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Cataloguing Education in the Era of 4IR: The Way Forward

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Abstract

The paper seeks to investigate Cataloguing Education (CE) in the era of 4IR and evolving technology with the observation that cataloguing is the core of any library service, without which there could be confusion in the retrieval of library information sources. Therefore, CE should equip students with skills that will enable them to work comfortably during any industrial revolution. Furthermore, 4IR entails transformation of humankind, and industries are now compelled to reconsider their ways of doing business to be in par with the economic world. Moreover, the exponential growth of information resources on the Internet and the World Wide Web has necessitated the need for more effective approaches for organising information to achieve improved resource discovery. The study used desk research. Findings indicated that although online cataloguing is included in the CE, courses as programming, coding, software developments, elements of Artificial Intelligence (AI) in cataloguing, etc. were not included. The study recommended a shift in CE to accommodate the 4IR demand.

Keywords: Cataloguing, Cataloguing Education, Fourth Industrial Revolution, Cataloguing Curriculum, 4IR

Introduction and Background

The contribution of cataloguing to the Fourth Industrial Revolution (4IR) is largely dependent on whether learners can acquire the necessary knowledge and skills that will make them employable in this field. Cataloguing is regarded as the cornerstone of the library, since it provides the gateway to library resources, a critical aspect of the library work without which there would be total chaos in the organisation of library materials, making location and use of such materials almost impossible (Monyela, 2019). Rafiu and Nwalo (2016) opined that cataloguing occupies an important place in the field of librarianship, a vital process in providing adequate access to library resources. Therefore, careers in librarianship are incomplete without a deep knowledge of cataloguing courses. Luther (1949) further asserted that cataloguing courses have always held a prime position in the curricula of library schools from its inception. Moreover, Gourkova (2007) opined that the cataloguing librarians have been the cornerstone of library services for centuries. The quality of their education highly influences their ability to effectively deal with the versatile challenges in the demanding field of knowledge management. However, Elrod (2008) observed a decline in cataloguing education that has resulted in a decline in the quality of records being contributed to bibliographic databases. The false assumption that automation can replace cataloguing, and relativistic standards for library school accreditation, have contributed to the growing problem. Furthermore, Monyela (2020); Monyela and Mutula (2019); El –Sherbini (2018); Beall and Kafador (2002); Ndumbaro

(2018); Ndungu (2017); Cabonero and Dolendo (2013); Snow (2011); Yusuf (2009); Hill (2008) found lack of cataloguing skills on the catalogue records and observed low quality records in the bibliographic utilities. Monyela and Mutula (2019) opined that even during the era of automation and copy cataloguing, skilled cataloguers are needed to carryout cataloguing. Cataloguing Education (CE) requires the use of cataloguing standards recognised internationally such as RDA; LCC; DDC; SEARS lists; LCSH; MARC 21 and others. Standards such as RDA, Web Dewey, MARC to name the few requires automated cataloguing and technology to function effectively and are responding to the third industrial revolution. The concept of the Fourth Industrial Revolution (4IR) was coined by Klaus Schwab at the World Economic Forum in Davos, Switzerland, in 2016, with the reference that it would be building on the third, the digital revolution and would be characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. According to Schwab (2017) the first industrial revolution spanned from around 1760 to 1840 and used renewable energy to mechanize production. The second industrial revolution which started in the late 19th century to early 20th century used electric power to create mass production. The third industrial revolution began in the 1960s. It is usually called the computer or digital revolution since it was catalysed by the development of semiconductors, main frame computing, personal computing and the internet. It used electronics and information technology to automate production.

Now, a fourth industrial revolution is building on the third, the digital revolution that has been occurring since the middle of the last century, 4IR is characterised by a much more ubiquitous and mobile internet, by smaller and more powerful sensors that have become cheaper than human labour force and artificial intelligence and machine learning. He pointed out that the three previous industrial revolutions created major social changes and opportunities, but today's transformation is unique in terms of the great speed with which new ideas and technologies are spreading around the world. Every company across every industry is now compelled to reconsider their traditional ways of doing business to keep pace with rapidly changing technology and consumer expectations (Schwab, 2015,2017). The world has witnessed a huge revolution in information technology and communications, which has been reflected in publishing and accessing information resources. Consequently, the world is experiencing high demand in everything including access of information sources, the production should also increase to meet the demand. If it means we need to make human like machines to increase production, so be it. Although each industrial revolution is often considered a separate event, together they can be better understood as a series of events building upon innovations of the previous revolution and leading to more advanced forms of production (Xu, David and Kim, 2018). While, 4IR technologies and Artificial Intelligence (AI) could be beneficial to cataloguing departments, cataloguers should be extremely skilled and master the technical services. CE should shift and adapt to the new revolution. Elrod (2008:2) opined that "I don't think it's a good thing when a librarian is in charge of supervising tasks and duties that he/she doesn't know how to do. It's unfair to the staff to have to work for someone who doesn't have a clue what they do, and it's unfair to the institution to have someone in charge who will not be able to train necessary replacements" or programme the cataloguing robots. Bowen-chang and Hosein (2009) opined that the infusion of technological innovations in to libraries and the changing role of cataloguers have discovered a new dimension in the sphere of cataloguing that influences its teaching as well. it is difficult to discharge a role without appropriate professional skills and competence. As the work of knowledge organization moves dominantly to a global information network environment, cataloguers will need professional upgrading in various areas. The work of a cataloguer requires dedication and

