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A comparative assessment of the technology attributes and learning outcomes of single-mode and dual-mode ODL university students in Southwest, Nigeria

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Abstract

This study aimed to assess the interplays between three technology attributes (technology affinity, interaction and accessibility) and the learning outcomes of students in both single- and dual-mode ODL universities. The study sought to address an identified research gap in the literature relating to the paucity of empirically- and iteratively-based facts regarding the interplays between technology attributes and learning outcomes amongst single- and dual-mode ODL students. The study deployed the basic descriptive survey design. Five hundred and thirty-four students drawn from six ODL universities located in three States in southwestern Nigeria participated. Data sources included a four-section researcher-designed New Media Environment Survey battery and a 15-item Technology-mediated Scientific Cognitive Abilities Test. Data were analysed using descriptive statistics and t-test. The study revealed no statistically significant differences between single- and dual-mode students in relation to technology affinity ($t(532) = 0.40$, $p = 0.686$, $\alpha = 0.05$), interaction ($t(532) = 1.68$, $p = 0.093$, $\alpha = 0.05$), attitude to learning ($t(532) = 1.76$, $p = 0.079$, $\alpha = 0.05$), and learning performance ($t(532) = 1.58$, $p = 0.114$, $\alpha = 0.05$). However, in relation to accessibility, the results indicated that single- and dual-mode students differed significantly ($t(532) = 1.96$, $p = 0.050$, $\alpha = 0.05$). The study concluded that single- and dual-mode ODL students are homogeneous groups in relation to their learning outcomes, technology affinity and interaction. It was recommended that educational institutions should prioritise the mapping of the factors that mediate the student-content environments. Further research should focus on investigating this study's subject-matter from an iterative rather than a purely quantitative viewpoint.

Keywords: Technology attributes, single-mode, dual-mode, learning outcomes, open and distance learning

The growing adoption of digital technologies for teaching and learning within the educational systems continues to drive a general shift in focus towards innovating education using the diverse opportunities offered by ICT as well as the multiplicity of tools, applications and services offered by existing and emerging digital technologies. Education and learning, in the words of Parusheva et al. (2018, p. 172), "are being increasingly impacted by web technologies, the concepts of Web 2.0 and Web 3.0, including also technologies connected with the social media". The Internet, aside from making the world smaller (Seema et al., 2018) and creating opportunities for m-learning, e-learning, and u-learning (Bozkurt et al., 2017), has equally been attracting the attention of university academics to the notion of distance education in a way that no previous technology has done (UNESCO, 2002). Many institutions are also reevaluating their traditional methods and considering providing pedagogical materials via the Internet (Rout & Patnaik, 2011).

Research has shown that the open and distance learning (ODL) modes are being driven largely by globalisation, the needs of learners and the growing availability of instructional technologies (Adebisi & Olatunji, 2022; Ngaruko, 2014). Quite expectedly, the ODL mode of education and learning have been showing a much more enduring affinity with digital technologies in recent times, thus illuminating that distinct mode of knowledge delivery and acquisition with most governments in the world today providing distance education (Ozgur & Kocak, 2016).

Increasingly, the global tendencies towards the ODL system are also being widely acknowledged (Ikegulu & Oranusi, 2014; Ozgur & Kocak, 2016), leading to rapid changes in the perception of distance learning as low-status (Geduld, 2014). As is the case in other countries, the acceptance of distance learning as a significant channel of accessing higher education is growing in Nigeria (Adebisi & Olatunji, 2022). This is in spite of the fact that the prevailing social, cultural and

economic norms still continue to value education delivered through the existing physical, political and legal infrastructures (Lane, 2016) and there is still in existence the phenomenon that Tait (2018) referred to as "the stereotype of what it means to be at university" (p. 105).

The increasing adoption of digital technologies has also been directing the interests of educational researchers towards the causal effects of the use of digital technologies on students' learning as well as the performance of educational institutions. This is as contemporary learners are becoming highly adept in using smartphones for text messaging and Internet activities just as message boards, social media and a wide variety of other means of online communication continue to enable learners to "keep in touch and discuss course related matters, whilst providing for a sense of community" (Epignosis, 2014, pp. 6-7). It has been observed that, overall, quite a large number of adolescents are using social media multiple times each day in relatively high quantities (Cingel et al, 2014), while the rate of use of smartphones, which are similar to computers, is increasing every day (Kor et al, 2017).

