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# Proficiency in Digital Extension Service Delivery among Public Agricultural Extension Personnel in Imo State, Nigeria

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**Abstract**

*The study examined digital extension service delivery proficiency among public extension personnel in Imo State, Nigeria. A sample of 105 extension personnel selected from the Imo State ADP using a multistage sampling procedure participated in the study. Data were collected using a validated structured questionnaire. Data were analyzed using mean and percentages. Results showed that the extension personnel was approaching retirement age ($\bar{x}$ = 52.3 years), more males (51.4%), earned an average of about ₦72, 000 monthly and had worked for an average of 25.7 years. It was found that the extension personnel gained digital awareness mainly from local training organized by extension organizations (90.0%). The*

*results revealed that the extension personnel had general digital awareness. It was further found that less than half (44.0%) of the personnel were at the foundation level while 41.0% were at the intermediate level of information, data and media literacy skills, more than half (53.0%) were at the foundation level of digital communication and collaboration skills while 42.0% were at the intermediate level in digital innovation and content creation skills. Also, the majority (81.0%) of the personnel were at the intermediate level in digital safety skills, more than half (53.3%) were at the foundation level in digital problem-solving and about half (51.0%) were at the foundation level in digital learning and development. The study concluded that the extension personnel were proficient at digital extension service delivery. The study recommended that capacity-building programmes should be organized by the extension organization to raise the digital proficiency of the extension personnel.*

## Introduction

The roles of agricultural extension services in rural and agricultural development in Nigeria have been documented. Aremu and Reynolds (2024) reported that agricultural extension services reduced households' food insecurity and increased household assets. Similarly, Camillone and Molnar (2021) found that agricultural extension services increased cassava farmers' exposure to and adoption of cassava production and processing technologies.

Despite the enormous contributions of agricultural extension services in rural and agricultural development in Nigeria, several drawbacks limit its efficiency. Challenges of extension services in Nigeria include inadequate funding, high workloads (extension to farmers ratio, 1:7500), poor motivation and security threats, understaffing, limited subject matter specialists, poor local plan format and lack of innovative approaches (Adeyemi et al., 2023; Camillone et al., 2020; Madukwe & Anungwa, 2020, TASAI, 2020). Others are inadequate transportation and equipment and a low extension-farmer ratio (Abdullahi et al. 2023). The dominance of the traditional supply-driven extension approach in the country has increased these challenges and thus prevented extension services from making significant impacts on food security. According to Aderinoye-Abdulwahab (2023) the traditional extension approaches suffer limited reach to rural farmers due to the use of inefficient communication channels. In addition to service delivery challenges, generating agricultural content tailored towards local conditions and specific needs of individual farmers can be costly. This oftentimes leads to the provision of blanket recommendations across large geographic areas. Cost-related barriers may hinder regular updating among extension staff (Fabregas et al., 2022).

As an innovative approach, the digital extension service has evolved to overcome the challenges of traditional extension systems and enhance the efficiency of extension services. According to Coggins et al (2022) digital extension service is the integration of digital tools in the sharing, accessing or discussion of agricultural information or knowledge by actors in extension service. Examples of digital extension tools include smartphones, digital apps, videos, social media platforms, mobile phones and radio. Digital extension service allows for two-way communication with farmers which can be harnessed to gather information about local conditions, farmers' backgrounds and experiences with inputs. Also, digital extension services can apply economies of scale to generate analytical insights and improve customization. The replication of this knowledge can progressively increase impacts over time (Fabragas et al., 2022). Furthermore, it is relatively cheaper and can overcome funding barriers as well as the low-extension-farmer ratio (Coggins et al., 2022).

The integration of digital tools in extension services will engender digital transformation. Digital transformations affect a firm on multiple levels and in different forms, reshaping traditional business models and strategies which have consequences for social interactions and networking (Philippart, 2022; Sultana et al., 2021, Singh et al., 2021). Solberg et al. (2020) stated that employees must develop a 'digital mindset' for the success of digital transformation. Solberg et al. (2020) further maintained that digital transformation requires a unique set of

skills and competencies including information literacy, information security, automation, cloud computing and agile and effective internal and external communication skills (Shlegel & Kraus, 2021; Simic, et al., 2020).

Developing digital proficiency is therefore crucial for building an organizational climate that supports digital transformation. Digital proficiency can be used interchangeably with digital capabilities (Ferrari, 2023) and it refers to the skills, knowledge, and resources that individuals or organizations possess to effectively utilize digital technologies for various purposes (Deepanie & Kanunaratne, 2023). Digital proficiency has significant positive impacts on change management, information and data literacy and information security management (Slakovic et al., 2023). Studies have investigated the relevance of digital capabilities on the performance of organizations. de Vasconcellos (2021) reported that firms investing in digital capabilities of their workforce achieved superior organizational performance. They maintained that more creative firms that develop digital capabilities could effectively mitigate the negative effects of time. This makes them more dynamic, flexible, resilient and adaptable to the challenges of digital transformation. Wang et al. (2022) found that digital capabilities facilitated co-creation of products among manufacturing firms. Setiawan et al (2022) found that digital capabilities had direct positive impacts on the competitive advantage of accounting firms in Indonesia.

Despite the importance of digital extension services delivery for sustainable agricultural development in Nigeria, the digital proficiencies of public extension workers remained under-studied. Olaolu et al. (2018) found that extension workers in Benue State, Nigeria were barely ready in terms of available resources, accessibility to ICTs, quality of ICTs and adherence to policies and regulations for digital extension services. Public extension personnel in Imo State, Nigeria were reported to be using a variety of digital tools in performing their duties (Nwaiwu & Okeke, 2019). However, their proficiency in using these tools is yet to be empirically examined. This hinders the formulation of evidence-based policies for digitalizing extension services in the state.

