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## An Integrative Review of Web 3.0 in Academic Libraries

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### Abstract

**Purpose** – The aim of this paper is to present an integrated literature review exploring the nature of responsive, semantic and interactive Web 3.0 technologies applicable for academic libraries.

**Design/methodology/approach** – We conducted an integrated review of the literature combining a strategy of automated and keywords search. The main source for identifying the studies are Emerald Library Studies and Information & Knowledge Management eJournals, Web of Knowledge, and Library, Information Science & Technology Abstracts (EBSCO) databases. To this end, a sample of (n= 140) studies were analyzed to characterize the Web 3.0 trends and its applications based on theme, years and document types.

**Findings** – A review of literature reveals that Web 3.0 needs evaluation as to what extent they are integrated, deployed and mainstreamed into library services and in information management practices. It is important to develop a conceptual framework that explores the linkages of Web 3.0 technologies and their applications in academic libraries.

**Originality/value** – This review shows how Web 3.0 technologies enhance library services in its holistic conceptualization and how academic libraries are moving into a more robust, inclusive and adaptable phase in their service values and innovation.

Keywords: Web 3.0, Library 2.0, Academic libraries, Web applications, Library Services, Integrated Literature Review

### Introduction

Since the 1990s, Web technologies have been widely used and have influenced online library services (McKenna, 1994). There has been an evolving learning process, innovative pedagogies and technology-based educational applications in the digital age where the learning and instruction emphasis is on just-in-time learning, constructivism, student-centered learning and collaborative approaches (Isaias et al., 2012). Academic libraries have been at the forefront to develop and deploy integrated library service platforms and Web technologies to enable interactive, semantic and responsive user experience through search technologies, electronic resources, audio-visual tools, blogs and social networking sites. Web applications and social media for user services are widely deployed to empower users and for online information bring service delivery to a new level (Shoniwa and Hall, 2007). Information marketing, user engagement and outreach strategies became indispensable, so that Web content of libraries and social media tools are organized into a cohesive process of workflows to manage library websites as hubs of information. As new

applications emerge, the notions of scholarly communication is changing and academic libraries should reposition themselves strategically and competitively to be the places to go to get started for research and to enhance the user experience of accessing resources seamlessly.

### **Web 3.0 Technologies for Libraries**

Having connected information (Web 1.0) and people (Web 2.0), Web 3.0 is about representing meaning, connecting knowledge and bringing these closer together to work in ways to employ intelligent agents, layered applications and interactive systems to provide a productive and intuitive user experience (Bolinder, 2008). Web 3.0 is conceptualized as a third generation technology upgrade through 2010-2020s, mainly characterized by semantics of—meaning and intelligence. As an evolving interactive platform for collective intelligence, Web 3.0 comprises a set of tools involving markup data, crowd-sourced content, data mining and machine learning to enhance intelligence, underlying frameworks and architecture of the Web towards establishing semantic connections, so that machines understand and interpret what humans exactly want—contextual, relevant results.

Envisioned to provide a common framework, the semantic Web is an extension of Web 3.0 connecting distributed data that can be shared and reused across applications, enterprises and community boundaries, towards building a Web of data (W3C, 2015). Furthering the data Web a step further, the semantic Web concepts, applications and rules drive formal languages (RDF and OWL), formalize defining the semantics of data structures, mapping concepts, entities and their relationship, publishing data records and querying them using SPARQL (Spivack, 2007). Web 3.0 defines next generation of Web standards to promote common data formats and exchange protocols on the Web, most fundamentally through XML, RDF, and OWL to not only read and write, but also execute and connect data with linkages as Web of data (Berners-Lee and O'Hara, 2013).

As a result, emerging third generation of Web based services such as collective intelligence, semantic Web services and recommender systems will uptake and intensify machine-to-machine discernable systems and services. Web 3.0 applications are implicit to yield the desirable results of semantic connections based on modelling of people, digital objects, entities through ontologies, controlled vocabularies and other knowledge organization systems. This is essential to organize the Web, especially the libraries as a Web of data, which generates and holds enormous data in the form of bibliographic records, data repositories, digital collections and research data. In this Web 3.0 phase libraries are expected to explore the unwieldy Web content, tap social media networks and disparate library resources and connect them together in a widely searchable, accessible, usable platform for unified searches, visible resources and contextual results. Linked and open data, semantic metadata and ontologies frameworks encapsulated by Resource Description and Framework (RDF) and Resource Description and Access (RDA) and metadata schema (Dublin

Core) models, library services are upscaling to Web scale discovery systems and integrated library services platforms where currency, accuracy and relevancy are at its core.

