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Article

Technological readiness and integration of digital technologies for teaching in government aided primary schools in Uganda

Robert Kyeyune[1], Benard Engotoit[2,*], Edgart Atwo Katarahweire[3], Abdal Kasule[2], Mayoka G. Kituyi[4]

[1] Department of Applied Computing and IT, Makerere University Business School, Kampala 1337, Uganda
[2] Department of Information Systems, Makerere University Business School, Kampala 1337, Uganda
[3] Makerere University Business School, Kampala 1337, Uganda
[4] Department of Computer Science and Engineering, Makerere University Business School, Kampala 1337, Uganda
*** Corresponding author:** Benard Engotoit, bengotoit@mubs.ac.ug

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Abstract: This study seeks to examine the relationship between technological readiness and integration of digital technologies for teaching in government-aided primary schools in Uganda. The study adopted a cross-sectional quantitative research approach, utilizing a survey design from which a structured, close-ended questionnaire was designed and administered to primary school teachers in Uganda to collect data. A total of 335 teachers were selected to participate in the study and these were sampled based on Krecjie and Mogan's table of sample size selection. The findings revealed that there is a positive association between technological readiness and integration of digital technologies for teaching in primary schools in Uganda. Further, to confirm the study hypothesis, the study found that technological readiness significantly predicted integration of digital technologies for teaching in government-aided primary schools in Uganda. This signifies that when teachers have access to IT infrastructure and internet connectivity, their integration and use of digital technologies in teaching will be enhanced. The study provides recommendations for concerned stakeholders to work towards providing teachers' access to IT infrastructure and internet connectivity so as to enable them to teach with the aid of technology. This study examines the dimensions of technological readiness and its influence on the integration of digital technologies for teaching in government-aided primary schools. No prior research has examined these concepts in relation to teachers and the use of digital technologies in Uganda, where the situation is made worse in rural areas.

Keywords: technological readiness; digital technologies; integration; primary schools

1. Introduction

The integration of digital technologies (DTs) within educational systems represents a contemporary development in the developing world, particularly in Africa, where advocates argue that such integration has the potential to transform and enhance educational frameworks [1,2]. Among African nations, Ghana has made significant strides by formulating comprehensive information and communication technology (ICT) policies and investing substantially in technology adoption across various sectors [3]. In the educational domain, the Ghanaian government has initiated the "One Laptop per Child Policy", an intervention designed to improve teaching and learning outcomes while fostering students' engagement with digital technologies. Similarly, in East Africa, Rwanda has implemented the "One Laptop per Child" initiative since 2008, aimed at equipping primary school children with

essential technological skills and competencies, which has significantly enhanced student learning and transformed educational practices [4].

The integration of digital technologies in educational institutions, particularly primary schools in Uganda, has been identified as a pivotal strategy for enhancing educational quality [5]. The Ugandan government has initiated a variety of measures aimed at promoting the utilization of digital technologies in educational settings, recognizing their potential to transform teaching and learning outcomes. A diverse array of digital technology initiatives has been implemented to strengthen the education sector, as documented by the Uganda Communication Commission [6]. For example, the MOES has formulated sector-specific policies designed to facilitate the adoption of digital technologies in education, alongside increasing financial allocations for the procurement of digital tools intended to improve the educational experience [7].

However, despite these commendable efforts, the actual integration of digital technologies in pedagogical practices remains markedly limited, especially in government-aided primary schools that primarily rely on government funding [7,8]. This deficiency can be attributed to a multitude of factors, including the inadequate technological readiness of educators within these institutions. Research indicates that many teachers lack the necessary skills and confidence to effectively incorporate digital tools into their teaching methodologies [7]. Furthermore, infrastructural challenges, such as unreliable internet access and insufficient technological resources, exacerbate the situation, rendering many schools ill-equipped to embrace digital learning environments [9].

The implications of these challenges are significant, as they hinder the potential benefits that digital technologies can offer in fostering interactive and engaging learning experiences. Studies have shown that the successful integration of technology in education is contingent upon comprehensive training for educators, as well as the establishment of robust infrastructure [10]. In light of these findings, there exists a critical need to conduct a thorough investigation into the technological readiness of educational institutions in Uganda, particularly within the context of primary schools. Such an inquiry is essential to assess their preparedness to effectively integrate digital technologies into teaching and learning processes, thereby facilitating a more equitable and quality-driven educational landscape.

