Can Academic Librarians as Data Scientists Revolutionise User-Centric E-learning?

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Abstract: This investigation illuminates the vital contributions of academic librarians (ALs) functioning as data scientists (DSs) within the e-learning landscapes of Malaysian public universities. Derived from comprehensive interviews with ten experience ALs, this study distinguishes three key areas of contribution towards user-centric and effective e-learning: bolstering user experience and usability; endorsing continuous improvement and professional development; and stimulating interdepartmental collaboration and innovation. Despite the significant progress made by ALs, the study acknowledges the formidable challenges faced by these professionals in their capacity as DSs, specifically in areas of professional growth and evaluation. The paper presents strategic recommendations to overcome these obstacles, such as amplifying ALs' data science competencies, advocating for ongoing professional development, and endorsing the validation of their expertise through accreditation. By highlighting the essential role and proactive contributions of ALs as DSs, this study offers valuable insights and guidelines towards cultivating a robust and influential e-learning environment. Concluding with suggestions for future research, this study aims to propel the progression of academic librarianship and the enhancement of e-learning outcomes.

Keywords: Academic Librarian as Data Scientist, E-learning Environment, User-Centric Learning, Continuous Professional Development, Technology Integration.

1. Introduction

The dynamic nature of the e-learning landscape demands that academic librarians undergo a profound redefinition of their roles, transcending conventional boundaries to optimize the learning experience in conjunction with remote instruction. This study is very important given the remarkable development of the Open Science Platform (MOSP) in Malaysia, a strategic initiative spearheaded by the Ministry of Science, Technology, and Innovation (MOSTI) aimed at strengthening the nation's open science ecosystem. MOSP's provision of a wide range of resources, including user guides, capacity-building programs, and a research data-sharing infrastructure, clearly lines up with the FAIR (Findable, Accessible, Interoperable, and Reusable) principle, thus cementing its status as an instrumental and pivotal component within Malaysia's research landscape while concurrently paving the way for future advancements (The Star, 2023). In conjunction with this, in the dynamic e-learning landscape, academic librarians (ALs) assume a vital role in navigating transformative trends. Their active engagement with MOSP empowers them to champion open science principles and collaborate closely with researchers, ultimately enhancing the learning experience and contributing to research advancement in the digital era.

This paper explores how ALs as data scientists (DSs) contribute to enhancing e-learning in Malaysian public universities and investigates the impact of user-centric and efficient e-learning environments on their changing roles and contributions. The paper includes an introduction and a literature review on ALs' roles in e-learning, focusing on their involvement in data science. It discusses the challenges faced by ALs as DSs in the e-learning environment. The results and research methodology are analysed, and a conceptual framework highlights the significance of the data science contributions by librarians in improving e-learning. The paper concludes with recommendations for future research in this important area.

2. Literature Review

2.1 Roles of ALs as DSs in E-Learning and the Application of User-Centric Design (UCD)

The UCD approach is highly applicable to ALs functioning as data scientists within the realm of e-learning, as it underscores the paramount importance of simplicity, usability, aesthetics, and alignment with user needs (Courage & Baxter, 2005). ALs assume a critical role in ensuring unfettered access to high-quality digital resources, fostering information literacy, and crafting instructional content of exemplary standards (Taylor & Thompson, 2018). However, a discernible knowledge gap persists regarding ALs' perception and enactment of their ever-evolving role as data specialists within the e-learning domain, thereby warranting meticulous investigation to bridge this scholarly chasm (Lynch, 2017; Cox & Verbaan, 2018). In this context, it becomes indispensably imperative for ALs to expand their professional repertoire, encompassing technological prowess, instructional design acumen, project management proficiency, and adeptness in advocating for and promoting library resources within academic circles, all in a concerted effort to efficaciously navigate the ever-shifting tides of their multifaceted responsibilities (Walter, 2016; Connor, 2020).

Data science, as an expansive discipline, incorporates manifold perspectives and approaches, serving as a paradigm that profoundly shapes our comprehension of data-driven practises (Kelling et al., 2009; Kitchin, 2014). In the specific context of academic librarianship, data science delineates the purview of ALs, who adroitly extract cogent insights from data via the application of sophisticated statistical and machine learning techniques (Hayes, 2014). Furthermore, ALs actively collaborate with esteemed faculty members, harmoniously integrating diverse educational resources into meticulously crafted curricula, orchestrating curated online tutorials, and, commendably, fostering a vibrant culture of active learning through an array of cutting-edge digital platforms (Mune, 2015).

