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Usability and Technology Acceptance of a Web-Based Digital Repository in Nigerian Army University Biu

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ABSTRACT
The detrimental environmental impacts of traditional paper usage, hence, advocating for digital solutions. The paper examines the usability of the User-Centered Web-Based Digital Repository (UCDER) as a sustainable e-book platform among students at Nigerian Army University Biu using Technology Adoption Model (TAM). Quantitative approach was employed, Questionnaires was designed to validate the Perceived Usefulness and Perceived Ease of Use of the (UCDER). 291 questionnaires were distributed and 265 was retrieved with response rate of 91%. Random sampling was used to administer the questionnaires. Amos Graphics was used to analyse the data. The results revealed that Perceived Usefulness has path coefficient of 0.18 with a p-value of 0.001. This indicated that the effect of Perceived Usefulness PU on Actual Use of UCDER is significant. Therefore, it can be interpreted that the perception of respondents (users), on performance and functionality of UCDER technology has been achieved. Similarly, Perceived Ease of Use path coefficient of 0.13 with a p-value of 0.000. This implies that the effect of Perceived Ease of Use PEU on Actual Use of UCDER is significant. This established that, performance and functionality of UCDER technology is user-friendly. The findings contribute to the understanding of user-centered design in digital repositories and highlight the importance of usability in fostering technology adoption within educational settings. The findings of the paper is limited to Nigerian Army University, suggesting further research is needed to generalize results across different academic environments. It underscores the potential of digital repositories to reduce paper dependency and foster sustainability in higher education.

Keywords: Performance, Technology, Perceived Ease of Use, Perceived Usefulness, User-Centred Design

INTRODUCTION

The production, consumption, and disposal of paper have significant environmental impacts, including deforestation, high water usage, water pollution, and carbon emissions. (Conservatree, 2015, Counsell & Allwood, 2007). Graphic designers, who commonly rely on paper and printing processes in their work, have an important role to play in minimizing these environmental consequences. Considering sustainability early in the design process is crucial, as designers can choose between physical or digital product options to reduce the environmental footprint of their projects (Isaias & Issa, 2020). The transition towards more sustainable materials, production methods, and waste minimization strategies should be a priority for graphic designers.

In the context of higher education, Robin, Potter & Yarrow (2002), Robin, Potter & Yarrow (2008) are of the view that many universities and colleges are adopting web-based learning platforms and e-books to decrease paper consumption and foster sustainability on campus (Mubanga Kapuka & Wizaso Munthali, 2017). Lozano (2011), identified some of the factors that contribute to resistance on the part of university students to engage with sustainability include lack of awareness. Studies have shown that the use of e-books can provide benefits like cost savings, preservation of natural resources, and reduced energy usage and emissions (Isaias & Issa, 2020, Manalu, 2019). Therefore, it is becoming less necessary to use printed materials at many American universities and colleges because of the adoption of digital textbooks and internet resources.

In UAE programs such as the Smart Learning Program was implemented to encourage digital learning and decrease the amount of paper used in classrooms and colleges. In addition, the National Digital Learning Materials Network, which offers students online materials, is one of the digital education projects in which the Australian government has financed. Moreso, an effort to use less paper, Canadian universities and colleges are progressively implementing e-book platforms like Canvas and Brightspace. Also, The Indian government has started programs like the e-Pathshala platform to encourage digital learning and lessen the need for students to use printed materials.

Omonigho, (2023) Asserted that in developing online programs, it is crucial to understand the vital importance of usability and user-oriented design. He further added that there is a need for a more intuitive user interface and a user-centric emphasis on web applications in the digital world due to their significant implications on users' satisfaction and long-term usage. User-centered design is a design philosophy and a process that focuses on putting the user at the center of the design and development of digital products and services (Norman & Draper, 1986, Martin Maguire, 2001). User-centered design according to Nielsen, (1994), Vredenburg & Butler, (1996) is considered the key to product usefulness and usability. The study titled "User-Centered Design (UCD) Approach for Analyzing User Experience and Enhancing Online News Portal Website (Case Study: Cakrawala.co)" authored by Mochamad Ihza Yudhakesuma Anita Muliawati, and Helena Nurramdhani, (2023), underscores the importance

