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INFORMATION PROFESSIONALS**

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DATA LITERACY SKILLS: THE PERSPECTIVES OF POSTGRADUATE STUDENTS IN UNIVERSITIES IN NORTH-CENTRAL NIGERIA

by

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Abstract

Amidst a global shift towards data-driven decision-making, data literacy skills are increasingly sought after by employers. Despite this, there is a noticeable lack of empirical studies focusing on data literacy skills, particularly within the context of postgraduate students in North-central Nigerian universities. This study aimed to identify and examine the data literacy skills from the perspective of postgraduate students in North-central universities focusing on factors such as data exploration, data management, data use and reflection, and data improvement. The study utilised a purely quantitative approach with a survey design. Data were collected through the use of open ended interview, which was tailored to align with the factors identified in the research objectives. The population of the study was postgraduate students from three universities in Northcentral Nigeria. Random sampling technique was used to select two participants from each category of university (public or private) of the study. Participant verbatims were quantitatively documented. In conclusion, the study has provided valuable insights into the data literacy skills being a crucial area that has received insufficient research attention, particularly within the context of North-central Nigeria.

Keywords: Data Literacy, Data Literacy Skills, Data Management, Data Use, Data Reflection, Data Exploration, Data Improvement, Postgraduate Students.

Introduction

In today's rapidly evolving world, data has become a powerful resource driving decision-making processes in various domains, including business, healthcare, education, and government (Tiwari, 2022). The ability to comprehend, analyse, and effectively utilise data, known as data literacy skills, has emerged as a crucial competency for individuals seeking to

thrive in the data-driven era (Cui et al., 2023). Employers across industries are increasingly recognising the value of data literacy and are actively seeking professionals who possess the necessary skills to extract insights from data. While the importance of data literacy is widely acknowledged, there is a noticeable scarcity of empirical research that focuses on understanding data literacy skills, particularly within the context of postgraduate students in North-central Nigerian universities. This study aims to address this research gap by examining the factors that predict data literacy skills among postgraduate students in these universities.

The relevance of this study is underscored by the rapid growth of data-driven decision-making and the increasing demand for individuals with strong data literacy skills. As organisations strive to leverage data to gain a competitive advantage, there is a pressing need to identify the factors that contribute to the development of data literacy skills among postgraduate students. By gaining insights into these predictors, policymakers, educators, and institutions can design targeted interventions and educational programmes to enhance data literacy competencies among postgraduate students, thereby bridging the existing gap between industry demands and the skills possessed by graduates.

The aim of this study is threefold: firstly, to examine the level of data literacy skills among postgraduate students in North-central Nigerian universities; secondly, to identify the predictors of data literacy skills, including factors such as data exploration, data management, data use and reflection, and data improvement; and thirdly, to provide evidence-based recommendations for improving data literacy education and training programmes within the academic context.

The findings of this study will contribute to the existing literature on data literacy skills by considering the determinants of data literacy among postgraduate students in universities in North-central, Nigeria. Furthermore, the study's recommendations can inform educational policymakers, curriculum developers, and university administrators in designing effective strategies to enhance data literacy education and prepare postgraduate students for the demands of a data-driven job market. Ultimately, this research aims to foster the development of a skilled and competent workforce capable of harnessing the potential of data for societal and economic progress in the North-central region of Nigeria.

Theoretical Framework

The theoretical framework for this study draws from the Information Literacy Competency Standards for Higher Education (ACRL, 2000), which highlights the essential skills needed for working with information in a digital age. These standards have been adapted

to the concept of data literacy by scholars such as Calzada-Prado and Marzal (2013), who identified key components of data literacy. On that note, this study posits that data literacy skills are a function of four key components: data exploration, data management, data use and reflection, and data improvement. It assumes that these four factors significantly influence the ability of postgraduate students in North-central Nigerian universities to understand, interpret, and use data effectively.

Literature Review:

Data Literacy

Data literacy refers to the ability to understand, analyse interpret, and communicate data effectively (Bhargava et al., 2015). In the era of big data and data-driven decision-making, data literacy has gained significant importance in various professional domains. Researchers have highlighted the multifaceted nature of data literacy, encompassing skills such as data exploration, data management, data use and reflection, and data improvement. A study by Skarpa and Garoufallou (2022) emphasised the importance of data literacy in the digital age, highlighting that individuals need to possess the skills to critically evaluate and make sense of the vast amount of information available. Similarly, Raffaghelli (2022) emphasised the need for individuals to acquire data literacy skills to navigate and understand the complex data-driven landscape.