Although the majority of extant research efforts have gone into empirical investigations of the cause-effect of specific technological objects, there is a gradual shift towards empirical and iterative explorations of the cognitive, emotional and behavioural implications of distinct human-technology attributes such as interaction, accessibility, channel affinity, communication competence, interaction involvement, technology affinity, engagements, and so on. A sizeable body of research and publications have addressed issues surrounding cognitive processes and human-technology interactivities, particularly from the vantage point of the impacts of technology attributes on learning outcomes (e.g., Bergdahl et al., 2018; Bet et al., 2014; Hietajarvi et al., 2019; Johari, 2016; Kitmitto et al., 2018; Mansuri, 2014; Rashid & Asghar, 2016) with just a handful of the existing literature addressing the interplays between cognitive processes and human-technology attributes among ODL students (e.g., Osunwusi et al., 2024a; Osunwusi et al., 2024b) as well as the socio-demographics and psychosocial peculiarities of distance learners (Adebisi & Olatunji, 2022), the operational structures (Olatunji & Adebisi, 2021) and assessment practices (Reju & Jita, 2020) in both single- and dual-mode universities. However, a review of the literature has revealed that empirically- and iteratively-based comparative assessments of the interplays between technology attributes and learning outcomes among single- and dual-mode ODL students remain largely sketchy and under-studied.

As increasing technological innovations continue to birth and support innovative ODL delivery modes, it is imperative to direct attention towards an understanding of how the key technology attributes and the cognitive capacities of learners play out among the different ODL modes. This study was, therefore, designed to assess the technology attributes and learning outcomes of single- and dual-mode ODL university students with a focus on the southwest of Nigeria. The study focused on three technology attributes: Technology affinity (a measure of the levels of a media user's physical attachment to particular digital devices); Interaction (a measure of the levels of a media user's affective and cognitive engagement with technological applications and services); and Accessibility (a measure of the ease of access to and frequency of use of technologies). Based on the identification of a characteristic heterogeneity in respect of the terminology for learning outcomes (Kummel et al., 2020), the scope of the study was limited to two strands of learning outcomes: learning performance (targeting the cognitive domain of learning), and attitude to learning (targeting the affective domain of learning).

Purpose of the Study

The purpose of this study was to conduct a comparative assessment of the technology attributes and learning outcomes of single- and dual-mode ODL university students in southwestern Nigeria. The specific objectives were to:

1) Determine whether there are statistically significant differences between single-mode and dual-mode ODL university students in terms of the levels of their technology affinity, accessibility, and interaction.
2) Determine whether there are statistically significant differences between single-mode and dual-mode ODL university students with respect to their attitude to learning and learning performance.

Research Questions

In an attempt to further guide this study, the following specific research questions were addressed:

1) What differences exist between students in single-mode ODL universities and those in dual-mode ODL universities across the variables of technology affinity, accessibility, and interaction?
2) What differences exist between single-mode and dual-mode ODL university students with respect to their attitude to learning and learning performance?

Null Hypotheses

It was postulated that significant differences exist between single- and dual-mode ODL students in terms of their technology attributes and learning outcomes. The following hypotheses were, therefore, tested at a 0.05 level of significance:

HO1: There are no significant differences between single-mode and dual-mode ODL university students across the variables of technology affinity, accessibility, and interaction.

HO2: There are no significant differences between single-mode and dual-mode ODL university students with respect to their attitude to learning and learning performance.

Methodology

Research Design

This study was designed as basic descriptive survey research.

Sample and Sampling Techniques

The sample consisted of 534 students selected from six ODL institutions (Single Mode = 3; Dual-Mode = 3) randomly selected from three States (Lagos, Osun, and Oyo) from the six States in southwestern Nigeria. The purposive random sampling technique was used to select the three states based on the state featuring a full complement of both a single-mode institution and a distance learning centre of a dual-mode conventional university. All the single-mode institutions involved were study centres of the National Open University of Nigeria (NOUN), owned by the Federal Government of Nigeria and licensed by the National Universities Commission (NUC).

