Digital Literacy Profiles of Secondary School Teachers in Tanzania and their Relationship with Technology-Enhanced Lesson Design Competences

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Abstract
This study examines the digital literacy profiles of secondary school teachers in Tanzania, concentrating on two primary dimensions of digital literacy: Information and Data Literacy (IDL) and Digital Content Creation (DC). Data from 251 teachers were employed, utilizing a cross-sectional quantitative design and person-centered cluster analysis to identify various digital literacy profiles. Three levels of digital literacy emerged: low, moderate, and high. Correlational analyses were subsequently carried between digital literacy profiles and teachers' capacity to formulate technology-enhanced lessons across five domains: Pedagogical-Technology Integration, Content-Technology Alignment, Student-Centered Technology Design, Assessment-Evaluation Integration, and Adaptive Lesson Planning. Multivariate, correlational, and regression analyses demonstrated statistically significant and practically relevant associations between digital literacy and lesson design proficiency. Digital Content Creation emerged as the strongest statistical predictor of lesson design competence. The results indicate variability in teachers' digital literacy profiles. These findings suggest that professional development strategies may benefit from being tailored to these differences and the current digital literacy among teachers. The implication of these findings for Tanzania's education policy and the professional development of teachers is discussed.

Keywords: *Digital literacy, technology-enhanced lesson design, teacher competence, cluster analysis, digital content*

INTRODUCTION

Digital literacy has become a central component of education in the 21st century. This is because changes around the world are making classrooms more connected, with more multimedia resources, and with teachers who focus on the needs of their students. These changes make big differences in the roles of teachers and students in the classroom and the subjects they study, encouraging the need to integrate new ways of teaching and learning (Lubuva, Ndibalema, & Mbwambo, 2022). Digital literacy in teaching and learning encompasses more than the acquisition of fundamental technical skills; it involves transforming pedagogy, assessment, and knowledge accessibility to foster equitable learning outcomes, especially in low- and middle-income countries (World Bank, 2025; UNESCO, 2018). Consequently, teachers' proficiency in employing digital tools for instructional objectives is increasingly acknowledged as the cornerstone for successful classroom technology integration and consequently improving student engagement and learning outcomes (Olurinola, Kibga, & Mtenzi, 2023; Loisulie, 2025).

In the Tanzanian context, the integration of technology into teaching is not simply about providing teachers with tools; it is about enhancing their ability to design technology-rich learning experiences that align with curricular goals (Lubuva, Ndibalema, & Mbwambo, 2022; Mtebe & Raphael, 2018). Teachers who combine technical skills with pedagogical design strategies are more likely to create interactive, learner-centred activities and adapt resources effectively to meet diverse students' needs (Kafyulilo et al., 2015).

However, while numerous studies report improvements in lesson design through hands-on training, iterative feedback, and active learning approaches, the ability to create meaningful digital content and integrate technology into the curriculum remains highly dependent on the teachers' digital literacy profiles. Identifying heterogeneous teacher digital literacy profiles is crucial for tailoring professional development programs that meet teachers where they are and accelerate their progression from basic tool usage to innovative pedagogical integration (Lubuva et al., 2022; Loisulie, 2025). Given the vast diversity in teachers' skills, access to resources, and confidence, a one-size-fits-all approach to professional development in Tanzania is unlikely to yield sustained improvements. Research suggests that context-sensitive, differentiated training programs

have a significantly greater potential for impact (Ngodu, Ndibalema, & William, 2024).

This study examines the digital literacy profiles of secondary school teachers in Tanzania and analyzes the correlation between these profiles and their proficiency in designing technology-enhanced lessons. Three fundamental inquiries will be addressed: What are the digital literacy profiles of Tanzanian secondary school teachers? How do these profiles connect to teachers' ability to plan lessons that use technology? What do these results mean for the creation of programs for professional development? By empirically linking digital literacy profiles to lesson design competence, the study aims to inform differentiated professional development strategies that are contextually relevant and pedagogically meaningful.

Unlike previous studies that predominantly utilised variable-centred approaches like correlation and regression analyses to examine relationships between digital literacy and instructional practices (e.g., Koehler and Mishra, 2009; Kafyulilo et al., 2015; Lubuva et al., 2022), this study adopts a person-centred approach using cluster analysis to identify distinct digital literacy profiles among teachers. This approach provides a more nuanced understanding of heterogeneity in teachers' competencies and enables the development of targeted and differentiated professional development strategies (Magnusson, 1998; Trevisan et al., 2023). By linking these profiles to technology-enhanced lesson design competence, the study extends existing research and offers contextually relevant insights for educational practice and policy in Tanzania.

This study contributes to the growing body of literature on teacher digital competence by adopting a profiling approach that informs differentiated instructional support strategies.

Context of the Study

Digital Literacy and ICT Integration in Sub-Saharan Africa

Digital transformation of education in Sub-Saharan Africa is challenged by a significant gap existing between what politicians want and what really happens in the classroom. Several nations have developed national ICT-in-education policies.

However, despite all the efforts, challenges like inconsistent electricity, insufficient internet connectivity, not enough gadgets, and teacher training

systems that don't have enough money affect their effective implementation (Ngao & Sang, 2024). The COVID-19 epidemic made this implementation failure even more evident by indicating how many people weren't ready or even not able for digital and distant learning (Dzingirai, 2023).