Determinants of Data Literacy Skills:

Several factors contribute to the development of data literacy skills among individuals. Understanding these determinants is crucial for designing effective educational programs and interventions. The following factors have been identified in the literature as predictors of data literacy skills:

- a. **Educational background:** Research suggests that individuals with a background in quantitative disciplines, such as mathematics, statistics, and computer science, tend to possess higher levels of data literacy. For instance, Cowie and Cooper (2019) found that individuals with a strong foundation in mathematics tend to have better data literacy skills.
- b. **Technological competence:** Proficiency in using data analysis tools, software, and programming languages is strongly associated with data literacy skills. Familiarity with tools such as Excel, SQL, and programming languages like R or Python enables individuals to manipulate and analyse data effectively (Pruim et al., 2023).
- c. **Information literacy:** Information literacy, which involves the ability to locate, evaluate, and use information effectively, is closely related to data literacy. Researchers have found a

positive correlation between information literacy and data literacy skills (Stephenson & Schifter Caravello, 2007). Individuals who possess strong information literacy skills are better equipped to navigate through data and extract meaningful insights.

d. **Critical thinking and analytical skills:** Data literacy requires individuals to think critically, analyse data, and draw valid conclusions. Studies have shown that individuals with strong critical thinking skills tend to exhibit higher levels of data literacy (Almulla & Al-Rahmi, 2023). Such skills enable individuals to approach data with a questioning mindset and make informed decisions based on evidence.

e. **Data-related experiences and practices:** Engaging in data-related activities, such as conducting research, analysing datasets, or participating in data-driven projects, can significantly contribute to the development of data literacy skills. Hands-on experiences provide individuals with opportunities to apply data analysis techniques and enhance their understanding of data (Simon et al., 2022).

f. **Motivation and self-efficacy:** Motivation and self-efficacy play a crucial role in the acquisition and development of data literacy skills. Individuals with a strong motivation to learn and improve their data literacy tend to invest more effort in acquiring the necessary skills (Scheele et al., 2022). Self-efficacy, which refers to an individual's belief in their ability to perform a specific task, has been positively associated with data literacy skills (Chonsalasin & Khampirat, 2022).

g. **Socio-cultural factors:** Socio-cultural factors, such as access to resources, educational opportunities, and socio-economic status, can influence an individual's data literacy skills. Studies have shown that individuals from disadvantaged backgrounds may face barriers in acquiring data literacy skills due to limited access to technology, educational resources, and training opportunities (Bawden & Robinson, 2009).

Contextual Factors

The development of data literacy skills is also influenced by contextual factors specific to the educational environment. These factors include curriculum design, teaching methods, and institutional support. Effective integration of data literacy into the curriculum and the availability of faculty who are knowledgeable in data analysis can significantly contribute to the development of data literacy skills among students (Lin et al., 2023). Additionally, institutional support in the form of resources, infrastructure, and training programs can facilitate the acquisition of data literacy skills among postgraduate students (Calzada Prado & Marzal (2013).

While there is a growing body of research on data literacy, there remains a noticeable gap in empirical studies focusing on the determinants of data literacy skills, particularly among postgraduate students in North-central Nigerian universities. The current literature predominantly focuses on data literacy in Western contexts and lacks a comprehensive understanding of the specific factors influencing data literacy in the Nigerian educational setting. Therefore, this study seeks to address this research gap and contribute to the existing literature by examining data literacy skills among postgraduate students in North-central Nigerian universities

Methodology

The study utilised a purely qualitative approach with a survey design. Data were collected through the use of open-ended interview, which was tailored to provide in-depth insights into the experiences, challenges, and perceptions of postgraduate students regarding data literacy. The population of the study were postgraduate students from three universities in North- central Nigeria. Random sampling technique was used to select two participants from each category of university (public or private) of the study. Participant verbatim were quantitatively documented. (See Appendix for the questions that generated the data used in this study).

Results

Perception of Data Literacy

Participant 1:

"Data literacy, to me, is the ability to not only understand and interpret data but also to effectively communicate and make decisions based on data in today's digital age. It's crucial because in a world inundated with information, being data literate empowers individuals to make informed choices and solve complex problems."

