

New Skillsets for Future Science, Technology, Engineering and Mathematics (STEM) Library Workforce

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Abstract:

The advent of new technologies makes it imperative for library staff to continually improve their skills, to meet user needs and for excellent service delivery. As a result, training and retraining of staff becomes top priority. With research in Science, Technology, Engineering and Mathematics (STEM) on the increase, libraries serving this population find that the rate of training and the skills needed in anticipation, for the workforce has to increase for them to meet future expectations of their users. This study was conducted to find out the perceived needs of the workforce (librarians and support staff) in STEM libraries on what skills they need for future service delivery. Questionnaires and Interviews were used for data collection. 70 librarians and library officers formed the target population of the study, of which 40 responded. The findings showed that respondents perceived that having a good grasp of future technologies, constant updating of literacy and digital skills as well as training in computer programming and design are absolutely essential skill sets for the future STEM library workforce. The future STEM librarian will need specialized clientele management training for effective service delivery. Formal training in use of computer assisted tools such as Artificial intelligence, immersive technology and others will be imperative for the future STEM workforce. Constant re-skilling and acquisition of critical thinking and computer programming skills will be absolutely essential moving forward.

Keywords: workforce development, Information technology, Science Technology Engineering and Mathematics (STEM), libraries, professional development, Nigeria

Introduction

Serving clients in the best way possible is the goal of any serious enterprise. Libraries though mostly not for profit, are not left out of this goal setting. Library users need to be served and the services to them need to be standard. Special libraries or libraries with special subject focus such as Science

libraries, libraries for mathematics, engineering and technology for instance have special focus and specialized services as well. The ability to provide the services optimally depends on the quality of the information services offered, and the workforce propelling the service.

Skills are competencies that allow continued learning in a knowledge domain. They are categorized into content, processing, and problem-solving skills. Content skills are the basic skills needed to acquire more specific skills in an occupation. Examples are reading comprehension, active listening, speaking, writing, mathematics, and science. Processing skills are the procedures that enhance the more-rapid acquisition of knowledge and skills. Some processing skills are critical thinking, active learning, learning strategies, and monitoring self-awareness. Problem-solving skills are skills that bring about the identification of complex problems and related information required to develop and evaluate options and implement solutions (Carvenale, 2013).

For librarians and others in the library workforce, acquiring the problem solving, processing and content skills involves lots of training and patient execution of routines. The library sector to provide excellent services, trains its workforce to have the following skills: Technology skills training, Job-oriented skills training, Management training, and Leadership training. Professional and support staff who work in Science Technology Engineering and Mathematics (STEM) libraries are particularly challenged to keep improving in their services if they wish to keep their clientele. The reason is that these study areas are very versatile and with research and more demands for current and up to date materials, the tempo has to be high in upgrading services. As such, the library workforce has to anticipate the user needs and endeavor to meet the needs. In realization of the fact that solutions can be found for workforce issues by the workforce themselves, these researchers carried out the study with the following objectives:

Objectives of the Study

Broadly, the study set out to find out the perceived needs of the workforce (librarians and support staff) in Science Technology Engineering and Mathematics (STEM) libraries on what skills they need for future service delivery.

Other specific objectives were to:

- 1.) find out how much time the workforce in Science Technology Engineering and Mathematics (STEM) libraries spent on work related issues,
- 2.) determine what skills the STEM library workforce need for effective service delivery,
- 3.) determine the importance of factors such as knowledge, skills, and personal attributes of the STEM workforce to the provision of future library services, and;
- 4.) seek ways in which the Science Technology Engineering and Mathematics (STEM) workforce can reskill themselves for future service delivery.

Research Questions

- 1.) How much time does the Science Technology Engineering and Mathematics (STEM) library workforce spend on STEM library work-related issues?
- 2.) What skills does the STEM library workforce need for future service delivery?
- 3.) How important are factors such as knowledge, skills, and personal attributes of the STEM workforce in the provision of future library services?
- 4.) In what ways can the STEM workforce reskill for future service delivery?

Methodology

Survey research design was used for the study. The instruments used for data collection were questionnaire and interview to elicit information from the respondents. A random sample of 35 male and 35 female all of whom were STEM library workforce was taken. 70 questionnaires were sent out through the SurveyMonkey online tool, but only 40 responded within the 2 weeks in which the survey was opened for responses. The respondents comprised 15 males and 25 females. The validity of the instrument, an adaptation of Federer (2018) instrument, was properly ascertained by two educational research experts. The study gathered information about skills and competencies from information professionals who spend a significant portion of their work providing data services in biomedicine and the sciences, including those who provided services in these fields as well as to nonscience fields.