skilful use of the various tools to teach in order to have a complete knowledge of the profession that can easily link the users of the library to the needed available resources in a particular library (Adamu, 2018). Nwalo in Adamu (2018) emphasized that it required intellect of a cataloguer who must be knowledgeable on a wide variety of subjects and logical in thought and who must pay attention to details and have a mastery of the technicalities of classification schemes. David-West and Angrey (2018) observed that, the current trends in cataloguing has re-engineered the basic structure of the library organisation.

In the past, cataloguing and classification were done manually which made the work very difficult, boring and time consuming. Recently, most libraries in developing countries have joined their counterparts in developed countries in the use of computers for processing library collections. Therefore, the author of this paper finds it necessary and important for cataloguing education to move with times and adapt to any changes in industrial revolution. Moreover, Kamaruzaman et al. (2019) also emphasised that, in this decade the impact of changes caused by the industrial revolution 4.0 increasingly has been felt. These changes are due to the development of advanced technology that will replace the human workforce with automation and robotics. Existing skills are no longer able to prepare graduates for this. In this regard, graduates should be given early exposure to, and be prepared for, the skills of 4IR. Scholars believes that technological changes can lead to huge job destruction and may result in reduced job offers in various sectors, as well as changing the practice of jobs (Frey and Osborne, (2017); Arntz, Gregory and Zierahn (2016); Singh, Sarkar, and Bahl (2018). Furthermore, Mtshali and Ramaligela (2020: 38) opined that "4IR era has arrived there is no turning back or ignoring the rapid unfolding of events. The education sector needs to enthusiastically catch the wave if it wishes to remain relevant today and in the future".

Problem Statement

Things are changing and the changes are owing to the development of advanced technology such as Internet of things (IOT), autonomous vehicles, 3D printing, nanotechnology, biotechnology, materials sciences, energy storage, quantum computing to name the few that replaces the human workforce with automation, Artificial Intelligence (AI) and robotics. Students today need to stay relevant for future job markets, as AI has produced and changing many jobs. World Economic Forums claim that 65per cent of kids enrolling in primary education today will end up working in jobs that haven't been created yet (World Economic Forum reports, 2016). Tella (2020) emphasized that librarians and students need to be exposed to and be prepared to develop the necessary skills of the 4IR. Cataloguing education should also shift to accommodate the new curriculum that could produce workers that would work comfortable in the evolving technology. The newly qualified cataloguers should be able to introduce 4IR technologies in cataloguing departments.

Research Objectives

- To examine the cataloguing curriculum in the institutions of higher learning
- To determine the 4IR skills and technologies used in cataloguing

Literature Review

Literature review was obtained from books, journals, theses, conference proceedings, databases, websites and electronic resources.