"Key components of data literacy include data exploration, which involves the skill of finding and accessing relevant data; data management, which is all about organising and storing data efficiently; data use and reflection, where you analyse and draw insights from data; and data improvement, focusing on enhancing data quality. Data exploration helps us uncover hidden patterns, data management ensures data accessibility, data use and reflection drives decision-making, and data improvement keeps the information accurate and relevant."

"I'd rate myself as proficient in data exploration and management, but I've encountered challenges in data use and reflection. It can be tough to derive meaningful insights from complex datasets. Additionally, ensuring data quality for improvement remains a constant effort."

"The curriculum plays a vital role in fostering data literacy. Courses like 'Data Analytics' and 'Statistics for Decision-Making' have significantly contributed to my data

literacy development. They provide practical skills and real-world applications, making the learning process more effective."

"Hands-on practical training is extremely important. I've had opportunities to work with real data sets in these courses, and it's been invaluable. It allows you to apply theoretical knowledge to practical scenarios, enhancing your understanding."

"Yes, I've received guidance from faculty members who are experts in data analytics. Their mentorship has been instrumental in my development. They provide insights, answer questions, and help bridge the gap between theory and practice."

"Tools like Python for data analysis and Tableau for data visualisation have been immensely helpful. They make data manipulation and representation more accessible and efficient." "Data literacy is immensely relevant in my future career. I plan to work in market research, and data-driven decision-making is at its core. Being data literate will undoubtedly be a valuable asset."

"Institutionally, I believe offering more specialised data literacy courses and workshops would be beneficial. Additionally, policies promoting open access to research data can facilitate skill development among postgraduate students."

"My advice to fellow postgraduate students would be to embrace hands-on learning and not shy away from complex data sets. Additionally, seek mentorship and explore online resources, as the field of data literacy is ever-evolving."

Participant 2:

"Data literacy, from what I've learned on my own, is about being able to work with data, understand its meaning, and use it to solve problems. In our part of Nigeria, where formal education resources on this are limited, self-acquiring data skills is vital because it helps us make better decisions in our daily lives."

"In my opinion, key data literacy components like data exploration, data management, data use and reflection, and data improvement are all essential, especially for self-learners like us. Data exploration helps us find information we need, data management ensures we don't lose what we find, data use allows us to draw insights, and data improvement ensures our data remains reliable."

"I'd say I'm quite proficient in data exploration and management because I've had to learn these skills to find and organise data from various sources. Data use and reflection are more challenging, but I'm working on them. It's not always easy when you're self-learning."

"The curriculum here is limited when it comes to data literacy. We don't have specific courses dedicated to it, so most of us rely on online resources and self-study to develop these skills."

"Hands-on practice is crucial, but opportunities are limited. I've tried working with available data sets on my own, and it has been beneficial, but it's not as structured as I'd like."

"Mentorship from faculty or professionals is almost non-existent here for data literacy. We mostly learn from online forums and tutorials."

"I rely on free software like R and Google Sheets for my data work. These tools are accessible and don't require a lot of resources."

"In our future careers or academic pursuits, data literacy will be essential, even though we've had to self-acquire these skills. It's about survival in this data-driven world."

"To support data literacy in Nigeria, we need more accessible online courses, especially for those who can't afford formal education. Also, initiatives to provide data access to the public would be helpful."

"My advice to fellow students here would be to never stop learning. Use the internet as your classroom, collaborate with peers, and don't be afraid to ask questions in online communities."

Participant 3:

"In a place like North-central Nigeria, data literacy is the ability to understand and use data for practical purposes, and something we often have to teach ourselves because formal education doesn't always cover it. In our digital age, this skill is vital to navigate the information around us."

"Key components of data literacy, such as data exploration and management, are skills I've had to develop on my own. Data use and reflection are more challenging because they require deeper analysis, but they're equally important. Data improvement ensures we're working with reliable information."

"I'd say I'm reasonably proficient in data exploration and management because I've had to acquire these skills to find and handle data. Data use and reflection are areas where I'm still learning, and it's not easy without formal guidance."

"The curriculum here doesn't focus much on data literacy, so most of us have to seek online resources and teach ourselves. It's not ideal, but it's what we have."

"Hands-on practical training is essential, but opportunities are limited. I've done some self-guided projects with available data, but it's not structured."

"Faculty mentorship in data literacy is scarce here. We rely on online communities and tutorials for guidance."