Literature Review

Information and communication technologies (ICTs) are proving to be an effective mechanism for library staff to improve their skills for effective service delivery. The productivity of staff depends upon the improved skills acquired and translated to excellent and effective service delivery. For effective service delivery, Ashcroft (2004) identified six basic skills categories for STEM librarians. These are: professional, marketing and promotion, evaluation, communication – negotiation – collaboration, censorship and personal transferable skills. Concerning the perceived need of the workforce in STEM libraries, Fisher (2004) analyzed a set of skills and pointed out that though with traditional role, STEM librarians will create organization information management systems, use the technique of information architects, manage access in digital documents, and will support every possible learning procedure. Ifidon & Obaseki (2016) itemize new skills for STEM librarians to include – internet search skills, electronic library establishment and management skills, indexing skills, cataloging skills, electronic data entering skills, classification, ICT use, research, website design/library software design and online book/journal article publishing. These could translate to effective service delivery if and when there is adequate sensitization of STEM librarians on the concept of new skills sets and their importance to the library profession. Other areas of sensitization are restructuring of library school curriculum to include new skill sets, sensitivity to workshop/seminar/conference attendance and positive attitude towards embracing new ideas, all of which define a job well cut for STEM librarians.

Libraries are some of the most active users of social media, making services more participatory, and embracing openness to reach a wider audience. This activity allows them to communicate and engage with their communities in dialogue, which informs and helps develop library products and services, and impacts on how they operate (Canty, 2012). STEM librarians can use social media tools in this context for effective service delivery. For example, services can create a strong presence and a modern image that could appeal to teenagers who are less frequent users of the physical buildings. STEM librarians can develop services online (for example, book discussion groups using blogs and wikis) to give service and product updates on social media tools such as Twitter, Instagram and the like. Web 2.0 can also offer cost effective solutions for the production of promotional and marketing materials about services and materials available using platforms such as YouTube. Web 2.0 helps raise awareness of services overcoming barriers associated with traditional methods of publishing (for example, by overcoming delays associated with posting information on the website of the wider organization, a process that is often controlled by the IT department). STEM librarians can use social media tools as a means of networking, communication and sharing of ideas with other professional organizations and colleagues, who work in different contexts, allowing the wide spread of ideas and creating expanding international networks (Chu and Du, 2013).

Tu (2007) made an attempt to determine the expertise and training necessary for providing health sciences (HS) virtual reference (VR) service. Virtual reference (VR) service facilitates computer-mediated reference assistance and comprises electronic methods such as email, online forms, interactive chat, and Web-browsing software by which libraries fulfill patrons' information needs. Tu's study was carried out in the realization that "in today's fast-paced health sciences (HS) information settings, health professionals need instant access to the best possible medical evidence". Evidence for the study was collected from practitioners on which knowledge skills were required to provide effective chat-based HS virtual reference services. Some of the knowledge skills identified in the study were online searching, reference interviews, interpersonal communication, and problem solving. Face-to-face reference techniques were also found to be useful in health science virtual reference services (Tu, 2007).

Emiri (2015) discussed the contemporary digital literacy skills among librarians in Edo and Delta states in Nigeria. The digital literacy skills found most common among them were electronic mailing, social networking, use of personal digital assistants (PDAs), mobile phones and internet surfing. The librarians acquired these skills either by getting assistance from colleagues, trial and error, information technology programmes or by formal education. Training for librarians was recommended to improve their skills while digital skills competence should be given priority when recruiting the workforce.

Findings and Discussion

Only 41 individuals returned the survey and 40 were found usable having provided complete data. Most of the participants were from biomedical or health sciences libraries, including academic libraries in general. Twenty seven of the 40 were from STEM libraries in Nigeria, 5 were from libraries in South Africa, 2 were from libraries in Ghana, 2 from Kenya, 2 from Uganda, 1 from Senegal, and 1 from the United States. Fifteen of the respondents representing 33.5% were male while 25 representing 62.5% were female. The jobs they did ranged from being STEM librarians to being Research Fellows in their libraries.

Table 1. Job Description of Respondents

S/N	Status/job title	No.	%
1.	STEM Librarian	20	50%
2.	Diversity Fellow	5	12.5%
3.	Digitization Librarian	1	2.5%
4.	Reference Librarian	2	5%
5.	Serial Librarian	1	2.5%
6.	Senior Librarian	4	10%
7.	College Librarian	1	2.5%
8.	Acquisition Librarian	2	5%
9.	Research Fellow	2	5%
10.	Cataloguing Librarian	1	2.5%
11.	Circulation Librarian	1	2.5%
	Total	40	100

It was revealed that half of the respondents (50%) were STEM librarians while 5 (12.5%) were diversity fellows, 1 each (2.5%) were digital librarian, serial librarian, college librarian, acquisition librarian, and research fellow, and 2 each (5%) were reference, cataloguing, and circulation librarian. Majority of the respondents were Masters Degree holders, 8 (20%) were first degree holders while 3 (7.5%) were specialized librarianship degree holders and only 1 (2.5%) had a Ph.D.

