

EMERGING LIBRARY TECHNOLOGY TRENDS IN ACADEMIC ENVIRONMENT - AN UPDATED REVIEW

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ABSTRACT

Due to a growing significance and applicability of information technologies to an academic institution, it is necessary to acquaint librarians and other information professionals with the technology which can be applied to academic environment since the development of digital competence is an inherent part of every school's curricula. Emerging library technologies such as Bibliographic Citation Management Software, Instructional System Design Software, Electronic Copyright Management System, Classroom Management Software, Library Automation Software, Electronic Resource Management Software and Integrated Search Software are very impactful as academic libraries move into the creation of digital contents. This paper reviewed the emerging library technology trend especially for academic libraries as well as the need to rethink and re-strategize on how increasing technological changes affect their services. Clear indications on libraries' need of emerging technology tools to support academic librarians for efficient and effective performance were presented. Recommendations were offered on persistent self-renovation by library professionals in order to stay ahead of technology learning curve.

Keywords: Academic library, Automation, Digital skill, Library technology, Software, Technological-know-how

INTRODUCTION

The technological-know how of an emerging library technology trend can be a challenge, as both the tasks that librarians are taking on and the tools, they are using to do them seem to be changing daily (Maideen and Oke, 2019). Nevertheless, it is especially important for academic librarians to be aware of technology skills and knowledge that are in-demand, because increasingly, these tools will be central to successful performance of their institutions. Depending on their work, all manner of online research tools such as scholarly databases, government e-resources, research citation and mapping tools, as well as international sources may be a requirement in order for academic librarians to perform their jobs effectively (Anderson, 2015). According to Katz and Macklin (2007), technology is the portal through which we interact with information, but people's ability to handle information to solve problems and think critically about information tells us more about their future success than their knowledge of specific hardware or software.

The step of technological change is quick and new library technologies are available while many more are looming. It may not be possible to adopt all the innovation and technologies because most libraries cannot afford to implement each and every innovation once it becomes obtainable. However, libraries must have a vision to match the new technologies to user and

institutional needs. Libraries need to have the aspiration in adopting new technologies. Undoubtedly, the implementation costs will be important for any kind of new technologies for all library categories especially academic libraries (Maideen and Oke, 2019). Before implementing the new technologies, the feasibility study is very important and need a focus approach that indicate it will work in the future.

As stated by King (2018), libraries do not only need to implement any technology on the basis of what it will do for library users today, but also with the hope that it will grow and change to meet the evolving needs of library users over the next few years. Therefore, technology decisions need to be made with an eye to the future. Digital library applications are closely linked to Web technology (Choi and Rasmussen, 2009). Consequently, as modern academic libraries move into the creation of digital content, its organisation and preservation through metadata creation and management to make their special collections more accessible via the Web, the need for knowledge of the following technologies becomes critical: Bibliographic Citation Management Software, Instructional System Design Software, Electronic Copyright Management System, Classroom Management Software, Library Automation Software, Electronic Resource Management Software and Integrated Search Software. Therefore, to stay on top of technology invention in higher institution of learning, academic library should be the first learning centre where such technology should be experienced either in documented or practical form. The objective of this paper is to explore different emerging library technologies applicable in academic environment, their usefulness and benefits. Systematic literature review approach was adopted to describe the variables as stated in the title.

Bibliographic Citation Management Software

Most popular bibliographic citation management software performs some basic tasks as its advantages are numerous to mention but a few, for academic community. First, it helps organize references. Using this software, user can collect and manage groups of citations; set up groupings by topic; sort references; select the ones to cite in a particular article; and so on. Naturally, one could do all this using a standard database program like Access or FileMaker Pro, but citation management software is already structured to accommodate the specific fields associated with bibliographic information (King *et al.*, 2011).

Next, this software will create bibliography and footnotes. All these packages allow user to select from hundreds of standard styles (for example, APA, Turabian, Chicago, and so on.). In addition, these packages are compatible with Word and all other standard word processing programs. This means that user can store the basic information within citation manager, and then set