## **Social Media**

Social media has become an important force to use for maximizing the usage of library resources and for information marketing, facilitating user participation and user-generated content and is central to engage, promote and disseminate research to a larger user groups in an academic setting (Flynn, 2012). Without geographical restrictions, social networking sites allow libraries to market and engage users about their library resources and services; build visibility, establish academic and research impact by enabling interactions among users to share, disseminate and gather information (Huang et al., 2015). For example, Twitter as a microblogging site connects with researchers and institutions to disseminate and follow research. There is more learning involved to understand the mechanics of social media engagement and target various user groups with contextual and interesting content to promote interactivity and responsiveness and making content more discoverable by brand hashtags. Though social media is used for information marketing effectively, valence (psychological value for learning outcomes and use of services) finds mention in few studies for library marketing

Supporting research dissemination, broadcasting library news and updates, publicizing events and resources through live feeds, re-packaging and delivering information to users are other ways to employ social media. Web 3.0 analytics measure the usage of academic resources on social media as one element of altmetrics. A large number of social media studies explored for libraries—contemporary and comparative—are often perceived as an extension of Web 2.0 theories (Xu et al., 2009).

## **Integrative Review**

We conducted an integrated literature review to explore various topics related to Web 3.0 technologies for academic libraries, combining a strategy of automated and keywords search. The main sources for identifying the studies are Emerald Library Studies and Information & Knowledge Management eJournals, Web of Knowledge, and Library, Information Science & Technology Abstracts (EBSCO) databases. To this end, a sample of (n= 140) studies were analyzed to characterize the Web trends, applications and based on themes, years and document types.

- Among the 140 studies, 50 articles were published on Web 3.0 (35.71 per cent), followed by 33 studies on Library Websites (23.57 per cent), 19 on Library 2.0 (13.57 per cent), 12 on Social media (8.57 per cent), 12 on LIS education (8.57 per cent), 11 on Adoption of technology (7.86 per cent) and 3 studies are on Mobile applications (2.14 per cent).
- The majority of studies which is 61, were published in 2008-2012 (43.57 per cent), followed by 2013-2017 a total of 55 articles (39.29 per cent), 15 articles during 2003-2007 (10.71 per cent) and 9 articles during 1998-2002 (6.43 per cent)..
- An analysis of document types reveals that of the 140 publications analyzed, 63 studies are Research papers (45 per cent), followed by 24 Conceptual papers (17.14 per cent), 16 General reviews (11.43 per cent), 9 Technical papers (6.43 per cent), 5 Grey literature (3.57 per cent), 5 Thesis/Dissertations (3.57 per cent), 5 Books (3.57 per cent), 4 Case studies (2.86 per cent), 4 Conference papers (2.86 per cent), 3 Literature reviews (2.14 per cent) and 2 articles of Viewpoints/Opinions (1.43 per cent).

### Web 3.0 Theory

As libraries and Web 2.0 users became perceptive, the Web 3.0 model will be a combination of how scholarly, social and semantic Web applications are converging—where the components of each will cohesively interact and develop together, see Figure 1 (Adapted from Spivack, 2007). The gray area shown across the middle line highlights the invisible Web that remains unexplored. The Web 3.0 phase for libraries will build and extend upon the scholarly, social and semantic Web architectures and data models (See Figure 2).

Figure 1. Libraries at the intersection of Web 3.0 technologies and social media.