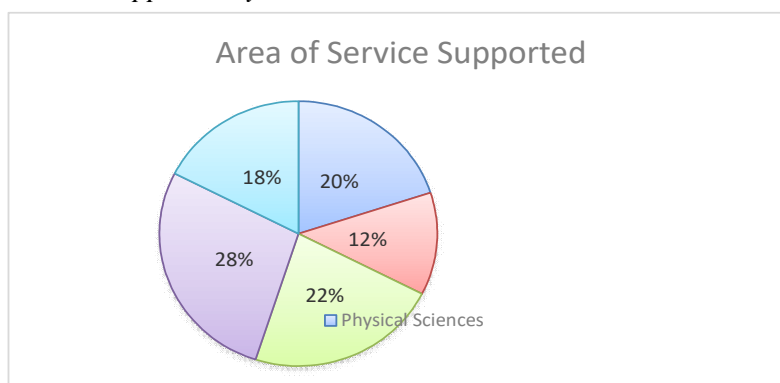
Table 2. Skills Potentially Relevant to Future Data Librarianship Work

S/N	Category Of Skills	No	%
1.	IT Skills	9	22.5%
2.	Technology Skills	6	15%
3.	Educational Literacy skills	10	25%
4.	Ability For Critical Thinking	15	37.5%
	Total	40	

Ability for critical thinking was found to be the category of skill most potentially relevant to future Data Librarianship by the respondents 15 (37.5%) indicating preference for it. Surprisingly technology skills were indicated by only 6 (15%) of the respondents. Information Technology (IT) skills and educational literacy were considered next to be potentially relevant with 9 (22.5%) and 10 (25%) respectively indicating them. This is unlike Ifidon and Obaseki (2016) study which identified technology based skills such as internet search skills, electronic library establishment, cataloging skills, and electronic data entering skills, classification, and other such online skills as most relevant and the new skills needed.

Area of service that was supported by their individual libraries was required of the respondents. They reacted indicating the support areas (See Figure 1).

Figure 1. Area of Service Supported by the Libraries



Those that indicated physical sciences were 8 (20%), and for Life Sciences 5 (12.5%). Most (11, 27.5%) supported in the area of Social Sciences, while engineering and computer science had 9 (22.5%), and mathematics 7 (17.5%).

The respondents also rated how important factors like Data Management, Technology and Information Technology, Teaching and Instruction, and Library Skills were to the STEM library workforce. Respondents were asked to mention skills that were not mentioned in the questionnaire that they perceived to be important for future STEM library work. They reacted thus (See Table 3):

Table 3. Other skills not in the list that could be important to future work

S/N	Skills identified	S/N	Skills identified
1.	<i>Hospitality Intelligence</i>	16.	<i>None (5)</i>
2.	<i>Mentoring and networking. (3)</i>	17.	<i>User interference</i>
3.	<i>Information literacy skill</i>	18.	<i>Repository data management skills</i>
4.	<i>Grant proposal writing skill for funding</i>	19.	<i>Scientific programming</i>
5.	<i>Collaborative project skills (2)</i>	20.	<i>Coding</i>
6.	<i>Lobbying for recognition</i>	21.	<i>Entrepreneurial skill</i>
7.	<i>Ability to analyse and interpret data</i>	22.	<i>Pedagogy training</i>
8.	<i>PhD</i>	23.	<i>Creativity</i>
9.	<i>Certification that can help us build our leadership and continental and international partnerships</i>	24.	<i>Knowledge management/ entrepreneurship skills and preservation skills</i>
10.	<i>Interpersonal relationship skills</i>	25.	<i>MOOC Teaching and learning skills</i>
11.	<i>Legal aspects of data management</i>	26.	<i>Reprographic skills</i>
12.	<i>Human relations</i>	27.	<i>Statistical software</i>
13.	<i>Curatorship of data</i>	28.	<i>Marketing and advocacy</i>
14.	<i>System design and management</i>	29.	<i>Skills in ethical issues</i>
15.	<i>Critical thinking</i>	30.	<i>Support is necessary for sustainable research in data management and archiving</i>

Acquiring these skills for them, was important for the STEM Library workforce. In addition, they gave general suggestions on ways in which the workforce can reskill. Thirty of them responded as under listed (See Figures2a and 2b):

Figure 2a. Suggestions for reskilling the workforce

Networking and Data sharing (2)
Mentoring (2)
Need for data management as an undergraduate program and short courses for continuous professional development. (2)
The future of librarianship looks bright and exciting with the emergence of data sciences and data science skills (2)
Training and re-training to remain relevant (2)
Need for continuous re-archiving plan due to rapid changes in technologies so as to mitigate hard and software obsolescence.
There is the need to be able to translate the knowledge and skills acquired in training to focus on meeting the information needs of the information users that we render information services to.
Hospitality Intelligence
Computer science.
Copyright local policy regarding the use of data.

