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ICT INTEGRATION EXTENT IN GHANA'S CIVIC EDUCATION DELIVERY EXPLAINED THROUGH THE CIVIC EDUCATION TECHNOLOGY ADOPTION FRAMEWORK

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ABSTRACT

Aim/Purpose	Civic education is a cornerstone of democratic governance; yet in Ghana, its delivery remains largely technology-free despite a decade-long mandate from the national ICT policy. This study investigates how far the National Commission for Civic Education (NCCE) has integrated Information and Communication Technology (ICT) into its field-level delivery, and why ICT integration remains limited.
Background	Ghana's 2015 ICT Education Policy requires ICT integration across all educational sectors, including non-formal civic education. Even so, no empirical baseline for ICT integration in NCCE's 261 district offices exists. The Civic Education Technology Adoption (CETA) Framework was developed by extending Technological Pedagogical Content Knowledge (TPACK) with an infrastructure needs assessment component to account for resource constraints that standard TPACK does not capture.
Methodology	We surveyed 165 civic educators, randomly selected from 45 districts across three geographical zones with a validated questionnaire (a = 0.71). In-depth interviews were conducted by adopting a semi-structured interview protocol with 22 participants. Ordinal logistic regression was employed to test predictors of

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	ICT use, whilst thematic analysis was utilised to explore barriers to civic education using ICT.
Contribution	The TPACK Framework was extended to include a needs assessment component, known as the CETA Framework. ICT usage in the selected districts across the three geographical zones was found to be low. Social media was found to be the primary ICT platform for civic education delivery across 45 districts in Ghana.
Findings	The use of ICT integration was predominantly low (72.4% probability of the "low use" category; ordinal logit: Tools index $\beta = 0.695$, $p = .003$), and social media (e.g., WhatsApp, Facebook) were the primary ICT tools for integration. Moreover, infrastructure (devices and Internet) and training were severely lacking, and minimal ICT integration was found despite policy mandate. These findings were attributable to infrastructure deficits and pedagogical capacity gaps.
Recommendations for Practitioners	The ICT department at the headquarters of NCCE should conduct an infrastructure audit across all 45 districts using the CETA framework dimensions. Also, a pilot WhatsApp-based civic education programme in 10 low-connectivity districts is recommended to evaluate its influence on target communities in those districts. In addition, ICT coordinators of NCCE should establish quarterly Technological Knowledge/Pedagogical Knowledge (TK/PK) training using a cascade model (train district coordinators → train staff). A final recommendation to practitioners is to launch the 'Civic Educator Digital Champions' programme to recognize innovative ICT integration.
Recommendations for Researchers	Future research should adopt an experimental design to focus on Technological Knowledge/Pedagogical Knowledge Training (TK/PK workshops) and on infrastructure (devices + connectivity) to establish causal pathways and identify cost-effective interventions.
Impact on Society	Integration of ICT, specifically with social media platforms, needs to be encouraged to increase participation and the extent of ICT integration. Civic educators also need to intensify the integration process to encourage citizen participation in good governance in Ghana.
Future Research	Future research should adopt an experimental design and randomly assign districts to Control, Training-only (TK/PK workshops), Infrastructure-only (devices + connectivity), and Combined (training + infrastructure), measuring integration at 6, 12, and 18 months to establish causal pathways for cost-effective interventions.
Keywords	assessing, CETA, TPACK, ICT integration, needs assessment, civic education, Ghana

INTRODUCTION

For the purposes of this study, 'Civic Education' refers to the organised process by which citizens are informed about their rights, responsibilities, and the workings of democratic governance, delivered through both formal schooling and non-formal community programmes (Kankam, 2016). Formal civic education is delivered in schools through social studies (Akowuah et al., 2025; Ayaaba et al., 2014; Ocansey, 2021), while NCCE delivers civic education informally (NCCE, 2020). 'Extent of ICT integration' refers to the degree to which digital tools are systematically embedded in the planning, delivery, and assessment of civic education activities operationalised in this study on a four-

point scale ranging from 'not at all' to 'great extent'. This framing distinguishes integration extent from binary presence/absence measures used in prior research. Civic education in Ghana has been delivered over the years using various media, rather than technology. The policy intent to integrate ICT in education in Ghana currently aligns with the 2015 ICT Policy of Ghana (Ministry of Education, Republic of Ghana, 2015).

Digital literacy and civic engagement increasingly intersect in 21st-century democracies, requiring civic education systems to integrate ICT tools effectively (Harmanto et al., 2023). Ghana's 2015 ICT Education Policy mandates the integration of ICT to leverage technology and enhance the NCCE's civic education delivery. In 2016, the budgetary allocation to NCCE was GH₵32,552,612; in 2017 and 2018, it was GH₵42,951,777 and GH₵48,019,612, respectively (NCCE, 2016; NCCE, 2017; NCCE, 2018). From 2022 to 2024, the budget allocations to NCCE were GH₵88,145,000; GH₵100,501,719; GH₵81,357,320, and GH₵82,008,359 annually (NCCE, 2022, 2023, 2024, 2025). This increased budgetary allocation from 2016 to 2025. The massive injection of Ghanaians taxes into the NCCE was to educate approximately 30,832,019 Ghanaians (Ghana Statistical Service, 2021). However, civic education delivery in Ghana clearly lacks empirical assessment of the extent of ICT integration and implementation barriers.