Cataloguing Curriculum

Cataloguing Education is regarded as the core course, backbone of librarianships professional qualification; a course that supports knowledge of library information and reference services; extremely useful for the critical analysis and synthesis of a library collection for the organization of knowledge in libraries (Ocholla and Ocholla, 2014; Boydston and Leysen, 2014). Adamu (2018) in the study of assessment of cataloguing and classification courses in two library and information science schools in north-east, Nigeria found the following cataloguing tools available (AACR2, LCSH, Sears Lists of Subject Headings, DDC, LC, MARC 21, Cutter Table, RDA, Library of Congress CD MARC). However, RDA and MARC received the lowest scores. Due to the results the author for this paper concludes that the participants were mainly taught manual cataloguing using AACR2. Similarly, Ocholla, Ocholla, Olson, Glover and Guimarães (2015) also found the course content taught at LIS schools in South Africa, Brazil and USA as AACR, MARC, LCC, DDC, LCSH, UDC, Abstracting, Authority control, Bibliographic control, cataloguing theory and history, Cataloguing practice and manuals, Classification theory, application and policies, Dublin core, Indexing, Information retrieval, Subject analysis, Thesauri. Sibiya and Shongwe (2018) found the following content included in cataloguing curriculum (Bibliographic control and bibliographic tools, Indexing and abstracting, Descriptive cataloguing standards and tools(ISBD, AACR2, RDA, MARC21, Inmagic) Cataloguing challenges, Development of a cataloguing plan or strategy of a small information centre, Dublin core and metadata relationships to cataloguing, Discussion of current trends and challenges of cataloguing in South Africa, Introduction to classification and classification tools, Classifying with DDC and LCC, Subject headings (LCSH, SEARS)Classification policies, Practices and limitations of the future of classification, Discussions of current trends and challenges of classification, Relationship of classification to other methods of subject analysis, Providing access points, Evaluation of the library catalogue, Limited cataloguing and cataloguing policy, Practical application of AACR2, RDA, MARC21 and metadata for a variety of formats Digital curation (digital collection, construction and preservation)Learning the Southern African Bibliographic Information Network (SABINET) online, The future of classification, Indexing Knowledge management, Subject analysis and controlled vocabulary, Evaluation of information retrieval systems).

Adamu (2018); David-West and Angrey (2018) further found that the time of teaching cataloguing modules was not enough and there were not enough professional lecturers. Gorman (2002) also observed that, there were numerous instances in which older Library and Information Science (LIS) teachers of cataloguing have re-tired and been replaced by non-library, disciplines, proclaiming that they produced information professionals capable of working within or without libraries. Some even dedicated themselves to producing mostly non-librarians or bragged of the high percentage of their graduates who found jobs outside libraries. The collapse of many sectors has taken some of the glitter off that boast. If library schools are not careful, AI will completely take over the libraries and LIS professionals may not be able to control them if they don't incorporate them in libraries and library education in general. Wahid, Warraich and Tahira (2018) found that cataloguing standards are subsequently evolving with the advancement of information technology. For example, the availability of electronic sources called for the shift from AACR2 to RDA to accommodate different types of electronic media.

Many initiatives have been taken to develop new models and standards for cataloguing to fulfil the ever-changing needs of information world. Now the Web has been transformed from "web of document" to "web of data" resulting in the emergence of a semantic Web. It is using the Linked Data (LD) technology to make Web data-aware and machine-readable. Collections are being described in Resource Description Framework (RDF) model/standard to create the LD cloud. Library management systems and open access catalogues are also focusing on the models that can adopt LD technologies (Wahid, Warraich and Tahira ,2018). Another format for the bibliographic description of digital content is metadata. It is structured information about the description, explanation and location of information resources to retrieve, use and manage them. In semantic Web environment, the metadata is not only managed but also interpreted by machines. According to Coyle (2013) plenty of information resources are added or being added to the digital world that are not under the bibliographic control of libraries. Wahid, Warraich and Tahira (2018) opined that to ensure the bibliographic control of these sources, libraries are using LD technologies by making the data machine-readable.

Libraries have been converting their legacy data into LD to shift catalogues from stable database to a networked world for all the users. So it is needed to transform library catalogue into such form that they can be connected with the LD. Libraries have trusted information sources that should be placed on the Web for a better access to wider audience. Conzales in Warraich and Tahira (2018) emphasised that, libraries need to integrate the principles of linked open data into library catalogues and information resources for sharing and publishing data on the web. Support and collaboration, understanding and use of new standards for library metadata is required to transfer library data into LD. Thus, CE should respond to the market by shifting the curriculum to accommodate newly developed technologies needed in cataloguing. David-West and Angrey (2018) opined that cataloguers have to embrace the new technology; it is no longer ideal for newly acquired information resources to be held up in cataloguing section more than necessary because there is an increase in demand of knowledge. Saeed and Chaudhry (2002) observed that categorisation of resources using different types of directory structures has been used by several services as a viable option for better organisation of Web-based information resources. Yahoo, Lycos, and Google appear to be among the pioneers in this initiative. Such directory structures are referred to by various terms such as subject directories, pathfinders, subject hierarchies, and taxonomies. Cataloguing should take note of these competitors and adapt to new changes in order to serve patrons quickly and efficiently. The rapid introduction of new technologies imply that cataloguers have to be flexible in adapting and adopting new skills and strategies in handling them. It is very important for cataloguers to acquire these skills so as to disseminate information to meet and satisfy the information needs of the society (David-West and Angrey, 2018).

