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An assessment of website quality at Nigerian polytechnics and colleges of education

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Abstract
This study assessed the quality of the websites of Nigerian polytechnics and colleges of education. Using two web diagnostic tools, SEOptimer and W3C Markup Validation Service, a total of 213 sites were evaluated in terms of six performance indicators: search engine optimisation (SEO), usability, operational performance, social media integration, security, and HTML validation. The weakest performance across the sites of both polytechnics and colleges of education was found to be with respect to social media integration, with the vast majority of sites in both categories making no use of social media. The other two indicators against which sites in both categories of institutions tended to perform poorly were SEO and operational performance. The two areas where the sites in both institutional categories generally scored well were usability and HTML validation. Meanwhile, for the security indicator, the performance was highly variable among both polytechnic and college of education sites, with significant numbers of both strong and weak scores for sites. It was also found that polytechnic sites outperformed college of education sites on SEO to a statistically significant degree (bearing in mind that both categories of sites were weak in this area). It was also found that, among the polytechnic sites, the sites of the state government-owned institutions outperformed, to a statistically significant degree, the sites of the privately owned institutions in their operational performance measure.

Keywords
institutional websites, polytechnics, colleges of education, website quality, Nigeria, search engine optimisation (SEO), usability, operational performance, social media integration, security, HTML validation

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1. Introduction

Websites play a vital role as the image maker of institutions because of their ability to boost institutional reputation and attract the desired audience. This makes it imperative for any educational institution to ensure optimised design and functionality of its website. According to Greenfield (2015), if a tertiary institution's web presence fails, the business operations will likely fail too because a non-optimised website can negatively impact on the school's operations, finance, enrolment, reputation, and credibility. Furthermore, a poorly designed school website can generate legal risks in terms of privacy and copyright issues, and credibility risks with respect to broken links, misspelt words, and outdated content (Greenfield, 2015). Tate (2017) states that visitors will often leave an institution's website if it has weaknesses in its site load time and navigation.

Geron (2018) states that institutional websites give site visitors such as prospective and current students, prospective and current lecturers, researchers, parents, alumni, employers, and companies information about the institution and reflect the institution's style, activities, and reputation. An outstanding tertiary institution website will also attract students and research fellows alike, who will have information about the school right at their fingertips due to a powerful web presence. A number of studies have investigated the website quality of academic institutions in different parts of the world, such as Iran (Andalib & Danaee, 2013), the Czech Republic (Kincl & Strach, 2012), Jordan (Almahamid et al., 2016), Ukraine (Kravchenko et al., 2021), Turkey (Akgül, 2021), India (Kaur et al., 2016), and Nigeria (Olaleye et al., 2018; Pechnikov & Nwohiri, 2012), amongst many others. Despite the fact that it should be the desire of any institution of higher learning to have their website perform optimally, most research efforts on the assessment of academic institutional websites have focused on university websites, leaving other institutions like polytechnics and colleges of education unattended to.

Nigeria's polytechnics and colleges of education are important institutions of tertiary education, and it is essential that their websites are of high quality. It therefore becomes pertinent to investigate the current state of these institutions' websites, in order to provide research-based evidence of their performance. In order to fill this

research gap, the present study focused on assessing the institutional websites of all accredited Nigerian polytechnics and colleges of education based on six performance indicators, namely: (1) search engine optimisation (SEO), (2) usability, (3) operational performance, (4) social media integration, (5) security, and (6) HTML validation. The study also sought to determine if there were correlations between institutional type and ownership type and the performance measures of their institutional websites.

Research questions

- How do Nigerian polytechnic and college of education websites perform in terms of search engine optimisation (SEO)?
- How do Nigerian polytechnic and college of education websites perform in terms of usability?
- How do Nigerian polytechnic and college of education websites perform in terms of operational performance?
- How do Nigerian polytechnic and college of education websites perform in terms of social media integration?
- How do Nigerian polytechnic and college of education websites perform in terms of security?
- How do Nigerian polytechnic and college of education websites perform in terms of their HTML validations?

Research hypotheses

- There are no significant differences in website performance between Nigeria's polytechnics and colleges of education.
- There are no significant differences in website performance among Nigeria's polytechnics based on institutional ownership type (federal, state, and private).
- There are no significant differences in website performance among Nigeria's colleges of education based on institutional ownership type (federal, state, and private).

