

## **ICT Facilities and Students' Awareness of Virtual Assessment Indicators- Moderated Mediation Roles of University Type and Lecturers' Self-Efficacy**

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### **Abstract**

Adoption of Information and Communication Technology (ICT) tools in the teaching and learning process continues to gain popularity with evolving digital tools and platforms in the virtual learning spaces, which provide opportunities for assessing students' learning outcomes. However, the successful adoption of the virtual assessment mode in universities depends largely on students' awareness of assessment indicators. These might be determined by certain factors, including perceived usefulness and ease-of-use, attitude, intention to use ICT facilities, university type, and lecturers' self-efficacy to integrate virtual assessment. This study, therefore, investigated relationships between ICT facilities and students' awareness of virtual assessment indicators, university type and lecturers' self-efficacy to integrate virtual assessment. In addition, it examined the mediating effect of lecturers' self-efficacy on the relationship between ICT facilities and students' awareness of virtual assessment indicators, as well as the moderating role of university type on lecturers' self-efficacy in the relationship between ICT facilities and students' awareness of virtual assessment indicators. Data collected were analysed using the Hayes Process Macro- Model 7- Moderated Mediation. Results showed both direct and indirect impact of ICT facility on students' awareness of virtual assessment indicators through lecturers' self-efficacy and the moderation by university type (moderated mediation index = -0.070, 95% CI = -0.490/0.430) were significant. The study concludes that lecturers' self-efficacy and university category are germane to successful virtual assessment in higher institutions. It is recommended that the National University Commission should provide benchmark on the quantity and quality of ICT facilities in each university based on number of lecturers and students.

*Keywords:* ICT facilities, virtual assessment indicators, moderated mediation roles of university type, lecturers' self-efficacy, students' awareness of virtual assessment

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## Introduction

The COVID-19 pandemic resulted in the closure of tertiary institutions and education programmes across the globe, including Nigeria. This forced a shift from in-school teaching to online teaching using ICT facilities like computer laboratories, multimedia rooms, smart classrooms, e-learning platforms, internet connectivity, Wi-Fi networks, and other infrastructure that facilitate the use of technology in education (Adewale, 2005). This situation increased the use of ICT and lecturers' professional development in ICT (Espino-Díaz et al., 2020; OECD, 2020). While ICT facilities were useful during the closure for teaching and learning, assessment methodologies that involve real examinations were not included in the arrangement because a method of security and proctoring had not evolved. Although tests and quizzes through Google and other methods were implemented, they were not sufficient to conduct semester-based examinations. However, virtual assessment is an emerging technique that has appreciable potential to ameliorate fundamental issues that arose during and after the pandemic period that caught the world unprepared. The phenomenon spurred institutions of higher learning, especially universities, to seek how they could reach out to their students scattered in various geographical locations for continued academic activities (Olasunkanmi, 2020; Ukoh & Adewale, 2014).

Universities promoted flexible learning and enhanced assessment practices through available digital technology tools and virtual platforms (Smith & Brown, 2018). Thus, they were able to embark on evaluating their students' knowledge and skills remotely, but were limited by their inability to proctor. Whichever mode of assessment was available in each university was sufficient to solve the problem at that stage. Therefore, the proposed assessment standards took into consideration the two important factors of security and proctoring. It was believed that for virtual assessment to be comparable to in-person assessment, certain standards had to be met. The objectives of assessment, face-to-face or virtual, must be aligned with course and programme learning outcomes to provide relevant learning opportunities and a standard of excellence which students should pursue (Vlachopoulos, 2020). Other standard assessment indicators are the content, teaching-assessment time ratio, assessment quality, proctoring, security, medium of transmission, cost effectiveness, feedback mechanism, and remediation loop. These factors are germane for meaningful engagement in the adoption of virtual assessment activities but may influence students' preparedness for optimal performance and overall satisfaction. However, awareness of virtual assessment indicators may be influenced by multiple factors, including the ICT facilities, the type of university students they attend, and the self-efficacy of their lecturers in integrating the technique.