Despite the pivotal role that ALs play in the expansive landscape of e-learning, a palpable dearth of knowledge persists vis-à-vis their continually transforming roles and the requisites indispensable for their successful adaptation to these transformative shifts (Lynch, 2017; Cox & Verbaan, 2018). Consequently, it becomes unequivocally evident that a comprehensive exploration, replete with scholarly rigour, is an essential prerequisite to unravelling the intricate tapestry of ALs' dynamic roles within the e-learning sphere, thereby facilitating a holistic comprehension of their lived experiences, effectively addressing challenges, and seizing the multitude of opportunities intrinsically embedded within this ever-evolving professional milieu (Xing & Du, 2018; Siemens & Baker, 2012). Notably, the deployment of predictive modelling techniques aptly fuels the trajectory of personalised learning, albeit accompanied by the complexities of ethical considerations, prompting an urgent need for meticulous safeguarding of student privacy and confidentiality (Drachsler & Greller, 2016). In addition, the advent of epochal forces such as big data, artificial intelligence (AI), and machine learning (ML) presents a pantheon of unparalleled opportunities alongside the concomitant complexities surrounding data management and processing, thereby warranting prudent deliberation (Picciano, 2012; Zhou & Brown, 2018).

To encapsulate, the application of the user-centric design (UCD) approach profoundly resonates with the professional aspirations of ALs functioning as DSs within the expansive domain of e-learning, firmly accentuating the inexorable significance of harmonising educational practises with the varied and nuanced needs of users. Librarians, equipped with data-driven tools, adroitly steer the course of instructional design, deftly personalising learning experiences, and enhancing educational outcomes through the judicious application of data science methodologies (Zhou & Brown, 2018). The acquisitive journey towards knowledge, coupled with the astute utilisation of data science frameworks, becomes an indispensable conduit that empowers ALs to successfully navigate the myriad complexities embedded within their rapidly evolving roles within the dynamic and ever-expanding realm of e-learning.

2.2 Theoretical Frameworks Guiding Librarians' Integration of Data Science in E-Learning

The role of ALs as DSs in e-learning contexts is characterised by a range of scholarly frameworks and models, despite lacking a specific theory to encapsulate it. Baker and Siemens (2014) lay the foundation for applying data and analytics in education, while Dede, Ho, and Mitros (2016) emphasise their role in e-learning. Martin and Ndoye (2016) exemplify data science in e-learning, using learning analytics to evaluate student progress. ALs can use the Community of Inquiry framework and social network analysis for data-driven enhancements (Garrison, Anderson, & Archer, 2000; Haythornthwaite, 2002). The Information Literacy Framework (ACRL, 2016) and Bruce's Seven Faces of Information Literacy (Bruce, 1997) highlight the evolving role of librarians in an evolving information landscape. Ray and Brown (2019) and Stephens et al. (2018) emphasise librarians as data mentors

and educators in e-learning, emphasising data literacy's importance.

Tijerina and Erdmann's influential report "Data Science in Libraries" (2017) forms the foundation of our examination of ALs as DSs. This report serves as a critical reference, particularly for emerging research environments such as exists in Malaysia, underscoring the need for more exploratory studies. Within the scholarly discourse, there exists significant divergence regarding the nomenclature, objectives, components, criteria for advancing to subsequent studies, and reporting practices associated with exploratory investigations (Lancaster, 2015). The report elucidates the fusion of data science and librarianship, demonstrating how librarians, as data curators and information specialists, can contribute to academic learning and research. Libraries are proposed as hubs for data science activities, with opportunities to enhance data literacy among learners through workshops and hands-on experiences. In an e-learning context, the report's implications are profound. Librarians, equipped with data science skills, can optimise the use of online learning platforms by analysing user behaviour and learning outcomes, leading to course improvements. They can also personalise learning experiences, provide targeted support, and utilise machine learning and data visualisation techniques.

