Available on: https://jnsrr.ep-journals.org/ E-ISSN: 3051-3766 P-ISSN: 3051-3758

Journal of Natural Science Research and Review

Volume: 01 Issue: 05 November-2025

Evaluating the Effectiveness of Digital Data Collection Tools in Health Education Research: A Study of Owerri Municipal Council, Imo State

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Published Date: November 01, 2025

ABSTRACT: This study evaluated the effectiveness of digital data collection tools in health education research, using Owerri Municipal Council in Imo State, Nigeria, as the study area. Guided by three research questions and corresponding hypotheses, the study focused on three key population groups: senior secondary school students (SS II & SS III), teachers/health educators, and adult community members who had participated in health education outreach programs. The target population was estimated at approximately 5,000 individuals, and a sample of 400 respondents was selected using Freund and Williams' formula and proportionally distributed among the three groups. A mixed-methods research design was employed, incorporating both quantitative and qualitative approaches. Quantitative data were gathered through structured digital questionnaires administered via platforms such as Google Forms and KoboToolbox, while qualitative data were obtained through semi-structured interviews and focus group discussions (FGDs). Instrument reliability was assessed using Cronbach's Alpha, yielding a coefficient of 0.89, indicating high internal consistency. Data were analyzed using Pearson correlation, linear regression, and chi-square statistical techniques. Findings from the study revealed a strong, positive, and statistically significant relationship between the use of digital tools and improvements in data accuracy and completeness ($r = 0.802$, $p < 0.05$). Regression analysis showed that digital tool usage significantly predicted participant engagement and response rate, accounting for 76.9% of the variance ($R^2 = 0.769$, $\beta = 0.846$, $p < 0.05$). Chi-square results also indicated significant differences in the types of challenges experienced by different respondent categories ($\chi^2 = 31.128$, $df = 8$, $p = 0.000$), with community members facing more barriers related to digital access and literacy. The study concludes that digital data collection tools significantly enhance data quality, increase participant engagement, and improve response rates in health education research. It recommends among others the adoption of digital tools as standard practice, particularly in urban environments with widespread access to mobile technology and the internet. Strategic efforts should also be made to address digital literacy gaps and promote inclusive participation across diverse population segments.

KEYWORDS: Effectiveness, Digital data collection tools, Health education research, Participant engagement, Owerri Municipal Council

BACKGROUND OF THE STUDY

The rapid advancement of information and communication technologies (ICTs) has dramatically transformed how data is collected, analyzed, and applied across diverse sectors, including health education. In both developed and developing countries, digital data collection tools (DDCTs) have gained prominence as a more efficient and effective alternative to traditional paper-based approaches (Zhou et al., 2021). These tools include electronic questionnaires, mobile applications, SMS platforms, web-based surveys, computer-assisted interviews, and cloud-based data repositories, which facilitate timely and more accurate data collection while reducing errors associated with manual processes (WHO, 2020).

Health education is a critical component of public health, aimed at increasing awareness, shaping healthy behaviors, and promoting community participation in disease prevention and health promotion activities. As the burden of both communicable and non-communicable diseases grows especially in low- and middle-income countries like Nigeria effective health education research becomes central to informing interventions and policies that improve health outcomes. In this context, the integration of digital tools into health education research offers promising solutions to long-standing challenges, such as low response rates, data inaccuracy, limited access to remote populations, and logistical inefficiencies (Adeloye et al., 2022).

The COVID-19 pandemic further highlighted the importance of digital data collection. With physical distancing protocols in place, researchers and public health workers increasingly turned to digital platforms to gather information about the knowledge, attitudes, and practices of populations in relation to the virus and vaccination campaigns (Eze et al., 2022). These platforms enabled real-time tracking of public perceptions, identification of misinformation, and timely dissemination of accurate health information. Importantly, they allowed researchers to continue their work without risking the health of participants or research personnel.