It is important to explain ICT before associating it with the awareness of virtual assessment indicators. Information and Communication Technology has made a remarkable impact in the field of education, particularly higher education (Adewale *et al.*, 2003). The evolving nature of ICT has birthed several innovative strategies and approaches in the instructional processes and assessment methods of virtual educational learning experiences. ICT facilities are repeatedly considered as signs of increased productivity and quality in education (Noor-Ul-Amin, 2013; United Nations Department of Economic and Social Affairs, 2015). As demonstrated by Annetta et al. (2010), it could enhance educational quality by engaging students in the learning process, imitating real-life experiences, and thus creating a viable and economic experiential learning environment. Voogt et al. (2008) describe ICT as a key element of transforming curricula from teacher-centred to student-centred. Ali et al. (2016) explain that ICT engages students in a personalized learning environment according to their interests and experiences. The recurring lockdowns during the multiple waves of the COVID-

19 pandemic forced world education systems to adopt virtual alternatives to physical instruction. Thus, online teaching-learning and use of technology have become an unprecedented education requirement today (OECD, 2020).

Lecturers' self-efficacy is the next variable that has the potential to influence students' awareness of the virtual assessment indicators. Bandura (1977), in his theoretical framework on self-efficacy, describes efficacy as a generative capability in which cognitive, social-emotional, and behavioural sub-skills are organized and effectively orchestrated to serve innumerable purposes. Efficacy beliefs function as key factors in the generative system of human competence. There is a significant difference between possessing a skill set and amalgamating those skills into appropriate actions in varying circumstances. The exploration of online teaching experiences by researchers suggests that for some, unsuccessful technological efforts result in negative emotions and may affect future efforts relating to technology innovation (Cron et al., 2005; de Vries et al., 2003; Venkatesh et al., 2003).

Researchers further suggest that an individual's failure to successfully learn how to use technology or participate in online teaching may induce a negative cycle of emotions and non-use (Cron et al., 2005; de Vries et al., 2003; Venkatesh et al., 2003). Such negative cycles may affect self-confidence and trust in technology within the faculty and may reduce self-efficacy in online teaching. Kidd et al. (2016) studied the experience of lecturers in public health faculties who engage in online teaching. Their findings indicated transformations in online teaching during the development process and associated activities. Lecturers' self-efficacy can be vital in helping students to embrace virtual assessment. This implies that lecturers who are confident in their ability to use virtual assessment tools will be more willing to design assessments that agree with the preconceived learning objectives of their courses (Thompson & Smith, 2017). Lecturers' self-efficacy can directly impact the quality of virtual assessment activities and indirectly influence students' awareness of assessment indicators. This will be evident in the way questions are designed to suit students' exhibition of knowledge and skills in relation to the expectations of the course.

The last variable in this study is the university type or category. There are three university types: federal, state, and private - each financed by the government, individuals, or groups that own them. As at 2024, there were 52 federal, 62 state, and 148 private universities, making a total of 262 universities in Nigeria (National Universities Commission, 2024). These are distributed across the six geopolitical zones as shown in Table 1.

**Table 1**

*Distribution of Federal, State, and Private Universities Across Geo-Political Zones in Nigeria*

	Federal	State	Private	Total
North Central	8	11	30	49
North East	8	7	5	20
North West	13	10	19	42
South South	9	11	24	44
South East	6	8	24	38
South West	8	15	46	69
Total	52	63	147	262

Note. Compiled and calculated by the authors from:

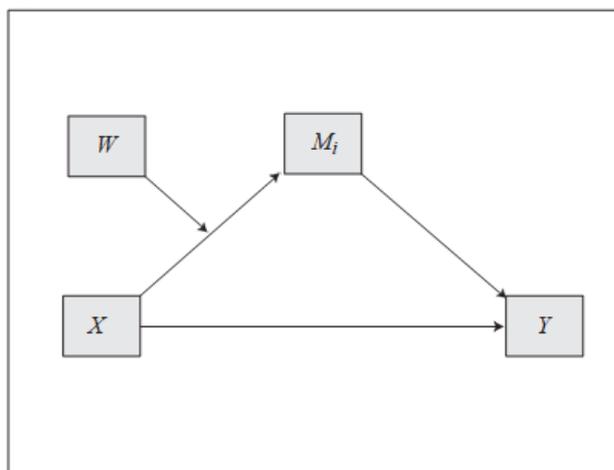
1. <https://punchng.com/full-list-147-private-varsities-in-nigeria/>
2. <https://drugsavant.com/state-universities-in-nigeria/>
3. Abusites (2024). Updated List of 262 Government-Approved Universities in Nigeria.