Moreover, understanding the barriers to technological integration will provide valuable insights for policymakers and educational stakeholders, enabling them to devise targeted interventions that address the specific needs of teachers and students in government-aided primary schools. As the global educational landscape increasingly leans towards digitalization, it is imperative that Uganda's educational institutions are equipped to navigate this transition effectively, ensuring that all learners have access to the benefits of modern educational technologies. This inquiry will be guided by the following research question:

RQ1: What is the contribution of technological readiness to the integration of digital technologies for teaching in government-aided primary schools in Uganda?

Addressing this research question will be informed by the Chapnick readiness model [11], which serves as an effective framework for assessing the readiness of educational institutions to incorporate digital technologies into their teaching

methodologies. This model evaluates the readiness for e-learning implementation within organizations by posing several critical questions: a) Is this achievable? b) If attainable, what methods can be employed to accomplish it? c) What outcomes can be anticipated, and how can they be assessed? Accordingly, this study aims to explore the relationship between technological readiness and the integration of digital technologies for teaching in government-aided primary schools in Uganda.

2. Literature review

2.1. Theoretical underpinning

This research is anchored in the Chapnick Readiness Model [11], which evaluates organizational preparedness for e-learning implementation. The model addresses critical questions regarding capability, methods for achievement, anticipated outcomes, and assessment strategies. [11] identifies several factors essential for assessing readiness, including psychological readiness which focuses on individual mindsets toward e-learning; sociological readiness which examines the characteristics of the environment; environmental readiness which considers influences on internal and external stakeholders; and human resource readiness which addresses support system availability for personnel. In addition to these factors, the Chapnick model emphasizes financial readiness, which pertains to budgetary constraints for e-learning programs, technological readiness which refers to the necessary technical support for initiatives, equipment readiness which is concerned with the availability of suitable devices, and content readiness which puts focus on the quality of the curriculum developed for instructional purposes. This model is particularly relevant for assessing primary schools' readiness to integrate digital technologies into teaching methodologies. This study's focus on technological readiness (infrastructure and internet access), while excluding other dimensions like psychological readiness, stems from a practical constraint: infrastructure and internet access are foundational for e-learning, and their presence or absence is relatively easy to measure. However, it is also noted that the impact of other dimensions like psychological readiness can be significant, potentially hindering e-learning adoption even with adequate infrastructure. Addressing these dimensions requires a more qualitative approach, possibly involving interviews or surveys which are not adopted in the current study.

2.2. Technological readiness

From an educational perspective, [12] define technology as any tool or platform that facilitates online learning, including email, video-sharing platforms, and audio tools. These technologies enhance the learning experience compared to traditional face-to-face instruction. However, [13] highlight significant technological challenges, such as inadequate infrastructure, unreliable internet connectivity, and limited digital literacy among educators, which hinder effective integration of digital tools in pedagogical practices. [8] stress the importance of collaborative efforts to improve digital literacy, particularly among marginalized groups, while [14] assert that educational institutions must be technologically prepared to successfully incorporate

digital technologies. [15] define technological readiness as an organization's capacity to adopt new technologies, encompassing aspects such as network connectivity, software and hardware availability, technical skills, and IT security. This readiness is evaluated based on technological infrastructure, access to digital technology, and the requisite technical skills [15,16].

Technological readiness is crucial for digital services, including digital learning, and is assessed in this study through two primary indicators: access to IT infrastructure and availability of internet connectivity.

2.3. Technological readiness and integration of digital technologies in teaching

Technological readiness enhances the ability to predict the benefits of technology adoption and identify necessary infrastructure for successful integration [17]. It also influences attitudes toward technological products and services [18]. Research indicates that individuals can hold both positive and negative perceptions of technology, affecting their readiness to adopt new tools. Higher levels of technological readiness correlate with greater preparedness for utilizing digital technologies. [19] emphasize that a lack of appropriate ICT resources and inadequate access can severely hinder e-learning initiatives. [20] further highlight that limited familiarity with technology and insufficient access to digital resources contribute to underutilization in educational contexts, particularly in subjects like Art and Design. These findings underscore the critical role of technological readiness in effectively integrating digital technologies into education.