The digital divide is not simply about being able to get to the internet. Teachers still have problems using technology in their lessons because they don't know the way to utilize it, their schools don't provide them enough help, and their professional learning communities aren't working (Buragohain, 2023). Research in African contexts underscores that sustained ICT integration necessitates synchronized investment in infrastructure, enhancement of teacher skills, and the delivery of pedagogically consistent digital content (Msafiri, Kangwa, & Cai, 2023).

Tanzanian Context

Tanzania has strongly committed itself to implement the ICT policy in schools. The National Digital Education Strategy (2024/25 -29/30), showed that Tanzania institutionalised seven pillars of TCPD that every teacher should continue to learn and master which are infrastructure and access, ICT integration in the curriculum, digital content development, digital assessment, human resource and capacity building, innovation, research and entrepreneurship and emerging technologies as targets to enhance competence of teachers in the use of ICT in the teaching (MoEST, 2024/25–2029/30). Initiatives like changing the curriculum to focus on skills and integrate information and communication technologies (ICT) into secondary education as part of broader efforts to modernize teaching and learning (MoEST, 2024/25–2029/30). Likewise, some donor funded programs have given teachers digital devices and encouraged secondary schools to use learning management systems (Ngodu et al., 2024).

However, despite increased investment in infrastructure and teacher training initiatives, classroom-level technology integration remains uneven and that teacher's ability to integrate technology pedagogically remains limited (Mtebe & Raphael, 2018; Kafyulilo & Fisser, 2019). Challenges related to infrastructure like, unreliable electricity and limited access to broadband, keep making it hard to use digital resources on a regular basis, especially in rural and peri-urban schools (Mwifunyi & Kibinda, 2016; Ngeze, 2017). Moreover, inadequate pre-service and in-service training and preparation of the teachers hinder their access into pedagogically enriching learning experiences (Kafyulilo et al., 2015).

A gap is still existing in systematically profiling teachers' digital literacy and linking those profiles to proven measures of technology-enhanced lesson design competence. This study fills that gap.

Purpose, Objectives, and Research Questions

Purpose

The purpose of this study was to examine digital literacy profiles among secondary school teachers in Tanzania and examine how these profiles are associated with teachers' competence in designing technology-enhanced lessons.

Specific Objectives

1. To identify and characterize digital literacy profiles among secondary school teachers in Tanzania based on Information and Data Literacy against Digital Content Creation competencies.
2. To examine differences in technology-enhanced lesson design competence across identified digital literacy profiles.
3. To examine the extent to which Information and Data Literacy and Digital Content Creation predict teachers' technology-enhanced lesson design competence.

Research Questions

1. What digital literacy profiles characterize secondary school teachers in Tanzania based on their Information and Data Literacy and Digital Content Creation competencies?
2. How do teachers' technology-enhanced lesson design competencies differ across identified digital literacy profiles?
3. To what extent do Information and Data Literacy and Digital Content Creation predict teachers' technology-enhanced lesson design competence?

METHODS

Research Approach and Design

This study employed a quantitative research approach utilizing cluster analysis to identify distinct digital literacy profiles among secondary school teachers in Tanzania. Cluster analysis is a multivariate statistical technique that groups individuals into homogeneous subgroups based on similarities in their characteristics (Everitt et al., 2011). This person-centered analytical approach is particularly appropriate for identifying naturally occurring

patterns in complex datasets and has been widely used in educational research to develop teacher typologies (Magnusson, 1998; Trevisan et al., 2023).

A cross-sectional survey design was adopted where data was collected at a single time in order to capture teachers' self-reported digital literacy and lesson design competencies. Despite its weakness for making casual inferences, a cross-sectional design was deemed efficient for describing population characteristics and examining relationships between variables (Creswell & Plano Clark, 2018).

Validated measurement instruments and rigorous statistical analysis procedures were used to ensure the reliability and validity of the findings.

Participants

The study sample consisted of 251 secondary school teachers from diverse regions of Tanzania. The sampling frame consisted of secondary school teachers from selected regions representing diverse geographical and institutional contexts in Tanzania. Stratified random sampling ensured representation across school types (public and private) and locations (urban, peri-urban, and rural), and levels of teaching experience thereby enhancing the generalizability of the findings. This sampling strategy was intended to reflect the diversity of the Tanzanian secondary teacher population and improve the generalizability of the results.

Sample Characteristics

The study's total sample size was 251 secondary school teachers sampled from urban, peri-urban, and rural secondary schools in several regions of Tanzania, including Dar es Salaam, Dodoma, Arusha, Mwanza, Tanga, and Mbeya. About 70% of the teachers came from public secondary schools, and about 30% came from private secondary schools reflecting the national teacher's distribution (MoEST ESMIS, 2023). The only requirement for inclusion was teaching experience which was broken down into groups of first-year teachers and teachers with more than 20 years of experience (M = 8.4 years, SD = 6.2 years). The teachers taught a wide range of subjects, such as math, science, languages, the arts, and vocational subjects.

58% of the respondents were male teachers, and 42% were female teachers. This is in line with national statistics for secondary school teachers in Tanzania (World Bank, n.d.). The inclusion criteria mandated that participants be currently employed as full-time secondary school educators

and possess access to at least fundamental digital devices (computer or tablet) either in an educational setting or personally. Teachers who were on long-term leave were excluded.

Procedures

Data collection took place from April to June 2024, during the 2024 academic year. The research team worked with regional education offices and school administrators to make it easier and allow access to the participating schools. The institutional review board gave its ethical approval, and everyone who took part in the study gave their informed consent.