The category of a university may be significant in helping students' experience and readiness for virtual assessment. The availability of ICT facilities and provision of support systems may create differences depending on whether the university is federal, state, or private. These could affect students' level of exposure to virtual assessment technologies with resultant influence on the awareness of assessment indicators (Brown & Johnson, 2019).

This study investigated the possible intricate relationships among ICT facilities, students' awareness of virtual assessment indicators, university type, and lecturers' self-efficacy in integrating virtual assessment. The study explored how lecturers' self-efficacy mediated the relationship between ICT facilities and students' awareness of virtual assessment indicators. Additionally, it examined the moderating role of university type in the mediation of lecturers' self-efficacy on students' awareness of virtual assessment indicators. With a deeper understanding of this relationship, the study seeks to contribute valuable insights in the field of virtual assessment in higher education. The findings could inform universities and educators about the importance of providing adequate and appropriate ICT resources, supporting lecturers' professional development in virtual assessment methods which could yield better results in devising strategies to enhance students' awareness of assessment indicators in diverse university categories.

The conceptual model of the study is patterned after the Hayes process macro model 7 moderated mediation. In this model, the variables are continuous. The model is designed to determine if a mediation is present as well as to find out if a moderator is changing the strength of the indirect effect of the mediator as illustrated in Figure 1.

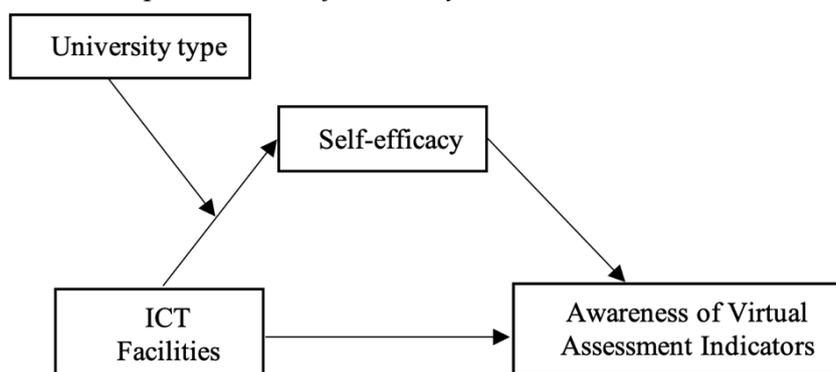
**Figure 1**  
*Hayes Process Macro Model 7 Moderated Mediation Conceptual Diagram*



In Figure 1, X represents the independent variable (ICT facilities) while the dependent variable is represented by Y (students’ awareness of virtual assessment indicators). The letter M1 stands for the Mediator (lecturers’ self-efficacy) while W (which is university type) represents the moderator impact effects on the mediator. The model allows up to 10 mediators operating in parallel and its statistical diagram is shown in Figure 2.

In this study, the model is used to determine the mediation of lecturers’ self-efficacy to effectively integrate virtual assessment on ICT facilities. In addition, it is employed to determine the moderation effect of university type or category on the mediation effect of lecturers’ self-efficacy on the strength of indirect effect of ICT facilities on students’ awareness of virtual assessment indicators. The complex relationships are diagrammatically represented in Figure 2.

**Figure 2**  
*The Conceptual Model of the Study*



Existing literature focuses on students’ awareness of e-learning methodologies in virtual teaching and learning and its effectiveness. With a dearth of literature on students’ awareness on virtual assessment indicators, this study aims at providing indicators of virtual assessment. In line with the conceptual model, the study is designed to investigate the relationship between ICT facilities and students’ awareness of virtual assessment indicators, the mediating role of lecturers’ self-efficacy to integrate virtual assessment, and the moderating role of university type on those relationships.