Hence, the study examined the proficiency for digital extension service delivery among public extension personnel in Imo State, Nigeria. The specific objectives were to:

- identify the personnel's sources of information on digital capabilities;
- ascertain the general digital awareness of the extension personnel; and
- determine the digital proficiency levels of the personnel.

**Methodology**

The study was carried out in Imo State, Nigeria. The state is located between latitude $5^{o}$ $10^{l}$ N – $6^{o}$ $00^{l}$ N and longitude $6^{o}40^{l}$ E – $7^{o}23^{l}$ E (www.mapcarta.com/imo_state). It has a population of about 5 million people (https://knoema.com/atlas/Nigeria/Imo). Imo State is divided agriculturally into three zones namely Owerri, Okigwe and Orlu which are further subdivided into blocks and circles. Extension services in the state are provided mainly by the Imo State Agricultural Development Programme (ISADP). The state has 191 extension personnel (Aja, 2023). All extension personnel in the Imo State ADP constituted the population for the study. Multistage sampling procedure was used to select the sample. In the first stage, three directors and three deputy directors (extension, communication and women-in-agriculture) were selected at the headquarters. In the second stage, three zonal extension managers (ZEMs), three zonal extension officers (ZEOs) and nine subject matter specialists (SMSs) were selected at the zone. Sixteen block extension officers (BEOs) and sixteen block extension agents (BEAs) were selected at the block level in the third stage. Finally, forty-nine extension agents (EAs) were selected from the cells in the fourth stage. A sample size of 105 extension personnel participated in the study.

Data were collected using a structured questionnaire. The instrument was validated using the face and content validity method. The instrument was given to seven lecturers in the

Department of Agricultural Extension, University of Nigeria Nsukka to study. Items approved by them were taken as valid and included in the instrument. The reliability of the scale measuring digital proficiency was established using the Pearson Moment Correlation Coefficient, r = 0.781. The personnel's sources of information on digital capabilities were identified by providing a list of sources through which information on digital capabilities can be obtained. The general digital awareness of the extension personnel was ascertained by categorizing digital skills into; the use of digital devices, information literacy, communication and collaboration, digital innovation and content creation, digital safety and digital infrastructure skills. Questions relating to each of the skill areas were generated and responses were recorded as correct or incorrect. Correct responses under every skill area with a percentage score ≥ 50.0% implied awareness of that skill by the respondents. Digital proficiency of the personnel was determined on each of the digital skill areas on a 7-point proficiency scale of 7 = can integrate professional practice and contribute to problem-solving, 6 = can contribute to professional practice and cannot contribute to problem-solving, 5 = can guide others with assistance, 4 = understand but not able to guide others, 3 = without guidance, 2 = autonomy with guidance where needed and 1 = with full guidance. The mean of the scale was computed by summing the values assigned to the scale and dividing by the number of points in the scale. A mean of 4.0 was obtained. Using the mean value obtained, the digital proficiency of the personnel was categorized as follows: 1.0 – 2.9 = foundation/basic level, 3.0 – 4.9 = intermediate level, 5.0 – 6.9 = advanced level and $\underline{\geq}$ 7.0 highly specialized level. Data were analyzed using percentages and mean.

**Table 1: Sample of extension personnel**

| Level | No./designation of personnel | No. |
|---|---|---|
| Headquarters | 3 directors, 3 deputy directors, 3 Chief SMS | 9 |
| Zone | 3 ZMs, 3 ZEOs, 9 SMS | 15 |
| Block | 16 BESs, 16 BEAs | 32 |
| Cell | 49 EAs | 49 |
| **Total** | | 105 |

**Source: Field Survey, 2023**

## Results and Discussion

### Channels and sources of information on digital capabilities

Figure 1 indicates that the extension personnel had various sources and channels of information on digital capabilities. The prominent channels were local training (90.0%), local workshops and seminars (72.0%) and computer institutes and training centres (43.3%). The prominent sources of digital capabilities to the extension personnel were friends and relatives (79.0%) and peers and colleagues (79.0%). The effect of different information sources on a worker's digital capabilities is multifarious, influenced by the integration of digital tools, workplace information literacy and collaborative practices (Information Literacy and Digitalization of the Workplace, 2023). Different sources of information available to workers can meaningfully influence their ability to adapt and thrive in a digital environment by improving knowledge length and breadth. For example, training enhances digital capabilities by fostering creativity, and improving organizational performance (Vasconcellos et al., 2021). Similarly, through peer groups, a worker can access support, guidance and motivation to improve their digital capabilities from their peers. Different sources of information enhance digital capability by improving knowledge breadth and depth.