up the references in document, using whatever style format chose (East, 2003). No more frantic searching through the style manual to make sure footnotes are correctly done – the software does all of that. There are several popular bibliographic citation management software packages available e.g EndNote, ProCite, Reference Manager, BibTeX etc. Butros and Taylor (2010) posit that developing expertise in the use and features of these programs to help the institution's faculty, researchers, and students, does increase the librarian's value in the institution. Most of these popular citation managers include their own search engines. These search engines allow users to connect to certain databases, conduct search, store citations, and format bibliography, all within one interface. It sounds great –but there can be some hidden disadvantages. The biggest disadvantage is that the databases needed may not be accessible in this manner. The search engines built into bibliographic software use a search protocol called Z39.50; they can only connect if there is a Z39.50 server at the other end (East, 2003). Not all databases have one. Thus, librarians should assist scholars by providing information and support about the proper citation tools to improve the research process (Francesse, 2013). Fry *et al.* (2019) observe that laypersons and students rarely showed interest in bibliographic instruction over the years because they believe that librarians were more about answering reference questions than about teaching the process of searching, retrieving and evaluating information. This therefore serves as a limitation to the use of bibliographic citation management software, hence, the need for academic libraries to introduce bibliographic instruction sessions taught by an instructional services librarian with specialized training and experience in pedagogical methods in addition to general library instruction or orientation.

Classroom Management Software

Classroom Management Software offers an end-to-end and modular information management solution that can be used by learning communities for admissions, enrolment and registration, student demographics, attendance, advanced scheduling, discipline, grades, state reporting, custom report cards, parent portal, student portal, standards-based grading, and more (Riley *et al.*, 2004). Some commonly used Classroom Management Software include Alma, Classter, iTunesU, ProClass, Classcraft, PlanbookEdu, ClassDojo, GoGuardian, LanSchool, eduphoria, ExamView, itslearning, eduCATE, ClassLink, TutorTrac, Showbie, ALL In Cloud etc (Capterra, 2019). Classroom management tools enable educational institutions to manage and deliver learning content in the most effective manner in an online environment. Capterra (2019) provides a review of the most popular classroom management and their advantages to include;

1. Empower learning communities with a future-ready software platform developed for today's challenges and tomorrow's opportunities in content delivery.
2. Offer an all-in-one cloud-based educational technology for efficient teaching and learning.
3. Encourage positive classroom behavior by awarding points for participation
4. Enhances learning by enabling platform that supports course authoring, homework and assignment distribution, integrated grading, forums, and more.
5. Provides content sharing, real-time feedback, and

communication tools in classroom instruction for education community.

6. Facilitates online teaching and learning for distance education.
7. Enables institution's administration to manage and streamline all aspects of school administration that features: gradebook, attendance, course integration and scheduling, etc.

Feshchenko *et al.* (2015) identify some of the limitations of classroom management software in academic environment to include: shallow system functionality associated with technical problems and unfriendly interface.

E-copyright Management System (ECMS)

The advent of digital technology has meant that digital content can be easily copied without loss of quality and also easily distributed (via the Internet) throughout the world. Famous legal battles demonstrate the potential threat that copyright holders feel from digital copying, especially their inability to control the dissemination of their work (Sellers, 2003). Rights-holders, however, have fought back by using technological measures to protect their work. This has posed a dilemma. On one hand, rights holders aim to protect their work from unauthorised copying and use; on the other hand, users desire greater freedom to use these works. This therefore compelled the use of E-copyright Management System ECMS especially in academic environment. It involves the use of Digital Rights Management (DRM) software or Intellectual Property Management software. It helps prevent unauthorized redistribution and copying of digital property of all types including images, PDF, video and web pages etc.

Copyright Management System is a scheme to make digital works harder to copy and easier to license. Some variations of this scheme are designed to be accomplished with special purpose software coupled with Web browser software (George, 2006). Generally, the software approaches involve the creation of a two-part "package," consisting of the actual copyrighted content, along with a set of instructions or terms for gaining access to that content. Examples of E-copyrights Management Software include TM Cloud, MemberSpace, Alt Legal, Bynder, RightsManager, Red Points, WebTMS, Equinox, AppColl Prosecution Manager, PatSnap, Patricia, IPzen Professional, IP Portfolio Manager, EditionGuard, AcclaimIP, Alliant Royalties, Brainbase, Chorus, DRMtoday, PlayReady, Widevine, CopySafe etc.(Capterra, 2019).

In addition, the proliferation of use and sharing has compelled academic community to employ the use of software programmes such as Turnitin and SafeAssignment (Wyburn and MacPhall, 2005) to manage plagiarism and other issues regarding academic ethics. The appearance of ECMS has happened in parallel to several digital library initiatives (USA) and electronic libraries (Europe) as opined by Isaias (2020). It is therefore apparent that digital/electronic libraries cannot exist in academic community without copyright issues being managed. According to Isaias, ECMS can enable the following: the control of the number of copies; printing and undertaking any other actions upon a work; what can be done with a work (for example: only permission to view); not to change a work (without permission).