## Research Questions

The following research questions were raised to guide the study:

1. What is the relationship between:
  - a. ICT facility and students' awareness of virtual assessment indicators?
  - b. Lecturers' self-efficacy and students' awareness of virtual assessment indicators?
2. Will ICT facility, lecturers' self-efficacy, and university type have impact on students' awareness of virtual assessment indicators?
3. Will the interaction of ICT facility and university type have impact on lecturers' self-efficacy?
4. Will the indirect impact of ICT facilities on students' awareness of virtual assessment indicators through lecturers' self-efficacy be moderated by university type?

## Methodology

The study adopted the correlational design in which data on students' awareness of virtual assessment indicators, virtual assessment integration, and lecturers' self-efficacy were gathered through surveys distributed to participants, students and lecturers in six Nigerian universities - two universities each owned by federal, state, and private groups or individuals.

Three departments each were purposively selected from science and humanities- faculties drawn from six universities purposively selected from the northern and southern parts of Nigeria.

The distribution of the lecturers from each department was one Professor or Associate Professor, two Senior Lecturers and two Lecturers I and II spread adequately across gender. The lecturers were randomly selected where there were more than the number needed. Fifty students (25 females and 25 males) were randomly selected per department, making a total of 600 students.

The study focused on ICT facilities in universities, awareness of virtual assessment indicators by students, university type and self-efficacy in integrating virtual assessment by lecturers in Nigeria. Professors, Readers, Senior Lecturers, Lecturers I and II were participants in the study. The Virtual Assessment Standard Indicators Scale was used for data collection. It has two major sections A and B. Section A dealt with the institutional variables while Section B measured students' awareness of virtual assessment. The instrument was administered to the selected students and lecturers electronically using Online Data Kit (ODK). The study adopted the Hayes Process Macro- Model 7- Moderated Mediation to analyse data. Unstandardised regression and beta coefficients were used in establishing the relationship, total, direct and indirect effects of the independent variable, moderated mediation variables on the endogenous variable.

## Results and Discussion

The four research questions were answered using different tables as presented.

### Research Question 1

What is the relationship between:

- ICT facility and students' awareness of virtual assessment indicators?
- University type and students' awareness of virtual assessment indicators?

The relationship between ICT facilities and lecturers' self-efficacy as independent variables and students' awareness of virtual assessment indicators as the dependent variable is carried out using the multiple regression analysis as presented in Table 2.

**Table 2**

*Relationships Between Independent Variables and Virtual Assessment Awareness*

	<b>Coeff</b>	<b>se</b>	<b>T</b>	<b>p</b>	<b>LLCI</b>	<b>ULCI</b>
Constant	26.07	3.29	7.92	0.00	19.58	32.57
ICT Facilities	-0.33	0.17	-1.97	0.05	-0.67	0.00
University Type	1.81	1.52	1.19	0.24	-1.19	4.80
R = 0.46; R-sq = 21; MSE = 32.69; F = 16.41						
df <sub>1</sub> = 3.00 df <sub>2</sub> = 181.00 p = .00						

The relationship between independent variables (ICT facilities and university type) and students' virtual assessment awareness indicators denoted by  $R = 0.46$ ;  $R \text{ square} = 0.21$ ;  $F = 16.41$  shows that 21% variance in students' virtual assessment awareness indicators is accounted for by the independent variables. Similarly, Table 1 shows that a combined significant influence exists between independent variables and virtual assessment awareness indicators. Moreover, the relationship between ICT facilities and students' virtual assessment awareness indicators is  $-0.33 \pm 0.17$  indicate a weak relationship. However, the relation between these two variables is significant. On the contrary, the relationship between university type and students' virtual assessment awareness indicators is  $1.81 \pm 1.52$  due to the presence of a large standard error. The relationship is not significant.

### Research Question 2

Will ICT facilities, lecturers' self-efficacy, and university type have impact on students' awareness of virtual assessment indicators?