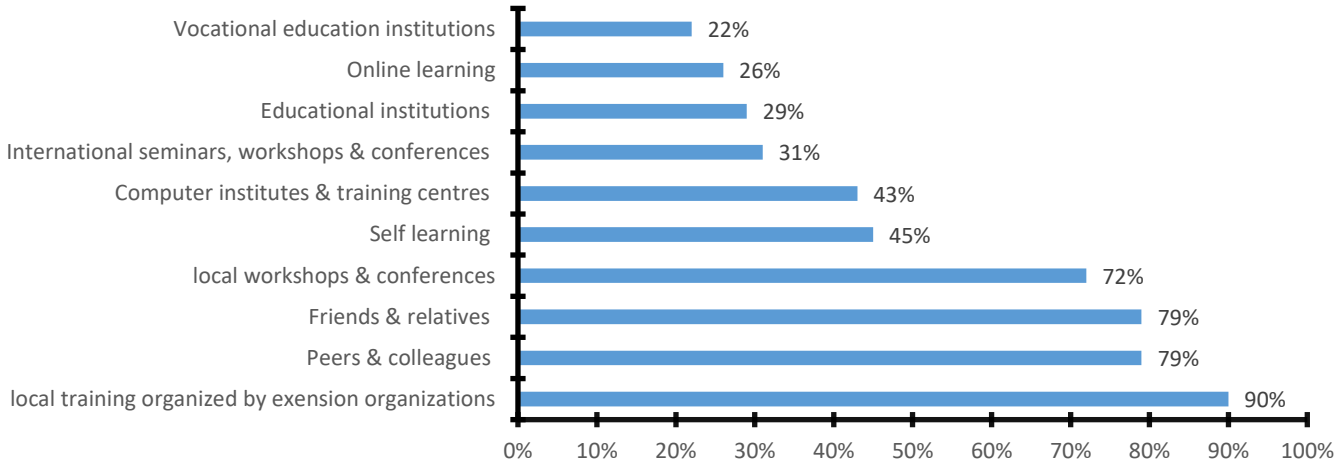


**Figure 1: Extension personnel's sources of information on digital capabilities (Multiple responses)**

## General Digital Awareness

### Awareness of the Use of Digital Devices

Results in Appendix A indicate that the extension personnel were aware of eight out of the ten items used to measure awareness of the use of digital devices. According to the results, the personnel were aware of the use of hard disks and flash drives (86.7%), how to hibernate of sleep a computer (82.9%), how to switch on mobile phones (82.9%), the use of a projector (74.3%) and the use of printer (72.4%). Others are how to shut down a computer (61.0%), how to boot a computer (56.2%) and how to use a smartphone as a modem (53.3%). The awareness of the use of digital devices would enhance the deployment of appropriate digital technologies in extension service delivery.

Under information literacy skills, Appendix A reveals that the extension personnel was aware of the use of the internet (63.8%), database management (58.1%), connecting to the internet (53.3%) and ways of enhancing online search (52.4%). Awareness of information literacy skills helps individuals to interact with information resources, make decisions and adapt to the digital landscape. As regards communication skills, Appendix A shows that the respondents understand the qualities of good digital content (59.0%), knowledge of the tools that make up social media platforms (52.4%), understanding of the strategies for good digital communication (52.4%) and visualization of information in different ways (52.4%). Digital communication skills are crucial for organizational strategies and relationships with the audience. They are also used in modern workplaces for effective task-related communication, enhancing performance and promoting the building of social ties (Sivunen & Laitinen, 2020).

Under digital innovation and content creation skills, the extension workers were aware of how to use short message services (75.2%), how to implement digital transformation (73.3%), how to use different dissemination strategies (67.6%) and knowledge of components of digital contents (56.2%). They were also aware of how to implement digital innovation (55.2%), knowledge of considerations for developing digital content (53.3%) and how to collaborate in digital innovations (52.4%). Digital innovation skills are crucial for firms to harness the advantages of digital transformation (Queiroz et al., 2020). It is also important in digital extension service delivery as it will enhance creativity amongst extension workers.

Under digital safety, Appendix A shows that the extension workers were aware of how to secure short message services (53.3%), how to protect personal information (53.3%), how to back up data regularly (52.4%) and how to secure a connection (51.9%). They were also

aware of how to enable multi-factor authentication (50.8%), software update (50.5%), understanding of privacy settings (50.5%) and being mindful of information shared online (50.1%) Awareness of digital safety is crucial to help users avoid potential risks. Ida (2022) stated that digital safety enables the display of responsible behaviour safeguarding individual and social well-being while in the digital workspace. This will enable users to apply ethical principles and respect for others in the digital space.

On digital infrastructure skills, the results in Appendix A show that the extension personnel were aware of network protocols (71.4%), understand the roles of online services (59.0%) and understand the configuration of operating systems (57.1%). Digital infrastructure covers essential facilities required for the effective operation of digital technologies and services. Thus, the awareness of digital infrastructure would enable the extension workers to understand their uses and put them into appropriate use. Awareness of digital infrastructure would enable extension personnel to interact with multiple stakeholders to coordinate their services and content needs. Constantinides et al. (2018) noted that digital infrastructure promotes creativity and innovation.

### Extension Personnel's Proficiency in Digital Extension Service Delivery

#### Proficiency in information, data and media literacy by the extension personnel

The result in Figure 2 shows that 44.8% of the extension workers were at the foundation level while 41.0% and 14.3% were at the intermediate and advanced levels of information, data and media literacy skills respectively. This result suggests that the workers can only perform basic and simple tasks in this area. By implication, the personnel can only perform tasks that involve remembering contents and instructions but need some guidance to execute them. Such tasks include the ability to search for information online and to save files. Tayia (2022) noted that media and information literacy skills are crucial for navigating information, evaluating media content, and engaging in democratic participation. Being at the foundation level in this skill might reduce the information-seeking and processing abilities of the workers.