The stratified random sampling technique was used to select the ODL institutions with stratification recognising institution type and mode. The number of students randomly selected from the 3 single-mode centres (n = 267) and the number of students selected from the 3 dual-mode centres (n= 267) were the same with selection criteria that were not gender-biased.

The participants were essentially students of the representative ODL institutions who were enrolled in science-oriented courses, including students enrolled in science-oriented education degree or diploma programmes. The sample, though, was not assembled in a manner that reflected bias against students who did not have access to the Internet or subscribed data. The sample also excluded students enrolled in technology- or engineering-oriented courses in an attempt to guard against the introduction of bias.

In terms of the level of study, 20% of the participants were on 100 level, 30% on 200 level, 25% on 300 level, 8% on 400 level, 4% on 500 level, 4% on 600 level, 4% on 700 level and 5% on 800 level. In relation to programme of study, 32% of the students were science education students, 27% Nursing Science, 4% Library and Information Science, 11% Computer Science, 3% Physics, 6% Chemistry, 2% Agricultural Science, 3% Mathematics, 4% Biology, 3% Public Health, 1% Environmental Science and 4% Postgraduate Education students. Ninety-one percent were engaged in Bachelor's Degree, 4% for diploma courses, and 5% were Master's students.

Research Instrument

A researcher-designed new media environment survey (NMES) battery and a Technology-mediated Scientific Cognitive Abilities Test (T-SCAT) were used. The NMES consisted of a Technology Affinity Scale (TAS) for measuring the level of physical association between the learner and specific new media tools and applications, an Interaction Involvement Scale (IIS) for measuring learners' interaction with the new technologies from the perspective of self-reported user-behaviour, an Attitude to Learning Scale (ALS) for the subjective assessment of learning outcomes from the perspective of the affective component of learning based on the learners' self-report, and a Technology Access Questionnaire (TAQ) for measuring the students' levels of accessibility to the tools and applications of the new technologies in the context of learning and in relation to knowledge seeking, knowledge sharing, and knowledge construction.

The T-SCAT was a 15-item cognitive abilities test developed to measure the students' learning performance based on performance on an objective multiple-choice questions (MCQ) aptitude test. The test items, which were graded by apportioning one (1) for each correct response and zero (0) for each incorrect response or unanswered question, measured a student's cognitive abilities in terms of scientific knowledge and understanding acquired in relation to digital technology concepts and the ability to apply those concepts to navigate the learning of science and solving scientific problems. The test was based on four subscales, namely: scientific reasoning and problem solving; numerical ability and image data analysis; identification and comprehension of digital scientific tools/techniques; and comprehension of technology-mediated quantitative relationships).

The TAS and ALS were each a 6-item scale scored using a 5-point Likert-type measurement option graded 5, 4, 3, 2, and 1 respectively. The IIS was an 8-item 5-point Likert-type scale graded 5, 4, 3, 2, and 1 respectively. The TAQ, which measured accessibility, integrated a Yes-No option with Yes and No graded 5 and 1 respectively and a 5-point modified Likert-type response option graded 5, 4, 3, 2, and 1 respectively.

Analyses

The instruments were face-validated and content-validated by four educational foundations experts prior to the pilot tests. The reliabilities of the TAS, IIS and ALS measures were established using Cronbach's Alpha, α, while the TAQ was analysed using the bivariate Pearson Correlation Coefficient based on the test-retest technique.

Given that the items of the T-SCAT test were assumed not to be of equal or nearly equal difficulty, the Kuder-Richardson Formula 20 (KR-20) statistical test, rather than the KR-21, was

used to compute the test's reliability coefficient using the formula:

$$KR-20=\frac{n}{n-1}\left[1-\frac{\sum pq}{SD^2}\right]$$

where: n = Number of test items; p = Proportion of students who responded correctly (also known as p-value or Item Difficulty Index); q = Proportion of students who responded incorrectly; and SD2 = Variance of scores on the test (Square of standard deviation).

The internal consistency reliabilities for the TAS, IIS, ALS, TAQ and T-SCAT measures were computed to be α = 0.79, α = 0.75, α = 0.79, r = 0.95 and KR-20 = 0.75 respectively.