2.3 A Challenge-Ridden Pathway for ALs

ALs face obstacles as they navigate the e-learning landscape as DSs. These challenges include privacy, security, and ownership concerns related to big data (Zimmer, 2022). Inconsistent data ownership policies among platforms and libraries compound the problem. Acquiring specialised data science skills is a significant barrier due to limited funding and access to training (Haddow & Mamtora, 2021). Inconsistencies in library data science practises, communication with stakeholders, data quality, and interoperability further impede progress (Jones, 2021; Al-Aufi & Houghton, 2021). Librarians must continuously update their skills due to the evolving nature of data science (Kitchin, 2022). Scaling from small-scale to large-scale applications presents data management challenges (Luo & Clarke, 2022). Finally, librarians must be mindful of algorithmic bias in machine learning to avoid skewed or unfair outcomes (Mittelstadt et al., 2019).

3. Study Methodology

The research design employed in this study employed stringent measures to establish credibility and validity, commencing with a comprehensive literature review (Leite, Padilha, & Cecatti, 2019) that informed the research problem and design (Yin, 2009). A phenomenological approach was deliberately adopted, targeting esteemed ALs hailing from prestigious Malaysian research universities (RU). These distinguished individuals boasted 10–15 years of professional experience, held the esteemed grade of S41, and fell within the age range of 40–45 years. The selection process meticulously considered their active involvement in diverse e-learning and innovation projects conducted under the aegis of top management.

Given the specific context of the research landscape in Malaysia, characterized by a limited number of five RU, regrettably, only two institutions evinced willingness to participate. Consequently, the scarcity of respondents in this study can be ascribed to the constrained availability of potential participants. The two participating RU, as evidenced in Table 1, were judiciously chosen based on their eminence and extensive involvement in e-learning and innovation endeavors.

While a larger sample size would have been ideal to enhance statistical generalizability, qualitative research often prioritizes depth and richness of data over the sheer magnitude of the sample. In this study, the emphasis was placed on obtaining invaluable insights from esteemed senior ALs possessing considerable expertise and actively engaged in e-learning and innovation projects within the participating RU. Their erudition and perspectives furnish significant contributions to the research objectives.

Data collection was meticulously undertaken through focus group interviews, ensuring scrupulous adherence to ethical considerations and securing prior consent from chief librarians and informants. The study encompassed the inclusion of ten senior ALs from the participating RU, as detailed in Table 1. Although the number of respondents may appear relatively limited due to the paucity of RU willing to partake, the inclusion of these highly experienced senior ALs facilitates a comprehensive exploration of their nuanced perspectives. Throughout the interviews, the utmost level of professionalism and respect was meticulously upheld, with audio recordings captured in MP3 format to facilitate detailed transcription and comprehensive data analysis.

Table 1: Demographic Profile

Elements of Sampling	Case A		Case B	
Academic library location in public university with RU granted	Centre of Peninsular Malaysia		Southern Peninsular Malaysia	
Overall library staff strength	170-180		170-180	
Working experience	Multiple Department (rotation basis)		Multiple Department (rotation basis)	
Number of participants	5		5	
Gender	Female	Male	Female	Male
	3	2	3	2
Key performance index in % (for 3 years directly)	90-95		90-95	
Years of experience	10-15		10-15	
Age range	40-45		40-45	
Qualifications				
Degree in Library Science	3		3	2
Degree In Islamic Studies		1		
Degree in Botany	1			
Masters in Information Management/ Library Science	5		5	
Current position	Senior Librarian		Senior Librarian	

4. Discussion of the Findings

This section provides a comprehensive discussion of the findings by integrating the insights from both Case A and Case B. The discussion is supported by relevant source citations, with CSA serving as the source citation, Q2 specifying the specific question related to the domain, and AL-C representing the cited AL.

4.1 Contributions

4.1.1 Enhancing User Experience, Optimising Usability and Evaluating and Enhancing Electronic Resources

Within the domain of library website usability, ALs play a vital role in enhancing user experiences and optimising usability. AL-C emphasises their commitment to user-centric design, stating, "We prioritise user-centric design principles to ensure seamless access and intuitive navigation" (CSA, Q2, AL-C). For instance, ALs have implemented intuitive search functionalities and personalised recommendation features, enhancing the overall user experience.