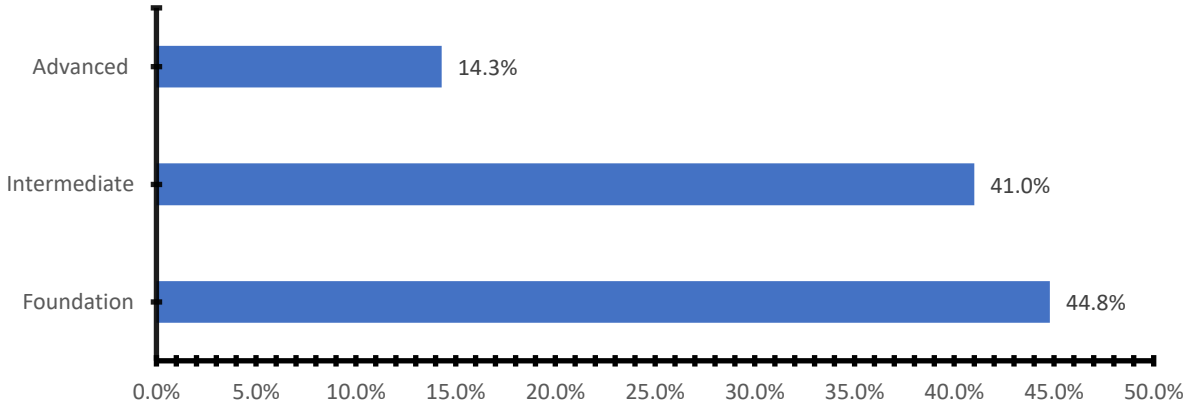


**Figure 2: Proficiency in information, data and media literacy**

#### Proficiency in digital communication and collaboration skills

Figure 2 shows that more than half (53%) of the extension workers were at the foundation level whereas 29.5% and 18.1% were at the intermediate and advanced proficiency levels of digital communication and collaboration respectively. This result suggests that the extension personnel can only perform entry-level tasks related to digital communication and collaboration such as using basic features of communication tools and sharing files. This however implies low proficiency in digital communication and collaboration skills. Low digital communication and collaboration skills could be a drawback to effective information exchange between extension workers and farmers. According to Nyikes (2018), individuals with low

levels of digital communication skills may face difficulties in processing information effectively. In social interactions, it could lead to misunderstandings and communication breakdowns. It could also hinder readiness for professional roles, low participation in information sharing and the spread of unreliable information (Resyadi, 2022, Tirado et al., 2020).

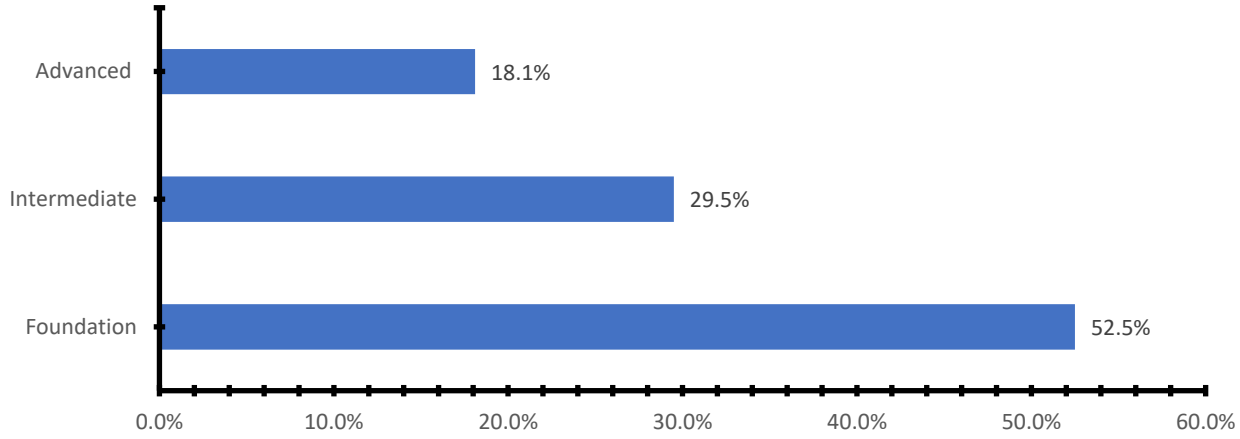


**Figure 2: Proficiency in digital communication and collaboration skills**

**Proficiency in digital innovation and content creation**

Results in Figure 3 show that 42.9% of the extension personnel were at the intermediate proficiency level of digital innovation and content creation skills while 41.0%, 15.2% and 1.0% were at the foundation, advanced and highly advanced levels respectively. This result reveals that extension personnel were moving into the highly advanced proficiency level which is an appreciable improvement over the preceding digital skill areas. This implies that more than half of the extension personnel can perform tasks above the foundation level like producing digital content in different formats, editing and modifying content. This will enable the personnel to develop new solutions to emerging farmers' problems. According to Bashir and Miyamoto (2020), intermediate skills enable people to independently deal with well-defined, routine and non-routine problems that involve understanding the content. According to Organizacion Internacional del Trabajo (2020), intermediate skills enable workers to use digital technologies to create content, work in automated processes and evaluate technologies.