The advantages of ECMS for academic community are;

- a. Protect the intellectual property rights of rights holders.

- b. Guarantee security and access control of a copyrighted work.
- c. Control access to data and provide comprehensive reporting and auditing features.
- d. Offer financial and moral rights to copyright holders.
- e. Offer academic incentives to authors in terms of feed-back from statistics for reading/searches of their work in real time.

The use of ECMS also has some disadvantages as outlined below:

1. Implementation and running costs - ECMS implementation has several costs, which include: personnel costs - informatics professionals to implement and run the service, as well as the costs of developing specific application software and the possible acquisition of complimentary modules to the system.
2. Restrictions on access and use: In protecting property rights of right holders, some restrictions create boundaries to access and use of works protected by ECMS.

Electronic Resource Management Software

With the rapid increase of electronic resources in the contemporary academic library environment, technical services departments are forced to look at their workflows and policies to manage this great change. Staff are spending more time than ever managing electronic resources, and the need to manage subscriptions in a different way has many libraries opening new positions titled "Electronic Resource Librarian," or re-allocating staff to cover the need (Collins, 2005). Hence, the need for Electronic Resource Management Software (ERMS).

Electronic Resource Management refers broadly to an evolving array of problems, tasks, processes and practices associated with the management of electronic resources such as databases, electronic journals and electronic books in libraries. It refers to systems that support management of the information and workflows necessary to efficiently select, evaluate, acquire, maintain, and provide informed access to electronic resources in accordance with their business and license terms (Anderson, 2015). ERMS on the other hand, are software packages that hold great promise in the management of electronic resources, from subscriptions to licenses to troubleshooting (Davis, 2005).

ERMS offer the following benefits to library management, staff and the patrons alike;

- i. It speeds up workflow and save staff time.
- ii. It reduces dead-end-user searches and patron confusion
- iii. It eliminates costly overlap between packages
- iv. It addresses the ever-growing size and complexity of e-resources
- v. It provides usage statistics for smart collection decisions
- vi. It simplifies set-up and maintenance with Innovative Content Access Service (CASE)
- vii. It helps library to make the most efficient use of library budget

Some companies are developing products that work with existing integrated library systems (ILS), while others are standalone products. The standalone ERMS could be at disadvantage to a library running an existing integrated system. Other factors which may hinder academic library from adopting ERMS according to Naik and Naik (2016) include narrow budget, lack of technical

expertise, and unstable network connection among others. However, the disadvantages may be peculiar to each library but not be general.

Electronic Resource Management tools/software can be classified into:

1. **Commercial:** Meridian – Endeavour Information Systems, Verde- ExLibris, EBSCONET- EBSCO, 360 Resource Manager- ProQuest, BLUE cloud eRM –SirsiDynix, Gold Rush®- Colorado Alliance of Research Libraries, True Serials, Innovative Interfaces etc
2. **Open Source:** CORAL, CUFTS, ERmes, SMDB etc
3. **In house Software:** HERMES - John Hopkins University Library, VERA- Massachusetts Institute of Technology Library, E-Matrix-NSCU Library and ERLIC - Pennsylvania State.

Instructional System Design Software

Instructional System Design (ISD) is the practice of systematically designing, developing and delivering instructional products and experiences, both digital and physical, in a consistent and reliable fashion towards an efficient, effective, appealing, engaging and inspiring acquisition of knowledge (Wagner, 2011). The process consists broadly of determining the state and needs of the learner, defining the end goal of instruction, and creating some "intervention" to assist in the transition. There are many instructional design models but many are based on the [ADDIE model](#) with the five phases: analysis, design, development, implementation, and evaluation. According Silber and Foshay (2010), instructional design is a systematic approach to course development that ensures that specific learning goals are accomplished. The purpose of instructional design is to maximize the value of instruction for the learner-especially the learner's time thereby creating incredible eLearning content. Instructional Design Software Tools include Whatfix, Adobe Captivate, Articulate Storyline, iSpring Suite, Lectora Publisher, Robohelp, Camtasia, CloudApp, Movavi Video Editor, Movavi Screen Capture Pro, Snagit, Screenflow, ShareX, Kahoot, QuizGame etc.