While prior research emphasizes the importance of technological readiness in the integration of digital technologies in higher education and corporate environments [17,18], there is limited evidence of its application to government-aided primary schools, particularly in resource-constrained contexts. Existing studies either focus narrowly on infrastructure (e.g., [14] or conflate technological readiness with broader digital literacy [8], overlooking systemic interdependencies highlighted by the Chapnick model. For instance, [21] identify underutilization of digital tools in Art and Design education but do not link this to institutional readiness factors like technical support or curriculum alignment. This study fills this gap by applying the Chapnick model to evaluate technological readiness and its impact on the integration of digital technologies in primary schools. The above literature thus leads us to hypothesize that:

H1. Technological readiness is positively and significantly associated with the integration of digital technologies for teaching in government-aided primary schools.

3. Methods

3.1. Research design

To fulfill the primary objective of this study, a cross-sectional quantitative research design was employed, which examines a specific phenomenon at a particular point in time [22]. The quantitative survey methodology was selected due to its effectiveness in describing and inferring relationships between variables. The

survey was administered to primary school teachers in government-aided primary schools located in Wakiso District, which is notable for having the highest number of such institutions in Uganda, totaling 256 schools and employing 2721 teachers [23]. Additionally, Wakiso District is characterized by the highest levels of computer usage in the country [20].

From the total population of 2721 primary school teachers, a sample of 338 respondents was selected based on Krejcie and Morgan sample size determination table, which indicates that a population size between 2600 and 2799 necessitates a sample size of 335 [24]. A simple random sampling technique was utilized to select primary school teachers from government-aided schools in Wakiso District for participation in the study. The research instrument consisted of a self-administered survey questionnaire featuring questions structured around a five-point Likert scale, with response options ranging from "Strongly disagree" (1) to "Strongly agree" (5). As noted by [25], a five-point Likert scale offers a balanced range of choices for respondents. A research assistant was employed to distribute the questionnaires, and the data collection process was closely monitored to ensure the integrity of the respondents' original perspectives. Out of the 335 distributed questionnaires, 162 were completed and returned, resulting in a response rate of 50.3%. This aligns with [26], who assert that a response rate exceeding 50% is considered significant when investigating cause-and-effect relationships among variables.

3.2. Measurement of variables

Both the independent variable (technological readiness) and the dependent variable (integration of digital technologies) were assessed using interval scales established in prior research. Technological readiness was evaluated based on indicators from previous studies [7,27]. The dimensions of technological readiness included access to IT infrastructure and the availability of the internet, with assessments conducted on a five-point interval scale, where 1 indicates "strongly disagree" and 5 signifies "strongly agree." Conversely, the integration of digital technologies was measured using metrics adapted from [28], which encompassed the usage and adoption of digital technologies.

3.3. Validity, reliability and data analysis

Prior to data collection, the research instrument was pre-tested among a subset of the intended respondents, leading to revisions of any inappropriate questions. To evaluate the validity of the instrument, five expert judges assessed the questionnaire using the content validity index (CVI) to determine whether each variable effectively measured its intended construct. The content validity questionnaire was structured on a five-point Likert scale, ranging from 1 (Not Relevant) to 5 (Very Relevant). For a research instrument to be deemed valid, it should achieve a CVI of at least 0.8 ([29]. The validity analysis indicated that the research instrument attained a CVI exceeding 0.8. Reliability was assessed using Cronbach's alpha coefficient, with pilot study results indicating that the questionnaire items yielded a coefficient of 0.70 or higher, which is considered acceptable for consistent and reliable responses [30].

During the data processing, analysis, and presentation phases, the collected data were meticulously examined for any missing or inadequate information. The analysis was conducted using both descriptive and inferential statistics, including correlation and regression analyses. Quantitative data were sorted, coded, edited, and classified into categories utilizing SPSS version 28. Cross-tabulation was employed to provide a general description of categorical data, such as age and gender, while multiple correlation and regression analyses were utilized to ascertain the nature, strength, and direction of relationships between the variables.

