled conditions are also the focus of e-science projects: that is, hypotheses are currently formulated with the aid of technological devices and then they are used to explain the experimental results of the studies. Therefore, this type of scientific research creates a new paradigm that requires replication and additional testing for validation purposes (Davenhall, 2011).

Examples of how science is conducted in this way include observations made by fields like geology and meteorology, using radars, telescopes, and sensors to capture real-time changes in the world and generate simulation and reduction as the basic ground on which to analyze a tangle of hybrid data from various sources. In this way, they can help to visualize and measure temperature, heartbeats, our consumer desires, and other things that can be modeled via computational algorithms and hardware. This cements the use of models to simulate complex systems, such as the interaction between man and information, and requires powerful technological infrastructures that have great processing

capability and the power to generate and treat data (Davenhall, 2011).

The intensive use of data is the product of modern forms of research as a consequence of e-science. This situation raises concerns about the retrieval and visualization of these research data, which is directly related to data mining: that is, the extraction of knowledge-information from large volumes of environmental data in order to identify associative relationships between data sets in information systems (Davenhall, 2011).

The next section in this essay will temporarily set IS aside to discuss the concept of technology from the standpoint of philosophy, approaching the possible significant questions about e-science so as to better understand people's relationships with information and technology.

Below, we suggest that the interdisciplinary dimension of IS works as an operator between the disciplines, as it enables dedication to other fields of study. Hence, from this point onward, we propose to look into the interaction between the theoretical premises of the philosophy of technology and strategic methods of constructing the fundamental relationship between e-science and IS from a non-deterministic viewpoint.

### **Contributions from the philosophy of technology**

E-science is surrounded by global collaboration and the new information technology infrastructures that are used by the various branches of science today. Scientists need network-computing resources to integrate, federate, and analyze information that is found in different locations. Against this backdrop, the technology cyber-infrastructure overlaps and boosts the new scientific research procedures through the technologies of information-as-thing (Hey et al., 2009).

One of the aims of this essay emerges from this context of justification: focusing on understanding the nature and meaning of technology in relation to the practices and theories of IS from the standpoint of the philosophy of technology.

The devices and artifacts created through technical mediation, which change our experience and raise relevant philosophical questions, create a basis for studies on the philosophy of technology. According to Scharff and Dusek (2006: 2) this "[...] involves the intimate interaction of a number of different fields of knowledge: philosophy of science, political and social philosophy, ethics, and some aesthetics and philosophy of religion [...]". This means that technology not only enhances our capacity to be in

the world, but its impact also changes fundamental branches of the theory of knowledge, such as metaphysics, epistemology, ethics, politics, science, and other conventional ways of looking at the natural world.

Technology can be defined as hardware, as rules, and as systems. First, technology is usually thought of being comprised of machines or tools—hardware—this is a way of looking at it as something concrete. However, a distinction between these concepts should be made, since users directly manipulate tools. On the other hand, machines are more independent of the user and require skills and training to be used/handled. A second standpoint views technology as rules. Software can be seen as a metaphor for this approach: it involves patterns of meaning and relationships, such as political rules, laws, and scientific principles, which are systematically developed. The third way of viewing technology is as systems. This suggests that hardware artifacts or software are technologies, but that they need to be considered in the context of their user (Scharff and Dusek, 2006).

Upon asking "what is technology?" Kline (1995) explains that the term is used to represent things, actions, methods, and systems. It is even used symbolically for working procedures and to represent progress. He focuses on two particular issues: how we can communicate across culture gap and how we understand the way in which we humans make our living on the planet.

Kline (1995) discusses four usages or possible answers to what technology is. The first encompasses all sorts of hardware/artifacts: that is, those things that do not occur naturally in the world. Second, the socio-technical system of manufacture, in which Kline (1995) believes all elements need to be a particular kind of hardware, a complete system and its inputs of people, machinery, resources, processes, and legal, economic, political, and physical environments. The third usage highlights technology as a rationalized methodology, which raises questions related to what it really is. It may be a method, a technique, know-how, or the very knowledge that is materialized in information processes, skills, and procedures. The fourth usage combines hardware and people to extend human capacities (Kline, 1995).

Technology changes and expresses the nature of scientific knowledge. The relationships between science and technology change the rules of scientific experimentation and inquiry, and bring to light the effects that the use of technology has on how we see the world. The pattern of creating hardware in special sociotechnical manufacturing systems and diffusing the hardware into other sociotechnical systems in

order to extend our human capacities is not a product of the high-tech age. On the contrary, these patterns were first adopted and adapted in an ancestral evolution process. They were assimilated in order to help us understand the nature of our sociotechnical systems and how we use these systems to create the bases for our societies (Kline, 1995).

As explained by David Kaplan (2009), there are four classic descriptions of technology in the philosophy of technology. These are neutrality, determinism, autonomy, and social construction. Each of these perspectives reflects a different type of view of technology, and presumably information, in relation to society. As stated by Scharff and Dusek (2006), the grandfathers of these studies are philosophers like Martin Heidegger and his students Hannah Arendt and Herbert Marcuse, Jacques Ellul in France, media and communication theorists like Marchal Mackluhan, post-modern philosophers Paul Virilio and Bruno Latour, and other authors.

First, Kaplan (2009) explains that technological neutrality defines technology in terms of its technical properties: this model presents technology as a form of applied science. This approach considers technology simply as a tool that can be used for a variety of human ends, be they good or bad. This theoretical view of technology believes that artifacts (technological devices) are independent of values. It considers technology as instrument-based knowledge. The neutrality of technology assumes a complete separation of technical means and human ends. Technical objects and human values have nothing to do with one another.

Second, David Kaplan (2009) presents technological determinism as the idea that technology is a factor that precedes historic paths and changes. Devices and machines are the primary engines of change to society and guide how society operates. Technological developments precede society's developments. This view of technology suggests that different historic ages were brought on by technological developments, such as the Industrial Revolution, steam-powered machines, and the Information Society, which has stemmed from the emergence of post-war communication and information technologies. There are two versions of technological determinism: weak and strong.

Kaplan (2009) characterizes strong technological determinism as that which sees technological development as the essential condition for social change. Technology imposes specific pathways on society and is therefore responsible for cultural, social, and political changes. Technical innovations spark social transformation; society responds more to technology

than technology does to society. The other form of technological determinism is weak, which is grounded on the premise that technology influences social relations. Technology mediates and steers society, but does not drive it.

The third philosophical perspective offered by the author states that technology will take control of society. It believes that humans will soon lose control of technology and that it will control them. We will become automatons: that is, we will be unable to make our own decisions without technology. This view imposes on society a way of life where everything is reliant on technology. Technology will constitute a new cultural system where humans are the objects of its control. This view is often depicted by the media in the genre of science fiction, including films such as *The Matrix*, *Equilibrium*, and *Blade Runner* (Kaplan, 2009).

The fourth possible approach sees technology as social construction: an idea that sees society and technology as hybrids that simultaneously shape one another. Humanity and technology are situated in a circular symbiotic relationship where one relies on the other. Humans make, use, and assign meaning to things in a variety of different ways. Technologies combine human, material, and social elements (Kaplan, 2009).

According to the theory of the social construction of technology, the other theories are watered down. Constructionists state that technological systems are complex. They insist that technology cannot be value-neutral and devoid of ethics because people are not value-neutral or devoid of ethics; technology cannot determine history because it never is so independent from society that it is in a position to dictate what happens; technology cannot be an autonomous force because it is a human affair, not a mere technical matter (Kaplan, 2009).