2. Literature review

Previous empirical studies

Many studies have been conducted to evaluate the quality of websites. Some have adopted the subjective website quality evaluation paradigm, using questionnaires to collect data relevant to research questions, while others have adopted the objective website quality evaluation paradigm, using qualitative models or diagnostic tools.

To evaluate the quality of websites from users' perspectives, a questionnaire research instrument is often used as a data-collection tool to ask users for their opinions on the websites. Jundillah et al. (2019) evaluated e-learning websites based on the results of the Webqual questionnaire and calculations using the importance performance analysis method. The questionnaire was distributed to 95 students in various study

programmes at Stikubank University in Indonesia. The parameters measured were the Webqual 4.0 measures for standard of usability, quality information, and service interaction. The study found that the average student was satisfied with the quality of e-learning websites with which they interacted.

Andalib and Danaee (2013) measured the quality of the website of Payame Noor University in Iran. The study considered the effects on customer loyalty of four quality parameters—efficiency, accessibility, achievement, and security—via two variables: trust and satisfaction. A questionnaire was used as the research instrument, administered to 387 active website users. A website quality parameter that seemed to be a major determinant of website quality was user satisfaction. The authors found that trust, efficiency, and achievement play an essential role in customer loyalty.

Almahamid et al. (2016) studied the website quality of Middle East University in Jordan. They found, through a quantitative study, that perceived usefulness and perceived ease of use are key determinants of behavioural intention in the use of the university website. Kravchenko et al. (2021) used a quantitative, model-based methodology called website QEM (quality evaluation method) to assess the quality of two higher education websites in Ukraine. The authors focused on the following attributes: quality of content, quality of design, ease of use of the site for applicants, and students' reputation. Based on the parameters evaluated, Taras Shevchenko National University of Kyiv was found to be performing significantly better than Kyiv National University of Trade and Economics.

Kincl and Strach (2012) studied user satisfaction with 44 business school websites in the Czech Republic. They reported that user satisfaction is multidimensional: different features of the websites impact differently on the level of user satisfaction with the websites. They also documented evidence that users' inability to complete a task when on a website resulted in a significant negative effect on user satisfaction. Another study that investigated user satisfaction is that of Søruma et al. (2012), which found no positive correlation between website quality and user satisfaction. Elling et al. (2012) developed a website evaluation questionnaire (WEQ) specifically for governmental websites and focused on seven website quality parameters: ease of use, hyperlinks, structure, relevance, comprehension, completeness, and layout.

Furthermore, Akgül (2021) evaluated the accessibility, usability, quality performance, and readability aspects of all Turkish state and private university websites. The results from the study indicated low levels of accessibility, usability, quality performance, and readability. A variety of web diagnostic tools were used in the evaluation process, including, but not limited to, Google Mobile-friendly Test for mobile responsiveness,

Web Page Analyzer for quality performance test, Alexa Traffic Rank for website popularity ranking, CSS Validation Service and HTML Markup Validation Service. Numerous automated evaluations of website quality, using web diagnostic tools, have also been conducted. One of the earliest studies, by Choudrie et al. (2004), evaluated global e-government sites using diagnostic tools, and discovered that significant work was needed in order to make the portals examples of "best practice" e-government services. Shi (2006) found that significant work was needed to improve the quality of World Expo websites in order to provide quality information and services to their users. Jati and Dominic (2009) considered the quality of five Asian e-government websites, using web diagnostic tools that checked for website performance, quality of links, markup validation, and accessibility. Their study revealed that the five e-government websites were not performing optimally.

Suwawi et al. (2015) evaluated the website of Telkom University, Indonesia, using an internationally recognised software evaluation standard, ISO/IEC 9126. Their findings revealed that the three website quality parameters that needed to be improved were reliability, usability, and functionality. Kaur et al. (2016) evaluated the website quality of five Indian university websites using web diagnostic tools to determine their performance, speed, number of requests, load time, page size, SEO, mobile rendering, and security. In an evaluation of 51 Turkish e-government websites using web diagnostic tools, Akgül (2016) discovered that the e-government websites were not meeting the standards as regards response time, download time, page size, number of items, and markup validation.