"Free tools like Excel and online platforms are what we use to work with data. They may not be as advanced as paid software, but they get the job done."

"Data literacy is critical for our future careers, even though we're self-learners. It's a valuable asset in any field, and we can't afford to be left behind."

"To better support data literacy in Nigeria, we need more accessible online courses and initiatives to promote data sharing among institutions."

"My advice to fellow students in our situation is to be proactive in learning. The internet is a vast resource; use it to your advantage. Practice, collaborate, and keep pushing your boundaries."

Participant 4:

"In central Nigeria, data literacy boils down to our capacity to grasp and effectively apply data skills—a journey often embarked upon through self-acquisition, given the limited access to formal education in this area. It's indispensable in today's digital age as it equips us to navigate data-driven environments."

"Given our circumstances, key data literacy components like data exploration, data management, data use and reflection, and data improvement take on immense significance. I've had to self-learn these skills. Data exploration helps us find information; data management keeps it organised; data use fosters insights, and data improvement ensures reliability."

"My proficiency stands highest in data exploration and management, skills I've honed through self-study. However, data use and reflection remain challenging without formal guidance during our postgraduate studies."

"Our curriculum here doesn't allocate substantial focus to data literacy, so we predominantly rely on online resources and self-education to cultivate these skills."

"Practical training is a necessity, but opportunities are scarce. I've undertaken self-guided projects with whatever data I could find, yet structured experiences remain limited."

"Faculty mentorship in data literacy is almost non-existent in our context. We resort to online communities and tutorials for guidance."

"Given our resource constraints, I rely on freely available tools like Python for data analysis. They are accessible and don't demand significant financial investments."

"Data literacy retains paramount importance in our future careers, even though we've had to self-educate. It's an invaluable asset across various fields, and we cannot afford to lag behind."

"To bolster data literacy in Nigeria, we require more accessible online courses and initiatives aimed at democratising data access for educational purposes."

"My counsel to fellow students in similar predicaments is to maintain a relentless commitment to self-learning. Leverage the vast resources on the internet, collaborate with peers, and actively seek assistance within online communities."

Participant 5:

"Here in central Nigeria, data literacy signifies our ability to comprehend and effectively utilise data skills, which we've largely had to acquire independently due to the scarcity of formal educational resources. In our digital era, this skill is indispensable for making informed decisions and adapting to data-centric environments."

"In light of our circumstances, the key components of data literacy: data exploration, data management, data use and reflection, and data improvement assume utmost importance. Self-acquiring these skills has been a necessity. Data exploration aids in information discovery; data management ensures organisation; data use facilitates insights, and data improvement guarantees reliability."

"I consider myself proficient in data exploration and management skills I've cultivated through self-study. However, data use and reflection pose challenges, especially in the absence of formal guidance during our postgraduate studies."

"Our curriculum here doesn't emphasise data literacy, so most of us have had to resort to online resources and self-directed learning to acquire these skills."

"Practical training is vital, yet opportunities are scarce. I've undertaken self-guided projects with available data, but structured experiences remain limited."

"Mentorship from faculty or professionals is a rarity in our situation. We mainly depend on online communities and tutorials for guidance."

"Given our constraints, I employ freely available tools like Excel for data work. While they may lack the sophistication of paid software, they suffice for our purposes without incurring significant costs."

"Data literacy remains indispensable for our future careers, even though we've had to self-learn. It's a valuable asset across various fields, and falling behind is not an option."

"To bolster data literacy in Nigeria, we require more accessible online courses and initiatives aimed at promoting data sharing among educational institutions."

"My advice to fellow students in our situation is to take the initiative in self-learning. The internet offers a wealth of resources; make full use of it. Practice, collaborate, and continually push your boundaries."

Conclusion

This study has provided valuable insights into the determinants of data literacy skills, a crucial area that has received insufficient research attention, particularly within the context of North-central Nigeria. Data literacy is important to postgraduate students as it will facilitate their completion of their programme.