Data collected were organized and analysed using descriptive statistics and t-test conducted using SPSS Version 25. Hypotheses 1 and 2 were tested with the independent samples t-test using a level of significance α = 0.05.

Results

Research Question 1: What differences exist between students in single-mode ODL universities and those in dual-mode universities across the variables of technology affinity, accessibility, and interaction?

To answer this question, descriptive statistics of technology affinity, interaction and accessibility scores were calculated with a view to assessing the relationship between and within the means and the variance of the scores. For the purpose of the analysis, the numerical (continuous) variables (technology affinity, interaction and accessibility) functioned as the dependent variables, while the ODL Mode (with values of '0' and '1') functioned as the independent variable. The descriptive values for the scores are reported in Table 1. A graphical depiction of the variability of the means of the variables in relation to the two modes is presented in Figure 1.

As can be seen in Table 1 and Figure 1, the differences between subjects in single-mode ODL universities and those in dual-mode ODL universities across the variables of technology affinity, interaction and accessibility were very insignificant, suggesting the existence of a negligible or no difference between single- and dual-mode students across the three independent variables. However, the variance of the variables showed levels of variability that were consistent with the existence of varying degrees of relationships between and among the variables.

Table 1: Descriptive Values of Predictor Variables for Single- and Dual-Mode Subjects

Statistic	Technology Affinity		Interaction		Accessibility	
	Single Mode	Dual Mode	Single Mode	Dual Mode	Single Mode	Dual Mode
N	267	267	267	267	267	267
Mean	41.56	41.27	29.20	30.01	47.90	46.85
SD	8.30	7.30	5.84	5.30	6.54	5.73
Median	42.00	41.00	30.00	30.00	49.00	48.00
Variance	68.95	53.30	34.10	28.10	42.78	32.81
Minimum	18.00	24.00	15.00	13.00	29.00	32.00
Maximum	60.00	59.00	41.00	40.00	60.00	60.00
Range	42.00	35.00	26.00	27.00	31.00	28.00
Interquartile Range	12.00	11.00	8.00	7.00	9.00	8.00
Skewness	-0.16	-0.14	-0.179	-0.33	-0.42	-0.35
Kurtosis	0.09	-0.67	-0.590	-0.11	-0.26	-0.23

In an attempt to further assess variability of data, assess normality of data distribution and check for the existence of outliers, further explorations of the descriptive data were conducted with a view to generating box plots and stem-and-leaf plots representative of the data values. The patterns of the stem of the plot relative to the leaf of the plot in each case suggested the normality of the distribution of data. In relation to the box plots, the relative positions of the median with respect to the first and third quartiles and the reaches of the whiskers (minimum and maximum) suggested the existence of differences in data distribution vis-à-vis the two modes of ODL.

Research Question 2: What differences exist between single-mode and dual-mode university students with respect to their attitude to learning and learning performance in ICT concepts?

To answer this question, descriptive statistics of the learning outcomes variables were calculated.