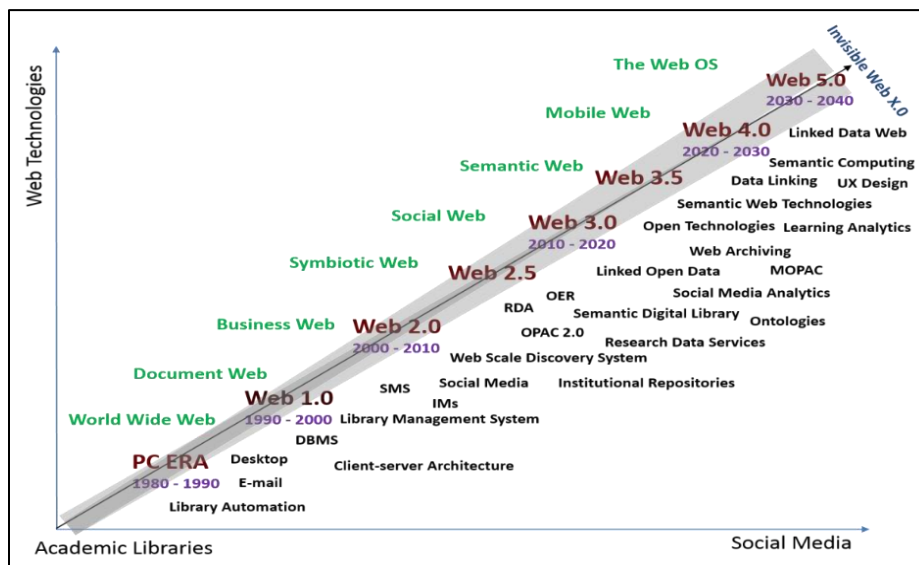
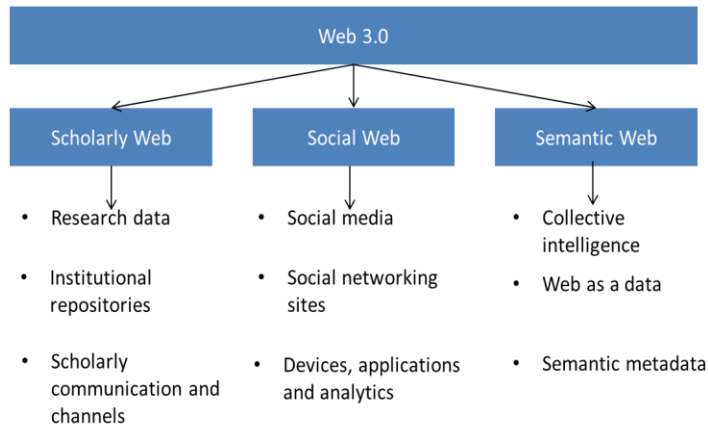


Figure 2. A scholarly, social and semantic Web in 3.0 phase.



## Library Websites

Studies on library Website design widely discussed structure of Web pages, usability, navigation, user experience design, functionalities and decentralization of content development. Moreover, many discussed incorporating best user interface (UI) and user experience design (UX) methods, which became a norm for academic library Websites with responsive design elements embedded in site structures and functionalities (Clausen, 1999). Decentralization of Website services by various units and staff members is weighed as the best way forward for building UX capacity in libraries (MacDonald, 2017). Credibility of Website content were analyzed by content analysis of Websites; Website quality, evaluation of online services, benchmarking of services and information security and privacy were discussed as well.

## Library 2.0

Many writings on Library 2.0 discuss the implications and applications of Web 2.0 for academic libraries, with proposed models, theories and parallels drawn between Web 3.0 and Library 3.0 (Xu et al., 2009). An emerging scenario of Library 3.0 captures the academic librarianship transitions in the following key areas at Table I.

Web 2.0	Web 3.0	Implications
Information gatekeepers	Information intermediaries	Indicates that librarians will be a facilitator for different pursuits of information on the Internet, assisting users to understand the information than just being custodians. This transformation is ‘where to find’ to ‘how to use’ (Kwanya et al., 2013).
Social Web	Semantic/Mobile Web	Mobile, apps, open access channels/spaces of scholarly communication, enhanced with semantic infrastructures (Torres-Pérez et al., 2016).
Information siloes	Integrated searches	One search box to search everything equipped with metasearching, centralized indexes searching physical, subscribed and external content (Comeaux, 2017).
Subject librarianship	Functional support	Repositioning libraries with new functional roles is debated. For example, research data management. (Hoodless and Pinfield, 2016).
Web accessibility	Web adaptability	Web standards will evolve to be more inclusive with robust Web architectures for serviceability (Kelly et al., 2009).

Table I. Key differences between Library 2.0 to Library 3.0.

## LIS Education

The dynamics of library services are evolving with new trends, metrics to measure and evaluating research impact, and analytics-driven ecosystems. Web based services are profoundly changing academic librarianship that necessitates understanding these conceptual changes and incorporating them into LIS teaching (Garoufallou and Charitopoulou, 2012; Harris, 2016). There is a need to revamp the LIS education incorporating of more of practice-based education for capacity building of a dedicated workforce trained for the changing times with an innovative curriculum (Foo and Ng, 2008).