### **Analysis of the relationship between epistemology and e-science: Limitations, problems and threats to the progress of knowledge and information**

Before concluding, we feel it is necessary to emphasize some of the points that have already been discussed. First, it is important to highlight the IR studies on which IS studies are based to this day. Certain issues have endured since the first experiences by information scientists in the 1950s. These studies now find new challenges, as research related to Timothy John Berners-Lee's semantic web reveal that the nature of information has changed. Information and its actual applications to the things of the world have

been assigned new meanings and information technologies have new uses. This changes the earlier views that only considered devices instead of their recipients: that is, the human subjects receiving the information through technology are no longer set aside.

A possible update to IS based on technology could be made by subverting the modern positivism of contemporary practices and rethinking the viewpoint of technoscientists who make use of experiments/inquiries, descriptions/interpretation, and computational model simulations to build a new way of doing science grounded on the use, collection, and sharing of data. When we consider that these three ways of doing science are being influenced by technology, we find that the substantial generation and use of data as fact has been developing rapidly (Kaplan, 2009).

This situation also amplifies the fact that information surrounds e-science, and that global collaboration and the new technological infrastructures used by the various branches of science are changing the way that science is done and that scientists work. Today, scientists need to access network computing resources to integrate, federate, and analyze the information found in different locations and made up of different data resources. With this backdrop, the technological infrastructure overlaps and boosts the new scientific procedures, thereby creating a sort of techno-epistemology.

In this context, the philosophy of technology can be seen as a source field of studies for us to understand the evolution of techniques and artifacts created by man. This can enable us to consolidate a new way of thinking about information in relation to technology and outline how these objects of study are reflected in everyday life, and even change the way it is lived, be that at the individual, social, or scientific level. In other words, the philosophy of technology will lend itself as a mirror to information as it seeks to examine the changes and effects that technology has on the natural world, and consequently its influence on the current activities carried out by computer-mediated science.

This techno-epistemology materializes when scientific investigation methods change as a developed result of using “scientific software” within cyberinfrastructures, as conventional scientific models, such as theoretical and empirical models, no longer support themselves. “Scientific software” is understood here, like software that is developed specifically for use in scientific processes, through how virtualization practices and the knowledge of traditional disciplines such as engineering are accepted by the scientific community: an example of this is computer aided design (CAD), which is useful in engineering for the

simulation of real world processes. The existing models are widened through the addition of computational simulation and data-intensive science, thereby leading to e-science.

Hence, we venture to offer the hypothesis that various types of thought systems have been created, or are being created, by means of technology. In an interconnected manner, they make up a rich universe of technical devices that record the scientific knowledge mediated by instruments and machines such as computers and post-computers (smartphones and tablets).

In that regard, we suggest following e-science from the social constructivist view of technology, which we believe is most suitable as it considers technological objects to be realities that are universally built. We believe that this can be a path for studying the universal features and scientific principles of technology in the context of IS and the interaction between man, information, and technology.

We believe in the hybridization of people with the objects that we make. Technology is not a mere thing, nor is information, because society is not a mere thing. Technology cannot be good or bad because society is not totally good or bad. The social constructivist view of technology show us how technologies and information are inexorably linked to human interests, our social practices, our laws, and a range of other factors that interconnect and question us every day.

However, it is important to treat the epistemological discourse about IS critically: it often extrapolates itself and creates a historic-descriptive narrative grounded on technological determinism, basing the changes to the concept of IS on the operating technical changes that are made to technologies, thereby setting its own essence aside. Additionally, the object of study—that is, information—is seen from reductionist views focused on classifying scientific facts and events instead of developing the theoretical object, therefore assuming that logical positivism is the ideological basis for a non-critical, deterministic historic narration of an object.

Hence, a constructivist view of technology and information enhances the quality of IS studies by highlighting its basic characteristics: that it is a social science connected to technology whose object is interdisciplinary information. IS should also be a field of knowledge-producing studies that are dedicated to technological issues, enabling the creation of a techno-epistemology connected to the concept of information. The history of this field cannot be related by simply mentioning dates or facts, otherwise we would be disregarding the social demands that have originated and legitimized its existence.

In this context, we venture to state that IS should focus more on issues related to the philosophy of technology, especially the constructivist view of technology and the development of contemporary society. If we go back to its origins, we can clearly see the connection between IS and the emergence of information technologies, and consequently its social-cultural characteristics connected to techno-epistemology, which is currently embedded in our society's way of being.

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### Notes

1. Samuel Thomas Khun (2000: 3) says “[...] a paradigm is the universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners”.
2. Thomas Davenport (2014) explains how Big Data, as a new ubiquitous term, is transforming science, engineering, medicine, healthcare, finance, business, and ultimately society itself. Big Data has become an emerging paradigm for the practitioners and researchers to explore the value of datasets whose size is beyond the ability of commonly used software tools. As such, big data management is spurring on tremendous amounts of research and development of related technologies and applications.

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## Abstracts

### قتطفات

#### The predicament of library value

قيمة المكتبة في مازق:

Ellen Ndeshi Namhila

العدد رقم 43:2 م مجلة الإفلا المتخصصة:

المُلخص:

يُسهّم هذا المقال في الجدل المُستمر حول "قيمة" المكتبة في إدارة المُقتنيات، ويتناول الأمر من منظور العمل المكتبي في الدول النامية، ويُركّز على المستوى الجزئي من المكتبات الفردية والمُقتنيات الأرشيفية وتوصل المقال إلى أن القيمة تبدأ مُتعدد الأبعاد فيمكن أن يكون للمُقتنى الواحد قيمة مُختلفة لدى كل شخص، ومجموعة، وأن يكون له أغراض واستخدامات مُختلفة أيضًا تتغير على مدار الزمن وليست ثابتة، مما يجعل إعادة فرز المُقتنيات واستبعاد مجموعة منها أمرًا مُعقدًا، يؤثر على الاستفادة من استخدام المكتبة بأشكال عدة، فقد تكون هناك قيمة تعليمية، ترفيهية، معلوماتية، بحثية، قانونية، نقدية، أو حتى قيمة عاطفية لكل من مُقتنيات المكتبة، والفرز الذي يتم على أساس معايير محدودة لمدى فائدة المُقتنى وصلته باحتياجات المُستخدم والفلق بشأن نفقات تخزينه وهي معايير قد لا تكون عادلة ولا تعمل للصالح الثقافي العام الذي تتبناه المكتبات.

#### Challenges of archiving and preserving born-digital news applications

التحديات التي تواجه أرشفة وحفظ تطبيقات الأخبار التي صدرت في صورة رقمية من البداية:

Katherine Eileen Boss, Meredith Broussard

العدد رقم 43:2 م مجلة الإفلا المتخصصة:

المُلخص:

تتزايد أهمية المحتوى الإخباري كونه أصبح المسودة التاريخية الأولى، ولأرشفة وحفظ هذا التاريخ أهمية محورية لمستقبل البحث الدراسي، ولكن تقف العديد من التحديات التقنية، والقانونية، والمالية، واللوجستية في طريق هذه الجهود لحفظ التاريخ؛ وخاصة في حفظ التطبيقات الإخبارية، والمواقع المُصممة حسب الاحتياجات والتي تضم بعضًا من أعقد الأخبار الصحفية، مثل مشروع "دولارز فور دوكس" الذي

أسسته "Propublica"، إن مُعظم التطبيقات الإخبارية برمجيات مُستقلة تستمد المعلومات من قاعدة بيانات، ولا يُمكن أرشفة هذه التطبيقات الفرعية مثل الأخبار الصحفية النصية، أو تسجيلها كاملًا من خلال أدوات أرشفة المواقع الإلكترونية، مثل "Archive-it"، والتي بدأت حاليًا في الابدثار، يُشير هذا البحث إلى التحديات العديدة التي تواجه أرشفة وحفظ التطبيقات الإخبارية الصادرة في صورة رقمية من بدايتها، كما تتناول اقتراحات بشأن التعامل مع مثل هذا العمل الهام.