The benefits of Instructional Design Software include:

- a. Compared with a human instructor, technology is less adaptive. Once a plan of integration is implemented, it is less likely to change it according to student's reactions. This is why instructional design plays an important role in bridging pedagogy and technology.
- b. Instructional design can help educators making the best use of technology; therefore guarantee a successful integration."
- c. It provides consistency between various courses developed by various instructors/designers. The general look and process of content exploration is standardized.
- d. It focuses on the most effective way to present content.
- e. It begins with the learner and the learner experience.
- f. Quality of course is ensured through Instructional design - covers all the phases of good development.
- g. Instructional design gives structure to the student's process of working through course material.
- h. Creates a transparent process - easier to track and utilize the experiences of development teams.

Instructional System Design Software may be marketed or freely available to the public however, some expenses may be incurred

for design, development, implementation, and training of staff. Other form of limitations to adopting ISD software by academic community are; insufficient budget, technical and security issues, lack of skill set to design courses, lack of control over the content and long-term commitment by academic institution. Involvement of an instructional designer to guide the subject matter expert in authoring content is imperative, because instructional design methodology is key to how content is understood and retained, therefore, removing the instructional designer from the process entirely can result in poor organization of information and reduced pedagogical integrity in the final product.

Integrated Search Software

Integrated Search Software is a software system that is designed to carry out web search by pulling information from various sources such as CRM software, ERP systems, HR management suites, or supply chain suites in a systematic way for particular information specified in a textual web search query (Chickering and Yang, 2014). The search is an organized retrieval of stored data within an organization so users can securely enter and find data across institution databases, intranets, and more. It is also referred to as federated search software, by automating the search process rather than manually search in every database for every search criterion, and finally integrating multiple databases search results (Ghafari *et al.*, 2012).

Some commonly used integrated search tools include Algolia Site Search, Swiftype, Microsoft Bing Image Search API, iManage, Microsoft Bing News Search API, Microsoft Bing Video Search API, Elasticsearch, AddSearch Site Search, IBM Watson Explorer, Microsoft Bing Web Search API, VuFind etc. Chickering and Yang (2014) discussed the need for broad based discovery tools described as a “centralized search model” that facilitates information retrieval.

The key benefits of Integrated Search Software include but not limited to the followings:

1. Helps clean and structure data to make information spread across a variety of repositories easier to find.
2. It helps unlock the power of data, as it's only useful if it can be found.
3. Enable unified access to diverse content sources.
4. Integrated search software creates a secure and powerful search function by tagging, filing, sharing, and retrieving information regardless of size and media type.
5. Simultaneous searching across all sources.
6. Efficiently find data and information to save employees' time and energy.
7. Equip users with an overview of data, enabling them to make smarter, data-driven decisions.

Some limitations of the current generation of integrated/federated search software as highlighted by Kumar *et al.* (2008) which may serve as drawbacks to its use in academic environment include;

- i. Relevancy ranking is limited by the quality of the metadata, which usually does not include abstracts or full-text information.
- ii. Federated search systems are fundamentally software, they must be implemented and managed as a service, it therefore takes a great deal of resources.
- iii. Federated search engines cannot improve on the native interface in terms of search accuracy and precision.

- iv. Lack of a uniform authentication standard means that some databases are inaccessible to federated search engines.
- v. Databases which require login, may not function properly with the federated search system
- vi. Some databases work with one federated search product but do not work with the other, while some do not work with any federated search at all.

Library Automation Software

Library Automation Software are web based multi user easy to use, specifically designed and developed to simplify the administration, circulation and acquisition of books and members of a library and institution (Harischandra *et al.*, 2016). The advents in computer and internet technology have greatly increased the library automation and automation is therefore indispensable for libraries. It is comprehensively packaged software that supports the librarian very effectively. The software might be either of use only for the librarian or might be useful for both – users and the library staff.

Library Automation Software comes in various shape and sizes (e.g. small library software, cloud based library management software etc.), platform-specific (e.g. Windows-only, Linuxonly, MAC-only) or supports multiple platforms (covering MAC, Linux, UNIX etc.), publisher-specific (e.g. Microsoft) or multi-vendor, static (i.e. fixed, updated manually by administrator) or dynamic (automatically updated by the SAM solution vendor), simple recognition (e.g. using just exe data) or complex recognition (e.g. tying together multiple footprints such as executable meta, registry entries, SWID tag data, package manager details or product-specific details gathered by running scripts). Some commonly used Library Automation Software – Koha ILS, OPALS, Liberty, Genesis G4, Atrium, Book Collector Pro, Destiny Library Manager, Oliver v5, SURPASS, Lucidea Integrated Library Systems, L4U, Handy Library Manager, Insignia Library System, Access-It Library, MODERN LIB, Atrium, LIBRARIAN, Readerware, SirsiDynix Symphony, Codeachi Library etc.