of achieving a commendable level of usability on a website to ensure its ease of comprehension and user-friendliness. Consequently, the system can be measured through user perception. User perception can be explained as a measure of perceived usability of a system. Other measures of perception include ease of use, usefulness of outcome and perception of time (Zhuang, Toms & Demartini, 2016). All these are measured after post the user's interaction with the system (Zhuang et al, 2016). However, these outcomes can be deduced to determine the functionality of a system based on user experience which determined the user perception. This provides a platform as an alternative to traditional use of paper in tertiary institutions. Similarly, the production and consumption of paper, which is commonly used in graphic design projects and academic settings, have significant environmental consequences. The paper industry is responsible for deforestation, high water usage, water pollution, and carbon emissions, contributing to the global climate crisis (Conservatree, 2015, Counsell & Allwood, 2007). Nigerian Army University students are exposed to printed study materials that contribute to waste generation within the environment of the institution. This problem is not unique to this university, as many higher education institutions worldwide face similar challenges in reducing paper consumption and promoting sustainability on campus. Consequently, user-centered e-book digital repository was designed and developed to provide students of Nigerian Army University with access to electronic data storage platform as a more sustainable alternative to archive printed materials and subsequently test the usability of the designed web-based e-book platform repository. this paper is conceived to validate the usability of the designed web-based e-book platform repository among students in Nigerian Army University Biu.

MATERIALS AND METHODS

The methodology describes the overall research design, process, and methodology applied. According to works of researchers like Leedy (1974), Conti, (1993) are of the view that, research designs are logical blue prints (Yin, 2011). However, the scope of this paper is focused on validating the usability of the designed web-based e-book platform repository among students in Nigerian Army University Biu. The total population of students in Nigerian Army University is about 1166 according to (Academic News, 2025). The appropriate sample size according to Sanders et al. (2009) table of sample size is 291 with 95% confidence and 5% margin of error. Even though, a smaller number can be use in case of validation but the sample size used was 291. The likert scale was used in designing the questionnaire. The Likert scale was used to determine the weight responses of the respondents. The scale 1 represents Strongly-Agree, 2 represents Agree,3 represents Neutral, while 4 represents Disagree and lastly 5 represents Strongly-Disagree. Random sampling was used as a technique in distributing the questionnaires and 265 was returned representing 91% of the questionnaires retrieved. In order to re-align the paper with acceptable technological concept in view of the validation of User-Centered Web-Based Digital Repository (UCDER). Similarly, the validation was based on user perception on Web-Based Digital Repository. This was also built on usability of the Web-Based Digital Repository. Usability is the degree of ease of use (by subjective assessment) and e!ectiveness of use (by objective performance) within the define range of users, tasks, tools, and environment (Bennet, 1984; Shackel, 1984). Although the subjective satisfaction was part of the original usability concept, most usability studies have been concerned mainly with the objective performance such as speed and accuracy of a task performed by the user (Han, Yun, Kim & Kwahk, 2000). Therefore, usability from it is definition has a similar construct with Technology Acceptance Model (TAM) has is adopted because of it is suitability. TAM has been used in research to explore the acceptance of new e-technology or new e-services (Davis, 1989; Davis & Venkatesh, 1996). TAM was used in similar research by (Liu, Du & Li, 2025) to determine the impact of user perception on continued knowledge purchase. Therefore, TAM can be used determine the Actual Use of the User-Centered Web-Based Digital Repository Using Web-flow Integrated Graphics among students in Nigerian Army University Biu. The applicability of the model is connected to its uncomplicatedness for the fact that it has only two constructs. These constructs are consequent from Bandura's Self Efficacy Theory (1982) which defines perceived usefulness as "the conclusions of how well one can perform courses of action needed to deal with potential condition" and from Rogers and Shoemaker (1971) paper which defines complexity (interpreted as ease of use) as "the degree to which an innovation is perceived as relatively difficult to understand and use". Accordingly, perceived usefulness is defined as the degree to which a user believes that using a specific system would enhance the job performance. While Perceived ease-of-use is defined as the degree to which a user believes that using a particular system would be effort-free (Aljarrah, Elrehail & Aababneh, 2016) Technology Adoption Model constructs are, "perceived usefulness" i.e. (performance) and "perceived ease of use" for forecasting degree of adoption of new technologies at individual level as shown in the TAM model framework that is used for validation of the UCDER below.