#### Using customer relationship management systems at university libraries: A comparative study between Saudi Arabia and Egypt

استخدام نُظم إدارة العلاقة مع المُستخدم في المكتبات الجامعية: دراسة مُقارنة بين المملكة العربية السعودية ومصر:

Nehal Fouad Ismael, Najah Al-Goblan

العدد رقم 43:2 م مجلة الإفلا المتخصصة:

المُلخص:

تقف المكتبات اليوم في موقف صعب يحتاج إلى بذل الجهود اللازمة؛ لإظهار قدرة المكتبة التنافسية في جذب مُستخدميها وتلبية احتياجاتهم في العالم الافتراضي المليء بمصادر المعلومات المُختلفة، وهو ما يحتاج من المكتبات الانتباه إلى علاقتها مع المُستخدمين؛ من أجل ما يريدون الوصول إليه في تنمية معارفهم وإلى استراتيجياتها في النجاح في ظل البيئة التنافسية التي يفرضها الوضع الحالي، ترمي هذه الدراسة إلى استطلاع إمكانية تطبيق نظم إدارة العلاقات مع المُستخدمين في المكتبات الجامعية، وهو ما يُمكن إتمامه من خلال تعريف هذه المكتبات بنظم إدارة العلاقات مع المُستخدمين، وآليات تطبيق هذه، ومدى قابلية المكتبات الجامعة لتبنيها، بالإضافة إلى ذلك تستطلع الدراسة العراقيل التي قد تحول بيننا وبين استخدام هذه النظم في المكتبات الجامعية السعودية والمصرية.

#### Undergraduates' assessment of Science, Technology, Engineering and Mathematics (STEM) information literacy instruction

تقييم الطلاب لتدريس العلوم والتكنولوجيا والهندسة والرياضيات:

Sasekea Yoneka Harris

العدد رقم 43:2 م مجلة الإفلا المتخصصة:

المُلخص:

يسعى هذا البحث إلى معرفة وجهة نظر الطلاب عن المنهج (أ) المُقدم لهم وإلى أي مدة أتاح لهم هذا المنهج فرصة معرفة معلومات وتعلّم مهارات جديدة، (ب) أداء المُحاضر، وتم عمل استطلاع رأي؛ لمعرفة آراء الطلبة وتم استخدام مقياس اختبار مُباشر؛ لإضافة قيمة لمفهوم الطلبة، تكشف هذه الورقة البحثية أن رأي الطلاب إيجابياً في أداء المُحاضرين، والمنهج، والفرص، المُتاحة لتعلّم مهارات ومعلومات جديدة، ويُمثل هذا البحث قيمة كبيرة حيث يُقدم هذا التقييم (لرأي المُتلقّي/الطالب) معلومات قيمة يُمكن استخدامها؛ لمتابعة مدى فاعلية التعليم، وكيف يُقدم، وتطوير الأداء والمُقارنة ووضع معايير، وبما أن مبدأ العلوم والتكنولوجيا والهندسة والرياضيات مبدأ ناشئ فكل عمل موثوق حولها يُشكل قيمة كبيرة.

### Digitization of indigenous knowledge on forest foods and medicine

رقمنة معارف الشعوب الأصلية حول الأطعمة والأدوية المُستخرجة من الغابات:

Margaret Sraku-Lartey, Stella Britwum  
Acquah, Sparkler Brefo Samar, Gloria Djaney  
Djagbletey

العدد رقم 43:2 م مجلة الإفلا المتخصصة:

المُلخص:

يُناقش هذا البحث رقمنة المعارف ذات الصلة بالشعوب الأصلية حول الأطعمة والدواء؛ من أجل إدارة موارد الغابات في غانا بفاعلية، ويقوم البحث على استطلاع رأي تم في تسع مُجتمعات في غانا من 606 شخص خلال مُقابلات تمت معهم وجهًا لوجه، وتهدف الدراسة إلى

تقييم معلومات المُجتمعات المحلية حول مُنتجات الغابة، خاصةً الدواء والأطعمة ذات الصلة بالشعوب الأصلية، وتكشف الدراسة أن نسبة استهلاك الشعوب الأصلية للأطعمة والأدوية الواردة من الغابات في اندحار، بينما ترتفع نسبة استهلاكهم للأدوية التقليدية، وتوصي الدراسة بالترويج لقوانين وأدوات قانونية تحمي المُجتمعات من الفرصة البيولوجية.

### E-science: An epistemological analysis based on the philosophy of technology

العلوم الإلكترونية: تحليل مفاهيمي حول فلسفة التكنولوجيا:

Alexandre Ribas Semeler, Adilson L Pinto,  
William Barbosa Vianna B Vianna

العدد رقم 43:2 م مجلة الإفلا المتخصصة:

المُلخص:

إنه بعد جديد من أبعاد العلوم، إن ظاهرة العلوم الإلكترونية هي البب في التغيرات التي طرأت على المجالات التقليدية لعلوم المعلومات، ويهدف هذا المقال إلى عرض الأصول التاريخية لعلوم المعلومات، باستخدام بعض العناصر المعرفية لفلسفة التكنولوجيا، إننا نعتبر العلوم الإلكترونية ظاهرة معلوماتية، ويكمن النقاش في تداخل مفاهيم العلوم الإلكترونية والتكنولوجيا، إن هذه المُشكلة المفاهيمية مكونة من أسئلة بسيطة: ما هي المعلومات؟ ما هو العلم الإلكتروني؟ ما هي التكنولوجيا؟ وتنقسم أجزاء المقال إلى: الخلفية التاريخية، والمفاهيم العامة لعلوم المعلومات، وظاهرة علوم المعلومات، وما تُسهم به فلسفة التكنولوجيا إلى العلوم الإلكترونية، ويختتم المقال أن المعلومات هي أساس العلوم الإلكترونية، ويُمكن تعريف التكنولوجيا كونها أداة، وقواعد، ونظم، ويتم استخدام مفهوم التكنولوجيا؛ لعرض أشياء، وأفعال، ونظم تكنولوجية، ومعلومات.

## 摘要

### The predicament of library value

Ellen Ndeshi Namhila

图书馆价值之困境

埃伦·德什·纳姆希拉

《国际图联杂志》，43-2，141—149

摘要：

本文是对时下图书馆馆藏管理“价值”的一次探讨。文章从发展中国家图书馆实践的角度切入。本文关注微观层面的图书馆和档案馆单个藏品，得出结论为价值是个多维概念，一件藏品对不同

的个人、不同的人群、不同的用途和目的可能具有许多种不同的价值，这并不是静止不动的，而是随着时间改变。这意味着图书馆和档案馆取消选择或者“剔除”材料是一个复杂的任务，对图书馆使用有不同方面的影响。图书馆的单个材料可能具有教育、娱乐、信息、研究、证据(法律上的)、财政、本质的、情感的等各种固有价值。基于有用性、专业相关性和保存成本考虑等狭隘标准进行的剔除可能无法充分发挥图书馆应体现的教育、社会和文化共同利益。

### Challenges of archiving and preserving born-digital news applications

Katherine Eileen Boss, Meredith Broussard

原生数字新闻应用程序归档和保存的挑战

凯瑟琳·艾琳·波斯, 梅雷迪思·布鲁萨尔

《国际图联杂志》, 43-2, 150—157

摘要:

原生数字新闻内容逐渐成为历史的第一稿形式。归档和保存这部分历史对未来的专业研究至关重要, 但技术、法律、财务和组织方面的诸多挑战阻碍了归档和保存工作。这对新闻应用程序, 或者定制网站而言, 尤其如此。新闻应用程序和定制网站包含当下一些最错综复杂的新闻故事, 例如“为了人民”(ProPublica)网站的“美元换文档”(Dollars for Docs)项目。许多新闻应用程序是独立的软件, 可查询数据库, 这类程序数量显著, 但无法像基于文本的新闻故事那样归档, 或者通过Archive-It等网页归档工具进行完整捕捉。因此, 这些应用程序目前正在消失。本文阐述了原生数字新闻应用程序归档和保存面临的各种挑战, 并就如何开展这一重要工作提出建议。

### Using customer relationship management systems at university libraries: A comparative study between Saudi Arabia and Egypt

Nehal Fouad Ismael, Najah Al-Goblan

在高校图书馆使用客户关系管理系统: 沙特阿拉伯与埃及的比较研究

内哈尔·福阿德·伊斯梅尔, 纳贾·戈布兰

《国际图联杂志》, 43-2, 158—170

摘要:

目前, 图书馆处境困难, 需要努力证明其在虚拟环境中吸引并满足客户的竞争能力, 而虚拟环境具备各种来源的信息。这要求图书馆高度重视向客户推广客户关系管理, 推广其知识发展目标方案和策略, 以在当前充满竞争的情况下取得成功。本研究旨在调研客户关系管理系统在高校图书馆的潜在实施。调研向高校图书馆介绍客户关系管理的概念、这些系统的实施机制, 以及高校

图书馆采用这些系统的倾向程度。此外, 本研究调研了沙特阿拉伯和埃及高校图书馆使用客户关系管理系统面临的障碍。

### Undergraduates' assessment of Science, Technology, Engineering and Mathematics (STEM) information literacy instruction

Sasekea Yoneka Harris

本科生科学、技术、工程与数学信息素养教育评估

萨塞基·尤奈卡·哈里斯

《国际图联杂志》, 43-2, 171—186

摘要:

本文致力于研究本科生对(1)所授课程及其提供的学习新信息技能机会的程度, (2)辅助人员表现的看法。研究采用了自行报告的方法(即调研)获取学生的看法, 以及直接的测试方法(测试)增加学生看法的价值。文章揭示出学生对辅助人员的表现、课程及其提供的学习新信息技能机会持积极看法。本文的评估(客户/学生看法)提供了富有价值的信息, 可用于监测教授内容、教授方式的有效性, 提高表现, 提供基本标准, 因而很有价值。鉴于科学、技术、工程与数学在牙买加是个新兴概念, 任何与此有关的活动记录文字都有价值。

### Digitization of indigenous knowledge on forest foods and medicine

Margaret Sraku-Lartey, Stella Britwum Acquah, Sparkler Brefo Samar, Gloria Djaney Djagbletey

森林食物与药物本土知识数字化

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《国际图联杂志》, 43-2, 187—197

**摘要：**

本文探讨了森林食物与药物本土知识的数字化，以有效管理加纳的林业资源。文章基于在加纳九个社区开展的一项调研，原始数据通过与606名受访者的面对面深度访谈而获得。研究目的是评估当地社区对森林产品，尤其是本土森林食物与药物的了解。研究发现，当地社区对本土森林食物和药物非常了解。当地社区熟悉森林里出产哪些食物和药物，如何使用，何时成熟。研究揭示出本土森林食物的消费呈下降趋势，而传统药物的使用处于优势地位。研究建议通过宣传法律法规来保护社区免受生物剝窃之害。

E-science: An epistemological analysis based on the philosophy of technology

Alexandre Ribas Semeler, Adilson L Pinto, William Barbosa Vianna B Vianna

电子科学：基于技术哲学的认识论分析

亚历山大·里巴斯·塞默勒，阿迪尔森·L·平托，威廉·巴尔博萨·维安纳

《国际图联杂志》，43-2，198—209

**摘要：**

作为科学的一个新类别，电子科学现象引发了传统信息科学领域的变化。本文目的是采用技术哲学的若干认识论元素，论述信息科学的历史起源。作者认为，电子科学是信息现象。文章探讨了信息、电子科学和技术等概念的叠覆。认识论问题由简单问题组成：什么是信息？什么是电子科学？什么是技术？文章各部分为：与信息科学相关的认识论历史背景和概述、电子科学现象，以及技术哲学对电子科学的贡献。结论是对电子科学而言最重要的概念是信息。技术可被定义为硬件、规则和系统。技术派认识论用于表现事物、动作、方法技术体系和信息。

**Sommaires****The predicament of library value**

[Le problème de la valeur bibliothécaire]

Ellen Ndeshi Namhila

IFLA Journal, 43-2, 141–149

**Résumé:**

Cet article contribue au débat permanent sur la « valeur » bibliothécaire dans le cadre de la gestion des collections. Il est rédigé depuis la perspective de la pratique bibliothécaire dans un pays en développement. Il se concentre sur le micro-niveau de la bibliothèque individuelle et les objets archivés, et en conclut que la valeur est un concept multidimensionnel et qu'un objet particulier peut avoir une valeur très différente selon les différents individus, groupes d'individus, usages et objectifs, qui ne sont pas statiques mais évoluent avec le temps. Cela fait du retrait ou du « déblayage » de matériel d'archives et bibliothécaire un exercice complexe, qui influence de diverses façons les avantages que représente l'usage des bibliothèques. La valeur peut avoir trait à l'enseignement, aux divertissements, aux informations, à la recherche, aux témoignages et preuves (juridiques), aux questions monétaires, ainsi qu'être intrinsèque, sentimentale ou autre valeur

inhérente au matériel d'une certaine bibliothèque. Le déblayage motivé par des critères – interprétés de façon restrictive – d'utilité, de pertinence des programmes d'études et de préoccupations au sujet des frais de stockage, peut ne pas rendre justice au bien commun éducatif, social et culturel qu'incarnent les bibliothèques.

**Challenges of archiving and preserving born-digital news applications**

[Les défis de l'archivage et de la conservation des nouvelles applications d'origine numérique]

Katherine Eileen Boss, Meredith Broussard

IFLA Journal, 43-2, 150–157

**Résumé:**

Le contenu d'information d'origine numérique devient de plus en plus le format de la première version d'une histoire. Archiver et conserver cette histoire a une importance fondamentale pour l'avenir de la recherche savante, mais de nombreux défis d'ordre technique, juridique, financier et logistique font obstacle à ces efforts. C'est spécialement vrai pour les nouvelles applications ou les sites web très spécialisés qui accueillent certains des articles journalistiques les plus sophistiqués d'aujourd'hui, par exemple le projet «

Dollars for Docs » de ProPublica. De nombreuses nouvelles applications sont des formes de logiciels autonomes qui interrogent une base de données, et cet important sous-ensemble d'applications ne peut pas être archivé de la même façon que des articles d'actualité sous forme de textes, ni recueilli intégralement par des outils d'archivage web tels qu'Archive-It. À ce titre, les applications de ce type sont actuellement en train de disparaître. Cet article aborde les différents défis que représentent l'archivage et la conservation des nouvelles applications d'origine numérique et fait des suggestions sur la façon de s'attaquer à cette tâche importante.