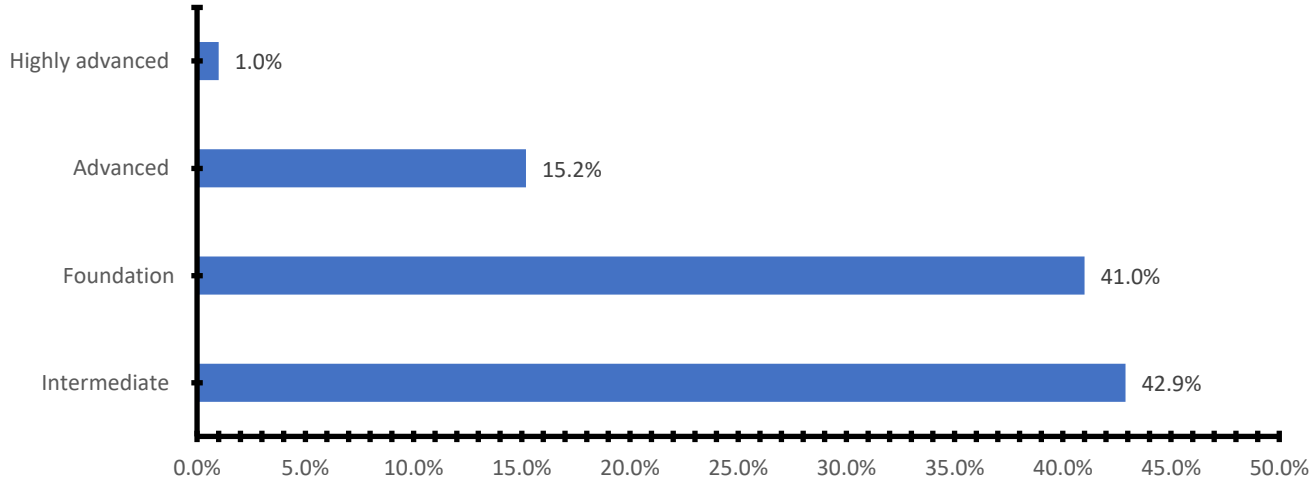


**Figure 3: Proficiency in digital innovation and content creation**

### Proficiency in Digital Safety

Figure 4 reveals that the majority (81.0%) of the extension personnel were at the intermediate proficiency level in digital safety. The remaining 18.1% and 1.0% were at advanced and highly specialized levels. This digital skill recorded the highest proficiency among the extension personnel. The result suggests that many of the extension personnel can perform digital safety-related tasks with a higher level of proficiency. Avoiding harm in the digital environment will improve communication (Protasenko & Mykhailova, 2024). Greater digital skills allow for more coping strategies that protect users against harm. Proficiency in digital safety skills enhances the safe and responsible use of digital technologies (Tomcyzyk, 2023). According to Safe Online (2023), digital safety skills prevent and minimize harm in the online environment by moderating illegal or harmful content, promoting responsible platform design and governance and empowering users to customize their digital experiences.

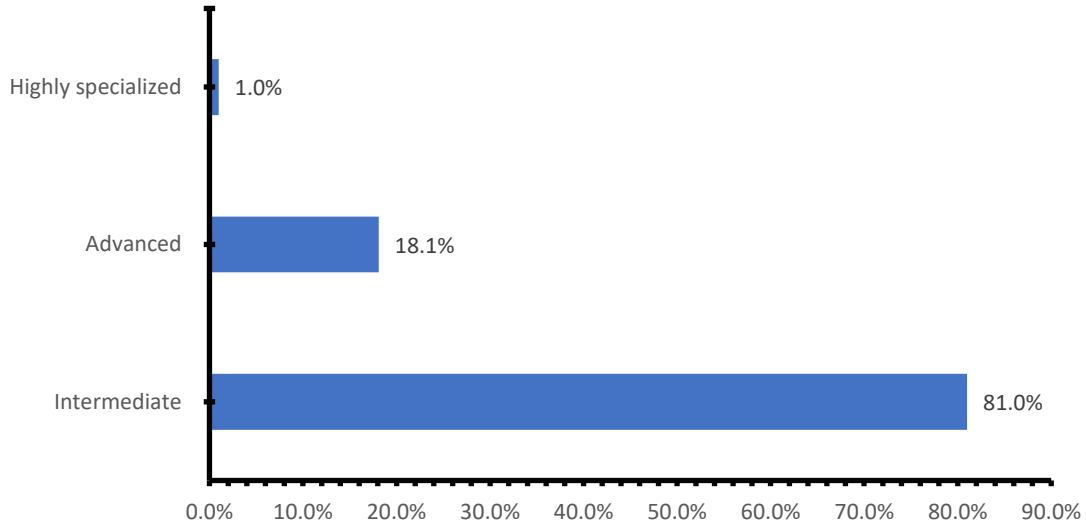


**Figure 4: Proficiency in digital safety**

### Digital Problem-Solving Proficiency

Figure 5 shows that 53.3% of the extension personnel were at the foundation level, whereas 33.3% and 12.4% were at the intermediate and advanced digital levels in problem-solving skills, respectively. However, 1.0% of the workers were highly skilled in digital problem-solving skills. According to the Open University (2024), digital problem-solving skills are essential in the workplace. Hamaainen et al. (2019) stated that problem-solving skills are essential to thrive in a technology-rich environment. Lin (2024) views problem-solving skills as essential competencies that significantly influence employee performance and organizational effectiveness. These skills enable employees to navigate complex challenges, make informed decisions and adapt to rapidly changing environments. Problem-solving skills also enable employees to identify challenges, analyse situations and devise effective solutions which are particularly crucial in dynamic and complex work environments.