Similarly, AL-E recognizes user-centric design. They focus on employing appropriate terminology, instilling user confidence, and establishing a well-structured information architecture and site navigation. By evaluating electronic resources for relevance, AL-E ensures they meet user requirements. AL-E states, "We empower researchers and professionals to easily access and utilise valuable agricultural resources. Our user-friendly interfaces, guided tutorials, and intuitive navigation enhance the overall user experience, enabling informed decision-making and promoting sustainable practises" (CSA, Q2, AL-E). For example, tooltips and contextual help features have been implemented to enhance users' understanding and utilisation of resources.

AL-D emphasises the commitment to continuous improvement, empowering users to navigate resources seamlessly and excel academically. AL-D states, "By continually refining and enhancing library websites, we empower users to navigate resources seamlessly, interact with content proficiently, and excel in their academic pursuits" (CSB, Q2, AL-D).

4.1.2 Dedication to Continuous Improvement, Skills in Using Web-Based Tools and Continuous Professional Development

The informants acknowledge that they leverage data visualisation to enhance students' understanding by presenting complex data in visually engaging formats. AL-C emphasises this process, stating, "The process of visualising complex data bolsters learners' comprehension and fosters a deeper appreciation of the subject matter" (CSB, Q2, AL-C).

Effective data communication plays a crucial role in empowering both educators and learners. AL-B asserts,

"Presenting data insights in a clear, comprehensible manner serves as a linchpin in converting raw data into valuable knowledge. This approach empowers both educators and learners, enabling informed decision-making and driving progress within the e-learning environment" (CSA, Q2, AL-B).

ALs demonstrate their dedication to continuous improvement and professional development. They constantly update their skills in using web-based tools to enhance e-learning processes and promote productivity. As stated by AL-D, "We are steadfast in our pursuit of continuous improvement, constantly updating our skills in using web-based tools to enhance e-learning processes and promote productivity" (CSB, Q2, AL-D).

Furthermore, ALs' deep understanding of big data, data-driven decision-making, and data security plays a vital role in shaping instructional design, optimising resource allocation, and ensuring the privacy and security of user information. AL-A affirms, "Through diligent analysis, we can reveal insights that inform instructional design, tailor learning experiences, and optimise resource allocation" (CSB, Q2, AL-A). AL-E adds, "Analysis of data trends, user behaviour, and learning outcomes assists in the formulation of strategic plans, elevates the e-learning experience, and optimises resource usage" (CSB, Q2, AL-E).

4.1.3 Interdepartmental Collaboration, Innovation and Partnerships

Insights from the cases highlight the profound impact of collaboration among ALs on productivity and creative thinking within library functions. Collaborative efforts mitigate redundancy, streamline processes, generate new ideas and expand the reach and relevance of library institutions. Consolidating cataloguing and acquisition divisions proved productive, fostering creativity among ALs. AL-A emphasises the strength that arises from difficult situations, stating, "We challenge each other to come up with even better ideas and solutions" (CSA, Q3, AL-A). In addition, AL-C emphasises the need for effective communication and collaboration as essential for organisational success and heightened productivity.

AL-E of Case B shared their experience of ALs collaborating through activities such as exchanging cataloguing records, building complementary collections, and utilising interlibrary loan and document delivery services. This collaborative approach enhances the availability and cost efficiency of resources while effectively supporting the teaching, learning, and research needs of the academic community. ALs go beyond their traditional role of information provision and demonstrate their competency in collaboration, leveraging networking opportunities to foster global knowledge growth. A notable example of successful collaboration is the Union Catalogue of Malaysia (KIK), which involves 128 libraries and facilitates interlibrary loan transactions. With its web-based database containing 5,688,235 bibliographic records, KIK optimises the utilisation of resources in the e-learning environment. The effective collaboration among ALs contributes to efficient, cost-effective, and innovative library operations in support of e-learning.

Based on the findings, we present Figure 1, which portrays the transformative nature of a paradigm shift towards user-centricity, underscoring the pivotal role played by ALs as DSs in revolutionising e-learning contributions. Through their expertise in harnessing data-driven insights, these librarians enhance the user experience and drive innovation within the realm of e-learning, leaving a lasting impact on the field.