**Using customer relationship management systems at university libraries: A comparative study between Saudi Arabia and Egypt**

[Utilisation des systèmes de gestion de la relation client dans les bibliothèques universitaires: une étude comparative entre l'Arabie Saoudite et l'Égypte]

Nehal Fouad Ismael, Najah Al-Goblan

IFLA Journal, 43-2, 158–170

Résumé:

Aujourd'hui, les bibliothèques se trouvent dans une position difficile qui exige d'elles des efforts importants pour démontrer leurs capacités concurrentielles à attirer et satisfaire leurs clients, dans un environnement virtuel où les sources d'information sont diverses. Dans le cadre de leurs projets et stratégies visant à développer les connaissances, les bibliothèques doivent veiller à promouvoir la gestion de la relation avec leurs clients, afin de réussir dans le climat actuel de concurrence. L'étude en cours examine la possibilité de mettre en place des systèmes (de gestion de la relation client) au sein des bibliothèques universitaires. Pour ce faire, le concept de gestion de la relation client est présenté aux bibliothèques universitaires, de même que les mécanismes de mise en œuvre de ces systèmes et le niveau d'adoption de tels systèmes par les bibliothèques. L'étude en cours examine également les obstacles que rencontre l'utilisation de systèmes de gestion de la relation client dans les bibliothèques universitaires en Arabie Saoudite et en Égypte.

**Undergraduates' assessment of Science, Technology, Engineering and Mathematics (STEM) information literacy instruction**

[Évaluation par les étudiants de premier cycle de la formation à la maîtrise d'informations dans les domaines sciences, technologie, ingénierie et mathématiques (STIM)]

Sasekea Yoneka Harris

IFLA Journal, 43-2, 171–186

Résumé:

Cet article cherche à déterminer la perception qu'ont les étudiants de premier cycle (a) du programme d'études proposé et de la mesure dans laquelle il permet d'apprendre de nouvelles informations et d'acquérir de nouvelles compétences et (b) de la performance des facilitateurs. Une mesure d'autoévaluation (étude) a été utilisée pour déterminer les perceptions des étudiants et une mesure de test direct (test) a été utilisée pour ajouter de la valeur à la perception des étudiants. Cet article montre que les étudiants ont une perception positive de la performance des facilitateurs, du programme éducatif et des possibilités qu'il offre d'apprendre de nouvelles informations et aptitudes. Cet article est intéressant dans la mesure où l'évaluation (perception du client /de l'étudiant) fournit des informations précieuses qui peuvent être utilisées pour vérifier l'efficacité de ce qui est enseigné et la façon dont cet enseignement est dispensé, ainsi que pour améliorer les performances et fournir des repères. Étant donné que les STIM sont un concept émergent en Jamaïque, tout travail documenté portant sur des activités relatives aux STIM est appréciable.

**Digitization of indigenous knowledge on forest foods and medicine**

[Numérisation des connaissances indigènes sur les aliments et les plantes médicinales provenant des forêts]

Margaret Sraku-Lartey, Stella Britwum Acquah, Sparkler Brefo Samar, Gloria Djaney Djagbletey

IFLA Journal, 43-2, 187–197

Résumé:

Cet article traite de la numérisation des connaissances indigènes sur les aliments et plantes médicinales provenant des forêts, afin de permettre une gestion efficace des ressources forestières au Ghana. L'article se base sur une étude menée au sein de neuf communautés au Ghana, qui a permis d'obtenir des données primaires de 606 personnes interrogées dans le cadre d'entretiens individuels approfondis. Cette étude avait pour objectif de déterminer les connaissances des communautés locales à propos des produits de la forêt, en particulier les aliments et plantes médicinales indigènes provenant des forêts. Les constatations de l'étude ont montré que les communautés locales ont des connaissances poussées des aliments et plantes médicinales indigènes provenant des forêts. Elles

connaissent bien les aliments et plantes médicinales disponibles dans les forêts, la façon de les consommer et le moment où ils parviennent à maturité. L'étude a montré que la consommation d'aliments provenant des forêts connaît un déclin, alors que l'usage de la médecine traditionnelle augmente. L'étude recommande la promulgation de lois et de dispositions légales pour protéger les communautés contre la biopiraterie.

### **E-science: An epistemological analysis based on the philosophy of technology**

#### **[E-science: une analyse épistémologique basée sur la philosophie de la technologie]**

Alexandre Ribas Semeler, Adilson L Pinto, William Barbosa Vianna B Vianna  
IFLA Journal, 43-2, 198–209

Résumé:

Le phénomène de l'e-Science, une nouvelle dimension des sciences, est responsable des changements qui

s'opèrent au sein des domaines traditionnels des sciences de l'information. Cet article souhaite présenter une origine historique de la science de l'information en utilisant certains éléments épistémologiques de la philosophie de la technologie. L'e-Science est considérée comme un phénomène informationnel. La discussion porte sur l'imbrication des concepts entre information, e-Science et technologie. Le problème épistémologique pose des questions simples: qu'est-ce que l'information? Qu'est-ce que l'e-Science? Qu'est-ce que la technologie? L'article aborde différents thèmes: le contexte historique et les aspects d'ordre général de l'épistémologie en rapport avec les sciences de l'information, le phénomène de l'e-Science et les contributions de la philosophie de la technologie à l'e-Science. Il en conclut que l'information est le concept primordial pour l'e-Science. La technologie peut être définie comme étant du matériel, des règles et des systèmes. La « techno-épistémologie » est utilisée pour représenter des objets, des actions, des méthodes, des systèmes technologiques et des informations.

## **Zusammenfassungen**

### **The predicament of library value**

#### **(Das Dilemma mit dem Wert von Bibliotheken)**

Ellen Ndeshi Namhila

IFLA-Journal, 43-2, 141–149

Zusammenfassung:

Dieser Artikel ist ein Beitrag zur anhaltenden Debatte über den „Wert“ von Bibliotheken beim Bestandsmanagement, und zwar in diesem Fall aus der Perspektive der Bibliothekspraxis in einem Entwicklungsland. Der Schwerpunkt liegt auf der Mikroebene einer einzelnen Bibliothek und individueller Archivstücke. Fazit: Der Wert ist ein mehrdimensionales Konzept, und ein einziges Stück kann für viele verschiedene Gruppen von Menschen, unterschiedliche Nutzungszwecke und Ziele einen sehr unterschiedlichen Wert darstellen, der nicht statisch ist, sondern sich mit der Zeit ändert. Dadurch wird die Bestandspflege mit Blick auf das Aussortieren von Bibliotheks- und Archivmaterial eine heikle Angelegenheit, die in mehrfacher Weise Einfluss auf die Vorzüge der Bibliotheksnutzung hat. Mit individuellem Bibliotheksmaterial können Bildungs-, Unterhaltungs-, Informations-, Forschungs-, Beweis- (rechtlich), finanzielle, intrinsische, sentimentale und andere Werte verbunden sein. Ein Aussortieren aufgrund zu eng gefasster Kriterien der Nützlichkeit, Relevanz

für ein Curriculum sowie Aspekten wie Lagerkosten können den Bildungs-, sozialen und kulturellen Aspekten, die mit Bibliotheken als kulturellem Gemeingut verbunden sind, unter Umständen nicht gerecht werden.

### **Challenges of archiving and preserving born-digital news applications**

#### **(Herausforderungen der Archivierung und Erhaltung von rein digitalen (born digital) Nachrichten-Apps)**

Katherine Eileen Boss, Meredith Broussard

IFLA-Journal, 43-2, 150–157

Zusammenfassung:

Rein digitale Nachrichten werden zunehmend das wichtigste Format für die Festlegung von Geschichte. Die Archivierung und Erhaltung dieser Geschichte ist für die Zukunft der wissenschaftlichen Forschung von größter Bedeutung. Allerdings gibt es zahlreiche technische, rechtliche, finanzielle und logistische Hürden zu überwinden. Dies gilt insbesondere für Nachrichten-Apps oder ganz spezielle Websites, die eine der aufwändigsten journalistischen Recherchen von heute enthalten, beispielsweise das „Dollars for Docs“-Projekt von ProPublica. Viele Nachrichten-Apps basieren auf einer für sich stehenden Software, die eine Datenbank abfragt, und diese Arten von Apps

können nicht auf die gleiche Weise archiviert werden wie textbasierte Nachrichten oder Nachrichten, die mit Netzarchivierungstools wie Archive-it erfasst werden können. Daher gehen sie zurzeit häufig verloren. Diese Arbeit skizziert die zahlreichen Herausforderungen in Bezug auf die Archivierung und Erhaltung rein digitaler Nachrichten-Apps und kommt mit Vorschlägen für den Umgang mit dieser wichtigen Arbeit.