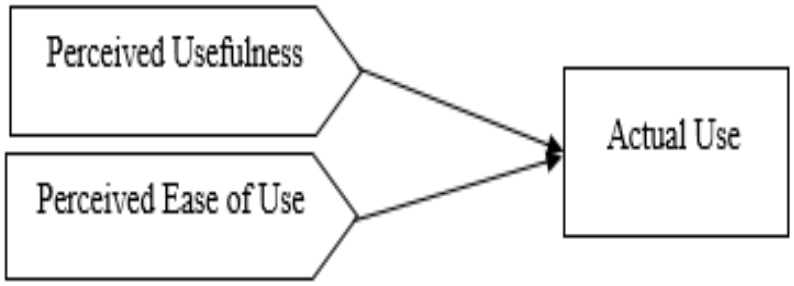


Figure 1: TAM Model Framework for Validation of (UCEDR)

The constructs and their meaning within the context of this paper is presented in table 1 below.

Table 1: TAM Model by Davis (1989)

Construct	Definition	Theoretical Background
Perceived usefulness (performance)	The degree to which a person believes that using a particular system would enhance his or her job performance. (This defines the perceived performance or usefulness of User-Centered E-Book Digital Repository (**UCEDR)**	Bandura's Self efficacy theory (1982)
Perceived ease of use	The degree to which a person believes that using a particular system would be free of effort. (This also defines the perceived extent of ease of use of User-Centered E-Book Digital Repository (**UCEDR)**	Rogers and Shoemaker (1971)

TAM was initially verified in the adoption setting of email service and file editor at IBM Canada with 14 items on each of 2 constructs. The outcomes of the survey on sample of 112 users authenticated the model with the conclusion that perceived usefulness is a stronger factor than perceived ease of use that drives technology adoption. Since then, TAM turned out to be well-established as a robust, influential, and parsimonious model for both technology performance (functionality) and forecasting user acceptance. In this research TAM is adopted to teste performance and evaluate the ease at which User-Centered E-Book Digital Repository (UCEDR) improves students' online practices in NAUB.

Table 2: Model Key Variables, Codes and Items

Construct	Variable Codes	Variable Descriptions
Perceived Usefulness	PU1	Using the system enhances my effectiveness
	PU2	Using the system increases my productivity
	PU3	Using the system improves my learning performance
	PU4	Using the system increases my learning satisfaction
	PU5	I found the various functions in this system were well integrated.
Perceived Ease of Use	PEU1	Learning to operate the system is easy for me
	PEU2	My interaction with the system is clear and understandable
	PEU3	The system is easy to use
	PEU4	I find the system easy to use
	PEU5	I do not need a guide to use the system
Actual Use	AU1	Using the system enabled accomplished task more quickly
	AU2	Using the system enhanced my productivity
	AU3	Using the system enhanced my effectiveness
	AU4	Using the system improved my performance

The reliability test results are shown in table 3 below. As it can be observed from table 3, PU construct has been tested using 5 items, PEU has been tested using 5 items while AU has been tested using 4 items. The Cronbach alpha value of all the constructs or components ranges from 0.821 to 0.943 which is not only above the acceptable limit it also indicates a strong reliability and internal consistency of data (Palant 2010).