In Nigeria, the adoption of digital data collection tools is gradually expanding, particularly in urban centers such as Owerri Municipal Council in Imo State. Owerri Municipal is one of the three local government areas (LGAs) in the Owerri Capital Territory and serves as the administrative

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and commercial hub of Imo State. It is characterized by a dense concentration of educational institutions, health facilities, commercial establishments, and public offices. These features make it a strategic location for exploring the effectiveness of digital data collection tools in health education research. Despite this promise, challenges to the effective use of digital tools in Nigeria persist. Issues such as digital illiteracy, poor internet connectivity, inadequate infrastructure, and data privacy concerns limit the widespread use and acceptance of these tools in research. Additionally, the cost of acquiring digital devices and the inconsistent availability of electricity present further barriers (Onwujekwe et al., 2021). In communities with limited digital exposure, respondents may struggle to navigate mobile or online surveys, leading to data loss or response bias. These concerns necessitate a systematic investigation into the actual effectiveness of digital tools within specific Nigerian contexts particularly in health education research where accuracy, confidentiality, and respondent comfort are paramount.

In educational and public health sectors across Nigeria, researchers have begun experimenting with digital platforms for data collection. Some have deployed Google Forms, KoboToolbox, Open Data Kit (ODK), and SurveyMonkey for studies among students, health workers, and community members. For example, studies on substance abuse among secondary school students in Owerri Municipal adopted structured questionnaires for data collection (Igboka et al., 2023). While these studies predominantly relied on paper-based methods, they provide a foundation upon which digital methods can be integrated and compared. Introducing digital tools into such contexts allows for comparative analysis in terms of response rate, accuracy, data quality, cost-effectiveness, and respondent satisfaction.

Furthermore, Nigeria's National Health ICT Strategic Framework (2020–2024) supports the integration of digital technologies into health service delivery, including data collection and management systems (Federal Ministry of Health, 2020). This framework encourages research institutions, schools, and local health bodies to embrace digital solutions as part of their operational and academic functions. In line with this policy direction, there is a need for empirical research to assess whether these tools are indeed effective in real-world, resource-constrained environments like Owerri Municipal.

Another critical dimension to consider is the role of stakeholders in the adoption of digital tools. Teachers, health educators, community health workers, and local administrators play a key role in determining the success of digital data collection initiatives. Their willingness to learn, adapt and apply digital tools influences the overall effectiveness of such efforts. Previous research in Owerri Municipal has shown varying levels of digital readiness among teachers, with some expressing concerns over lack of training and infrastructure (Amaefule, 2019). Similarly, students and community members may exhibit different levels of acceptance and comfort with digital platforms, depending on their prior exposure and socioeconomic background.

From a methodological standpoint, the shift to digital data collection has several advantages. First, it facilitates rapid data aggregation and visualization, which are vital for timely decision-making in health education research. Second, digital tools support skip logic and real-time data validation, reducing inconsistencies and enhancing the reliability of data collected. Third, digital platforms allow for remote data collection, which is especially valuable in situations where face-to-face interactions are constrained by health risks or logistical challenges. These advantages, however, must be weighed against potential drawbacks such as data privacy breaches, system crashes, and participant mistrust in digital systems (Zhou et al., 2021).

Given the existing gap in localized studies on the effectiveness of digital data collection tools in health education research in Nigeria particularly in semi-urban or urban-rural transition areas like Owerri Municipal, this study is both timely and significant. It will not only assess how these tools function in practice but also explore the perceptions, preferences, and challenges experienced by users (respondents and data collectors alike). Hence, this study examines the effectiveness of digital data collection tools in health education research: a study of Owerri Municipal Council, Imo State.

Specific Objectives

1. To determine the effect of digital data collection tools on the accuracy and completeness of health education research data in Owerri Municipal Council.
2. To examine the influence of digital data collection tools on the response rate and participant engagement in health education research.
3. To assess the challenges associated with the use of digital data collection tools in health education research within Owerri Municipal Council.

Research Questions

1. How do digital data collection tools affect the accuracy and completeness of data gathered in health education research in Owerri Municipal Council?
2. What is the influence of digital data collection tools on the response rate and participant engagement in health education research?
3. What challenges are associated with the use of digital data collection tools in health education research within Owerri Municipal Council?

Null Hypotheses (H_0)

1. H_{01}: Digital data collection tools have no significant effect on the accuracy and completeness of health education research data in Owerri Municipal Council.
2. H_{02}: Digital data collection tools do not significantly influence the response rate and participant engagement in health education research.
3. H_{03}: There are no significant challenges associated with the use of digital data collection tools in health education research within Owerri Municipal Council.