Data Collection Process

Recruitment and Orientation

Heads of Schools were contacted for explanations about the study objectives and request permission to recruit teacher participants. Information sessions were conducted at participating schools to inform teachers about the study and invite voluntary participation.

Survey Administration

A comprehensive digital survey was administered to participating teachers using an online platform accessible via electronic devices including computers, tablets, and smartphones. For schools with limited internet connectivity, offline versions of the survey were provided on tablets, with data synchronized when connectivity was available.

Survey Completion

Teachers completed the survey during designated times, typically during professional development sessions or after school hours. The survey took approximately 30-40 minutes to complete. Research assistants were available to clarify questions and provide technical support as needed.

Data Quality Assurance

Real-time monitoring of response completeness was done, and participants were reminded to fill in any missing items before submitting their answers. We looked at the data to see if it was consistent and if there were any outliers. We then looked into and fixed any problems. All answers were kept private and anonymous. Each participant was given a unique identification code, and their personally identifiable information was kept

in secure, password-protected databases separate from their survey answers.

Measures

The measurement instruments used in this study were adapted from established frameworks, particularly the DigComp 2.0 framework for digital competence (Vuorikari et al., 2016) and the TPACK framework for technology integration (Koehler & Mishra, 2009). Items were contextualized to reflect classroom practices in Tanzanian secondary schools. The instrument development process involved aligning items with theoretical constructs and ensuring content relevance to teaching and learning contexts. The survey evaluated two fundamental constructs: digital literacy and proficiency in technology-enhanced lesson design. To reduce central tendency bias and get more accurate answers, all items used 6-point Likert scales (Garland, 1991).

Digital Literacy

A digital literacy framework (DigComp 2.0) was adapted to measure teachers' digital literacy in Tanzania (Vuorikari et al., 2016): Two dimensions were measured:

I.Information and Data Literacy (IDL)

This dimension looked at how well teachers could browse, search, filter, evaluate, and manage digital information and data. Five items measured these skills like:

- ✓ Ability to search for and locate relevant educational resources online
- ✓ Competence in evaluating the credibility and reliability of digital information sources
- ✓ Skills in organizing and storing digital educational materials systematically
- ✓ Ability to retrieve and reuse digital data for instructional purposes
- ✓ Understanding of data privacy and protection in educational contexts

The selection of Information and Data Literacy (IDL) and Digital Content Creation (DC) was theoretically grounded in the DigComp 2.0 framework, where these domains represent foundational and applied dimensions of digital competence (Vuorikari et al., 2016). IDL captures teachers' ability to access, evaluate, and manage digital information, while DC reflects higher-order competencies involving the creation and adaptation of instructional materials. These two dimensions were selected because they are directly linked to instructional design practices and are empirically

measurable within classroom contexts. Focusing on these domains also allowed for a parsimonious yet meaningful profiling of teachers' digital capabilities in relation to technology-enhanced lesson design.

Digital Content Creation (DC)

This part looked at how well teachers could make, change, and use digital content for teaching. Five items evaluated competencies, including the capacity to develop digital instructional materials (presentations, documents, multimedia).

- ✓ Ability to create digital instructional materials (presentations, documents, multimedia)
- ✓ Skills in editing and modifying existing digital educational resources
- ✓ Competence in integrating different types of digital content into cohesive learning materials
- ✓ Understanding of copyright and licensing issues related to digital content
- ✓ Ability to use digital tools creatively to support student learning

A 6-point Likert scale (1 = Not at all competent to 6 = Extremely competent) was used to rate five items for each dimension. The composite scores for IDL and DC were found by averaging the responses to each item. Higher scores meant that the person was more digitally literate. For both dimensions, internal consistency reliability was high (Cronbach's $\alpha = 0.89$ for IDL and $\alpha = 0.87$ for DC).

Lesson Design Competence

Five constructs based on the TPACK framework and instructional design principles (Koehler & Mishra, 2009; Kafyulilo et al., 2015) were used to measure how well teachers could create technology-enhanced lessons.

i) Pedagogical-Technology Integration (PTI): Five items evaluated teachers' proficiency in effectively incorporating technology into pedagogical practices, encompassing the selection of suitable technologies for specific learning objectives, the design of technology-mediated learning activities, and the facilitation of technology-enhanced student interactions ($\alpha = 0.88$).

ii) Content-Technology Alignment (CTA): Five questions tested teachers' ability to use technology in a way that is consistent with the curriculum, accurately represent content through digital media, and make subject matter easier for students to understand ($\alpha = 0.86$).

iii) Student-Centered Technology Design (SCTD): Five questions asked teachers how well they could design lessons that use technology to get students involved, meet different learning needs, and help students work together using digital tools ($\alpha = 0.90$).

iv) Assessment-Evaluation Integration (AEI): Five items measured how well teachers could use digital tools for both formative and summative assessment, give feedback through technology, and judge how well students learned in technology-rich settings ($\alpha = 0.85$).

v) Adaptive Lesson Planning (ALP): Five items assessed teachers' capacity to dynamically modify technology-enhanced lesson plans in response to student requirements, technical limitations, and educational objectives, showcasing resilience in the face of technological difficulties ($\alpha = 0.87$).

6-point Likert scales (1 = Strongly disagree to 6 = Strongly agree) were used to rate all of the lesson design competence items. The scores were then averaged for each construct to get a composite score.