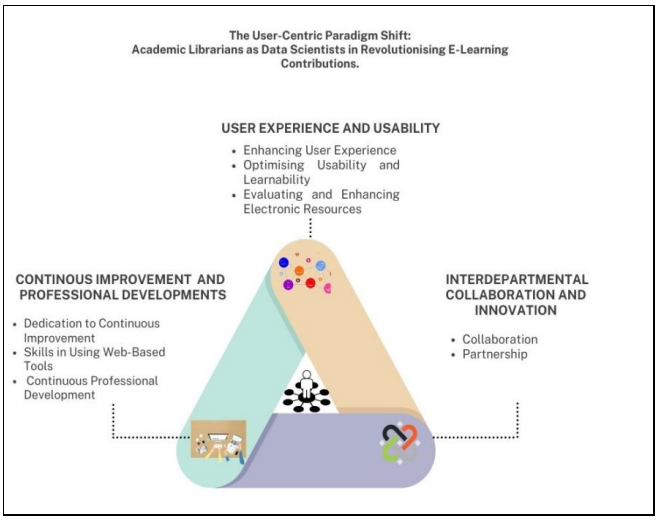

Figure 1: The User-Centric Paradigm Shift: The Vital Role of ALs as DSs in Revolutionising E-Learning Contributions.

4.2 Challenges

4.2.1 Performance Evaluations and Job Expectations

ALs often feel excluded from accountability and assessment conversations, hindering their ability to demonstrate their value in e-learning initiatives. As articulated by AL-B, "We are being omitted from the accountability and assessment conversation, which sometimes fails to recognize what they are not being asked to do" (CSA, Q1, AL-B). Furthermore, ALs face increasing job demands, particularly in relation to RU granted. This includes the need to align with the RU parameter measuring innovation within the cluster of information services or engagement in knowledge-intensive activities. These increasing job expectations have led ALs to bring work home, resulting in a work-life imbalance. AL-C highlights the challenges of multiple competing projects, the unpaid work brought home, and the increased pressure faced by ALs.

4.2.2 Data Science Proficiency Gap and Copyright Literacy Deficit

The informants admit to a lack of a solid foundation in data science, which hinders their effectiveness in utilising data-driven approaches for e-learning. As AL-E emphasises, "Data Science courses organised by MOSTI require submitting assignments within designated timelines. While attendance is not mandatory, ALs who have completed the courses now have a solid grounding in the subject and exhibit exceptional performance in assigned tasks" (CSB, Q1, AL-E). Moreover, AL-D highlights the complexity of copyright issues in academic libraries, where librarians must navigate the role of "information police" while facilitating access to information. AL-D states, "ALs find themselves caught between the demands of copyright law and the expectations of users, publishers, and creators. It is crucial for librarians to stay vigilant, constantly learning and adapting to the ever-changing legalities of copyright law" (CSB, Q1, AL-D). For instance, the ambiguity surrounding the digitization of only 24 pages in the information repository system exemplifies the need for careful copyright management.

4.2.3 Insufficient Motivation and Assistance for e-Learning Innovation

In terms of motivating and supporting e-learning innovation, ALs face obstacles. Existing reward systems are ineffective at motivating employees, which inhibits innovation. AL-B identifies the problem, stating, "Staff are rewarded under the Service Excellence Award based on rotation rather than their innovative accomplishments, which is unfair and biased" (CSA, Q1, AL-B). This inhibits their willingness to share ideas and to promote innovation. Moreover, leadership does not provide the necessary support and guidance to ALs. AL-C emphasises the significance of a supportive environment and clear incentives for innovation, stating, "Leadership encouragement and management support are vital to foster a culture of innovation and provide the necessary resources for e-learning innovation" (CSA, Q1, AL-C).

4.2.4 Pressure on Accreditation and Responsibilities

ALs face the additional challenge of meeting accreditation requirements in the context of e-learning and data science. AL-D highlights the current situation, stating, "For the time being, if you want to add your accreditation, it's under TS (Technology Specialist), a recognition issued by the Malaysia Board of Technologists (MBOT), which is the professional body that gives professional recognition to technologists and technicians in related technology and science. But librarianship is a unique field, and we are not really sure which area we fall under as the fields listed in MBOT are limited. In the context of DS, there should be a special stream for librarians, either recognised by MBOT or Persatuan Pustakawan Malaysia (the Malaysian Librarian Association). We are performing the tasks of a DS, but no official recognition is given to us for this duty" (CSA, Q2, AL-D).