Subsequently, Moruf, *et al.* (2020) discuss Koha, NewGenLib, Evergreen, PMB and OpenBiblio as the most commonly adopted open source library automation software in academic libraries. Egunjobi, and Awoyemi (2012) postulated that patrons adore services rendered in an automated environment and library staff enjoy working with it as it enables easy generation of records, space conservation, less drudgery, improvement of information services, and easy retrievals among other things.

The advantages of automation software in library system cannot be overemphasised. It has offer great value and benefits in the following ways;

- i. Library Automation software is helpful in better decision making about what sort of materials need to be stocked or improved.
- ii. The total cost of handling the library is reduced.
- iii. Maintenance is not time-consuming.
- iv. Work of the library staff gets smoother and even the work of tracking different modules in the software can be divided among the staff for better control.
- v. There is no need for constant hardware/software updates in cloud computing based software.

- vi. The library staff can focus on their jobs more easily with the updated data.
- vii. The software doesn't require IT support if the library staff is trained well.
- viii. Some software also has the provision of data sharing which can be useful for the user and the library staff to communicate effectively.
- ix. With right inputs from the first day, the entire process of library management gets simplified.

Despite the significance of library automation software, some of the drawbacks which limit its performance are highlighted below;

- a. The security of the data might be a problem due to the virus attack.
- b. There might be problems in customizing or configuring the options of the software according to the needs of the library.
- c. The users might not be aware of the origin of the information appearing on the screens and might not trust the software if there are discrepancies or errors with the status of the actual items. This makes it necessary to keep all the data updated periodically.
- d. The library staff must add value to their library facilities and not increase dependency on the software. They have to create an atmosphere of attracting users to the library facility which is not done by the software.

Staying Ahead of the Library Technology Curve

The role of libraries and librarians are expanding, and being able to incorporate these emerging skill sets into a librarian's job responsibilities is prudent in today's emerging technology environment. Staying on top of the technology learning curve is a critical professional activity for academic librarians but can be daunting at best. King (2018) opined that it is important to start planning to future-proof the libraries, having no plan for staying on top of technology change practically guarantees failure and irrelevance for libraries. Instead of that bleak outlook, it becomes imperative to learn to ride these technology changes as they happen, and be ready by responding adequately to our customers when they come to us with new tools and questions.

Below are recommended ways that would help monitoring the most relevant as well as new technologies in the field of Library and Information Science:

1. **Monitoring key online resources:** E-newsletters, Information Today Inc., tech-guru blogs and podcasts in library and information topic areas, discussion lists for relevant special interest groups in library associations and other leading professional groups.
2. **Monitoring job postings:** Most job advertisement in Library and Information Science profession often state required skills sections to see what technology knowledge they are requesting.
3. **Joining relevant professional IT and LinkedIn groups:** LinkedIn track discussions and asking questions on who is migrating to a new system, who used a new platform and what challenges have people encountered with new library technology tools.

4. **Monitor webinar and conference presentation topics:** Participating and monitoring relevant conference topics through webinar will reveal emerging or increasingly popular/mainstream library technologies and people who have expertise in those technologies that would possibly be willing to share their expertise.
5. **Subscription to relevant mailing lists:** Individual subscription to mailing lists such as ALA Tech Source, where librarians discuss and learn the new technologies as being published.
6. **Scanning the horizon for emerging trends and Train customers and staff:** Make sure to teach staff how to use a variety of consumer technology tools.
7. **Setting up a technology petting zoo:** If library's budget allows it, buy some technology tools and let staff learn hands-on. This allows library staff to learn how a new technology device works in advance, instead of encountering it for the first time with a customer.

Conclusion

This review clearly indicates that the transformational role of library and librarians with technology advances cannot be undermined as users' expectations and demands are growing. Library resources and services therefore require emerging library technologies such as Bibliographic Citation Management Software, Instructional System Design Software, Electronic Copyright Management System, Classroom Management Software, Library Automation Software, Electronic Resource Management Software and Integrated Search Software to support academic librarians for efficient and effective performance in academic institutions. However, library professionals will be able to fulfil their duties and responsibilities only if they are subjected to persistent self-restoration and enthusiasm to staying on top of the technology learning curve

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