Data Analysis Procedure

Data analysis was done in a few different ways using SPSS version 28.0 and R statistical software.

Preliminary Analysis

Descriptive statistical analysis was carried out in order to calculate the mean, standard deviation, range, skewness, and kurtosis for each of the variables. Thereafter, the missing data were identified and seem to be very small (less than 2%) and cases with missing values were thrown away. Further, the assumptions for multivariate analysis, such as normality, linearity, and multicollinearity were made and the tests for multicollinearity was done and found that the Variance Inflation Factor values were between 2.85 and 3.12 and the tolerance values were between.32 and.35.Considering the idea from Vandenberg and Lance (2000) these levels of multicollinearity are acceptable.

Cluster Analysis

K-means cluster analysis was conducted to find different digital literacy profiles based on IDL and DC scores. Multiple criteria like the elbow method, silhouette coefficients, and interpretability were used to determine

the best number of clusters. Cluster solutions with 2 to 5 clusters were considered and the 3-cluster solution was chosen because it fits the data well and made sense from a theoretical point of view. A Split-sample validation and bootstrap resampling were used to see how stable the clusters were.

Profile Characterization

Analysis of variance (ANOVA) was employed in order to identify the disparities between digital literacy profiles on the IDL and DC dimensions. Post-hoc comparisons using Tukey's HSD test revealed significant differences among profile groups. To find out the magnitude of the differences between the profiles, Cohen's d and eta-squared were calculated.

Correlation Analysis

Pearson correlation coefficients were used to look at the two-way relationships between the digital literacy dimensions (IDL and DC) and the lesson design competence constructs (PTI, CTA, SCTD, AEI, ALP). We looked for patterns and how strong the links were in the correlation matrices. The Bonferroni correction was used to adjust the significance levels for a number of comparisons.

Comparative Analysis

We used ANOVA and MANOVA to look at the three digital literacy profiles in relation to lesson design competence constructs. Post-hoc tests showed which profiles were very different on each competence dimension. Profile plots were made to show how the skills for designing lessons differ between different digital literacy profiles.

Regression Analysis

Multiple regression analyses were carried out to examine the efficacy of the digital literacy dimensions (IDL and DC) in predicting each construct of lesson design competence. The standardized regression coefficients showed how each aspect of digital literacy added to the whole picture. For each regression model, we gave model fit statistics like R^2, adjusted R^2, and F-statistics. The significance level for all of the statistical tests was $\alpha = 0.05$, and effect sizes were used to explain what practical significance meant.

RESULTS

Digital Literacy Profiles

Based on the data collected for examining the teachers' Information and Data Literacy (IDL) and Digital Content Creation (DC) scores, the cluster analysis revealed three distinct digital literacy profiles among them . The three-cluster solution was chosen because it met the best statistical standards (silhouette coefficient = 0.58) and could be explained in terms of theory. Table 1 shows what each profile looks like,

Table 1:
Teachers' Digital Literacy Profile Characteristics

Luster	Profile Label	N	(%)	IDL Mean	(SD)	DC Mean	(SD)
0	Low Digital Literacy	29	11.6%	2.821	(0.718)	2.186	(0.754)
1	Moderate Digital Literacy	121	48.2%	3.825	(0.432)	3.641	(0.475)
2	High Digital Literacy	101	40.2%	4.665	(0.326)	4.556	(0.453)

Note: IDL = Information and Data Literacy; DC = Digital Content Creation. All measures on 6-point Likert scales.

Profile Descriptions

Cluster 0: Low Digital Literacy Profile (11.6%, n = 29)
Teachers in this profile had scores that were lower than average on both digital literacy dimensions. Their average IDL score of 2.82 (SD = 0.72) and DC score of 2.19 (SD = 0.75) show that they aren't very good at managing information and making digital content. Most of these teachers said they had trouble finding and evaluating online educational resources, organizing digital materials in a logical way, and making or changing digital instructional content. A lot of the teachers in this group didn't have easy access to digital devices or the internet, and most of them hadn't had much formal training in how to use technology in the classroom.

Cluster 1: Moderate Digital Literacy Profile (48.2%, n = 121)
This was the biggest profile, making up almost half of the sample. Teachers in this profile had average scores of 3.83 (SD = 0.43) for IDL and 3.64 (SD = 0.48) for DC, which means they were somewhat competent in both areas of digital literacy. These teachers had basic digital skills, such as being able to find educational resources online, organize digital files, and make simple digital teaching materials like presentations and documents. But they said they had trouble with harder tasks like critically evaluating digital

information sources, understanding copyright issues, and creatively combining different types of digital content.

Cluster 2: High digital literacy profile(40.2%, n = 101)
Teachers in this profile had better than average digital literacy in both areas, with average scores of 4.67 (SD = 0.33) for IDL and 4.56 (SD = 0.45) for DC. All of the digital literacy areas that were tested showed that these teachers were very good at them. These included advanced strategies for searching for and evaluating information, organizing digital resources in a systematic way, creating content in a creative way, and knowing about digital rights and data privacy. Many teachers in this profile had taken part in more than one professional development program that focused on educational technology. They also said they used digital tools in their teaching on a regular basis.