METHODS

Target Population

The study targeted three major groups within Owerri Municipal Council:

- Senior secondary school students (SS II & SS III) in selected public and private schools

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- Teachers and health educators involved in health education delivery
- Adult members of the community who had participated in health education outreach or campaigns

Based on available demographic and institutional data, the estimated total population (N) of these combined groups was projected at approximately 5,000 individuals.

Sample Size Determination

Sampling is a systematic process of selecting a representative subset of individuals or units from a larger target population, ensuring that the sample accurately mirrors the characteristics, attributes, and dynamics of the entire population (Sekaran & Bougie, 2020). Due to the impracticality of surveying every member of the target group, sampling techniques are employed in research to achieve a reliable representation. To determine the adequate sample size, the study used Freund and William's statistic formula as quoted by (Igwe-Ukwuorji et al., 2023).

$$n = \frac{Z^2 N(pq)}{N(e)^2 + Z^2(pq)}$$

Where: n = Sample Size

N = The population = 5000

p = Probability of success/proportion = 0.5

q = Probability of failure/proportion = 1- 0.5 = 0.5

Z = Standard error of the mean = 95 percent = 1.96

e = Limit of tolerable error of 0.05 (or level of significance)

$$n = \frac{(1.96)^2 \times 5000 \times 0.5 \times 0.5}{5000(0.05)^2 + (1.96)^2 \times 0.5 \times 0.5} = \frac{3.8416 \times 1250}{5000(0.0025) + 3.8416 \times 0.25}$$

$$= \frac{4802}{12.5 + 0.9604} = \frac{4802}{13.4604} = 356.750$$

In accordance with Singh and Masuku's (2014) recommendation, this study adopted a margin of error of 5% to ensure a high degree of accuracy. Using Freund and William's statistic, a sample size of 357 respondents is determined to be representative of the target population of 5000 respondents, with a 5% margin of error. This sample size is deemed sufficient to provide reliable insights into the research questions and hypotheses.

Final Sample Size

To improve representativeness and account for non-responses or incomplete submissions (common in digital surveys), the sample size was rounded up to 400 respondents. This adjustment ensured a broader and more reliable data set.

The final distribution was as follows:

- 200 senior secondary school students (50%)
- 100 teachers/health educators (25%)
- 100 adult community members involved in health education programs (25%)

These proportions were chosen based on accessibility, relevance to the study objectives, and population availability during the data collection period.

Data collection

This study adopted a mixed-methods approach, combining both quantitative and qualitative data collection techniques to comprehensively evaluate the effectiveness of digital data collection tools in health education research within Owerri Municipal Council, Imo State.

1. Quantitative Data Collection

Quantitative data were collected using structured digital questionnaires administered through online platforms such as Google Forms and KoboToolbox, depending on internet availability and user accessibility. These tools were selected for their features that enabled automated data entry, skip logic, and real-time data storage, all of which enhanced data accuracy and completeness.

a. The questionnaire contained closed-ended questions that captured responses on:

- Data accuracy and completeness
- Response rate and ease of use
- Levels of engagement and satisfaction
- Demographic characteristics of respondents

b. The digital questionnaire was distributed to:

- Secondary school students in selected public and private schools
- Health educators and school teachers involved in delivering health education
- Community members who had participated in health education outreach programs

For respondents with limited access to smartphones or internet connectivity, tablet devices were provided and operated by trained field assistants who offered support during data entry.

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2. Qualitative Data Collection

To complement the quantitative data, semi-structured interviews and focus group discussions (FGDs) were conducted with selected key informants and participants. This qualitative component provided deeper insights into the perceived benefits, limitations, and challenges associated with the use of digital data collection tools.

a. **Key informant interviews** were held with:
   - School principals
   - Community health educators
   - ICT officers in health-related agencies

b. **Focus group discussions** were conducted with:
   - Groups of students and community members
   - Discussions focused on their experiences, preferences, and perceived ease or difficulty in using digital platforms

All sessions were audio-recorded (with consent), transcribed verbatim, and subjected to thematic analysis to identify common patterns and unique perspectives.