ALs must also balance multiple responsibilities, such as research, technology adoption, and meeting accreditation requirements. This is made more complicated by the lack of recognition within the librarian profession for their roles as DSs. "Institutions and professional associations should provide appropriate recognition and support to ALs performing data science duties, aligning their accreditation requirements with the evolving needs of e-learning and data-driven practises" (CSA, Q2, AL-D).

Figure 2 highlights the main challenges faced by ALs in the context of e-learning initiatives, as derived from findings

Figure 2: Challenges Faced by ALs in e-Learning Initiatives

4.3 Recommendations

The findings of this study identified several key recommendations for enhancing the contributions of ALs as DSs in the Malaysian e-learning context. These recommendations, derived from the challenges and unique requirements of the e-learning environment, provide valuable insights into promoting effective data-driven practises.

Competency Development: ALs should develop comprehensive competencies to effectively fulfil their roles in the e-learning environment. This includes acquiring expertise in data visualisation and communication, utilising various visualisation and analytical tools, and having a strong understanding of e-learning systems, instructional design principles, and curriculum development.

*Communication: S*trong communication skills are essential for ALs to convey research findings effectively to stakeholders in the e-learning environment. ALs should prioritise the development of clear and concise presentation skills to facilitate informed decision-making and promote the adoption of best practises.

Big Data Management: ALs should possess a deep understanding of big data concepts and demonstrate proficiency in managing and analysing large datasets. By effectively utilising big data, ALs can contribute to data management processes and enable data-driven decision-making in the e-learning context.

Data Security and Privacy: Ensuring data security and privacy is crucial in the e-learning environment. ALs should stay up-to-date on data security principles, implement appropriate safeguards, and adhere to relevant data protection regulations to protect student data and digital resources.

Continuous Improvement and Professional Development: ALs should embrace a culture of continuous improvement and actively engage in professional development. This commitment allows ALs to stay updated on emerging technologies, methodologies, and trends in e-learning, enabling them to adapt to evolving challenges and contribute effectively to the field.

Future Research: Further research is crucial to enhance the contributions of ALs as DSs in the e-learning environment. Key areas for investigation include:

- Impact of ALs' data-driven practices on student learning outcomes and academic success in e-learning;
- Effectiveness of different data visualization techniques in conveying information to diverse stakeholders in e-learning;
- Role of ALs in promoting data literacy among students and faculty, and its influence on data-driven decision-making and research productivity;
- Efficacy of training and professional development programs for ALs in acquiring data science skills for e-learning;
- Ethical considerations and challenges in data collection, storage, and usage in the e-learning environment; and
- In advancing knowledge in these areas, rigorous methodologies should be employed, such as mixed-method approaches integrating qualitative and quantitative techniques. Longitudinal studies can track the

long-term impact of ALs' interventions on student outcomes and institutional practices. Collaboration among scholars, ALs, and educational institutions is vital to facilitate data access and enhance the utility of findings.