3.4. Ethical issues considered

To mitigate any potential ethical violations, the researcher ensured the confidentiality of the respondents' answers by including declarations on all research instruments, indicating that the study was strictly academic and that the data collected would be handled confidentially and exclusively for the specified purpose. Furthermore, the researcher adhered to the principles of informed consent prior to engaging prospective respondents in the study. It was ensured that respondents voluntarily provided consent to participate and that no coercion was exerted. Lastly, all necessary approvals from relevant authorities were obtained before engaging with the respondents.

4. Findings

4.1. Demographic profile of the respondents

Table 1. Respondents' demographic profile.

Demographic characteristics	Frequency	Percent
Gender (*n* = 162)		
Female	87	53.7
Male	75	46.3
Respondents age (*n* = 162)		
18–25	32	19.8
26–30	26	16.0
31–35	23	14.2
36–40	40	24.7
Above 40	41	25.3
Highest education (*n* = 162)		
Certificate	10	6.2
Diploma	71	43.8
Bachelor's Degree	81	50.0

Source: Primary data.

The majority of the respondents were female representing 53.7% compared to 46.3% for their male counterparts, implying a fair representation of both genders in the study. In relation to the age of the respondents (25.3%) were above 40 years of age. This was closely followed by respondents in the age bracket of 36–40 years

(24.7%). Those in the age brackets of 18–25 years, 26–30 years and 31–35 years were 19.8%, 16% and 14% respectively. This indicated that all categories of respondents in reference to different age groups were represented in this study. The majority of the respondents possessed bachelor's degree qualifications (50%), followed by diploma holders (43.8%) and lastly certificate holders (6.2%), implying that most of the respondents were highly qualified to respond to the questions asked in the questionnaire as shown in **Table 1**.

4.2. Factor analysis of the study variables

Factor analysis was employed to identify the dimensions measuring technological readiness and integration of digital technologies, assess the sufficiency of the study sample for analysis, and confirm the convergence of all retained factors in measuring their latent variables.

4.3. Factor analysis for technological readiness

Principal component matrix analysis with varimax was performed to ascertain the factor loadings for each component and to determine the cumulative variance explained by factors in each component. From the Factor analysis conducted, two components were obtained interpreted as Internet availability with four factors and Information Technology also with four factors. Each factor loaded above 60%. Internet availability had a Variance of 37.719% and Information Technology Infrastructure had a variance of 15.162% explaining 46.881% of total variance in technological readiness as shown in **Table 2**.

Table 2. Component matrix for technological readiness.

Rotated Component Matrix—Technological Readiness	**Component**	
	Internet Availability	Access to IT Infrastructure
My school has stable internet	0.844	
I am satisfied with the cost of internet	0.800	
The speed of internet connection at my school is appropriate.	0.796	
My school has access to the internet	0.702	
My school can afford the necessary software needed for teaching.		0.844
My school has an able ICT support service to address challenges associated with the use of digital technologies.		0.783
My school readily has the necessary hardware.		0.779
I have access to ICT service support within a reasonable time frame		0.608
Total	3.172	1.516
% of Variance	31.719	15.162
Cumulative %	31.719	46.881

Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

While 60% is a general benchmark, lower variance thresholds are acceptable in exploratory factor analysis (EFA), particularly in applied educational research where practical significance often outweighs statistical ideals. Studies in low-resource

settings, for instance, in Ugandan primary schools, frequently report lower variance due to heterogeneous infrastructure conditions and measurement limitations [31].

4.4. Factor analysis for integration of digital technologies

Further, principal component matrix analysis with varimax was also executed to ascertain the factor loadings for each component and to determine the collective variance explained by factors for each component. From the analysis conducted, factor analysis yielded two components which were interpreted as adoption of digital technologies with one factor and usage of digital technologies with four factors. Each factor exhibited loadings above 70%. Adoption of digital technologies had a variance of 42.998% while usage of digital technologies had a variance of 12.840%. This explains 55.838% of total variance in integration of digital technologies as shown in **Table 3** below.