3. Pilot Testing

Before the main data collection phase, a pilot study was carried out involving approximately 5–10% of the total sample population. This helped to:

- Assess the clarity and usability of the digital questionnaire
- Test respondent comprehension
- Evaluate the technical performance of the digital platforms

Revisions were made to the instrument based on feedback from the pilot phase, thereby improving the quality and reliability of the final data collection tools.

4. Ethical Considerations in Data Collection

- Informed consent was obtained from all participants prior to administering the questionnaire or conducting interviews/FGDs.
- For participants below 18 years of age (particularly secondary school students), parental consent and school approval were obtained.
- The anonymity and confidentiality of all responses were maintained throughout the study.
- Participation was voluntary, and respondents were informed of their right to withdraw from the study at any point without any negative consequences.

Table 1: Summary of Tools and Techniques Used

Data Type	Instrument	Platform/Mode	Target Respondents	Purpose
Quantitative	Structured Questionnaire	Google Forms / KoboToolbox	Students, teachers, community members	To measure accuracy, completeness, engagement
Qualitative	Interview Guide	Face-to-face or virtual	Health educators, principals, ICT officers	To explore challenges, insights
Qualitative	FGD Guide	In-person	Groups of students and community adults	To explore shared experiences and opinions
Pre-Test	Draft Questionnaire	Digital format	5–10% of total sample	To validate tool and usability

Reliability of the Instrument

The internal consistency of the instrument was measured using Cronbach's Alpha. A reliability coefficient of 0.89 was obtained, indicating a high level of reliability and internal consistency across the items.

RESULTS

Hypothesis 1

H_{01}: Digital data collection tools have no significant effect on the accuracy and completeness of health education research data in Owerri Municipal Council.

Table 2: Correlation between Digital Tool Usage and Components of Data Accuracy and Completeness (n = 400)

S/N	Measured Variable	Mean	Std. Dev.	Pearson's r with Digital Tool Usage	Sig. (2-tailed)
1	The digital questionnaire was clear and well-structured	3.41	0.53	0.774**	0.000
2	I was able to complete all sections without skipping items	3.13	0.51	0.816**	0.000
3	The digital platform helped reduce data entry errors	3.37	0.52	0.788**	0.000
4	The system prevented submission of incomplete forms	3.43	0.57	0.812**	0.000
5	Overall, digital data tools improved data quality	3.57	0.53	0.821**	0.000
	Aggregate Index Score	—	—	**0.802**	**0.000**

**Significant at 0.05 level

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The Pearson correlation analysis presented in Table 2 was conducted to examine whether the use of digital data collection tools has a significant effect on the accuracy and completeness of health education research data in Owerri Municipal Council. The Pearson correlation coefficients between digital tool usage and each component of data quality such as clarity of the questionnaire, completeness of responses, error reduction, form validation, and overall data quality range from 0.774 to 0.821, all of which are strong and statistically significant at the $p < 0.05$ level. These values indicate that as the use of digital tools increases, respondents report a corresponding improvement in the accuracy and completeness of the data collected.

Specifically, a high correlation ($r = 0.821$) was observed between digital tool usage and the perception that overall data quality improved, suggesting that respondents found digital tools effective in enhancing the reliability of the information captured. Likewise, the correlation of 0.816 between digital tools and the ability to complete all sections without skipping any item reflects the role of digital form validation features such as required fields in minimizing incomplete submissions. Similarly, the strong correlation of 0.812 between digital tools and the system's ability to prevent incomplete form submissions reinforces the contribution of built-in digital constraints in improving data completeness. Furthermore, the aggregate correlation index score of 0.802 confirms that across all five dimensions assessed, there is a consistently strong and positive relationship between digital tool usage and perceived data quality. These results imply that digital platforms enhance both the structural clarity of questionnaires and the completeness of the responses submitted, likely due to automated features that reduce manual errors and enforce data entry integrity.