Perçin (2021) used two decision-making models, namely the fuzzy decision making trial and evaluation laboratory (fuzzy DEMATEL) and the generalized Choquet fuzzy integral (GCFI), to evaluate the website quality of Turkish hospitals. The results of the study showed that hospitals should focus more on reliability, visual content, and assurance issues to improve websites. Dominic et al. (2011) used decision-making models—linear weightage model (LWM), analytical hierarchy process (AHP), fuzzy analytical hierarchy process (FAHP), and new hybrid model (NHM)—to determine the quality of five Asian e-government websites. They reported that the five e-government websites did not fulfil the criteria of a high-quality website. Other studies conducted by Chou and Cheng (2012), Dominic and Khan (2013), Dominic et al. (2013) and Faustina and Balaji (2016) also used decision-making models. Some other studies conducted by Abdel-Basset et al. (2018), Dani and Agrawal (2021), and Gong et al. (2021) have also used decision-making models.

In Nigeria, Olaleye et al. (2018) used web diagnostic tools such as WooRank, CheckMyColors, GTmatrix, Link Polularity, and W3C Markup Validator to perform a comparative analysis on 141 university websites across federal, state, and private universities. The study found that the private Nigerian universities generally had websites of better quality than the federal and state university websites.

The study reported on in this article is unique in the Nigerian context because it not only evaluated the quality of all 213 websites of Nigerian polytechnics and colleges of education, but also compared quality between the two types of institutions and among the three types of institutional ownership.

3. Research design and methodology

The research framework adopted for the study belongs to the objective website quality evaluation paradigm, and used two web diagnostic tools: SEOptimer and W3C's HTML Markup Validator. Advances in technology have provided web diagnostic tools, such as the two used in this study, which can rapidly generate in-depth insights and robust figures on a number of website quality parameters. This allows for a large number of websites—in this case, more than 200—to be rapidly evaluated and analysed.

SEOptimer provides a comprehensive report on a website based on website quality parameters when the website's URL is inputted into the analysis field of SEOptimer. It reviews a website's SEO, usability, operational performance, social presence, security, and technology used in developing the website. These parameters are the broad categories that form the general report for the website's quality and its tendency to be found faster by search engines. Some intricate factors that are reported on are backlinks, broken links, page speed, page size, number of resources, malware check, email privacy, and more.

HTML Markup Validator checks a website's HTML to validate the extent to which the website meets technical web quality. When the URL of a website is inputted into the analysis field, Markup Validator scans through the website's HTML structure for errors and warnings. The number of errors and warnings, and exactly what they are, are posted on the platform. A detailed report is given on each error and warning.

SEOptimer produces grades: A+, A, A–, B+, B, B–, C+, C, C–, D+, D, D– and F. We coded these grades into five categorical weights: Excellent (A+, A, A–), Good (B+, B, B–), Fair (C+, C, C–), Poor (D+, D, D–), or Very Poor (F). Markup Validator reports numeric values based on the number of HTML errors. Again we coded into five categorical weights: Excellent (1–25 errors), Good (26–50 errors), Fair (51–75 errors), Poor (76–100 errors), and Very Poor (more than 100 errors). Then each of the five weights, for the results from both tools, was assigned a numerical weight—5, 4, 3, 2, and 1—for Excellent, Good, Fair, Poor, and Very Poor respectively.

According to Burns and Grove (2009), a research design is a plan that is adopted for conducting a study in a way that there would be an adequate control over such factors that could hinder the credibility of the findings. The present study adopted the content analysis method of research.

The population of the study comprised 213 accredited Nigerian polytechnics and colleges of education. This study adopted a complete enumeration strategy, because the total population was of a manageable size (Glen, 2018). The disaggregation of the population for Nigerian polytechnics is 28 federal, 45 state, and 50 private, for a total of 123. In the case of Nigerian colleges of education, the disaggregation is 21 federal, 44 state, and 25 private, for a total of 90. The entities whose websites were evaluated for this research are approved by the respective regulatory bodies, which are the National Board for Technical Education (NBTE) for polytechnics and the National Commission for Colleges of Education (NCCE) for colleges of education. The study adopted a primary data collection method, with data collected in March 2020 through use of SEOptimer and W3C's Markup Validator.

To collect the necessary data, SEOptimer's URL (https://www.seoptimer.com) was inputted in a Google Chrome browser. The URL for each institution's website was entered in SEOptimer for auditing. The audit button was then selected in order to generate the result of the analysis based on the aforementioned website quality parameters. SEOptimer then returned the website quality of the audited institution on an A+ to F– grade scale, which, as explained above, were assigned categorical weights of 5, 4, 3, 2, or 1. The individual grades of the parameters were aggregated to give the website quality grade of the institution. There was in-depth analysis for each parameter, and intricate factors such as backlinks, broken links, page speed, page size, number of resources, malware check, and email privacy were reported back. A screen capture plugin on the Chrome browser was used to save the results of each website analysis.