### **Using customer relationship management systems at university libraries: A comparative study between Saudi Arabia and Egypt**

#### **(Der Einsatz von Kundenbeziehungsmanagementsystemen in Uni-Bibliotheken: Eine vergleichende Studie zwischen Saudi-Arabien und Ägypten)**

Nehal Fouad Ismael, Najah Al-Goblan

IFLA-Journal, 43-2, 158–170

Zusammenfassung:

Bibliotheken haben heute einen schweren Stand. Sie müssen ihre Wettbewerbsfähigkeit unter Beweis stellen, indem sie Wege finden, für ihre Kunden in einer virtuellen Umgebung mit unzähligen Informationsquellen attraktiv zu bleiben und sie zufrieden zu stellen. Die Bibliotheken müssen daher in Bezug auf die Pläne und Strategien für die Wissensentwicklungsziele ihrer Kunden deutlich auf CRM setzen, um sich in diesem sehr konkurrierenden Umfeld behaupten zu können. Die vorliegende Studie untersucht die potenzielle Implementierung von (CRM-)Systemen in Uni-Bibliotheken. Dazu enthält die Studie zunächst eine Einführung in das CRM-Konzept für Uni-Bibliotheken, den Implementierungsmechanismus dieser Systeme und bespricht das Maß, in dem die Bibliotheken bereit sind, sich darauf einzulassen. Darüber hinaus werden in der Studie die Hindernisse für den Einsatz von CRM-Systemen in Uni-Bibliotheken in Saudi-Arabien und Ägypten besprochen.

### **Undergraduates' assessment of Science, Technology, Engineering and Mathematics (STEM) information literacy instruction**

#### **(Einschätzung von Studenten im Grundstudium über den Erwerb von Informationskompetenz von in den MINT-Fächern (Mathematik, Informatik, Naturwissenschaften und Technik))**

Sasekea Yoneka Harris

IFLA-Journal, 43-2, 171–186

Zusammenfassung:

In dieser Arbeit wird die Auffassung von Studenten im Grundstudium (a) über das Curriculum und die Möglichkeiten, neue Informationen und Fertigkeiten zu erlernen, und (b) über die Leistungen der Unterrichtenden untersucht. Um die Auffassungen der Studenten zu erfahren, wurde ein Selbstauskunftsinstrument eingesetzt (Umfrage), außerdem sollte mit einem direkten Testinstrument (Test) die Auffassung der Studenten bewertet werden. Fazit dieser Untersuchung war, dass die Studenten einen positiven Eindruck der Leistungen der Unterrichtenden, des Curriculums und der Möglichkeiten haben, neue Informationen und Fertigkeiten zu erlernen. Diese Arbeit ist deshalb so wertvoll, weil die Einschätzung (Kunden-/Studenten-Auffassung) wichtige Informationen liefert, die zur Überwachung der Wirksamkeit der Lerninhalte, der Vermittlung dieser Inhalte und zur Verbesserung der Leistungen verwendet werden kann. Außerdem kann sie als Benchmark dienen. Da MINT in Jamaica ein boomendes Konzept ist, ist jede dokumentierte Arbeit in Bezug auf MINT von größtem Wert.

### **Digitization of indigenous knowledge on forest foods and medicine**

#### **(Digitalisierung von Kenntnissen der eingeborener Gemeinschaften über Nahrungsmittel und Heilmittel aus dem Wald)**

Margaret Sraqu-Lartey, Stella Britwum Acquah, Sparkler Brefo Samar, Gloria Djaney Djabbletey

IFLA-Journal, 43-2, 187–197

Zusammenfassung:

Diese Arbeit befasst sich mit der Digitalisierung der Kenntnisse eingeborener Gemeinschaften (indigenous knowledge, IK) zu Nahrungsmitteln und Heilmitteln zur Förderung eines effektiven Managements der Ressourcen der Wälder Ghanas. Die Grundlage bildete eine in neun Gemeinschaften in Ghana durchgeführte Umfrage, bei der mittels einer mündlichen und ausführlichen persönlichen Befragung Primärdaten von 606 Respondenten erhoben wurden. Die Studie wollte herausfinden, welche Kenntnisse in lokalen Gemeinschaften über die Produkte des Waldes, insbesondere über indigene Nahrungsmittel und Heilmittel des Waldes, bekannt waren. Es stellte sich heraus, dass diese Gemeinschaften über eingehende Kenntnisse zu Nahrungsmitteln und Heilmitteln aus dem Wald verfügen. Die Menschen sind mit den Nahrungsmitteln und Heilmitteln vertraut, die der Wald ihnen liefert, mit ihrer

Art der Verwendung und dem Zeitpunkt, an dem sie geerntet werden können. Die Studie stellte aber auch fest, dass der Konsum indigener Nahrungsmittel aus dem Wald rückläufig ist, während sich die Verwendung traditioneller Heilmittel im Aufwind befindet. Zum Schutz dieser Gemeinschaften vor Bio-Piraterie empfiehlt die Studie die Verabschiedung entsprechender Gesetze und die Bereitstellung von Rechtsinstrumenten.

### **E-science: An epistemological analysis based on the philosophy of technology**

(E-Science: Eine epistemologische Analyse anhand der Technikphilosophie)

Alexandre Ribas Semeler, Adilson L Pinto, William Barbosa Vianna B Vianna  
IFLA-Journal, 43-2, 198–209

Zusammenfassung:

Eine neue Dimension der Wissenschaften, das Phänomen der E-Science, sorgt für grundlegende

Veränderungen im traditionellen Feld der Informationswissenschaften. Mit diesem Aufsatz sollen die historischen Anfänge der Informationswissenschaften aufgezeigt werden. Dazu werden epistemologische Elemente der Technikphilosophie herangezogen. Wir betrachten die E-Science als informationelles Phänomen. Die Diskussion bezieht sich auf die Konzeptüberschneidung zwischen Informationen, E-Science und Technik. Das epistemologische Problem besteht aus sehr einfachen Fragen, wie „Was ist Information?“, „Was ist E-Science?“ und „Was ist Technik?“ Nach den Kapiteln zum historischen Hintergrund und den allgemeinen Aspekten der Epistemologie in Bezug auf die Informationswissenschaften, das Phänomen E-Science und den Beitrag aus der Technikphilosophie zur E-Science gelangt der Artikel zu dem Schluss, dass das wichtigste Konzept für E-Science die Information ist. Die Technik lässt sich als Hardware, als Regeln und als System definierten. Die Techno-Epistemologie dient zur Darstellung von Sachen, Handlungen, Verfahren, technologischen Systemen und Information.