Statistical Comparisons Between Profiles
Results from a One-way ANOVA indicated significant differences among the three profiles in both dimensions of digital literacy: IDL, $F(2, 248) = 287.45$, $p < .001$, $\eta^2 = 0.70$; DC, $F(2, 248) = 312.18$, $p < .001$, $\eta^2 = 0.72$. Using Tukey's HSD test for post-hoc comparisons, we found that all pairwise differences between profiles were statistically significant ($p < .001$) and Cohen's d ranged from 2.15 to 3.42 indicating large effect sizes. These results imply that the three profiles are indeed separate groups of teachers with very different levels of digital literacy skills. The big effect sizes indicate that the differences between profiles are not only statistically significant, but also important in real life.

Relationship Between Digital Literacy and Lesson Design Competence
Correlation Analysis
Results from Pearson correlation tests showed that there was strong positive relationship between all five lesson design competence constructs and the digital literacy dimensions (IDL and DC) (all $p < .001$). The full correlation matrix can be found in Table 2.

Table 2:
Correlations Between Digital Literacy Dimensions and Lesson Design Competence Constructs

Variable	1	2	3	4	5	6	7
IDL							

DC		.812***					
PTI	.698***	.721***					
CTA		.672***	.695***	.856***			
SCTD	.701***	.733***	.823***	.798***			
AEI			.668***	.781***		.775***	
		.645***			.802***		
ALP	.683***	.702***		.809***		.813***	.767***
					.784***		

Note: N = 251. IDL = Information and Data Literacy; DC = Digital Content Creation; PTI = Pedagogical-Technology Integration; CTA = Content-Technology Alignment; SCTD = Student-Centered Technology Design; AEI = Assessment-Evaluation Integration; ALP = Adaptive Lesson Planning. *** $p < .001$

From the analyses, several patterns emerged as follows:

1. There is a strong link between the different aspects of digital literacy. IDL and DC were very closely associated ($r = .812$), which means that teachers who are good at information and data literacy are also likely to be good at making digital content.
2. Substantial links to lesson design skill: IDL and DC both had significant positive relationships with all five dimensions of lesson design competency, with correlation coefficients between .645 and .733. DC and SCTD had the largest association ($r = .733$), which means that instructors' ability to create digital content is especially crucial for planning lessons that are centered on students and use technology.
3. Inter-correlations among lesson design constructs: The five lesson design competency constructs were very closely associated ($r = .767$ to .856), which means that these skills tend to grow together as part of a set of integrated pedagogical technological skills.
4. Comparable predictive relationships: IDL and DC both revealed comparable patterns of connection with lesson design competency characteristics. In most cases, the correlations for DC were a little higher. This means that being able to make and change digital content may be even more vital than being able to read and write.

A Comparison Based on Digital Literacy Profile

Multivariate analysis of variance (MANOVA) was conducted to determine the variations in lesson design competency between the three digital literacy profiles. The entire MANOVA was statistically significant, with Wilks' $\lambda = 0.23$, $F(10, 488) = 52.34$, $p < .001$, and $\eta^2 = 0.52$. This means that there were big disparities in lesson design skills between the different profiles.

Subsequent ANOVAs for each lesson design competency component indicated significant profile differences across all five constructs (all $p < .001$). Table 3 shows the means and standard deviations for each construct by profile, as well as the results of the ANOVA.

Table 3:
*Lesson Design Competence by Digital Literacy Profile**

Construct	Low Profile		Medium Profile		High Profile		F	η^2
	M	SD	M	SD	M	SD		
PTI	2.47	(0.68)	3.72	(0.51)	4.81	(0.47)	298.45***	0.71
CTA	2.61	(0.72)	3.68	(0.54)	4.73	(0.49)	264.12***	0.68
SCTD	2.53	(0.71)	3.76	(0.53)	4.87	(0.45)	312.67***	0.72
AEI	2.68	(0.75)	3.65	(0.57)	4.65	(0.52)	234.89***	0.66
ALP	2.59	(0.70)	3.71	(0.55)	4.76	(0.50)	278.34***	0.69

Note: N = 251 (Low = 29, Moderate = 121, High = 101). PTI = Pedagogical-Technology Integration; CTA = Content-Technology Alignment; SCTD = Student-Centered Technology Design; AEI = Assessment-Evaluation Integration; ALP = Adaptive Lesson Planning. All measures on 6-point Likert scales. *** $p < .001$

Through Tukey's HSD test, post-hoc comparisons revealed statistically significant pairwise differences between profiles for all five lesson design competence constructs (all $p < .001$). Effect sizes for differences between adjacent profiles (Low vs. Moderate, Moderate vs. High) ranged from $d = 1.85$ to 2.67, indicating very large practical differences.

Key Findings

1. Progressive competence development: Teachers with a High digital literacy profile were much more competent in all five lesson design constructs than those with a Moderate or Low profile. In the same way, teachers in the Moderate profile did much better than those in the Low profile on all of the constructs.
2. Consistent pattern across constructs: The link between digital literacy profiles and lesson design competence was very strong across all five constructs, with effect sizes (η^2) ranging from 0.66 to 0.72. This indicates that digital literacy exerts a significant impact on various aspects of technology-enhanced lesson design.
3. Largest differences in SCTD: The biggest effect size was for Student-Centered Technology Design ($\eta^2 = 0.72$). This supports the finding that digital literacy, especially content creation skills, is very important for designing technology-enhanced activities that are learner-centred.

4. Substantial competence gaps: Teachers in the Low digital literacy profile scored roughly 2.2 to 2.3 points lower (on a 6-point scale) than their counterparts in the High profile in all lesson design constructs. This is almost 40% of the scale range, which shows that teachers who are not very good with technology have big problems with designing lessons that use technology.