The URL of each institution's website was also inputted into the analysis field of the W3C Markup Validator, which scanned through the website's HTML structure for errors and warnings. The number of errors and warnings, and exactly what they were, were posted on the platform. A detailed report was provided on each error and warning. The researchers could then view both the summary report and the detailed report. Screen capture was again used to save the result of each analysis.

The data collected from the web diagnostic tools were coded and analysed using Statistical Package for the Social Sciences (SPSS) version 20.

4. Findings

Search engine optimisation (SEO)

As shown in Table 1, the only two "Excellent" websites, in terms of SEO, were indentified at colleges of education. However, polytechnic websites were more strongly represented in the "Good" and "Fair" categories, and in terms of mode value, the polytechnics performed better ("Fair") than the colleges of education ("Poor"). At the same time, the polytechnic sites had roughly the same percentage (33.3%) of "Poor" ratings as the college of education sites (34.3%), and it was only because of the polytechnic sites' slightly higher percentage (35.5%) of "Fair" sites that the polytechnic sites achieved a mode value of "Fair". One of the 123 polytechnic websites had no SEO ranking reported for it by the SEOptimer. This might have been due to it not having adequate features upon which the tool could assess its SEO state.

Table 1: SEO

		Polytechnics	Colleges of education
	Excellent (%)	0 (0%)	2 (2.2%)
	Good (%)	20 (16.3%)	10 (11.1%)
	Fair (%)	43 (35.0%)	22 (24.4%)
	Poor (%)	41 (33.3%)	31 (34.4%)
	Very Poor (%)	18 (14.6%)	25 (27.8%)
	Unreported ranking (%)	1 (0.8%)	0 (0%)
Mode		Fair	Poor

Usability

As shown in Table 2, the mode value for usability was "Excellent" for both the polytechnic websites and the college of education websites, with the polytechnic sites slightly better represented in the "Excellent" and "Good" categories. At the same time, the percentages of "Very Poor" sites—15.4% of polytechnic sites, 17.8% of college of education sites—were notable. Also, one of the 123 polytechnic websites had no usability ranking reported by the SEOptimer. This was likely due to it not having adequate features upon which the tool could assess its usability state.

Table 2: Usability

		Polytechnics	Colleges of education
	Excellent (%)	84 (68.3%)	58 (64.4%)
	Good (%)	16 (13.0%)	11 (12.2%)
	Fair (%)	3 (2.4%)	4 (4.4%)
	Poor (%)	0 (0%)	1 (1.1%)
	Very Poor (%)	19 (15.4%)	16 (17.8%)
	Unreported ranking (%)	1 (0.8%)	0 (0%)
Mode		Excellent	Excellent

Operational performance

As shown in Table 3, the mode value for the operational performance of polytechnic websites was "Very Poor", while the mode value for the college of education websites was "Fair". The stronger mode value for the college of education sites was driven by their relatively high percentage (18.9%) of "Excellent" ratings, compared to only 9.8% of polytechnic sites. At the same time, the percentage of college of education sites (24%) in the "Very Poor" category was identical to the percentage of "Very Poor" polytechnic sites, showing that nearly one-quarter of sites in each category were in serious need of improvement in terms of their operational performance. Also, one of the 123 polytechnic websites had no operational performance ranking reported by the SEOptimer tool.

Table 3: Operational performance

		Polytechnics	**Colleges of education**
	Excellent (%)	12 (9.8%)	17 (18.9%)
	Good (%)	26 (21.1%)	13 (14. 4%)
	Fair (%)	26 (21.1%)	25 (27.8%)
	Poor (%)	28 (22.8%)	13 (14. 4%)
	Very poor (%)	30 (24.4%)	22 (24.4%)
	Unreported ranking (%)	1 (0.8%)	0 (0%)
Mode		Very Poor	Fair

Social media integration

As shown in Table 4, the sites of the polytechnics and colleges of education both had mode values of "Very Poor" in respect of social media integration, with 92.2% of college sites and 86.2% of polytechnic sites receiving a "Very Poor" score. Testing of the social media dimension uncovered the worst website performance in each category.