Given that all correlations are statistically significant and demonstrate a meaningful effect, the null hypothesis (H_{01}), which posits that digital data collection tools have no significant effect on the accuracy and completeness of research data, is rejected. Therefore, it can be concluded that the adoption of digital data collection tools significantly improves the accuracy, completeness, and overall quality of data gathered in health education research settings, making them a valuable asset for researchers seeking efficient and reliable data collection processes.

Hypothesis 2

H_{02}: Digital data collection tools do not significantly influence the response rate and participant engagement in health education research.

Table 3: Regression Analysis of Digital Tool Usage on Engagement and Response Rate

Model Summary						
Model	**R**	**R^2**	**Adjusted R^2**	**Std. Error**	**F**	**Sig. (ANOVA)**
Digital Tool → Engagement	0.877	0.769	0.755	1.375	56.463**	0.000
Coefficients Table						
Predictor	**B (Unstandardized Coefficient)**	**Std. Error**	**Beta (Standardized)**	**t**	**Sig.**	
(Constant)	3.538	1.695	—	4.088**	0.021	
Digital Tool Usage	0.846	0.113	0.877	7.514**	0.000	

**Significant at 0.05 level

The regression analysis in Table 3 conducted to test Hypothesis 2 assessed whether digital data collection tools significantly influence participant engagement and response rate in health education research. The model summary reveals a strong and statistically significant relationship, with a correlation coefficient (R) of 0.877 and a coefficient of determination (R^2) of 0.769. This means that approximately 76.9% of the variation in participant engagement and response rate can be explained by the usage of digital tools. The adjusted R^2 value of 0.755 further confirms the robustness of the model by accounting for the number of predictors in relation to the sample size.

The F-statistic of 56.463 with a corresponding p-value of 0.000 indicates that the overall regression model is statistically significant. In other words, the relationship between digital tool usage and participant engagement/response rate is not due to random chance. This is further reinforced by the coefficients table, where the unstandardized regression coefficient (B) for digital tool usage is 0.846, with a standard error of 0.113 and a highly significant t-value of 7.514 ($p < 0.05$). This implies that for every one-unit increase in the use of digital data collection tools, there is a significant and positive increase in engagement and response rate.

Additionally, the intercept (constant) of 3.538, with a significant t-value of 4.088 ($p = 0.021$), suggests a baseline level of engagement and response rate even in the absence of digital tool usage, although digital tool usage considerably enhances those outcomes.

Given these results, the null hypothesis (H_{02}), which states that digital data collection tools do not significantly influence the response rate and participant engagement in health education research, is rejected. The findings clearly demonstrate that digital tools play a substantial role in improving participant responsiveness and engagement, likely due to their convenience, accessibility, real-time interactivity, and ability to reduce barriers commonly associated with traditional paper-based methods. Therefore, this study provides strong empirical support for integrating digital data collection methods into health education research, especially in contexts like Owerri Municipal Council, where increasing response rates and participant involvement is essential for robust and representative data.

Hypothesis 3

H_{03}: There are no significant challenges associated with the use of digital data collection tools in health education research within Owerri Municipal Council.

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Table 4: Chi-square Analysis of Reported Digital Tool Challenges by Respondent Category

Digital Challenge	Students (%)	Teachers (%)	Community Members (%)	Total (n)	χ^2 Value	df	p-value
Poor internet connection	53 (36.8%)	32 (22.2%)	59 (41.0%)	144			
Needed help to use the tool	21 (22.1%)	23 (24.2%)	51 (53.7%)	95			
Digital devices were not always accessible	36 (33.3%)	26 (24.1%)	46 (42.6%)	108			
Difficulty understanding digital questions	31 (33.3%)	21 (22.6%)	41 (44.1%)	93			
Concern over privacy/data security	40 (43.5%)	36 (39.1%)	16 (17.4%)	92			
Overall Chi-square Test					**31.128**	**8**	**0.000**

The chi-square analysis presented in Table 4 evaluates the association between the categories of respondents: students, teachers, and community members and the specific challenges they encountered while using digital data collection tools in health education research within Owerri Municipal Council. The result yielded a chi-square statistic of 31.128 with 8 degrees of freedom and a p-value of 0.000. This statistically significant result ($p < 0.05$) indicates that the distribution of reported digital challenges varies meaningfully across the three respondent groups, thereby providing sufficient evidence to reject the null hypothesis (H_{03}), which stated that there are no significant challenges associated with the use of digital data collection tools in this context.