## Adoption of Technology

Many studies have widely discussed the adoption theory and technology acceptance models as to what and why embracing new generation of technologies is important to understand the perceived ease of use and perceived usefulness. Because of technological innovations, diffusion and adoption theory is needed to study the relationship between whole and/or parts of libraries focused on how

Web 3.0 technologies are adopted and how different libraries are prepared to equip with varying degrees of readiness toward technology adoption (Blackburn, 2011). The degree of diffusion of adoption rate vary across developed and developing countries at various levels among learners, staff, LIS faculty and professional associations including at policies, funding, government support and organizational structure levels, which are stakeholders in this process (Virkus, 2008; Hussain 2015). Generational theories, similarities and differences of perception and Web 3.0 tools usage between generations—baby boomers, generation X, millennials and understanding the differences in perceptions and utilization of technology among these generations were the targets in many studies (Rosario, 2012). Many studies have concentrated on the Web 3.0 technologies as enablers but also discussed the barriers, risks, and mitigation factors, see Table 2. Some of the studies from the least developed countries and developing countries reported the infrastructure issues (Baro et al., 2013). However, few university libraries provide technology lending—to borrow laptops, tablets and other mobile devices for users (See the example at <http://www.lib.cuhk.edu.hk/en/use/borrowing/kindle>).

<b>Enablers</b>	<b>Barriers</b>
<ul style="list-style-type: none"> <li>• Information marketing</li> <li>• Responsive design</li> <li>• User interface and experience design (UI and UX)</li> <li>• Anytime, anywhere access</li> </ul>	<ul style="list-style-type: none"> <li>• Poor investments for research on semantic applications for libraries</li> <li>• No dedicated staff (additional work, besides the primary job)</li> <li>• Financial constraints</li> <li>• Lack of infrastructure</li> <li>• Poor networks (Low bandwidth, power outages)</li> <li>• Misinformation (e.g. Fake news)</li> <li>• Lack of institutional social media policy</li> </ul>
<b>Risks</b>	<b>Mitigation</b>
<ul style="list-style-type: none"> <li>• Web 3.0 risks <ul style="list-style-type: none"> <li>-Legal</li> <li>-Regulatory</li> <li>-Institutional</li> </ul> </li> <li>• Electronic disasters</li> <li>• Security breaches</li> <li>• Data privacy</li> </ul>	<ul style="list-style-type: none"> <li>• Robust Institutional social media policy</li> <li>• Strategic compliance management programs and plans</li> <li>• Information security audits and programmes</li> <li>• Comprehensive social media policy audits</li> <li>• Education programmes</li> <li>• Proven-effective technology</li> <li>• Effective mobile device policy</li> </ul>

Table 2. Key factors in Web 3.0 adoption in academic libraries.

## **Mobile Applications**

Mobile Web adoption is gaining momentum on how mobile access to academic libraries is provided and what is the quality of academic apps and mobile Websites. Few studies observed that many university libraries have their own institutional or library apps available for Android and iOS devices to browse and search library Websites, mobile OPACs and resources accessible via smartphones and for off-campus access. Nonetheless, it is found that mobile Web is designed across multiple platforms for use at Apple, Blueberry, Microsoft, and Android devices (For example see, <http://www.uaeu.ac.ae/en/vc/doit/mobile> and some of the highly used mobile applications used in library services are QR codes, SMS, WeChat, WhatsApp, iTunes U and Snapchat (Torres-Pérez et al., 2016)

## **Conclusion**

As this review of the literature demonstrates, there is a considerable growth and diverse use of Web 3.0 technologies for academic libraries. The adoption of Web technologies and applications for academic libraries is one of the critical area in Web 3.0 theory. In the light of above discussions, Web 3.0 is more function-oriented, as academic libraries are experimenting using new Web technologies to benchmark their own activities to potentially optimize the library resources, engage with users through social media, assess staffing patterns, and expand library services into a far better research environment. This is an environment where search technologies, digital inclusion, resource discovery platforms, digital reference services and mobile applications will play a vital role to try new approaches integrating Web 3.0 applications and semantic technologies into library services. Though the uptake of Web 3.0 technologies and social media is widely discussed in many studies, linked open data and semantic applications are in their nascent stage but will increasingly be mainstreamed into library services.

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