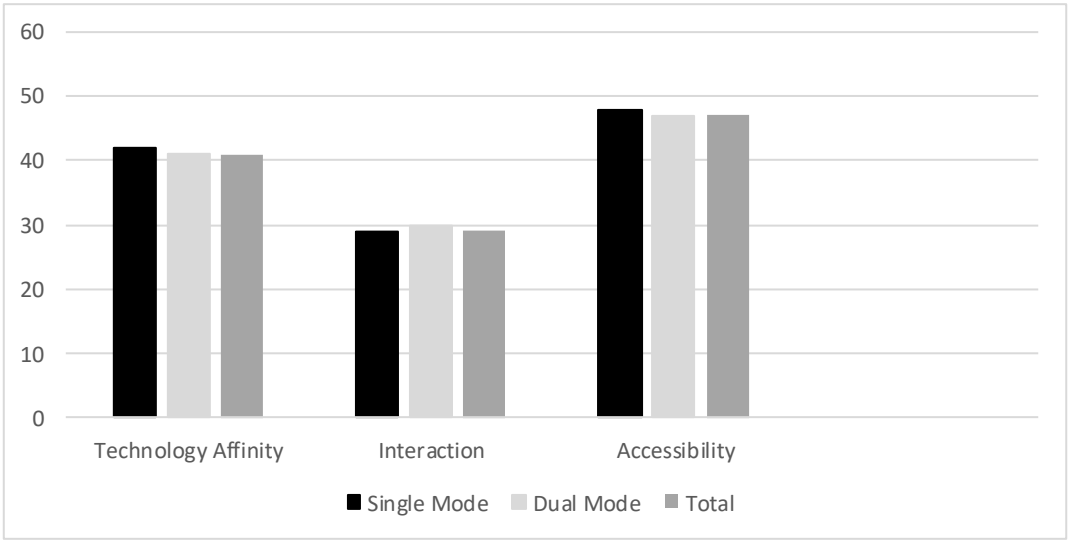

Figure 1: Comparison of the Means of the Predictor

The descriptive values for the scores are reported in Table 2. A graphical depiction of the variability of the mean of the criterion variables about the two modes is presented in Figure 2.

Table 2: Descriptive Values of Learning Outcomes Variables for Single- and Dual-Mode Subjects

	Attitude to Learning		Learning Performance	
Statistic	**Single Mode**	**Dual Mode**	**Single Mode**	**Dual Mode**
N	267	267	267	267
Mean	21.14	21.64	8.90	8.57
SD	3.40	3.23	2.39	2.42
Median	21.00	22.00	9.00	9.00
Variance	11.53	10.46	5.70	5.86
Minimum	15.00	10.00	3.00	3.00
Maximum	30.00	30.00	14.00	14.00
Range	15.00	20.00	11.00	11.00
Interquartile Range	5.00	4.00	4.00	3.00
Skewness	0.34	-0.83	-0.07	-0.32
Kurtosis	-0.39	1.46	-0.39	-0.20

As can be seen in Figure 2 and Table 2, there was no difference between subjects in single-mode ODL universities and those in dual-mode ODL universities in relation to learning performance, while the difference existing in relation to attitude to learning was very insignificant. This is strongly suggestive of the existence of a negligible or no difference between single- and dual-mode students across the two dependent variables However, the variance of the criterion variables showed slight variability that was consistent with the existence of varying degrees of relationships between the variables.

Hypothesis 1: There are no significant differences between single-mode and dual-mode ODL university students across the variables of technology affinity, accessibility, and interaction.

Figure 2: Comparisons of the Means of Criterion Variables

To test this hypothesis, Independent-Samples t-Tests were conducted to test the hypothesis:

H0: μsingle-mode-μdual-mode = 0,

where μsingle-mode and μdual-mode are the population means for single-mode ODL students and dual-mode ODL students respectively on the basis of the assumptions that

the means were normally distributed and that the mean of the distribution was zero.

The statistical analysis represented ODL mode as a dummy variable with single-mode coded 1 and dual-mode 2. A summary of the descriptive values and results of the independent-samples t-tests conducted is reported in Table 3.

The results of the t-tests revealed that single-mode ODL students (M = 41.56, SD = 8.30) and dual-mode ODL students (M = 41.29, SD = 7.30) did not differ significantly (t (532) = 0.40, p = 0.686, α = 0.05) in relation to technology affinity. The results in respect of interaction also revealed that single-mode ODL students (M = 29.20, SD = 5.84) and dual-mode ODL students (M = 30.01, SD = 5.30) did not differ significantly (t (532) = 1.68, p = 0.093, α = 0.05).

Table 3: Descriptive Statistics and Results of t-tests across Technology Attribute Variables

	Single-Mode Students			*Dual-mode Students*					
Variable	**N**	**M**	**SD**	**N**	**M**	**SD**	**t**	**df**	**p**
Technology affinity	267	41.56	8.30	267	41.29	7.30	0.40	532	0.686
Interaction	267	29.20	5.84	267	30.01	5.30	1.68	532	0.093
Accessibility	267	47.90	6.54	267	46.85	5.73	1.96	532	0.050

However, in relation to accessibility, the results indicated that single-mode ODL students (M = 47.90, SD = 6.54) and dual-mode ODL students (M = 46.85, SD = 5.73) differed significantly (t (532) = 1.96, p = 0.050, α = 0.05).