Table 4: Social media integration

		Polytechnics	**Colleges of education**
	Excellent (%)	1 (0.8%)	1 (1.1%)
	Good (%)	0 (0%)	0 (0.0%)
	Fair (%)	5 (4.1%)	1 (1.1%)
	Poor (%)	9 (7.3%)	4 (4. 4%)
	Very Poor (%)	106 (86.2%)	83 (92.2%)
	Unreported ranking (%)	2 (1.6%)	1 (1.1%)
Mode		Very Poor	Very Poor

The extremely large number of websites found to be "Very Poor" in their social media integration all tended to lack the use of one or more of Facebook, Twitter, Instagram,

YouTube, and LinkedIn. Thus, the vast majority of Nigerian polytechnics and colleges of education were not, at the time of the research, harnessing the opportunities afforded by integration of social media into their websites, that is, opportunities to drive traffic to their websites, to build their brands, and to attract potential future students. Two of the 123 polytechnic websites and one of the 90 college of education websites had no value reported for their social media integration.

Security

As shown in Table 5, only 35% of polytechnic websites and 28.9% of college of education websites were found to have "Excellent" security. While the mode value for both categories of institution was "Excellent", the majority of sites in both categories had scores of "Fair" or worse, and there were a large number of sites with "Poor" and "Very Poor" scores. Roughly one-quarter of sites in each category were found to have "Poor" security, and roughly one-fifth of sites in each category had "Very Poor" security.

Table 5: Security

		Polytechnics	Colleges of education
	Excellent (%)	43 (35%)	26 (28.9%)
	Good (%)	0 (0.0%)	0 (0.0%)
	Fair (%)	23 (18.7%)	21 (23.3%)
	Poor (%)	30 (24.4%)	23 (25.6%)
	Very Poor (%)	27 (22%)	20 (22.2%)
	Unreported ranking (%)	0 (0%)	0 (0%)
Mode		Excellent	Excellent

Websites with excellent security are SSL-enabled, integrate HTTPS redirection of their pages, are flagged as safe by popular malware scanners, and ensure that no email addresses are found in plain text on webpages. The results suggest that insufficient number of Nigerian polytechnics and colleges of education are showing the necessary level of seriousness in their efforts to ensure the security of their websites.

HTML validation

As shown in Table 6, large percentages of the websites of both polytechnics (66.7%) and colleges of education (72.2%) were found to be "Excellent" in their HTML validation, meaning that they had between 1 and 25 HTML errors. Accordingly, the mode value for HTML validation was "Excellent" for the sites of both types of institution. The fewer the HTML errors, the better the chances of these websites having good indexing on search engines. Two of the 123 three polytechnic websites and one of the 90 college of education websites had no HTML validation ranking reports.

Table 6: HTML validation

		Polytechnics	Colleges of education
	Excellent (%)	82 (66.7%)	65 (72.2%)
	Good (%)	21 (17.1%)	13 (14.4%)
	Fair (%)	6 (4.9%)	4 (4.4%)
	Poor (%)	4 (3.3%)	2 (2.2%)
	Very Poor (%)	8 (6.5%)	5 (5.6%)
	Unreported (%)	2 (1.6%)	1 (1.1%)
Mode		Excellent	Excellent

Polytechnic websites versus colleges of education websites

As seen in Table 7, which provides the results from a non-parametric Mann-Whitney U test, there were no significant differences in the usability, operational performance, social media integration, security, or HTML validation measures between the websites of the polytechnics and those of the colleges of education. There was, however, a statistically significant difference in SEO performance between the polytechnic websites and those of the colleges of education ($U = 4553.5$, $P = 0.027$). The mean rank of polytechnic websites was higher than that of college of education websites, meaning that, overall, the polytechnic websites outperformed the college of education websites, on SEO performance, to a statistically significant degree.

Table 7: Mann-Whitney U test results

Performance parameter	Type of institution	N	Mean rank	Sum of ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
SEO	Polytechnic	122	114.18	13929.5	4553.5	8648.5	–2.211	0.027
	College of education	90	96.09	8648.5				
	Total	212						
Usability	Polytechnic	122	108.93	13289	5194	9289	–0.802	0.423
	College of education	90	103.21	9289				
	Total	212						
Operational performance	Polytechnic	122	103.06	12573	5070	12573	–0.973	0.33
	College of education	90	111.17	10005				
	Total	212						