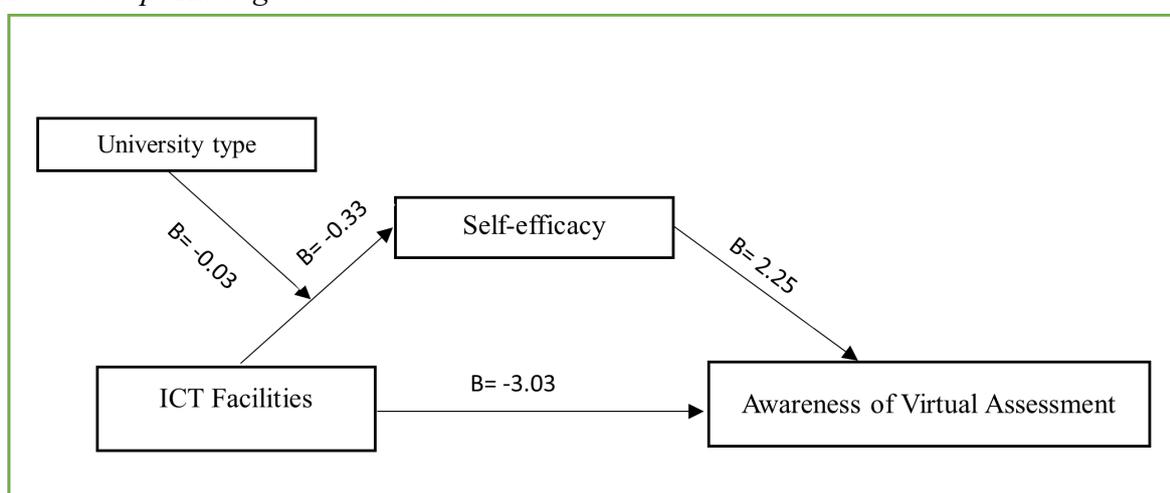
This research question was answered using both the regression analysis and the Hayes Process Macro Model 7 hypothesised Moderated Mediation diagram (Figure 3). The ICT facilities has a negative significant impact on students' awareness of virtual assessment indicators ( $b = -3.03$ ,  $t = -1.97$ ,  $p < 0.05$ ). That implies that ICT facilities in universities negatively impacted the students' awareness of virtual assessment indicators. This could mean that the more ICT facilities are available in a university, the lower the student are aware of the virtual assessment indicators and vice versa.

**Table 3**  
*Direct Relationships Among the Variables*

Direct Relationships	Unstandardised Coefficient	T values	Sig.t
ICT Facility (ICTF) → Self-Efficacy (SE)	-0.330	-1.970	0.05
Self-Efficacy (SE) → Awareness of Virtual Assessment Indicators (AVAI)	2.250	3.620	0.00
ICT Facility (ICTF) → Awareness of Virtual Assessment Indicators (AVAI)	-3.030	-4.790	0.00
ICT Facility (ICTF)*University Type → Self-Efficacy (SE)	-0.030	-0.380	0.27

These are further illustrated in Figure 3.

**Figure 3**  
*Relationships Among the Variables*



**Research Question 3**

Will the interaction of ICT facility and university type have impact on lecturers’ self-efficacy?

Table 2 shows that ICT facilities have a negative significant impact on lecturers’ self-efficacy (b = -0.33, t = -1.97, p < 0.05). That implies that ICT facilities in the universities negatively impact lecturers’ self-efficacy. It can be seen that the more facilities a university has, the less the self-efficacy of the lecturers in that university.

Furthermore, the interaction of ICT facilities and university type did not significantly impact lecturers’ self-efficacy (b = -0.03, t = 0.38, p > 0.05).

**Research Question 4**

Will the indirect impact of ICT facilities on students’ awareness of virtual assessment indicators through lecturers’ self-efficacy be moderated by university type?

The research question was answered using the result output of the Hayes Process Macro Model 7 Moderated Mediation analysis. The result shows that the indirect impact of ICT facilities on students' awareness of virtual assessment indicators through lecturers' self-efficacy was moderated by university type as indicated by the index of moderated mediation (index = -0.070, 95% CI = [-0.490/0.430]) since the 95% does not include zero.