Table 3: Reliability Test of the Research Variables

Constructs	PU	PEU	AU
Measurement Items	PU1	PEU1	AU1
	PU2	PEU2	AU2
	PU3	PEU3	AU3
	PU4	PEU4	AU4
	PU5	PEU5	
Cronbach Alpha	0.943	0.821	0.943

Incidentally, AMOS Graphics software was among the method used to conduct the analysis of this research; the following tables of results, are all parts of the analysis; The model fit index descriptions in table 4, Model Fitness Indices in table 5, and Uni-dimensionality Outcomes of Measurement Model Indices and the Structural Model in table 6. Usually, the model is always accepted if the fit indices revealed good fit. However, the model with intolerable fit indices will normally be respecified to improve the model fit as an alternative to being rejected. Therefore, it is worth noting that, fit indices are classified as either absolute or incremental (Hoyle & Panter, 1995) see table 4.

Table 4: Fitness Index Description

Name of Category	Name of Index	Index Full Name	Supportive Literature
1. Absolute Fit	Chi-Square	Discrepancy Chi Square	Weaton *et al* (1977)
	RMSEA	Root Mean Square Error of Approximation	(Browne *et al*., 1993)
	GFI	Goodness of Fit Index	Joreskog and Sorbom (1984)
2. Incremental Fit	AGFI	Adjusted Fit Index	(Tanaka & Huba, 1985)
	CFI	Comparative Fit Index	(Bentler, 1980)
	TLI	Tucker Lewis Index	(Bentler & Bonett, 1980)
	NFI	Normed Fit Index	(Bollen, 1989)
	Chisq/df	Chi-square /degree of Freedom	(Marsh *et al*., 1985)

i. Absolute fit indices are connected to the degree or extent to which the hypothesised or proposed model reproduces and represent the sample (Shah & Goldstein, 2006). The most basic index of this type of measure is Chi-square usually represented as (χ^2) statistics, which usually include the value of χ^2, degree of freedom (*df*) and significance level (*p*-value). Normally, the non-significant χ^2 indicates that the model fits the data, consequently the model is accepted. Likewise, on the other side, significant χ^2 ($p < 0.05$) suggests that the model does not really fit the data and therefore should be rejected. Because of such a traditional contrasting rule, numerous ambiguities and uncertainties exist which are linked to the interpretation of χ^2 (Hoyle & Panter, 1995).

ii. Incremental fit indices – are connected to the extent to which the model in question is superior to the following alternative models: (1) the null model in which no covariances among the variables are specified; and the model that fits perfectly with the data (Hoyle & Panter, 1995; Shah & Goldstein, 2006). Some of the most popular incremental fit indices are: normed-fit index (NFI), Tucker-Lewis index (TLI) and comparative-fit index (CFI) see table 4 above.

Table 5: Model Fitness Indices Limits

Name of Category	Name of Index	Levels of Acceptance	Comments
1. Absolute Fit	RMSEA	RMSEA < 0.80	RMSEA=0.020 Acceptable
	GFI	GFI > 0.90	GFI = 0.992 is a good fit
2 Incremental Fit	AGFI	AGFI > 0.90	AGFI > 0.90 is a good fit
	CFI	CFI > 0.90	CFI = 0.998 is a good fit
	TLI	TLI > 0.90	TLI = 0.997 is a good fit
	NFI	NFI > 0.90	NFI = 0.985 is a good fit
	Chisq/df	Chisq/df<5.0	Chisq/df=1.121 is a good fit

Uni-dimensionality can be evaluated through model fit indices and the threshold limit of the indices which are presented in table 5 (Koufteros, 1999). Table 5 above also contain the names of the index, levels of acceptance of each index such as GFI, AGFI, CFI, TLI and NFI which are all 0.90, the table also indicates the goodness of fit of all the indexes.