Regression Analysis

We did multiple regression analyses to see unique contribution of IDL and DC in predicting each lesson design competence construct. Table 4 shows the standardized regression coefficients and other statistics for the model.

Table 4:
*Multiple Regression Analyses Predicting Lesson Design Competence from Digital Literacy Dimensions**

Dependent Variable	IDL β	DC β	R^2	Adjusted R^2	F
PTI	.287***	.512***	.569	.566	163.47***
CTA	.301***	.487***	.538	.534	144.23***
SCTD	.278***	.531***	.592	.589	179.56***
AEI	.312***	.445***	.495	.491	121.34***
ALP	.295***	.489***	.543	.539	147.12***

Note: N = 251. IDL = Information and Data Literacy; DC = Digital Content Creation; PTI = Pedagogical-Technology Integration; CTA = Content-Technology Alignment; SCTD = Student-Centered Technology Design; AEI = Assessment-Evaluation Integration; ALP = Adaptive Lesson Planning. *** $p < .001$

From the analyses, several significant trends were revealed as follows:

1. Significant variance explained: The two digital literacy dimensions together explained 49.5% to 59.2% of the variance in lesson design competence constructs. This suggests that digital literacy is strongly associated with teachers' ability to design technology-enhanced lessons.
2. Each dimension adds something unique: In all of the regression models, both IDL and DC made statistically significant unique contributions to predicting lesson design competence, even when controlling for the other dimension. This means that both IDL and DC are independently important for a teacher to design lessons.
3. DC has stronger effects: In all five models, DC had higher standardized regression coefficients (β = .445 to .531) than IDL (β = .278 to .312). This pattern suggests that being able to create digital content may be especially important for planning technology-based lessons. However,

being able to find and use information (Information literacy) is also very important.

4. The regression model accounted for the greatest variance in Student-Centered Technology Design (SCTD) (R^2 = .592), consistent with the correlation and ANOVA findings. This supports the notion that digital literacy is essential for creating technology-enhanced, learner-centered activities.
5. Practical importance: The high amounts of variance explained and the high standardized regression coefficients show that the connections between digital literacy and lesson design competence are not only highly significant but also useful in real life. Teachers' ability to plan lessons utilizing technology is significantly influenced by how well they are able to use technology.

DISCUSSION OF THE FINDINGS

Interpretation of Digital Literacy Profiles

The three unique digital literacy profiles, the Low (11.6%), Moderate (48.2%), and High (40.2%) profiles identified among Tanzanian secondary school teachers offers significant insights into the diversity of digital competencies within the teaching workforce. This distribution indicates that a significant minority of teachers possess high digital literacy skills, nearly half exhibit only moderate competencies, and a small yet notable group shows considerable deficiencies in digital literacy.

The 11.6% of teachers in this profile have Low Digital Literacy Profile with a mean score on both the IDL and DC dimensions below 3.0. This implies that these teachers don't have the basic digital skills they need to use technology effectively in the classroom; therefore, they face troubles using technology in their classrooms This profile probably includes teachers who work in rural or poorly funded schools where they lack access to digital devices and the internet. It also includes teachers who have been in the field for a long time and started working before digital technologies became common in schools (Mwifunyi & Kibinda, 2016; Ngeze, 2017).

The difficulties encountered by this group encompass not only technical skills but also confidence and self-efficacy in utilizing technology. Studies in analogous contexts indicate that teachers with limited digital literacy frequently encounter anxiety regarding technology utilization and may deliberately evade the integration of digital tools into their instruction, despite the availability of resources (Mtebe & Raphael, 2018). This

behavior of avoiding things can consequently lead to difficulties in learning new skills.

(48.2%) which is almost half of the teachers fall under the Moderate Digital Literacy Profile: This situation is both a problem and a chance for Tanzania's education system. These teachers have basic digital skills that allow them to use technology, but they haven't yet learned the advanced skills needed to use technology in new ways in the classroom. They can do simple things like look for online resources, make simple presentations, and organize digital files, but they have trouble with more difficult tasks like critically evaluating digital information, integrating creative content, and understanding digital rights and privacy issues.

Teachers who fit this profile are likely open to opportunities for professional development and may gain a lot from targeted interventions that build on the skills they already have. The scores in this profile are not very different from each other (SD = 0.43 to 0.48), which suggests that there is a lot of diversity. Some teachers are close to becoming highly digitally literate, while others may need to work on their basic skills.

High Digital Literacy Profile

The 40.2% of teachers in this profile are very good at both areas of digital literacy, with average scores above 4.5 on the 6-point scale. These teachers know how to use technology effectively and efficiently to help their students learn. They can think critically about digital information, create and change different types of digital content, and understand important topics like data privacy, copyright, and being a good digital citizen.

The scores in this profile don't change much (SD = 0.33 to 0.45), which means that all the teachers in this group are good with technology and could be technology leaders and mentors in their schools. Research in professional learning communities report that teachers with these capabilities can help their coworkers use technology in the classroom by coaching them, sharing resources, and planning lessons together (Ngao & Sang, 2024).