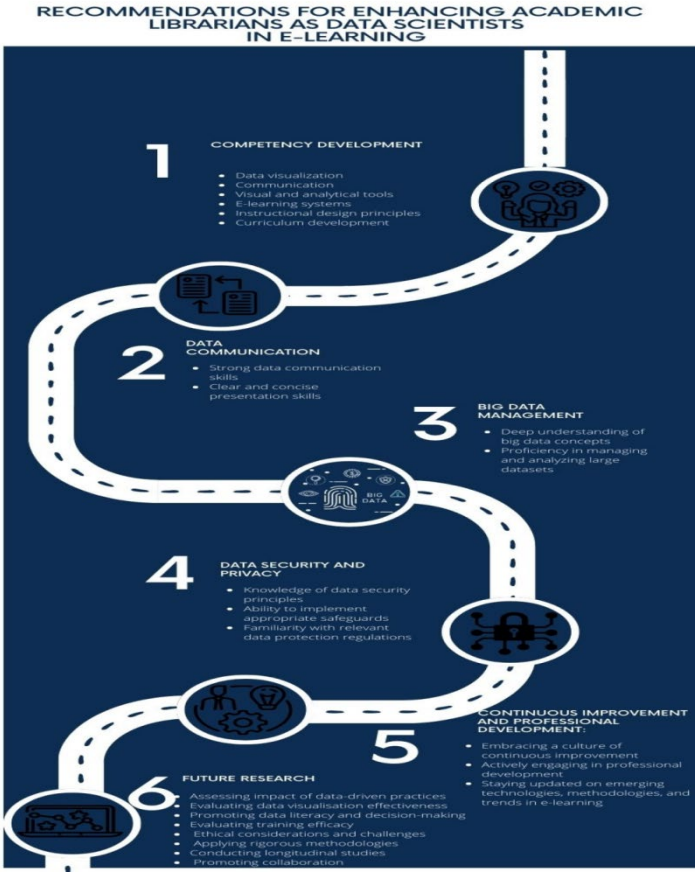

Figure 3: Recommendations for Enhancing ALs' Contributions as DSs in e-Learning

5. Conclusion

The urgent need for adaptable educational platforms amidst the COVID-19 crisis has accelerated the integration of e-learning into Malaysia's educational landscape. ALs, functioning as DSs, play a pivotal role in optimising resource allocation and enhancing e-learning initiatives through data analysis, visualisation, and their contribution of thought-provoking topics that stimulate further academic debates. Their expertise cultivates data literacy, informed decision-making, critical thinking, and intellectual engagement among students and faculty, fostering a culture of data-driven learning and scholarly discourse. ALs, with their comprehensive research and subject knowledge, actively contribute to academic debates by introducing topics that elicit diverse viewpoints, generate thoughtful discussions, and invite scholarly deliberation. This contribution serves to enrich the discourse, expand knowledge boundaries, and foster intellectual growth within the academic community. Positioned to spearhead global advancements in e-learning practises, ALs contribute to Malaysia's aspiration to become an international education hub through extensive research collaborations, continuous innovation, and their active engagement in promoting topics for academic debates. By fostering intellectual exchange and providing platforms for robust discussions, ALs facilitate the development of innovative ideas, foster collaboration, and push the boundaries of knowledge in the field of online education. Recognising the irreplaceable significance of ALs, stakeholders, including educational institutions and policymakers, must wholeheartedly support their involvement in both data analysis and the promotion of topics for academic debates. It is crucial to provide ample resources, professional development opportunities, and platforms for intellectual exchange to further nurture the transformative potential of ALs in fostering academic debates and advancing knowledge in the field. By harnessing the invaluable contributions of ALs in data analysis, active participation in academic debates, and their role as DSs, Malaysia can effectively navigate ongoing challenges and exploit the opportunities presented by data-driven practises in e-learning. Building Malaysia's position as a

leading force in online education requires not only embracing data-driven practises and fostering a culture of innovation but also creating an environment that encourages intellectual discourse and the exploration of topics for further academic debates. Initiatives like the MOSP play a vital role in strengthening the research landscape by offering comprehensive guidelines, capacity-building programmes, and state-of-the-art research data-sharing infrastructure. Embracing data-driven practises, open science principles, and actively promoting topics for academic debates solidifies Malaysia's trailblazing status in online education. To summarise, the successful incorporation of e-learning into Malaysia's educational framework relies on the crucial involvement of ALs functioning as DSs, engaging in data analysis and visualisation, and actively promoting topics for academic debates. Their expertise propels resource optimisation, continuous refinement of e-learning practises, intellectual growth, and the cultivation of critical discussions. Recognising their significance, stakeholders must provide unwavering support and embrace the transformative potential of ALs in both data analysis and fostering academic debates. Through these concerted efforts, coupled with a commitment to innovation, intellectual exchange, and the development of a thriving scholarly discourse culture, Malaysia will ascend to the pinnacle of online education. Initiatives like the Open Science Platform will fortify the research landscape and usher in unprecedented advancements. Malaysia shall rightfully assume its preeminent stance as a formidable force in the realm of online education through these collective undertakings, encompassing the active participation of ALs in data analysis, promoting topics for academic debates, and their resolute role as DSs.

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