Table 6: Uni-Dimensionality Outcomes

Constructs	ChiSq	df	P-Value	ChiSq/df	TLI	CFI	NFI	GFI	RMSEA
PU	87.34	48	0.001	1.82	0.94	0.95	0.95	0.92	0.070
PEU	50.21	32	0.000	3.31	0.97	0.96	0.90	0.99	0.030
AU	43.11	44	0.002	1.42	0.92	0.94	0.97	0.94	0.022
Structural Model	51.21	38	0.000	2.11	0.98	0.91	0.94	0.96	0.040

Uni-dimensionality takes place when the indicator variables load on only one construct. In other words, uni-dimensionality measures the extent to which each construct correlate well with its measurement items (Koufteros, 1999). If the fit indices of the model, with all the factors specified to be loaded on only a single construct, are satisfactorily subject to the aforementioned fit indices criteria this leads to the achievement of uni-dimensionality. Therefore, uni-dimensionality or measurement model analysis for PU, PEU, AU and Structural Model have all been presented in table 6 above. The results of all these models such as Chi-sq, P-value, GFI, AGFI, CFI, TLI, NFI and RMSEA are all equal or above the acceptable limits and therefore uni-dimensionality is achieved.

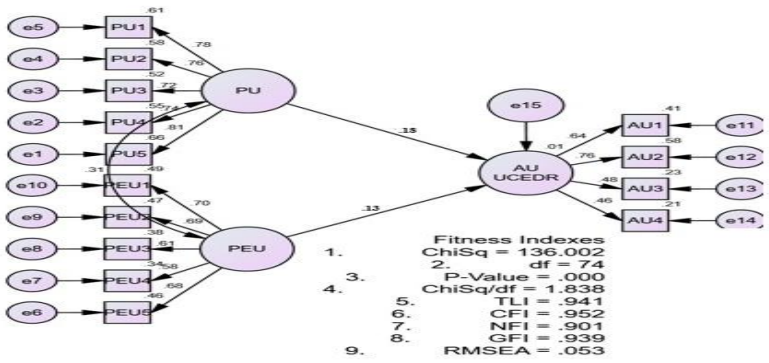


Figure 2: The Structural Model of (UCDER)

RESULTS AND DISCUSSION

Table 7: SEM Results

Paths	Estimate	S.E.	C.R.	P-Value	Result
AU-UCDER<--- PU	.18	.100	.368	***	Significant
AU-UCDER<--- PEU	.13	.153	1.511	***	Significant

*** = p-value<0.005

In this regard, Table 7 revealed the results of Amos Graphics analysis where AU-UCDER<--- PU path coefficient shows significant level of 0.18 *** = P-value <0.005. This threshold limit indicates that whenever P-Value fall less than 0.005, the result becomes significant (Awang *et al*, 2016). Therefore, this implies that the effect of Perceived Usefulness PU on Actual Use of UCDER is significant. This indicates that, based on the perception of respondents (users), performance and functionality of UCDER technology has been achieved. Furthermore, it can be deduced that Perceived Usefulness (PU) indicated a strong positive influence on actual use. This suggests that students believe that using the UCDER enhances their learning performance and satisfaction, aligning with the principles of the TAM that emphasize the importance of perceived usefulness in technology adoption.

Similarly, the result revealed that AU-UCDER<--- PEU path coefficient, which shows significant level of 0.13*** = P-value <0.005. This also indicates that whenever P-Value fall less than 0.005, the result becomes significant (Awang, 2016). Consequently, this implies that the effect of Perceived Ease of Use PEU on Actual Use of UCDER is significant. This indicates that, based on the perception of respondents (users), the performance and functionality of UCDER technology have not only been achieved, but has also been established that the technology is also user-friendly. Perceived Ease of Use (PEU) also demonstrated a significant relationship with actual use. This finding indicates that students find the UCDER user-friendly, which is crucial for encouraging ongoing engagement with the platform.

While the findings are promising, it is essential to note that the study's context is limited to the Nigerian Army University. Thus, the results may not be fully generalizable to other academic institutions. Future research should explore the applicability of the UCDER in diverse educational settings to validate its effectiveness across different user groups.

CONCLUSION

The study successfully validated the usability of the User-Centered Web-Based Digital Repository (UCDER) among students at the Nigerian Army University Biu. The findings underscore the significance of perceived usefulness and ease of use in fostering technology adoption in educational contexts. The UCDER not only offers a sustainable alternative to traditional paper-based resources but also enhances students' learning experiences. The positive responses from the participants indicate a strong potential for the UCDER to contribute to reducing paper dependency and promoting environmentally sustainable practices within higher education.

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