Salaba (2020) opined that educating knowledge organisation professionals does not stop with cataloguing or domain specific metadata standards. Broad content of knowledge representation, classification and indexing, conceptual models, best practices, data processing, data management, information systems and technologies including semantic web technologies should be included in CE. Eberhard et al. (2017) also emphasised that skills such as equipment operation and control, programming, quality control, software and system development, new technologies, judgement and decision making, system analysis, should be included in the curriculum for the preparation of 4IR. A study of smart work: the transformation of the labour market due to the fourth industrial revolution by Eberhard et al. (2017) found that in Europe, most universities adapt the curricula of the study programs every five to six years due to

new trends, student feedback, companies' feedback, new technologies, new laws and adaption to the European system. Companies are highly involved in the adaptation process. Moreover, guest lectures from companies were the main teaching methods participants used. Professors adjust their teaching methods and contents based on the outcome of these sources like new trends, new technologies, latest researches and publications as well as own experiences, feedback of the professors, students and companies. Cotet, Balgiu and Zaleschi (2017) proposed an assessment model for a constellation of skills and personal qualities necessary for Industry 4.0 in respect of three subjects, robotics, machine-tools/manufacturing systems and logistics, registered by undergraduate students at a Romanian University. The model consists of five dimensions: self-actualisation; conscientiousness; agreeableness; maturity; and extroversion. Additionally, it comprises soft skills such as interpersonal skills; asserting; respect; strength of self; perseverance; empathy; will spirit of perfection; self-discipline; intellectual curiosity; refining; independence; and creativity. Most importantly, in this constellation, creativity is the epicentre of the top three skills needed. It is followed by emotional intelligence and proactive thinking, respectively. Robotics students scored highly in conscientiousness, whereas machine-tools/manufacturing systems students scored highly in self-actualisation.

Technology has long been another major impetus for transformation in descriptive cataloguing, and especially so since the rise of electronic systems and records in the late twentieth century. One of the most significant emerging technological developments associated with cataloguing is the linked data movement. Linked data encompasses online encoding and publishing practices designed to identify and disambiguate entities, combine metadata about these entities from different sources, and support both human and machine understanding and use of data. Underlying much of this linked data are ontologies, highly expressive knowledge organization systems offering representations of the entities and relationships relevant to a particular domain of knowledge. While Functional Requirements for Bibliographic Records (FRBR) offered an entity-relation-ship model of the bibliographic domain, its successor, Library Reference Model (LRM), moves closer toward an ontology and was designed with linked data technologies in mind. As RDA incorporates more of LRM into its structure and content, the stage will be set for the creation of bibliographic data more in line with linked data practices. This emphasis on linked data technologies may also see cataloguing data leave the long-used MARC standard behind.

Unlike MARC encoding, linked data encoding practices are guided by the Resource Description Framework (RDF) model of data interchange. RDF is focused on metadata at the statement rather than record level, which allows for individual elements of metadata to be repurposed as well as the creation of composite records made up of metadata from different sources. Recently, the Library of Congress has led the development of BIBFRAME, a conceptual model and standardized vocabulary meant to encode and pub-lish cataloguing data as linked data. If libraries can develop and adopt-based encoding standards such as BIBFRAME, descriptive cataloguing data will take a more prominent place within the web of linked data. Not only will this data be more easily combined with data from other sources, it may also move beyond the confines of traditional bibliographic records to power new means of representation and discovery (Dobreski, 2020). Frey and Osborne (2013) postulated that by the year 2033, 47% of the jobs in advanced economies are at "high risk" of being automated. CE should not lag behind but incorporate teaching of advanced technologies in the curriculum to remain relevant in the 4IR business model. Technological innovations in the fields of

digitalization, nanotechnology, 3D printing, genetics and robotics, just to mention a few, are radically altering the labour market landscape (Eberhard et al., 2017).

Fourth Industrial Revolution Skills and Competencies

Eberhard et al. (2017) argued that fourth industrial revolution is transforming the labour market by demanding new professional skills and by digitalizing jobs done by the human resources of companies. Alonso and Rodriquez in (Eberhard, et al., 2017) opined that, big data analysis, digitalization and robotization are enforcing the automation and substitution of human workforce in areas such as logistics, paralegal contract law, patent law tasks, accountancy, transport, manufacturing work, housekeeping, healthcare, as well as some highly skilled medical tasks. Educational institutions must react to these trends and adapt their formation in order to provide their students with the adequate skills for future jobs. The usage and analysis of large amounts of data, the employment of sensors, robots and new technologies like the 3D printing offer new opportunities to increase the overall productivity of a production system. Therefore, new working approaches are required. Furthermore, industry 4.0/ 4IR intends to improve the productivity and efficiency over the overall value chain (Eberhard et al., 2017). Cataloguing could take advantage of 4IR by programming robots to increase production. Several studies such as Monyela (2020); Chapman and Massey (2002); Miksa (2004); Beall (2000); Shedenhelm and Burk (2011) found low utilization of cataloguing standards; errors in catalogues records and huge backlogs in cataloguing sections. The introduction of 4IR technologies could assist in increasing the production. Therefore, the integration of new technologies and pedagogies needs to be placed at the heart of institutions' teaching and learning strategies, and they should become an integral component of everyday institutional business. Abdullahi, Jabor and Akor (2020) found the following teaching methods in response to 4IR (Flipped Classroom; Project based learning; Cooperative learning; Gamification; Problem-Based Learning; Design Thinking; Competency-Based Learning; Service Learning; Problem-Oriented Project-Based Learning; Thinking-Based Learning)