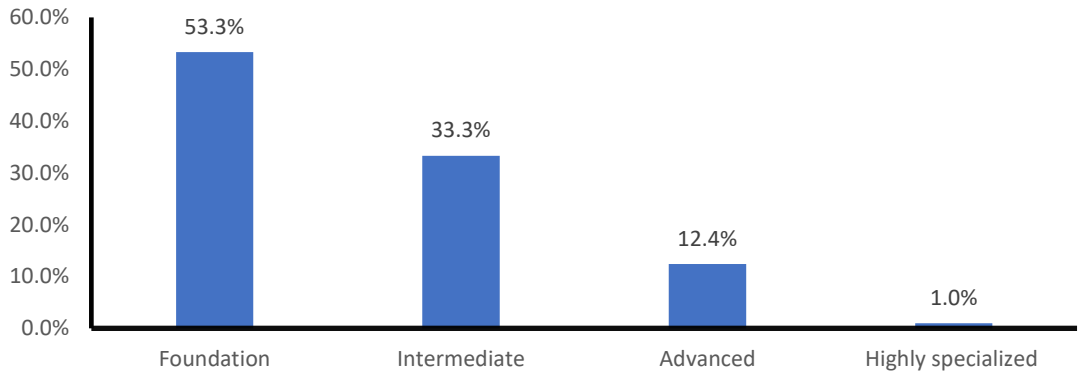


**Figure 5: Proficiency in digital safety skills**

**Proficiency in Digital Learning and Development**

Figure 6 shows that more than half (51.4%) of the extension personnel were at the foundation proficiency level of digital learning and development while 33.3%, 13.3%, and 1.9% were at the intermediate, advanced, and highly specialized proficiency levels respectively. It could be inferred from the result that nearly half of the extension personnel can perform digital learning and development tasks beyond the foundation level. Dijieh et al. (2024) noted that the acquisition of digital learning and development skills helps in the cultivation of soft and self-reliant skills and promotes global competitiveness. Developing employees enables them to become competitive in the workplace. Digital learning and development skills can enable extension personnel to engage in continuous programme development to boost their capabilities. Digital learning enhances collaboration (Langset, 2018) and for the extension organization, this could promote the exchange of ideas and information among actors in the agricultural innovation and knowledge system. Haleem et al. (2022) opined that digital learning and development could encourage co-creation of innovations.

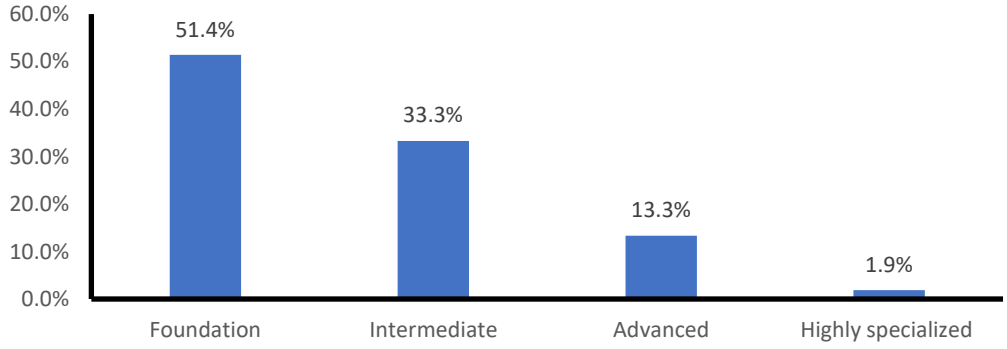


**Figure 6: Proficiency in digital learning and development**

**Conclusion and Recommendations**

Agricultural extension personnel in Imo State ADP had general digital awareness. They gained their awareness through many sources of which local trainings organized by extension organizations were the most used. The extension personnel were proficient at digital extension service delivery. However, their proficiency was mostly at the foundation levels in the various digital skill areas. This could impair the effectiveness of digital extension service delivery in the state. Therefore, routine capacity-building programmes on digital skills should be organized to enhance the digital proficiency of the extension personnel. Also, the aging extension workforce in the state calls for the recruitment of young people into the organization since they are more likely to be tech-savvy.

## References


Abdullahi, S. (2023). Farmers' assessment of extension services delivery in Bauchi State, Nigeria. doi: 10.59331/njaatv3i1.460

Aderinoye-Abdulwahab, S., Adefalu, L., Obafemi, B.O., Ayanda, V.O., Idris, K., Hafiz, A. & Raza, A. (2023). Traditional and modern perspectives in agricultural extension practice in Nigeria. *Journal of Social Sciences Review,* 3(1), 552 – 561. https://doi.org/10.54183/jssr.v3i1.196

Adeyemi, O., Adejoh, V.A., Anjorin, O., Ariyo, O., Makanjuola, B.A., Sablah, M. & Onabolu, A. (2023). Nutrition capacity assessment of agriculture extension services in Nigeria. Food and Nutrition Bulletin. https://doi.org/10.1177/03795721231158417

Aigbogun, O., Fawehinmi, O. & Xing, M. (2024). Deciphering the mediating role of problem-solving skills in predicting employee turnover intention decision. *Asian Development Policy Review*, 12(1), 53 – 69. https://doi.org/10.55493/5008.v12i1.4972

Aremu, A. & Reynolds, T.W. (2024). Welfare benefits associated with access to agricultural extension services in Nigeria. *Food Security*, 16, 295 – 320. https://doi.org/10.1007/s12571-023-01428-7

Bashir, S. Miyamoto, K. (2020). Digital skills: Frameworks and programmes. The World Bank. https://documents1.worldbank.org.org/curated/en/562351611824219616/pdf/Digital-Skills-Framewors-and-Programs.pdf

Camillone, N., Dulker, S.W., Bruns, M.A., Onyibe, J.E. & Omotayo, A. (2020). Context, challenges and prospects for agricultural extension in Nigeria. *Journal of International Agricultural and Extension Education in Nigeria*. https://doi.org/10.5191//jiaee.2020.274144

Coggins, S., McCampbell, M., Sharma, A., Sharma, R., Haefele, S.M., Karki, E., Hetherington, J., Smith, J. & Brown, B. (2022). How have smallholder farmers used digital extension tools? Developer and user voices from sub-Saharan Africa, South Asia and Southeast Asia. *Global Food Security*, 32, 100577. https://doi.org/10.1016/j.gfs.2021.100577

de Vasconcellos, S.L., Freitas Jr., J.C. & Junges, M.F. (2021). Digital capabilities: Bridging the gap between creativity and performance, 411 – 427. https://doi.org/10.1007/978-3-030-42412-1_21

Deepanie, A,M.S. & Kanunaratne, T.P. (2023). Digital capabilities of teachers: A comparative case study. *Journal of Higher Education, Theory and Practice*. https://doi.org/10.33423/jhetp.v23i5.5946