The critical decisions resulting from the analyses conducted to test hypothesis 1 are summarized in Table 4.

Table 4: Decisions on Test of Hypothesis 1

Variables	ODL Modes	Critical Values/Rejection Region	Decisions
Technology affinity	Single Mode Dual Mode	Significance level, α = 0.05; Reject H_0 if p ≤ α	*Accept* H_0 (p > α)
Interaction	Single Mode Dual Mode		*Accept* H_0 (p > α)
Accessibility	Single Mode Dual Mode		*Reject* H_0 (p ≤ α)

Hypothesis 2: There are no significant differences between single-mode and dual-mode ODL university students with respect to their attitude to learning and learning performance.

In order to determine whether there is a statistically significant difference between single-mode and dual-mode ODL students in relation to the two clusters of learning outcomes, an independent-samples t-test was conducted to test the following hypothesis:

H0: μsingle-mode -μdual-mode = 0,

where μsingle-mode and μdual-mode are the population means for the single-mode ODL students and the dual-mode ODL students respectively.

The statistical analysis was premised upon the assumptions that the means were normally distributed and that the mean of the distribution was zero. The analysis also represented ODL mode as a categorical or dummy variable with single-mode coded 1 and dual-mode coded 2.

A summary of the descriptive values and results of the independent-samples t-test conducted is reported in Table 5. The results revealed that there was no statistically significant (t (532) = 1.76, p = 0.079, α = 0.05) difference between single-mode ODL students (M = 21.14, SD = 3.40) and dual-mode ODL students (M = 21.64, SD = 3.23) in relation to their attitude to learning. The results in respect of learning performance also revealed that single-mode ODL students (M = 8.90, SD = 2.39) and dual-mode ODL students (M = 8.57, SD = 2.42) did not differ significantly (t (532) = 1.58, p = 0.114, α = 0.05).

The critical decisions resulting from the statistical analysis conducted to test hypothesis 2 are summarized in Table 6.

Table 5: Descriptive Statistics and Results of t-test on Learning Outcome Variables

	Single-Mode Students			**Dual-Mode Students**					
Variable	**N**	**M**	**SD**	**N**	**M**	**SD**	**t**	**df**	**p**
Attitude to Learning	267	21.14	3.40	267	21.64	3.23	1.76	532	0.079
Learning Performance	267	8.90	2.39	267	8.57	2.42	1.58	532	0.114

Table 6: Decisions on Test of Hypothesis 2

Variables	ODL Modes	Critical Values/Rejection Region	Decisions
Attitude to Learning	Single Mode Dual Mode	Significance level, α = 0.05; Reject H_0 if $p \leq \alpha$	*Accept* H_0 ($p > \alpha$)
Learning Performance	Single Mode Dual Mode		*Accept* H_0 ($p > \alpha$)

Discussion

This study aimed to undertake a comparative assessment of the interplay between three key technology attributes and the learning outcomes of ODL students in both single-mode and dual-mode ODL universities. The present study sought to address an identified research gap in the literature in respect of the paucity of empirical facts emanating from comparative investigations of the interplay between distinct human-technology characteristics and learning amongst single- and dual-mode distance learning students. A key finding is that single-mode and dual-mode ODL learners are not heterogeneous groups in terms of technology affinity and interaction as well as affective and cognitive outcomes, although the findings also suggest heterogeneity when it comes to another key technology attribute – accessibility.

The finding regarding no statistically significant differences between single-mode and dual-mode ODL students in relation to technology affinity, interaction, attitude to learning and learning performance may be suggestive of a level of homogeneity across students in the ODL system of education in terms of mode of delivering learning resources, educational resources and the levels of motivation and enthusiasm in relation to affinity for and interaction with technology. Although the finding in respect of the existence of a level of homogeneity in relation to affective and cognitive outcomes contradicts Ngaruko's (2014) finding regarding the existence of significant differences in desired educational quality output amongst delivery modes, it nevertheless corroborates Adebisi and Olatunji's (2022) finding regarding the existence of striking similarities between single- and dual-mode learners in terms of the positivity of their psychosocial experiences involving the "capacity to negotiate meaning and acquire knowledge…" (p. 77). The authors' finding regarding the existence of a commonality amongst the two modes in terms of self-directedness and interdependence, which are crucial motivators of interaction, may buttress Demir Kaymak and Horzum's (2013) finding that an increase in interaction revolves around an increase in students being able to fulfil their individual learning needs based, according to Vululleh (2018), on the belief that interaction with technology will improve communication with peers and tutors.