Performance parameter	Type of institution	N	Mean rank	Sum of ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Social media integration	Polytechnic	121	108.02	13071	5079	9084	–1.349	0.177
	College of education	89	102.07	9084				
	Total	210						
Security	Polytechnic	123	108.8	13382.5	5313.5	9408.5	–0.517	0.605
	College of education	90	104.54	9408.5				
	Total	213						
HTML validation	Polytechnic	121	103.46	12518.5	5137.5	12518.5	–0.706	0.48
	College of education	89	108.28	9636.5				
	Total	210						

Polytechnic website performance and institutional ownership (federal, state, and private)

Table 8 shows the results from the Kruskal-Wallis test that was carried out to examine whether there were differences in website performance that correlated with institutional ownership (federal government, state government, and private). As shown in the table, there were no statistically significant differences in the SEO, usability, social media integration, security, and HTML validation measures of Nigeria's polytechnic websites based on their ownership type (federal, state, and private). There was, however, a statistically significant difference (Chi-Square = 6.263, df = 2, P = 0.044) in the operational performance of Nigeria's polytechnic websites based on institutional ownership type (federal, state, and private).

Further testing found that the statistically significant difference in the operational performance lay between sites of the state government-owned and privately owned polytechnics. The mean rank of state government-owned polytechnic websites was higher than that of privately owned polytechnic websites. This shows that state government-owned Nigerian polytechnic websites had, overall, a statistically significant higher operational performance measure than the sites of the privately owned Nigerian polytechnics. There was, however, no statistically significant difference between federal government-owned and state government-owned polytechnic websites, or between federal government-owned and privately owned polytechnic websites.

Table 8: Kruskal-Wallis test results (polytechnic site performance and ownership type)

Performance parameter	Ownership type	N	Mean rank	Chi-Square	df	Asymp. Sig.
SEO	Federal	28	59.54	0.176	2	0.916
	State	45	62.92			
	Private	49	61.32			
	Total	122				
Usability	Federal	28	64.7	1.418	2	0.492
	State	44	57.38			
	Private	50	63.34			
	Total	122				
Operational performance	Federal	28	63.54	6.263	2	0.044
	State	44	70.3			
	Private	50	52.62			
	Total	122				
Social media integration	Federal	28	66.93	3.736	2	0.154
	State	44	57.58			
	Private	49	60.68			
	Total	121				
Security	Federal	28	61.13	0.033	2	0.983
	State	45	61.89			
	Private	50	62.59			
	Total	123				
HTML validation	Federal	28	67	1.592	2	0.451
	State	45	59.43			
	Private	48	58.97			
	Total	121				

College of education website performance and institutional ownership (federal, state, and private)

Table 9 provides the results of a Kruskal-Wallis test looking for correlations between college of education website performance and institutional ownership (federal government, state government, and private). As seen in Table 9, there were no significant differences in any of the six quality measures based on institutional ownership type.

Table 9: Kruskal-Wallis test results (college of education site performance and ownership type)

Performance parameter	Ownership type	N	Mean rank	Chi-Square	df	Asymp. Sig.
SEO	Federal	21	56.31	5.505	2	0.064
	State	44	43.68			
	Private	25	39.62			
	Total	90				
Usability	Federal	21	49.17	0.8	2	0.67
	State	44	43.91			
	Private	25	45.22			
	Total	90				
Operational performance	Federal	21	50.69	1.165	2	0.559
	State	44	44.31			
	Private	25	43.24			
	Total	90				
Social media integration	Federal	20	48.65	2.728	2	0.256
	State	44	43.98			
	Private	25	43.88			
	Total	89				
Security	Federal	21	46.24	0.131	2	0.937
	State	44	44.52			
	Private	25	46.6			
	Total	90				
HTML validation	Federal	21	51.43	3.574	2	0.167
	State	44	41.43			
	Private	24	45.92			
	Total	89				

5. Analysis of findings

The present study investigated six research questions to determine the performances of Nigerian polytechnic and colleges of education websites in six website parameters, pertaining to search engine optimisation, usability, social media integration, operational performance, security, and HTML validation. The study reported different levels of performance across the institutional types and website parameters. As reported in the findings, the majority of polytechnic websites were fair in search engine optimisation, while the majority of college of education websites were poor in search engine optimisation. The implication of this is that most of Nigeria's polytechnic and college of education websites are missing many critical SEO elements that can ensure improved web presence, ranking in search engines, visibility, and discoverability in the internet space (Lemos & Joshi, 2017; MintTwist, 2016).