Figure 2b. Suggestions for reskilling the workforce

Organised and good time management.
Advanced IT and information science competencies.
Being passionate in the skills created.
Strong data.
Researches.
21st century skills.
Management Skill too is very important.
Sponsoring staff for workshops.
Practical application of the theory learnt.
Advocacy
Self-appraisal skills
It will enhance efficiency.
STEM Librarians must be proactive, and versatile in programmes skills.
Provision of data storage facilities.

Interviews

Four respondents who were not part of those who responded to the questionnaire were interviewed. Two males and 2 females were randomly chosen by the researchers. One of the interviews was face to face while three were telephone interviews recorded with the consent of the respondents. The recordings were transcribed and notes taken during the face-to-face interview. Respondents are referred to by initials MOU (m), WNA (f), OIO (f) and OO (m).

MOU, male, between age 35 to 39, a PhD holder and a medical librarian, felt that the use of robots, virtual reference services, and remote database search would be key to future STEM library service providers.

"To achieve this, emotional intelligence, originality and creativity would be key skills STEM librarians should have. They have to be very creative in serving their users". "To be able to serve my STEM library users, I would be attending relevant workshops, trainings and participating in simulations, that is simulations of the Science, Technology Engineering and Mathematics laboratories. I need to learn along with them sometimes to provide the best service".

This respondent believed in acquiring the necessary skillsets by participating in the acquisition of knowledge about the STEM curriculum, being creative about service provision, and having emotional intelligence. This does not strictly corroborate Tu (2007) in identifying knowledge skills and providing virtual reference health sciences services, but goes beyond. Emotional intelligence, originality and creativity are added skills needed.

WNA, female, in the age bracket 30-40, a Senior Librarian and Clients Support Officer having a Masters degree, identified resource sharing and virtual reference services as the likely trend going futuristic. *"Twenty years from now, those will be the STEM library focus since no one library has it all". "I think Digital Library training will be able to solve the issues at stake and will be highly required, to work in the STEM library of the future". "I would go about acquiring the skills through online training. There are Massive Open Online Courses (MOOCs), webinars and short courses online that could train me. I would search online for such."* This corroborates Emiri (2015) and Chu and Du (2013) on using digital tools to great advantage in serving users.

O.I.O, female, between 41 to 50 years old, a PhD holder and Senior Librarian/ Electronic Resources Librarian described skills needed by STEM librarians as:

"They need to get a PhD, it develops one's critical thinking skills. STEM librarians need to become full time researchers, to be very relevant. They need not be part time researchers but need in-depth research."

"On what I can do, I am already doing some already, practicing advanced research skills, doing systemic reviews. The only one missing is using Artificial Intelligence (AI). I will be adept at it soon."

"What to do to acquire the skills? I am searching for opportunities to train. I already am a member of the American Library Association, on the International Relations Roundtable (IRRT). I am seeking training opportunities there. They send notices. One can provide data services, packaging and designing of information products which we are not currently doing. One can make a brochure for a target group, jingle for Television programme. Make it so users come to the library to get ideas, software programming serves information in the future, we might have AI, robots registering users, telling about materials in the library, to acquire materials based on user behaviour. For example, "20 users used this material today", it will be easy for forecasting what to acquire".

Respondent O.O, male, in the age bracket 41 - 50, a top Data Manager with a Master's Degree discussed issues concerning STEM library workforce thus:

"In 20 years' time, the STEM library will be more like providing virtual services, a knowledge management hub which involves data of many kinds that people can reap from. This will lead into data engineering combined to bring out new ones using available data."

"What skills are needed for this, it means going beyond traditional library training. Information Science and Data Management are germane. Critical thing and teaching skills are needed to serve users."

"To achieve this going forward, I just need to read, read, read and read!. I need to read to update my knowledge and skills."

Recommendations and Conclusion

The use of immersive technology, re-skilling for all cadres of workforce, developing critical thinking skills is absolutely essential for the future STEM library workforce. The workforce should have computer programming skills, since robotics and AI will be in use. PhD will be important as it helps one to develop critical thinking skills. In view of the training needs of future STEM library workforce, it is recommended that Library schools should upgrade their curriculum to reflect the new trends in Librarianship. The new components should offer hands-on practice of the technologies. Furthermore, a component of these new courses should be offered to librarians on the job who were not initially taught these, to take short courses to keep them abreast of New Librarianship trends especially for STEM.

For the workforce to be able to do these, the management of their workplaces should provide an enabling environment for the workforce, in terms of structures, and amenities that will aid and boost their productivity. There should be motivation and the workforce must be seen to have job satisfaction. This is a recommendation that will help the workforce in the delivery of excellent services to their users.

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