## **Рефераты статей**

### **The predicament of library value**

**(Трудности определения библиотечной ценности)**

Эллен Ндеши Намхила

IFLA Journal, 43-2, 141–149

Аннотация:

В настоящей статье приводятся аргументы в рамках непрекращающегося обсуждения «ценности» при управлении фондами библиотеки. Здесь практические методы рассматриваются с точки зрения их применения в библиотеках развивающейся страны. Основное внимание в статье сфокусировано на микроуровне личной библиотеки и архивных предметов, а вывод гласит, что ценность является многогранным понятием, и что один предмет может обладать множеством различных ценностей для различных людей, групп людей, различных способов применения и различных целей, которые не статичны, а изменяемы с течением времени. В связи с этим исключение из выборки или «прореживание» библиотечных и архивных материалов является комплексным мероприятием, оказывающим многостороннее влияние на преимущества пользования библиотеками. Конкретный

материал библиотеки может обладать ценностью с образовательной, развлекательной, информационной, исследовательской, фактологической (юридической), монетарной, объективной, сентиментальной и иных точек зрения. Прореживание на основании узко истолкованных критериев практической пользы, актуальности с точки зрения учебной программы, а также беспокойства о расходах, связанных с хранением, могут воспрепятствовать должной оценке общественной пользы, приносимой библиотеками в образовательной, социальной и культурной сферах.

### **Challenges of archiving and preserving born-digital news applications**

**(Серьезные задачи, связанные с архивированием и сохранением новостных приложений, изначально созданных в цифровом формате)**

Кэтрин Эилеен Босс, Мередит Бруссар

IFLA Journal, 43-2, 150–157

Аннотация:

Новостная информация, изначально возникающая в цифровом формате, все активнее претендует на роль чернового наброска истории. Архивирование

и сохранение этой истории имеет первостепенное значение для будущих научных исследований, однако на пути подобных усилий стоит множество трудноразрешимых вопросов технического, юридического, финансового и логистического плана. Это особенно актуально для новостных приложений, или разработанных по индивидуальному заказу веб-сайтов, включающих в себя сегодня одни из самых замысловатых журналистских материалов, таких как проект “Доллары для докторов” (Dollars for Docs) новостного портала ProPublica. Многие новостные приложения являются самостоятельными компонентами программного обеспечения, которые отправляют запросы в базу данных, и эта значительная подгруппа приложений не может быть заархивирована таким же образом, как текстовые новостные репортажи, либо полностью охвачена сетевыми сервисами по архивированию, такими как Archive-It. В силу вышесказанного они сейчас исчезают. В настоящей работе будут описаны различные задачи, связанные с архивированием и сохранением изначально цифровых новостных приложений, а также изложены общие предложения относительно подходов к данной ответственной работе.

### **Using customer relationship management systems at university libraries: A comparative study between Saudi Arabia and Egypt**

**(Использование систем управления отношениями с клиентами в библиотеках университетов: Сравнительное исследование между Саудовской Аравией и Египтом)**

Нехал Фоуад Исмаэл, Наджа Аль-Гоблан

IFLA Journal, 43-2, 158–170

Аннотация:

Сегодня библиотеки находятся в сложном положении, которое требует от них приложения усилий, чтобы подтвердить в условиях конкуренции свои способности по привлечению клиентов и удовлетворению их запросов в виртуальной среде, насыщенной различными источниками информации. Для этого требуется, чтобы библиотеки уделяли повышенное внимание содействию развития системы управления отношениями со своими клиентами для того, чтобы их целевые планы и стратегии развития знаний были успешны в текущих конкурентных условиях. Настоящее исследование направлено на изучение потенциала внедрения в библиотеках университетов систем управления

отношениями с клиентами (CRM). Для этого концепция CRM представлена применительно к библиотекам университетов, указаны механизмы реализации таких систем, а также уровень предрасположенности библиотек к принятию этих систем. В дополнение к этому в настоящем исследовании рассмотрены факторы, препятствующие применению систем CRM в библиотеках университетов Саудовской Аравии и Египта.

### **Undergraduates' assessment of Science, Technology, Engineering and Mathematics (STEM) information literacy instruction**

**(Оценка студентами инструкции по повышению грамотности в области информации, связанной с наукой, техникой, проектированием и математикой (STEM))**

Сасекеа Йонека Харрис

IFLA Journal, 43-2, 171–186

Аннотация:

Данная работа направлена на определение того, как студенты относятся к (а) предлагавшейся им программе обучения и к той степени, в которой эта программа представляла им возможность узнавать новую информацию и обучаться новым навыкам и (б) эффективности деятельности методистов. Для сбора сведений о восприятии студентами вышеупомянутых факторов использовался метод самоотчета (опрос), а для увеличения достоверности полученных от студентов данных использовался метод прямого тестирования (тест). Настоящий документ показывает, что студенты положительно оценивают эффективность деятельности методистов, программу обучения, а также те возможности в плане знакомства с новой информацией и обучения новым навыкам, которые она им представила. Значимость данной работы заключается в том, что проведенная оценка (восприятия клиентом / студентом) дает ценную информацию, которая может быть использована для контроля эффективности как предмета преподавания, так и используемых методов подачи информации, для повышения эффективности, а также закладывает основу для проведения сравнительного анализа на основе эталонных показателей. С учетом того, что в настоящее время концепция STEM (наука, техника, проектирование и математика) активно развивается на Ямайке, значение имеют любые документально оформленные работы, связанные с деятельностью в рамках STEM.

### Digitization of indigenous knowledge on forest foods and medicine

(Перевод в цифровой формат знаний коренных народов о пище и лекарственных средствах, которые можно добыть в лесу)

Маргарет Сраку-Лартей, Стелла Бритвум Аккуа, Спарклер Брефо Самар, Глория Джейни Джагблетей  
IFLA Journal, 43-2, 187–197

Аннотация:

В данной работе рассматривается вопрос перевода в цифровой формат знаний коренных народов о пище и лекарственных средствах, которые можно добыть в лесу, и целью такого перевода является эффективное распоряжение лесными ресурсами Ганы. Документ основан на опросе, проведенном в девяти сообществах Ганы, в рамках которого первичные данные были получены от 606 респондентов в ходе обстоятельных личных бесед. Целью исследования была оценка тех знаний, которыми располагают местные сообщества относительно даров леса, и в особенности относительно лесных продуктов питания и лекарственных средств, используемых коренными народами. В результате выяснилось, что местные сообщества располагают глубокими знаниями относительно лесных продуктов питания и лекарственных средств, используемых коренными народами. Они прекрасно осведомлены о том, какие пищевые продукты и лекарственные средства можно добыть в лесу, каким образом их необходимо употреблять и когда они созревают. Исследование показало, что потребление используемых коренными народами лесных пищевых продуктов снижается, в то время как использование средств народной медицины возрастает. В документе содержится предложение о принятии законов и правовых актов, направленных на защиту сообществ от биопиратства.

### E-science: An epistemological analysis based on the philosophy of technology

(Электронная наука: Эпистемологический анализ на основе философии техники)

Александре Рибас Семелер, Адилсон Л Пинто, Уиллиам Барбоса Вианна Б Вианна  
IFLA Journal, 43-2, 198–209

Аннотация:

Новое измерение в области научных знаний, феномен, известный как “электронная наука”, несет ответственность за перемены в традиционных областях информатики. Целью данной работы является описание исторического происхождения информатики с использованием некоторых теоретико-познавательных элементов философии техники. Мы рассматриваем электронную науку как информационный феномен. Дискуссия разворачивается вокруг пересечения понятий информации, электронной науки и техники. Эпистемологическая проблема состоит из простых вопросов: что такое информация? Что такое электронная наука? Что такое техника? Работа разбита на разделы: исторический контекст и общие эпистемологические аспекты, относящиеся к информатике, феномену электронной науки, а также вклад философии техники в электронную науку. Вывод: принципиальным понятием для электронной науки является информация. Техника может быть определена как технические средства, как правила и как системы. Техно-эпистемология используется для представления предметов, действий, технологических систем и информации.