Eberhard et al. (2017) observed that in Europe, programs like Erasmus plus, Euro Skills, INTERREG EUROPE, SaveComp, GLOBE Cosme and FFG in Austria were created and financed within the Horizon 2020 strategy in order to support universities and students to gain the skills that the dynamic labour markets of the future requires. Kamaruzaman et al. (2019) found the following skills required for 4IR engineering workforce (analytical thinking and innovation; active learning and learning strategies; creativity, originality and initiative technology design and programming; critical thinking and analysis; complex problem solving; leadership and social influence; emotional intelligence; reasoning, problem solving and ideation; system analysis and evaluation). Abdullahi, Jabor and Akor (2020) found the skills needed by engineering entrepreneurial education in response to 4IR as (Problem-solving skills; Financial Management Skills;Critical thinking skills; Emotional Intelligence; Research/Information retrieval; Creativity/Innovation skills; Team working skills; Communication skills; Active learning skills; Reasoning skills; Organisation skills; Interpersonal skills; leadership skills; Self-directed thinking; Life-long learning; Time management skills; Resources management; Public Presentation skills; Critical evaluation of literature). Mtshali and Ramaligela (2020) indicated the following as the core skills needed for civil technology field (knowledge of technology education, knowledge of contemporary issues) especially because at most, employers prefer people with knowledge of how to improve structures in the physical world and make them more aesthetic as well as understanding

different specialisations in the subject, such as civil services, construction and woodworking. Chaka (2020) opined that, four of the sectors in which the 4IR hype has gained traction are technology, job market, production (factories and industries) and education. Chaka (2020) found the following competencies required in the 4IR (knowledge of big data, data analysis ability, and knowledge and management of software and interfaces intended to support operations management; virtual collaboration, knowledge and management of simulation systems, and ability to adopt new models; developing employee skills and capacities, encouraging participation, and knowledge of lean manufacturing techniques; creativity in designing strategies to introduce new practices, developing research, and transdisciplinary; leadership skills, and critical and disruptive skills.

Though this paper highly recommends full online catalogues, introduction of cataloguing robots, AI in cataloguing, cataloguing departments should have highly skilled cataloguers who can programme and manage the robots and carryout quality control of catalogue data. CE should produce graduates of value to libraries and Information Centres. Gorman (2002:2) used the term enemies of cataloguing to describe people who believed that "OCLC records grow on trees and their libraries can safely dispense with original cataloguers to rely on ill-paid staff to pick the fruit of the OCLC trees and construct incoherent catalogues of increasingly less use to their users" Since these administrators do not value cataloguing enough to maintain effective cataloguing departments, it is scarcely likely that they will value it enough to demand a sound cataloguing education of new employees in other parts of the library (Gorman, 2002). Robots or AI cannot replace cataloguers but will assist them to increase production.

Methodology

A desk research was conducted by extracting literature from different information sources using the key concepts of the study such as cataloguing education, cataloguing curriculum, fourth industrial revolution, fourth industrial revolution technologies, 4IR. The literature was then interpreted and conclusions were drawn from the results.

Recommendations

Based on the literature reviewed and the conclusion thereof, the following recommendation were made:

Need to Transform CE Curriculum

Although there are some elements of machine generated metadata in the cataloguing curriculum, CE curriculum should be altered to add some 4IR elements such as digitization, AI, robotics, programming, innovation, to name a few. Salaba (2020) emphasized that cataloguing curriculum should cover global trends, responsiveness to community needs, collaboration and resource sharing. Chigwada and Chisita (2021) discovered that libraries are affected by the technological changes that arises from the 4IR and librarians should develop their skills to be in par with other sectors in the 4IR era. Therefore, librarians' education should prepare graduates with skills needed.

Concluding Remarks

The industry, academia and education sectors should prepare their students and workforce to remain relevant in the 4IR era and beyond.

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