This finding is in line with that of Mbanaso et al. (2015), who found in 2015 that 88% of Nigeria's polytechnics and 68% of Nigeria's colleges of education that they studied had a basic web presence. This could, therefore, mean that the developers of these institutional websites have not regarded search engine optimisation as an important parameter for attention over the past several years. However, it was at the same time found that most of the institutional websites in Nigeria's polytechnics and colleges of education were excellent in terms of their usability. This shows that these websites were able to render properly on mobile and hand-held devices, and were easily used with mobile viewports, favicons, legible font sizes, and tap target sizing.

This study found that the majority of polytechnic websites had very poor operational performance measures, while the majority of college of education websites had fair operational performance measures. According to Marszałkowski et al. (2014), some of the issues that are associated with websites that have very poor operational performance are slow server response time, large page file size, JavaScript errors, poor optimisation of images, and the use of inline styles, while fair operational performance implies fewer issues such as non-optimisation of images, deprecated HTML tags, and the use of inline styles. It is important that Nigerian educational institutions continuously review these and other operational performance measures. Furthermore, most of the institutional websites in Nigeria's polytechnics and colleges of education were found to be very poor in their social media integration performance measures. This shows that these websites lacked adequate connectivity to large social media networks like Facebook, Twitter, Instagram, YouTube, and LinkedIn. They had also not taken advantage of social media resources like Facebook Pixel and Twitter Cards. This presents opportunities to harness social media platforms in the Nigerian post-school education sector.

A minority of institutional websites in Nigeria's polytechnics and colleges of education were found to be "Excellent" in terms of their security. Websites with excellent security are SSL-enabled, integrate HTTPS redirection of their pages, are flagged

as safe by popular malware scanners, and ensure that no email addresses are found in plain text on webpages. This finding shows that the developers of a minority of the websites regarded security as a very important parameter. This is alarming given the challenge of cyber insecurity that is pervasive in the country (Ubabukoh, 2016).

At the same time, most of the institutional websites in Nigeria's polytechnics and colleges of education were found to be excellent in terms of their HTML validation. The fewer the HTML errors, the better the chances of these websites having good indexing, which improves their rankings on search engines. Markup validation is important for two reasons. First, it helps in cross-browser, cross-platform, and future compatibility. Second, when search engines encounter websites that have markup errors, they can take a variety of possible decisions in response to those errors—with many of these decisions resulting in some keywords not being parsed correctly and parts of the webpage not being indexed (Heng, n.d.).

Three inferential statistical tests were carried out to investigate if institutional types (polytechnic and college of education) or institution ownership types (federal, state, and private) had any significant effect on the website performance measures. The first test revealed that institutional type had no significant effect on the websites' performances in usability, operational performance, social media integration, security, or HTML validation. The search engine optimisation of polytechnic websites was, however, significantly better than that of the college of education websites. Ownership type had no significant effect on each of the six website parameters of colleges of education, while state-owned polytechnic websites performed better than privately owned polytechnic websites only in the operational performance parameter.

These findings show that the performance of the websites was mostly not affected by either the institutional type or the ownership type. This then suggests that the attention of the developers of these institutions' websites and of the stakeholders in these institutions needs to be shifted towards improving their weak points while not relenting on maintaining their strong points in website quality. The comparative approach taken in this present study is in line with some existing studies such as those of Kravchenko et al. (2021) and Akgül (2021), where institutional websites were assessed based on different website parameter types and different institutional ownership types.

6. Conclusions

The most noteworthy findings from this study are, in our analysis, (1) the sites' weak performance with respect to social media integration, SEO, and operational performance; and (2) their highly variable scores on security. It is clear that the vast majority of Nigerian polytechnics and colleges of education were not, at the time of the data collection, taking social media sufficiently seriously—in spite of ample evidence of the great amount of time that Nigerian youth spend on social

media, as noted by Adaugo et al. (2015). The youth must certainly be a core target audience for Nigerian polytechnics and colleges of education. Deficiencies in SEO and operational performance also call into question the seriousness of these higher education institutions about the task of building their brands and attracting new students.

Meanwhile, the highly variable scores on website security must, of course, be cause for concern. While it is laudable that a sizeable number of polytechnic websites (35%) and college of education websites (28.9%) were found to have "Excellent" security, it is unacceptable that the majority of sites in each category scored "Fair" or worse in this crucial performance area—and that about one-quarter of sites in each category were found to have "Poor" security, and roughly one-fifth of sites in each category were found to have "Very Poor" security.

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