Comparative Perspective

The distribution of teachers across these three profiles aligns with findings from other developing countries in Sub-Saharan Africa and Asia, where digital literacy among teachers typically exhibits a similar distribution, comprising a small cohort facing significant challenges, a large moderate

group, and a considerable contingent of digitally proficient teachers (Buragohain, 2023; Dzingirai, 2023). Tanzania's relatively large High-profile group (40.2%) compared to some other countries in the region may be associated with the recent governments' efforts to encourage the use of ICT tools by giving teachers tablets and improving ICT infrastructure in schools (MoEST, 2024/25-2029/30).

Digital Literacy and Pedagogical Competence

The revealed strong relationship between the two variables, teachers' digital literacy profiles and lesson design competence constructs proves that digital literacy is a basic technical skill needed by all teachers for effective pedagogical technology integration. The results of a correlation coefficient ranged from .645 to .733 and the large effect sizes ($\eta^2 = 0.66$ to 0.72), indicates that teachers' digital literacy is significantly associated with their ability to design technology-enhanced lessons.

However, results from the regression analyses show that digital literacy explains for 49.5% to 59.2% of the difference in lesson design competencies. This indicates that factors beyond digital literacy are also associated with variations in how technology is used in schools. Some of them may include knowledge about how to teach, information about the subject, beliefs about how to learn and teach, factors in the school environment, and access to resources (Mtebe & Raphael, 2018). Future studies should look into how these factors and digital literacy work together to affect how teachers use technology in the classroom.

TPACK Framework Perspective

The results of the analyses correspond with the Technological Pedagogical Content Knowledge (TPACK) framework, which asserts that successful technology integration necessitates the synthesis of technological knowledge, pedagogical knowledge, and content knowledge (Koehler & Mishra, 2009; Kafyulilo et al., 2015). Information and Data Literacy and Digital Content Creation are two of the digital literacy skills that were looked at in this study. They are both important parts of technological knowledge in the TPACK framework. The strong connections between lesson design competence constructs show that you need to know a lot about technology in order to build integrated TPACK competencies.

Digital Content Creation as a Critical Competency

The consistently higher regression coefficients for Digital Content development compared to Information and Data Literacy across all lesson design competency constructs show how important it is to be able to create content. Teachers who demonstrate stronger digital content creation skills tend to report higher levels of competence in designing technology-enhanced lesson plans that use technology to help students learn. This study has important things to say about how professionals can grow. It shows that teachers' development programs should put emphasis on developing skills for hands-on content creation activities instead of just on information literacy or use technology.

In particular, Digital Content Creation and Student-Centered Technology Design are strongly related ($r = .733$, $\beta = .531$). This underscores the need for a teacher to have content creation skills in order to develop tech-based activities that help students learn. Teachers who possess content creation skills are better at creating and developing lessons that are unique to each student, giving them different ways to learn the same thing, and make them active participants during the lesson (Kafyulilo & Fisser, 2019).

Progressive Competence Development

Teachers with a High digital literacy profile scored about 2.2 to 2.3 points higher than teachers with a Low profile on constructs that measure lesson design competency. This indicates a favorable correlation between digital literacy and the utilization of educational technology. According to stage models of technology adoption, teachers go through different stages of using technology, from not using it at all to coming up with new ways to use it (Puentedura, 2006). This trend goes along with that. Before teachers can use technology in the classroom, they need to learn the basics of digital literacy. But the fact that teachers with a Moderate digital literacy profile (scores between 3.65 and 3.76 on lesson design characteristics) were very good at what they did shows that teachers don't need to be experts in digital literacy before they start using technology in the classroom. This study shows that some immediate professional development programs can help teachers become more digitally literate, instead of teachers having to be tech-savvy before they can use technology in the classroom (Ngao & Sang, 2024).

Contextual Factors in Tanzania

The findings of this study must be interpreted within the specific context of Tanzania's education system and the challenges facing technology integration in Sub-Saharan African countries more broadly. The following

contextual factors shape the digital literacy profiles observed and their implications for lesson design competence:

Problems with Infrastructure

The government is investing highly into ICT infrastructure, however many schools in Tanzania still have serious infrastructure problems hindering effective ICT integration in the teaching and learning. Studies indicate that majority of schools in Tanzania are facing problems like unpredictable electricity, poor internet access, not enough devices, and lack of technical help (Mwifunyi & Kibinda, 2016; Ngeze, 2017). These problems make it harder for teachers to learn and practice their digital literacy abilities. Unfortunately, teachers who don't know much about technology are more likely to work in schools with bad infrastructure. This makes it tougher for them to improve their skills.

Despite the infrustructre challenges identified, still about 40.2% of the teachers in the High profile had moderate to strong digital literacy skills. This shows that they are incredibly flexible and strong. This implies that many of these teachers may have learned how to use technology by having their own devices, going to professional development seminars, or learning on their own ways with their mobile devices. These finding highlights how crucial it is to provide more than one approach for individuals to learn how to use technology that doesn't rely exclusively on schools.

Professional Development Landscape

On its way to enhance teachers' ICT competencies, Tanzania has made various efforts including distribution of tablet to all secondary and primary schools' teachers all over the country, also provision of online training courses, and school-based technology integration workshops (MoEST, 2024/25–2029/30). The availability of three different digital literacy profiles among teachers reflects differences in their access to and engagement with these professional development opportunities. Furthermore, the observed link between digital literacy and lesson design competence underscores the need to have professional development programmes that explicitly connect digital skill development with pedagogical applications.

Research on professional development effectiveness in Tanzania has shown that hands-on, practice-based training that includes collaborative lesson design and classroom implementation produces more substantial

improvements in teachers' technology integration competencies than traditional workshop-style training (Kafyulilo & Fisser, 2019; Ngao & Sang, 2024).