Dijieh, A.E. & Okon, E.E. (2024). Digital learning in prevocational-home economics and business studies and development of self-reliant skills. *Nigerian Journal of Home Economics*, 12(9), 59 – 67. https://doi.org/10.61868/njhe.v12i10.309

Fabregas, R., Harigaya, T., Kremer, M. & Ramrattan, R. (2022). Digital agricultural extension for development. In: T. Mardon, A.J., Gadgil, R. Anderson, L. Casaburi, K. Lee & A Rezaee (Eds.), Introduction to Development in Engineering. Springer, Cham. https://doi.org/10/1007/978-3-030-86065-3-_8

Ferrari, A. (2013). DIGCOMP: A framework for developing and understanding digital competence in Europe. JRC Scientific and Policy Reports. Luxembourg: Publication Office of the European Union.

Haleem, A., Javaid, M., Asim, M., Qadri, M.A. & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operation and Computers*, 3, 275 - 285. https://doi.org/10.1016/j.susoc.2022.05.004

Hamalainen, R., De Wever, B., Nissinen, K. & Cicinnato, S. (2018). What makes the difference – PIAAC as resource for understanding the problem-solving skills of Europe's higher education adults. *Computers & Education*, https://doi.org/10.1016/j.compedu.2018.10.013

Ida, C. (2022). Digital capital and safety in socialization process: An Italian case study. https://doi.org/10.3631

Kayworth, T. & Whitten, D. (2010). Effective information security requires a balance of social and technology factors. MIS Quarterly, Exec, 9, 2012 – 2052

knoema. Retrieved from https://knoema.com/atlas/Nigeria/Imo on 1st July, 2024.

Langset, I. (2018). Digital professional development: Towards a collaborative learning approach for taking higher education into the digitalized age. https://doi.org/10.18261/issn.1981-943x-2018-01-03.

Lin, C.P. (2024). Developing problem-solving efficacy and job performance: Moderation of knowledge –oriented leadership. *International Journal for Education and Vocational Guidance*, https://doi.org/10.1007/s10775-024-09700-8

Madukwe, M.C. & Anungwa, I.Q. (2020). Provisions for agricultural extension services in the implementation manuals of the World Bank Assisted Fadama Development projects in Nigeria: Gaps and lessons. *Journal of Agricultural Extension*, 24(3), 138 – 143. https://doi.org/10.4314/jae.v24i3.12

Nyikes, Z. (2018). Compensation of digital competence deficiency with software ergonomic tools. *Interdisciplinary Description of Complex Systems*, 16(1), 132 – 138. https://doi.org/10.7906/indecs.16.1.0

Olaolu, M.O., Agwu, E.A., Ivande, P.D. & Olaolu, T.A. (2018). E-readiness of public extension personnel for service delivery in Benue State, Nigeria. *Journal of Agricultural Extension*, 22(2), 110 – 124. https://doi.org/10.4314/jae.v22i2.10

Organizacion Internacional del Trabajo. (2020). Digital skills. https://oitcinterfor.org/en/digitalizacion/digital-skills.../

Philippart, M.H. (2022). Success factors to deliver organizational digital transformation: A framework for transformation leadership. *Journal of Global Information Management*, 30(8), 1 -17. Doi:10.4018/JGIM.304068

Protasenko, O. & Mykhailova, E. (2024). Transformation of safety culture in the context of digitalization. *Komyhanbhe MICT*, 1(8), 223 – 228. DOI: 10.33042/2522 – 1809 – 2024-1-182-223-228. https://doi.org/10.33042/2522-1809-2024-1-182-223-228

Queiroz, J., Leitao, P., Pontes, J., Chaves, A., Parra-Dominguez, J. & Perez-Pons, M.E. (2020). A quality innovation strategy for an inter-regional digital innovation hub. *Advances in Distributed Computing and Artificial Intelligence Journal Regular Issue*, 9(4), 31 – 45. https://doi.org/10.14201/ADCAIJ20200943145.

Resyadi, H. (2022). Misunderstanding and offense in the digital world as impacts of community low level of language literacy and communication skills*. Palaka: Media and Islamic Communication*, 3(1), 1 – 12. doi: https://doi.org/10.30863/palaka.v3i1.2709.

Safe Online. (2023). What is digital safety and how do we measure it? https://safeonline.global/what-is-digital-safety-how-do-we-measure-it.../

Setiawan, A., Yenty, Yulana, O.Y. & Devie, D. (2022). IT capability's impact towards competitive advantage through business process agility on Indonesia's accounting firms during pandemic. *Jumal Akuntansi dan Bisnis,* 22(1), 94 – 94. https://doi.org/10.20961/jab.v22i1.768

Shlegel, D. & Kraus, P. (2021). Skills and competencies for digital transformation – A critical analysis in the context of robotic process automation. International Journal of organizational Analysis, in press. https://doi.org/10.1108/IJOA-04-2021-2707

Simic, M., Slavkovic, M. & Ognjanovic, J. (2020). Information literacy competencies in digital age: Evidence of from small and medium-sized enterprise. In: Proceedings of the International Scientific Conference EBM, Contemporary Issues in Economics, Business and Management, Faculty of Economics University of Kragujevac, The Republic of Serbia. 14th December, pp. 105 – 114.

Singh, S., Sharma, M. & Dhir, S. (2021). Modeling the effects of digital transformation in Indian manufacturing industry. Technology in Society, 67, 101763. Doi:10.1016/j.techsoc.2021.101763.