The study found statistically significant differences between single- and dual-mode students in terms of accessibility. This finding, which can be attributed to disparities in terms of access to technological and educational resources, might explain Adebisi and Olatunji's (2022) finding that, in terms of basic socio-demographic indices, single-mode learners are largely unconventional learners while their dual-mode counterparts are typically conventional learners. These variations in the degrees of conventionalism suggest adequate access or otherwise to educational resources and technologies, a suggestion that corroborates Itasanmi et al.'s (2020) finding of a statistically significant difference among learners in two dual-mode and one single-mode ODL universities in terms of the availability of educational resources, technical support services and infrastructural facilities. The authors have attributed the relatively higher mean recorded by learners in Ladoke Akintola University of Technology Distance Learning Centre, a dual-mode university, to the fact that the university is a technology-oriented institution that should be able to muster robust educational resources and support for its students. The finding can also be interpreted as suggesting that the degrees of preference for and use of static digital devices (e.g., desktop computers) and dynamic digital devices (e.g., smartphones and tablets) are not the same among the students in single- and dual-mode ODL universities.

Against the backdrop of the results of this study, the author believes that the two typologies of ODL mode could work towards commonalities in terms of quality, operational structures, assessment process and practices, learning environment and so on by adopting research-based approaches to identifying variables that could help entrench process harmonization and integration.

Limitations and Future Research

One challenge to the generalization of the results of the present study is the restriction of the study area to the southwestern region of Nigeria, which may not be representative of the ODL learner population in Nigeria. However, the coverage of the study centres of the National Open University of Nigeria, with tentacles covering Nigeria's six geo-political regions, may provide a basis for the generalizability of the results. The findings should also be treated with caution in the case of ODL universities in other

countries, particularly in countries whose ODL organizational and operational structures are dissimilar from the Nigerian scenarios.

The methodological approach adopted in this study is strictly quantitative. For a research seeking to measure key attributes of individual learners, a mixed approach that integrates qualitative and quantitative approaches might have provided a treasure trove of research evidence from diversified perspectives. Future research could, therefore, adopted a mixed or an iterative approach to resolving the problems informing this research.

Conclusion

This study undertook a comparative assessment of single- and dual-mode ODL university students in the context of the interplays between and within their technology attributes and learning outcomes. The study considered only three technology attributes (interaction, technology affinity, and accessibility) as well as the affective and cognitive dimensions of the students' learning outcomes. The results revealed a striking homogeneity among the students in relation to affective and cognitive capacities as well as the students' levels of technology affinity and student-technology interaction. However, the statistically significant difference in relation to accessibility might suggest that the students were heterogeneous groups as far as technological access, ownership and usage are concerned. This may actually be a pointer to the level of technological interventions adopted by the institutions. Further investigations may be required to uncover other factors responsible for this heterogeneity.

The homogeneity revealed among students in both single- and dual-mode institutions suggests the feasibility of adopting operational commonalities in terms of assessment practices, educational resources, operational structures, programme validation, delivery modes, policy frameworks and the harmonisation of subsisting levels of conventionalism with a view to fostering a much more robust physical interaction between tutors and learners.

Recommendations

Talking from the vantage point of administrative or policy implications, the results of this study demonstrate the necessity of recommending the need for educational administrators, instructional system developers, and institutional policy makers responsible for technology adoption in the ODL systems to focus on the perspectives of students' behavioural intentions, affinity towards technologies and the various dimensions of human-technology interactivities in drawing up enduring and integrated policies and strategies for the sustainable adoption of digital technology for purposeful educational effects. Institutional e-learning desk officers should also prioritise the mapping of the broad variety of factors that mediate the student-content environments, including logistic and attitudinal elements that have the potential of fostering or impeding positive educational effects.

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