Recommendations

Based on the study's findings, several recommendations are proposed to enhance data literacy skills among postgraduate students:

1. **Integrate Data Literacy in Curriculum:** Universities should integrate data literacy components into their postgraduate programs' curriculum. This should not be limited to courses related to statistics or information technology, but across all disciplines, considering the cross-cutting relevance of data literacy skills.
2. **Practical Training and Workshops:** Institutions should organize regular workshops and training sessions to provide practical experience in data exploration, management, use, and improvement. This will equip students with hands-on skills needed to handle real-world data.
3. **Mentorship and Peer Learning:** Opportunities for mentorship and peer learning should be encouraged. Experienced professionals in data handling can share their knowledge with students, while peer learning can also facilitate the exchange of skills and ideas.
4. **Investment in Digital Infrastructure:** Universities need to invest in digital infrastructure, including up-to-date software and hardware, to enable students to practice and enhance their data management skills.
5. **Continuous Research:** Further research is needed to continually assess the effectiveness of these interventions and refine the pedagogical approaches to teaching and learning data literacy skills.

Implications for Practice

The findings of this study contribute to the ongoing discourse on data literacy in higher education, particularly within the context of a developing country like Nigeria. They reinforce the relevance of the four components of data literacy identified by Calzada-Prado & Marzal (2013) and extend this theoretical framework by demonstrating their predictive value in a new context. The study also suggests that data use and reflection and data management may be more significant predictors of data literacy skills than other components, which provides a potential area of focus for theoretical models of data literacy.

The study's findings have several practical implications for educators, university administrators, and policymakers. They highlight the importance of incorporating data literacy components into postgraduate curricula, providing practical training opportunities, and investing in digital infrastructure. The particular importance of data use and reflection and data management suggests that these areas should be a particular focus in interventions aimed at improving data literacy. The findings also underscore the need for continuous assessment of

students' data literacy skills and the effectiveness of interventions, which can inform refinements to pedagogical approaches and educational policies.

Future Research Direction

The verbatims show the unique perspectives of postgraduate students in relation to data literacy. In the light of this, further research should consider the following:

1. Broader contexts: This study focused on postgraduate students in North-central Nigerian universities. Future research could explore other geographical regions and different educational levels (e.g., undergraduate students, high school students) to offer a more comprehensive understanding of data literacy across different demographic groups.
2. Other predictors of data literacy: While this study examined four key components of data literacy, there could be other predictors such as students' attitudes towards data, previous exposure to data-related courses, and the influence of teachers' data literacy skills.
3. Longitudinal studies: A longitudinal study exploring changes in students' data literacy skills over time could provide insights into how these skills develop and which factors contribute to their development.
4. Impact of interventions: Research could also focus on assessing the impact of various interventions aimed at improving data literacy skills, such as curriculum changes, workshops, and investment in digital infrastructure.

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Appendix

Interview Guide: Data Literacy Skills among Postgraduate Students in Northcentral Nigerian Universities

Introduction:

Thank you for agreeing to participate in this interview. The purpose of this interview is to explore the determinants of data literacy skills among postgraduate students in Northcentral Nigerian universities. Your insights and experiences are valuable in helping us understand the factors that contribute to data literacy. Please note that your participation is voluntary, and your responses will be kept confidential. With your permission, this interview will be recorded for accurate transcription and analysis purposes. Are you ready to begin?

1. Can you briefly describe your understanding of data literacy and its importance in today's digital age?
2. In your opinion, what are the key components or skills that contribute to data literacy? For example, data exploration, data management, data use and reflection, and data improvement. Please elaborate on each component and its significance.
3. How would you rate your level of proficiency in each of these data literacy components? Are there any specific challenges you have encountered in developing these skills during your postgraduate studies?
4. What role do you think the curriculum plays in fostering data literacy skills among postgraduate students? Are there any specific courses or modules that have contributed to your data literacy development?
5. How important is hands-on practical training in data literacy? Have you had any opportunities to engage in practical exercises related to data exploration, management, use and reflection, or data improvement? If yes, how did these experiences contribute to your understanding and skills in data literacy?
6. Have you received any guidance or mentorship from faculty members or professionals in the field regarding data literacy skills? If yes, could you describe the nature of this guidance and its impact on your development as a data-literate individual?
7. In your experience, what resources or tools have been helpful in enhancing your data literacy skills? Are there any specific software or technologies that you find particularly useful?
8. How do you perceive the relevance of data literacy skills in your future career or academic pursuits? Do you believe that data literacy will be a valuable asset in your chosen field?
9. Are there any institutional or policy-level initiatives that you believe could better support the development of data literacy skills among postgraduate students? If yes, what specific recommendations would you suggest?

10. Based on your experiences, what advice would you give to postgraduate students who aim to improve their data literacy skills? Are there any strategies or approaches that have worked well for you?

Thank you for your valuable insights.