Table 3. Component matrix for integration of digital technologies.

Rotated Component Matrix—Integration of Digital Technologies	**Component**	
	Adoption of digital technologies	Usage of digital technologies
I currently use email for teaching	0.850	
I encourage students to design their own technology-based learning activities.		0.752
I incorporate technology in my teaching to such an extent that it has become a standard learning tool for my students.		0.919
I assign students to use the computer to do content-related activities on a regular basis.		0.837
I often require my students to use e-mail to complete their assignments.		0.733
Total	5.590	1.669
% of Variance	42.998	12.840
Cumulative %	42.998	55.838

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

4.5. Descriptive statistics and correlation analysis

Descriptive statistics were used to measure the means and standard deviation values of the study variables and if they fit the observed variables. Relatedly, a Pearson correlation coefficient was conducted to establish the nature and type of association between technological readiness and integration of digital technologies for teaching.

Results in **Table 4** show that the means and standard deviations fit the observed data. Thus, the mean for technological readiness is 2.28 and the standard deviation is 0.615. On the other hand, the mean for the integration of digital technologies is 2.14 and the standard deviation is 0.627. The Pearson correlation analysis results show a positive association between technological readiness and integration of digital technologies for teaching in government-aided primary schools ($r = 0.675^{**}$, $p < 0.01$). The constructs of technological readiness namely internet availability and access to IT infrastructure also had a positive association with the integration of digital technologies in teaching ($r = 0.534^{**}$, $p < 0.01$ and $r = 0.665^{**}$, $p < 0.01$

respectively). This therefore indicates that internet availability and access to IT infrastructure by teachers of primary schools are associated with integration of digital technologies for teaching, measured in terms of adoption of digital technologies and usage of digital technologies.

Table 4. Correlation coefficients.

Analysis	Mean	SD	1	2	3	4	5	6
Technological Readiness (1)	2.2785	0.61523	1					
Internet Availability (2)	2.2978	0.68112	0.885**	1				
Access to IT Infrastructure (3)	2.2593	0.70270	0.893**	0.581**	1			
Integration of digital technologies in teaching (4)	2.1426	0.62700	0.675**	0.534**	0.665**	1		
Adoption of digital technologies (5)	2.3551	0.67625	0.661**	0.560**	0.614**	0.939**	1	
Usage of digital technologies (6)	1.9300	0.66114	0.605**	0.440**	0.633**	0.936**	0.758**	1

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed)
Source: Primary data.

4.6. Regression analysis

The study employed a linear regression analysis shown in **Table 5** to confirm the hypothesis set earlier in this study. The study established the predictive potential of technological readiness on variance in integration of digital technologies. The rationale here included validating the set hypothesis (H1) which stated that technological readiness is positively and significantly associated with the integration of digital technologies. The results indicate that technological readiness was found to have a positive significant predicting power on integration of digital technologies (Beta = 0.675, sig = 0.000). This implies that technological readiness influences integration of digital technologies. Therefore, a change in technological readiness will bring about a (0.675) change in the integration of digital technologies. Technological readiness was also found to explain 45.3% of the variance in integration of digital technologies (Adjusted *R* Square = 0.453). This therefore validates the set hypothesis (H1) and also confirms what previous scholars assert [21,32] indicating that technological readiness is a significant predictor of integration of digital technologies for teaching in government-aided primary schools in Uganda as shown in **Table 5**. The significant regression results (Adj. $R2 = 0.453$, $p < 0.01$) suggest that technological readiness remains a critical predictor of integration, even if the effect size is marginally overestimated.

Table 5. Regression analysis coefficients.

Model		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		B	**Std. Error**	**Beta**		
1	(Constant)	0.574	0.140		4.095	0.000
	Technological Readiness	0.688	0.059	0.675	11.585	0.000

a. Dependent Variable: Integration of digital technologies in teaching.
R = 0.675[a]; *R* Square = 0.456; Adjusted *R* Square = 0.453; Sig = 0.000; SEE = 0.46382.
Source: Primary data.