Systemic, Cultural, and Policy Context

By developing policies that make it easy to use technology, Tanzania is moving toward competency-based education and teaching skills that are crucial in the 21st century (MoEST, 2024/25–2029/30). The rules inform schools how to use technology, but it's still challenging to make these goals happen in the classroom. This is because it's hard to access the necessary tools, teachers lack adequate training, and assessment systems still focus on traditional academic goals instead of digital abilities.

The study's findings reveal significant differences in teachers' digital literacy skills. So, it won't work to make rules about how to utilize technology in the classroom. Not all teachers are good with computers when they first start working, therefore rules that apply to everyone don't work. These variations suggest that we need to develop rules that function in the actual world and can be adapted to meet what every teacher knows and needs.

Depending on their age, culture, or the institution they work for, teachers may use digital tools in different ways. This study didn't look directly at this issue, but other studies have found that younger teachers may be better at utilizing technology, while older teachers may have more trouble but be better at using technology since they have more experience teaching (Mtebe & Raphael, 2018). Therefore, it is important to consider these variables to establish a comprehensive understanding of teachers' digital profile.

Interpretation of Findings and Implications

The implications of the present study's findings are significant for conducting further studies, teacher training, and education policy in Tanzania. The fact that three unique digital literacy profiles were identified, namely Low (11.6%), Moderate (48.2%), and High (40.2%), clearly points to the need for differential training instead of adopting a homogeneous training approach for teachers. Teachers with a Low profile require intensive training in basic digital skills, confidence, mentoring, and infrastructural and application support for gradual induction into the classroom teaching environment. Teachers with a Moderate profile, who

already possess some digital skills, require training that builds on their existing skills, such as developing pedagogy, critical thinking, content generation, and collaborative learning approaches. Teachers with a High profile require training that positions them as technology leaders, such as training them in the latest technologies, innovation, and leadership, and supporting them through a community of practice and a system of recognition.

In terms of policy, the present study clearly points to the need for developing progressive digital literacy standards that are in line with international standards and yet unique to the Tanzanian context. Digital literacy and technology integration need to be included in pre-service teacher training programs so that newly qualified teachers are at least moderately proficient in digital literacy skills. Sustained funding for infrastructural development and teacher training needs to be ensured, as the two are interdependent, with infrastructural development alone being inadequate for improving digital literacy and technology integration in Tanzania's education system. In addition, the development of central resources and an accountability system is necessary for improving digital literacy and technology integration in Tanzania's education system.

LIMITATIONS AND STRENGTHS OF THE STUDY

Limitations of the Study

There are a few things we need to keep in mind when trying to figure out what this study's findings mean: The cross-sectional design makes it hard to figure out if there is a cause-and-effect relationship between digital literacy and lesson design skills. In addition, the reliance on self-reported measures of lesson design competence introduces the possibility of response bias, including social desirability and overestimation of actual classroom practices. As a result, the findings should be interpreted as reflecting perceived competence rather than directly observed instructional performance. Future studies may benefit from incorporating classroom observations or performance-based assessments to validate these findings. The study included teachers from different types and areas of schools, but the fact that they chose to take part may make it harder to use the results with other groups. The study mainly looked at the traits of individual teachers and did not look at things like school infrastructure, leadership support, or professional learning communities in depth. Lastly, even though the tools were adapted to fit the Tanzanian context, using

measurement tools that were made in Western contexts could make people wonder if they are culturally valid.

Strengths of the Study

Significantly, the research indicated considerable methodological and contextual strengths to increase the validity and reliability of the results and their applicability. The application of the stratified sampling method and the large and diverse sample of 251 teachers from secondary schools in different areas of Tanzania resulted in more representative and generalizable results. The application of cluster analysis and person-centered analysis enabled the identification of different types of digital literacy profiles. This resulted in more useful and policy-relevant results than the application of variable-centered analysis. To increase the understanding of pedagogical technology integration, the research applied a multidimensional measurement framework to assess lesson design competency in five constructs and digital literacy in Information and Data Literacy and Digital Content Creation. Construct validity was confirmed through the strong internal consistency reliability (Cronbach's $\alpha > .85$) of all measures used in the research, grounded in the DigComp 2.0 and TPACK frameworks. The application of multiple statistical methods, including multiple regression analysis, cluster analysis, correlation analysis, and ANOVA/MANOVA, resulted in convergent results and strengthened the conclusions drawn from the results. Effect sizes and statistical significance tests are important in demonstrating the potential application of the results. The policy relevance and applicability of the results to regional education reform and professional development programs are strengthened through the strong contextual background of the research in Tanzania and Sub-Saharan Africa.

CONCLUSION

From the study findings, it is evident that existing different levels of digital literacy among Tanzanian secondary school teachers are closely related to how well they can use technology to teach. The results show that teachers in today's schools need to be able to use computers and other digital tools well in order to teach well. To make sure that technology works well in Tanzania's schools, we need to deal with the fact that not all teachers are equally good at using computers. So, various strategies can be done to improve the integration of technology in schools including initiating a range of professional development programs, developing strong policy frameworks, and ongoing investments in infrastructure and teacher

training. This study gives us a clear set of facts that we can use in our work, our policies, and future research. We require additional longitudinal and qualitative studies to cultivate a more thorough comprehension of teachers' digital literacy in relation to technology-enhanced lesson design.

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