Sivunen, A. & Laitinen, K. (2020). Digital communication environments in workplace. In: L. Mikkola & M. Valo. (Eds.), Workplace communication (pp. 41 - 53). Routledge. https://doi.org/10.4324/978049196881-4

Slakovic, M., Pavlovic, K., Nikolic, T.M., Vucenovic, T. & Burgarcic, M. (2023). Impact of digital capabilities on digital transformation: The mediating role of digital citizenship. Systems, 11, 172. https://doi.org/10.3390/systems.11040172

Solberg, E., Traavik, L.E. & Wong, S.I. (2020). Digital mindsets: Recognizing and leveraging individual beliefs for digital transformation. California Management Review, 62, 105 – 124. https://doi.org/10.1177/0008125620931839

Sultana, S., Akter, S. & Dhir, S. (2021). Modeling the effects of digital transformation in Indian manufacturing industry. *Journal of Global Information Management, 29(3), 165 – 187. Doi: 10.4018/JGIM.2021050107*

Tayia, S.A.R. (2023). Media and information literacy to counter disinformation. Insights into Language, Culture and Communication, 2(2), 83 - 84. http://dx.doi.org/10.21622/ilcc.2022.02.2.083. https://doi.org/10.21622/ilcc.2022.02.2.083

The Action Seed Access Index, TASAI. (2020). Nigeria ratio of Agricultural extension workers to farmers lowest in Africa – Report.

The Open University (2024). OpenLearn. https://open.edu.openlearn/mod/outcontent/view.php?id+105152&section=3.3

Tirado, L.C., Crawford-Visbal, J.L., Ortiz-Zaccaro, Z.Z. & Abalo, F. (2020). Competencias digitales en estudiantes de comunicacion a traves de cuatro universidades latinoamericanas. Education in the Knowledge Society, 21, 201 - 2014 https://doi.org/10.14201/eks.19112

Tomczyk, L. (2023). Skills in the area of digital safety as a key component of digital literacy literacy among teachers. *Education and Information Technologies*, 25(3), 471 – 486. https://doi.org/10.1007/s10639-019-09980-6

Wang, X., Gu, Y., Ahmad, M. & Xue, C. (2022). The impact of digital capability on manufacturing company performance. Sustainability, 14(10), 6214 - 6214. doi: 10.3390/su14106214. https://doi.org/10.3390/su14106214

Wei, S., Xu, D. & Liu, H. (2021). The effects of information technology capability and knowledge base on digital innovation: the moderating role of institutional environments. *European Journal of Innovation Management*, 25(3), 720 – 740. https://doi.org/10.1108/EJIM-08-2020-0324.

## **Appendix** A**: General digital awareness of the extension personnel**

| **Digital skill areas** | **% (n = 105)** |
|---|---|
| **Use of digital devices** | |
| The use of hard disks and flash drives | **86.7*** |
| How to hibernate or sleep a computer | **82.9*** |
| How to switch on a mobile phone | **82.9*** |
| The use of projector | **74.3*** |
| The use of printer | **72.4*** |
| How to shut down a computer | **61.0*** |
| How to boot a computer | **56.2*** |
| How to use a smart phone as a modem | **53.3*** |
| The use of router | 43.8 |
| How to scan a document | 34.3 |
| **Information literacy skills** | |
| Internet use | **63.8*** |
| Database management | **58.1*** |
| Connecting to the internet | **53.3*** |
| Ways of enhancing online search | **52.4*** |
| How to use bookmarking | 45.7 |

| | |
|---|---|
| How to launch a web browser in a device | 39.0 |
| How to select a network in a device | 37.1 |
| How to protect a network from unwanted internet access | 30.5 |
| How to use advanced search operators | 21.0 |
| How to search information in a web browser | 8.6 |
| **Communication skills** | |
| Knowledge of qualities of good digital content | **59.0*** |
| Knowledge of tools that make up social media platforms | **52.4*** |
| Knowledge of the strategies of a good digital communication | **52.4*** |
| Visualization of information in different ways | **52.4*** |
| Things to avoid during online communication | 45.7 |
| How to develop online contents | 39.0 |
| How to communicate using social media platforms | 27.6 |
| Use of various social media platforms | 25.7 |
| **Digital innovation & content creation skills** | |
| How to use short message services | **75.2*** |
| How to implement digital transformation | **73.3*** |
| How to use different dissemination strategies | **67.6*** |
| Knowledge of components of digital content | **56.2*** |
| How to implement digital innovations | **55.2*** |
| Knowledge of considerations for developing digital contents | **53.3*** |
| How to collaborate in digital innovations | **52.4*** |
| Knowledge of features of innovation management process | 49.5 |
| Ability to facilitators of digital innovation | 47.6 |
| **Digital safety skills** | |
| How to secure short message services | **53.3*** |
| How to protect personal information | **53.3*** |
| How to back up data regularly | **52.4*** |
| How to secure a connection | **51.9*** |
| How to enable a multi-factor authentication | **50.8*** |
| Software update | **50.5** |
| Understanding of privacy settings | **50.5** |
| Being mindful of the information shared online | **50.1** |
| Limiting the amount of personal information shared online | 20.0 |
| Requirements for password protection | 19.0 |
| **Digital infrastructure skills** | |
| Understanding network protocols | **71.4*** |
| Understanding of roles of online services | **59.0*** |
| Understanding configuration of operating systems | **57.1*** |
| Understanding of cloud computing | 48.6 |
| Understanding of categorization of digital platforms | 25.7 |
| Understanding of functions of data centres | 21.0 |
| Understanding of features of mobile networks | 14.3 |
| Requirements for data centres | 14.3 |
| Understanding of emerging technologies like artificial intelligence | 8.6 |

**Source: Field Survey, 2023**