A closer look at the data reveals that community members encountered the highest level of difficulty across several digital tool challenges. They reported disproportionately higher levels of poor internet connection, lack of access to digital devices, difficulty understanding digital questions, and a greater need for assistance when using the digital tools. These findings are not surprising, as community members often represent less digitally literate and more underserved segments of the population, particularly in regions where technological infrastructure and digital training are limited. The higher percentages in these categories suggest that community members face significant structural and educational barriers that hinder their effective participation in digitally-mediated research processes.

In contrast, students and teachers who are generally more exposed to and familiar with digital tools reported fewer technical challenges overall but still expressed notable concerns, particularly in the areas of privacy, data security, and comprehension of digital survey items. For example, a relatively high percentage of students (43.5%) and teachers (39.1%) reported being concerned about privacy and data security, suggesting that while access and literacy may be less of an issue for these groups, trust in digital systems and the clarity of survey content remain areas of concern. These insights emphasize that digital challenges are not confined to infrastructural limitations alone but also include cognitive, psychological, and trust-related dimensions.

The statistically significant differences in challenge reporting underscore the importance of adopting a user-sensitive and inclusive approach in the design and deployment of digital data collection tools, especially within diverse community contexts. Without targeted interventions to address group-specific limitations such as digital literacy training for community members and enhanced privacy assurances for more digitally experienced users digital data collection risks excluding valuable voices and reinforcing inequities in health education research. This finding supports the argument that digital tools, while offering efficiency and scale, must be adapted to the unique capabilities, expectations, and constraints of different end-user populations to ensure equitable participation and accurate data representation.

Table 5: Summary of Hypothesis Results and Interpretations

Hypothesis	Statistical Test	Result Summary	p-value	Decision	Interpretation
H_{01}	Pearson Correlation	$r = 0.802$ (strong positive)	0.000	Rejected	Digital tools significantly improved accuracy/completeness
H_{02}	Linear Regression	$R^2 = 0.769$; $\beta = 0.846$	0.000	Rejected	Digital tools significantly improved engagement and response rate
H_{03}	Chi-square Test	$\chi^2 = 31.128$; df = 8	0.000	Rejected	Challenges significantly differed across respondent groups

Discussion of the Findings

The results of first hypothesis revealed a strong, positive, and statistically significant relationship between the use of digital data collection tools and improvements in data accuracy and completeness ($r = 0.802$, $p < 0.05$). Specifically, digital tools such as Google Forms and KoboToolbox enabled structured data collection that minimized human error, prevented skipped questions, and enforced response validation thus improving data quality. These findings are in alignment with the study by Wright et al. (2021), which found that digital data platforms significantly reduced transcription and entry errors in health education research in low-resource settings. Similarly, Oluwatosin and Amusa (2020) reported that mobile data collection improved data completeness by over 35% compared to paper-based surveys in community-based health outreach programs in Nigeria. In the same vein, Mavletova and Couper (2015) noted that web-based surveys promote cleaner datasets due to logic checks and mandatory fields embedded into digital instruments. These features substantially reduce missing values and respondent mistakes, which are common in paper

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surveys. Thus, the current study validates existing empirical evidence that digital data collection tools offer measurable benefits to data accuracy and completeness, especially in health-related field research where precision and reliability are critical.