**Table 4**  
*Indirect Relationship of the Variables*

Indirect Relationships	Direct Effect	Indirect Effect (SE)	Confidence Interval Low/High	T values
ICT Facilities > Self-Efficacy > Awareness of Virtual Assessment Indicators	-3.030	-0.900 (0.300)	-1.52/-0.34	3.0
Probing Moderated Indirect Relationships	Effect	SE	Confidence interval Low/High	t-statistics
Federal university	-0.820	0.370	-1.650/-0.220	-2.216
State university	-0.900	0.300	-1.520/-0.340	-3.00
Private university	-0.970	0.390	-1.770/-0.280	-2.62
Index of Moderated Mediation	-0.070	0.220	-0.490/0.430	0.318

Figure 3.0 shows the hypothesized moderated mediated model which was tested using the process macro model 7. This signifies that the indirect effect of ICT facilities on awareness of virtual assessment indicator through self-efficacy is moderated by university type (index -0.07, 95% CI = [-0.49/0.43]) and significant since the 95% does not include Zero.

### Discussion

The relationship between ICT facilities and students' awareness of virtual assessment indicators is fully mediated by their lecturers' self-efficacy. ICT facilities, including internet connectivity, are for the university community's usage, especially students and lecturers. It is assumed that the presence of ICT facilities should have a positive impact on the students' awareness of virtual assessment; however, this is not the case as there is a negative relationship between the two variables. The implication is that students use ICT facilities for social networking and other things that are not connected with virtual assessment or teaching and learning (Erdogdu & Erdogdu, 2015). The use of ICT facilities allows students to connect and share ideas irrespective of time and geographical locations they may find themselves.

Sütlüoğlu (2015) states that today, young people are in a process of socialization and identity building not only during the time spent in front of the screen, but through the transitions between online and offline worlds. Considering the mediated role of lectures' self-efficacy, it is believed that students' awareness of virtual assessment indicators depends on the comfort teachers feel about using ICT in the classroom, their ability to integrate computers into lessons and programmes, and the degree to which students get opportunities to use them (Bozdogan & Ozen, 2014; Martinovic & Zhang, 2012).

The relationship between lecturers' self-efficacy and students' awareness of virtual assessment indicators is moderated by university type. Lecturers' self-efficacy directly impacts the quality of virtual assessment activities and indirectly influences students' awareness of assessment indicators. It is assumed that ICT facilities vary based on the type of universities, which ordinarily will influence the self-efficacy of lecturers in those universities. Lecturers' exposure to online teaching improved their self-efficacy, but those who were unsuccessful in the use of technology displayed negative self-efficacy (Cron *et al.*, 2005; de Vries *et al.*, 2003; Venkatesh *et al.*, 2003). With improved self-efficacy of lecturers in the use of ICT, lecturers who are confident in their ability to use virtual assessment tools would be more willing to design assessments (Thompson & Smith, 2017), and this may increase students' awareness of virtual assessment indicators.

### **Conclusion and Recommendations**

The study concludes that lecturers' self-efficacy and university category are germane to successful virtual assessment in higher institutions. It can be inferred from the study that increased availability of ICT facilities in the different types of universities will lead to greater lecturers' use of ICT tools and enhance self-efficacy. Similarly, lecturers' greater use of technology for assessment will make students more aware of virtual assessment indicators. It is recommended that:

- i. Adequate ICT facilities should be available in federal, state, and private universities. The National University Commission should provide a benchmark on the number of ICT facilities in each university based on the number of lecturers and students.
- ii. Since technology innovations move at the speed of light, students and lecturers with little competence in technology should be provided with professional development to improve lecturers' self-efficacy for successful integration of virtual assessment in universities.
- iii. Since students' awareness of virtual assessment indicators is influenced by available ICT facilities and lecturers' self-efficacy, lecturers should use ICT facilities, especially in assessment methodologies, to increase students' awareness of virtual assessment indicators.

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