## Resúmenes

### The predicament of library value

(La disyuntiva del valor de las bibliotecas)

Ellen Ndeshi Namhila

IFLA Journal, 43-2, 141–149

Resumen:

Este artículo contribuye al debate abierto sobre el «valor» de las bibliotecas en la gestión de colecciones.

Está redactado desde la perspectiva de la práctica bibliotecaria en un país en vías de desarrollo. Se centra en el micronivel de obras de archivo y biblioteca individuales y concluye que el valor es un concepto multidimensional y que una obra puede tener valores diferentes para personas distintas, grupo de personas distintos, usos y fines distintos que no son estáticos, sino que evolucionan con el tiempo. Esto hace del expurgo de material de biblioteca y archivo un ejercicio complejo, que afecta de diversas formas a los beneficios del uso de la biblioteca. El material bibliotecario individual puede tener valor educativo, de

entretenimiento, informativo, de investigación, probatorio (contexto jurídico), monetario, intrínseco, sentimental o de otra índole. El expurgo basado en criterios de utilidad, relevancia curricular y coste de almacenamiento interpretados estrictamente puede no hacer justicia al bien común educativo, social y cultural que defienden las bibliotecas.

### **Challenges of archiving and preserving born-digital news applications**

#### **(Dificultades inherentes al archivado y la preservación de aplicaciones de noticias creadas de forma digital)**

Katherine Eileen Boss, Meredith Broussard

IFLA Journal, 43-2, 150–157

Resumen:

El contenido de noticias creado de forma digital se está convirtiendo en el formato de referencia del primer borrador de un reportaje. El archivado y la preservación de este reportaje son de vital importancia para el futuro de la investigación científica, pero se interponen muchos obstáculos técnicos, jurídicos, financieros y logísticos. Este hecho es especialmente cierto en el caso de las aplicaciones de noticias o sitios web hechos a medida que hoy en día recogen algunos de los reportajes periodísticos más sofisticados, como el proyecto «Dollars for Docs» de ProPublica. Muchas aplicaciones de noticias son programas informáticos independientes que consultan una base de datos, y este gran subconjunto de aplicaciones no se puede archivar como se archivan los reportajes de noticias de texto, ni pueden ser capturadas por herramientas de archivo web como Archive-It. Ese es el motivo de que estén desapareciendo. Este ensayo describe las dificultades para archivar y preservar aplicaciones de noticias creadas de forma digital, además de ofrecer sugerencias para abordar esta importante tarea.

### **Using customer relationship management systems at university libraries: A comparative study between Saudi Arabia and Egypt**

#### **(Uso de sistemas de gestión de la relación con el cliente (CRM) en las bibliotecas universitarias: un estudio comparativo entre Arabia Saudí y Egipto)**

Nehal Fouad Ismael, Najah Al-Goblan

IFLA Journal, 43-2, 158–170

Resumen:

En la actualidad, las bibliotecas ocupan una difícil posición que requiere la realización de esfuerzos que demuestren sus habilidades competitivas para atraer y satisfacer a sus clientes en un entorno virtual que tiene diversas fuentes de información. Para ello, las bibliotecas deben prestar mucha atención a la promoción de la gestión de relación con sus clientes al objeto de que sus planes y estrategias de desarrollo de conocimientos se cumplan en el actual entorno competitivo. El estudio actual pretende analizar la posible implantación de sistemas (CRM) en bibliotecas universitarias. Esta implantación se realiza por medio de la introducción del concepto de CRM en las bibliotecas universitarias, la aplicación de mecanismos de estas bibliotecas y la disposición de la biblioteca a adoptarlos. Además, el estudio analiza los obstáculos que dificultan el uso de sistemas CRM en bibliotecas universitarias de Arabia Saudí y Egipto.

### **Undergraduates' assessment of Science, Technology, Engineering and Mathematics (STEM) information literacy instruction**

#### **(Evaluación de la alfabetización en materia de información sobre competencias de ciencias, tecnología, ingeniería y matemáticas (CTIM) de estudiantes de grado)**

Sasekea Yoneka Harris

IFLA Journal, 43-2, 171–186

Resumen:

Este artículo pretende determinar la percepción de los estudiantes de grado sobre (a) el plan de estudios impartido y la medida en que este ofrece la oportunidad de aprender información y destrezas nuevas y (b) el desempeño de los facilitadores. Se usó una medida auto-declarada (encuesta) para recoger las percepciones de los estudiantes y una medida de evaluación directa (test) para añadir valor a dichas percepciones. Este artículo revela que los estudiantes tienen una percepción positiva del desempeño de los facilitadores, el plan de estudios y las oportunidades para aprender información y destrezas nuevas. El documento resulta valioso como evaluación (percepción de estudiantes / clientes) que aporta información susceptible de usar para supervisar la eficacia de lo que se enseña y cómo se enseña, mejorar el desempeño y servir como referencia comparativa. Dado que CTIM es un concepto en boga en Jamaica, todos los estudios documentados

sobre actividades relacionadas con estas competencias resultan valiosos.

### **Digitization of indigenous knowledge on forest foods and medicine**

#### **(Digitalización de los conocimientos indígenas sobre medicamentos y alimentos forestales)**

Margaret Sraku-Lartey, Stella Britwum Acquah, Sparkler Brefo Samar, Gloria Djaney Djagbletey

IFLA Journal, 43-2, 187–197

Resumen:

Este documento analiza la digitalización de los conocimientos indígenas (CI) sobre medicamentos y alimentos forestales para la gestión efectiva de los recursos forestales de Ghana. Se basa en una detallada encuesta personal realizada en nueve comunidades de Ghana a la que respondieron 606 personas. El objetivo del estudio era evaluar los conocimientos de las comunidades locales sobre productos del bosque, especialmente medicamentos y alimentos forestales indígenas. Los resultados revelan que las comunidades locales tienen profundos conocimientos sobre los medicamentos y los alimentos forestales indígenas. Están familiarizados con los alimentos y medicamentos disponibles en los bosques, su forma de consumo y su momento de maduración. El estudio revela que el consumo de alimentos forestales indígenas se está reduciendo, mientras que el uso de medicamentos tradicionales aumenta. El estudio recomienda la promulgación de leyes e instrumentos legales destinados a proteger a las comunidades de la biopiratería.

### **E-science: An epistemological analysis based on the philosophy of technology**

#### **(e-Ciencia: un análisis epistemológico basado en la filosofía de la tecnología)**

Alexandre Ribas Semeler, Adilson L Pinto, William Barbosa Vianna B Vianna

IFLA Journal, 43-2, 198–209

Resumen:

El fenómeno e-Ciencia, una nueva dimensión de las ciencias, es el responsable de los cambios en ámbitos tradicionales de la ciencia de la información. El propósito de este ensayo es presentar los orígenes históricos de la ciencia de la información empleando algunos elementos epistemológicos de la filosofía de la tecnología. Consideramos la e-Ciencia un fenómeno divulgativo. El debate se centra en la imbricación conceptual entre información, e-Ciencia y tecnología. El problema epistemológico se compone de preguntas sencillas: ¿Qué es la información? ¿Qué es la e-Ciencia? ¿Qué es la tecnología? Los apartados del ensayo son: antecedentes históricos y aspectos generales de la epistemología relacionados con la ciencia de la información, el fenómeno de la e-Ciencia y las aportaciones de la filosofía de la tecnología a la e-Ciencia. Concluye que el principio conceptual de la e-Ciencia es la información. La tecnología se puede definir como hardware, como reglas y como sistemas. La tecno-epistemología se emplea para representar cosas, acciones, métodos, sistemas tecnológicos e información.