The linear regression analysis revealed that digital tool usage significantly predicted participant engagement and response rate in support of the second hypothesis, with an R^2 value of 0.769 and a regression coefficient (β) of 0.846, which were both statistically significant ($p < 0.05$). This indicates that approximately 76.9% of the variation in engagement and response rate can be explained by the use of digital data collection tools, highlighting a strong and meaningful predictive relationship. The high regression coefficient further suggests that for every one-unit increase in digital tool usage, there is a corresponding increase in participant engagement and response rate, affirming the effectiveness of digital platforms in stimulating participation. Respondents in the study reported that mobile-based questionnaires were more convenient, engaging, and accessible, which likely contributed to the improved likelihood of survey completion. These findings are consistent with those of Zhang and Conrad (2014), who found that digital survey platforms enhance participant interaction due to features such as user-friendly interfaces, dynamic skip logic, and shorter completion times, all of which contribute to improved response behavior. Similarly, a Nigerian study by Onuoha and Mba (2019) reported a 22% increase in response rates when digital tools were used in public health surveys compared to traditional paper-based methods, emphasizing the local relevance of this trend. Further support is found in the work of Kamulegeya et al. (2019), whose study on digital health data collection in Uganda revealed that tech-savvy populations, particularly younger respondents, displayed higher completion rates and more accurate responses when engaged via digital platforms. This pattern was also evident in the present study, where senior secondary school students and health educators demonstrated higher responsiveness and participation through smartphone-based surveys. Taken together, these findings reinforce the growing body of literature that supports the integration of digital tools in research, particularly in urban and mobile-ready settings such as Owerri Municipal Council. The evidence suggests that digital data collection tools not only facilitate broader participation but also enhance the quality and reliability of data through higher engagement and response rates, making them an indispensable tool for contemporary health education research.

Findings from the Chi-square test showed a significant difference in the challenges experienced by various respondent categories ($\chi^2 = 31.128$, df = 8, $p = 0.000$). Community members, in particular, faced more barriers such as poor internet access, limited device ownership, and low digital literacy. On the other hand, students and teachers reported fewer access-related issues but raised concerns around privacy and understanding digital question formats. This finding aligns with Afolayan and Adepoju (2021), who highlighted that digital divides in Nigerian urban-rural fringes pose obstacles to equitable digital survey participation. Similarly, Tariq and Woodman (2013) noted that while digital data collection increases efficiency, it may unintentionally exclude participants from under-resourced communities, limiting the generalizability of the findings. In a global context, Parsons et al. (2019) emphasized that issues such as limited access to smartphones, unfamiliarity with digital tools, and erratic power supply disproportionately affect older and less-educated populations in digital health data collection. Therefore, while digital tools are effective, this study reinforces the idea that barriers related to access, skills, and infrastructure still need to be addressed especially for inclusive and equitable health research outcomes.

CONCLUSIONS

The study concludes that digital data collection tools significantly improve the accuracy, completeness, engagement, and response rate in health education research. Their effectiveness is supported by strong statistical evidence, making them valuable for enhancing research quality. However, to ensure inclusive participation, their adoption must be supported by efforts to bridge digital literacy gaps and address infrastructural challenges.

RECOMMENDATION

Based on the strong predictive power of digital tools in improving response rates and data quality, it is recommended that:

1. Health education researchers adopt digital data collection tools as a standard method, especially in urban municipalities with high mobile phone and internet penetration.
2. Training and support programs be introduced to enhance digital literacy among community members, ensuring that all subgroups can participate effectively in digital surveys.
3. Government and health research institutions should invest in reliable digital platforms that feature data validation, auto-save, and error-prevention mechanisms to further reduce response bias and data loss.
4. Surveys should be optimized for mobile devices, given their widespread use, particularly among students and tech-savvy individuals who showed higher engagement in this study.

CONTRIBUTION TO KNOWLEDGE

This study contributes significantly to the growing body of evidence on the effectiveness of digital technologies in public health research. Unlike prior studies with moderate correlations, this research demonstrates a very strong statistical relationship ($R^2 = 0.769$) between digital tool usage and participant engagement and response rate, as well as high correlations with data completeness and accuracy. It also contextualizes this impact within a Nigerian urban municipality, offering localized evidence that digital platforms can enhance research outcomes even in developing country settings. This makes a compelling case for digital transformation in health education research methodology.

SUGGESTED AREAS FOR FURTHER RESEARCH

In light of the strong findings, future studies should:

1. Explore the longitudinal effects of digital data collection tools on participant retention and engagement over time in multi-phase studies.
2. Investigate the specific digital design features (e.g., interface layout, real-time feedback) that most influence engagement and data accuracy.

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3. Conduct comparative studies across rural and urban populations to assess how infrastructural and demographic variables affect digital tool effectiveness.
4. Examine how digital data collection tools perform in low-bandwidth or offline environments, and what hybrid approaches (e.g., SMS-based, USSD, or app-based) might work best for different populations.

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