5. Discussion of findings

The results of the study indicated a statistically significant positive relationship between technological readiness and the integration of digital technologies among educators in government-aided primary schools in Uganda. This research emphasizes the necessity for teachers to possess the requisite skills and support systems to effectively implement digital technologies within the classroom, thereby enhancing the overall efficacy of e-learning initiatives. The findings highlight the critical role of technological readiness, particularly in terms of access to information technology infrastructure and internet connectivity. It is suggested that when educators demonstrate a high level of technological readiness, there is a corresponding positive impact on their integration of digital technologies in instructional practices, which subsequently improves the utilization of such technologies in their classrooms.

These conclusions align with the findings of [32], who noted that teachers' technological readiness significantly affects their adoption and integration of e-learning. They argued that a lack of resources and support could hinder teachers' integration efforts, a sentiment echoed in this study's results. Additionally, this study corroborates the results of other researchers [8,21], who similarly found that technological readiness plays a significant role in the integration of digital technologies, reinforcing the notion that educational institutions must prioritize technological infrastructure and training for teachers to enhance educational outcomes.

Similarly, a study by [33] highlighted the critical role of teachers' technological self-efficacy in fostering the adoption of digital tools in education. The findings of this study align with these assertions, suggesting that when educators possess a high level of technological readiness, they are more likely to utilize digital technologies effectively in their teaching. In contrast however, a study by [27] highlighted that while technological readiness is essential, it is not the sole determinant of successful technology integration. They pointed out that pedagogical beliefs and teaching practices also play a crucial role. This perspective suggests that while enhancing technological readiness is vital, it must be complemented by professional development initiatives that focus on pedagogical strategies to effectively integrate technology into teaching. The interplay between technological readiness and pedagogical approaches could provide a more holistic understanding of the factors influencing technology integration in education.

6. Conclusion and recommendations

This investigation underscores the significance of technological readiness in the context of integrating digital technologies in teaching, specifically within government-aided primary schools, as framed by the Chapnick Readiness Model. Analysis of data collected from 335 primary school teachers in Uganda revealed that technological readiness is positively and significantly correlated with, and is a strong contributor to, the integration of digital technologies in educational settings.

From a theoretical perspective, this study extends the applicability of the Chapnick Readiness Model to the integration of digital technologies in government-aided primary schools in Uganda. Furthermore, it addresses gaps identified in the

existing literature regarding the limited research on technological factors that facilitate the integration of digital technologies in education. The findings confirm that technological readiness and its associated dimensions are substantial contributors to the effective integration of digital technologies in these educational institutions.

In practical terms, the study advocates for enhancing teachers' access to digital technologies infrastructure and internet connectivity, which is essential for the effective use of digital technologies in teaching. Stakeholders, including relevant governmental bodies such as the Ministry of Education and Sports and the National Information Technology Authority (NITA-U), should prioritize ensuring that educators have access to necessary technological resources. For instance, increased funding for the Ministry of Education and Sports and NITA-U could facilitate improved internet connectivity and access to IT infrastructure, thereby promoting the digitization of teaching in all government-aided primary schools across Uganda. The government of Uganda could enter into a public-private partnership with the private sector players in providing low-cost technology programs for primary schools.

7. Research implications

While this study presents valuable insights into the integration of digital technologies in teaching, it is not without its limitations, which warrant careful consideration when applying the findings. The cross-sectional design of the study may not adequately capture the dynamic nature of behavioral factors, which are known to evolve over time. Future research could benefit from employing longitudinal study designs. Additionally, the reliance on a quantitative structured questionnaire may restrict a comprehensive understanding of the variables involved. Therefore, subsequent studies might consider incorporating qualitative research methodologies to enrich the exploration of this topic and provide richer insights into the integration experience. Whereas the current study examined the influence of technological readiness on the integration of digital technologies in primary schools in Uganda, other confounding factors such as teacher training, curriculum design, psychological readiness, financial readiness, among others should not be ignored and hence can be investigated by future research.

Further, the 50.3% response rate and sample size reflect pragmatic challenges in low-resource educational research. While nonresponse bias may slightly inflate technological readiness estimates, the study's methodological rigor, demographic representativeness, and theoretical grounding lend credibility to its conclusions. Transparent reporting of these limitations enriches interpretations and guides future replication studies in similar contexts.

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