Understanding the extent of ICT integration (as the degree to which digital tools are systematically embedded in the planning, delivery, and assessment of civic education activities, operationalised on a four-point scale) is critical for three reasons. First, Ghana was ranked 98th out of 134 countries in digital skills among its population (Portulans Institute, 2023), limiting civic participation in increasingly digital governance platforms (e-voting, online public consultations). Second, rural-urban digital divides risk creating civic engagement disparities if technology-mediated civic education is inaccessible to 46% of Ghana's population, who lack internet access (Dabalen & Mensah, 2023). Ghana's decentralized governance, linguistic diversity, and rural-urban digital divide distinguish the findings from those of other African comparators. Third, there was capital expenditure (Capex) of GH₵7,012,700 allocated to NCCE in 2023 (NCCE, 2023). The Capex includes the acquisition of machinery, furniture, building infrastructure, and ICT infrastructure, as well as measuring actual utilization, which may not be sufficient for NCCE's operations.

Civic education delivery in Ghana is primarily through non-formal institutions by the NCCE, rather than through formal institutions like schools, as in Indonesia (Rahmadi et al., 2020). Civic education is unique in its Content Knowledge (democratic values, rights discourse) and Pedagogical Knowledge (community dialogue, deliberation), which could integrate ICT to deliver civic messages. However, the gap identified was not quantified. This study fills these gaps by measuring the extent of ICT integration across 45 Ghanaian districts and testing an extended Technological, Pedagogical Content Knowledge (TPACK) framework that incorporates an infrastructure needs assessment.

The result would serve as a basis for future research. It would also help to raise awareness among civic education practitioners and to accelerate the implementation of the 2015 ICT policy with respect to civic education delivery. In addressing the underexplored nexus between ICT policy in Ghana and how the NCCE utilises it in civic education delivery, we intend to explore the extent of ICT integration in civic education delivery across 45 districts in Ghana, and how the components of the extended TPACK framework explain barriers to ICT integration in Ghana's civic education context. The use of the standard TPACK is insufficient for the analytical lens, given the intent to explore the constraints on infrastructure needs for ICT integration. While TPACK is widely utilized to understand ICT integration in education, its application as an analytical lens is insufficient for the specific context of civic education in a resource-constrained environment. TPACK operates primarily as a closed-system model focusing on teachers' knowledge domains (technology, pedagogy, and content) while treating 'context' as a nebulous periphery. This TPACK structure has not addressed ICT infrastructure, geographical context, and external factors influencing the use of technology to teach civic education in Ghana. Therefore, extending the TPACK framework to Civic Education Technology Adoption (CETA) is needed to address the limitations identified as lying in foundational layers

rather than peripheral contexts. The extension of TPACK to CETA, therefore, is to provide a more robust analytical lens for the specific constraint environment in which civic education through technology adoption will be explained.

We set two research questions to find a solution to the research gap as follows:

1. What is the level of ICT integration in civic education delivery across 45 districts in Ghana, and what factors (device availability, tool diversity, instructional use patterns, internet connectivity) predict integration extent?
2. How do the components of the extended TPACK framework explain barriers to ICT integration in Ghana's civic education context?

The remainder of this paper is organised into the literature review, methodology, results, and discussion of the findings. The literature discusses ICT integration in civic education, TPACK framework applications and limitations, and social media in civic education. The methodology examines the research approach, sampling phases, sample size, instrumentation, data collection procedures, ICT integration measures, and data analysis. The results and discussion sections follow the methodologies for the study. The paper concludes with theoretical, policy, practical, key contributions, critical implications, recommendations, and future research directions.

LITERATURE REVIEW

ICT INTEGRATION IN CIVIC EDUCATION

ICT plays a pivotal role in Indonesia's efforts to enhance civic education through digital platforms (Anggraeni et al., 2025; Wijaya & Amalia, 2024), just like an earlier study conducted in Ecuador (Guaña-Moya et al., 2022). The use of online resources and interactive multimedia has been noted to have influenced the focus of civic education in Indonesia and Ecuador. Digital skills largely depend on the digital literacy knowledge in Indonesia (Harmanto et al., 2023). However, the difference between the two studies was the target population. In the case of Harmanto et al. (2023), the study focused on teachers' digital involvement in civic engagement in Indonesia, whereas in Ecuador, the focus was on students' civic abilities. Despite targeting different groups, these studies shared the underlying theme of using digital platforms for civic education.

Latvian students in Northern Europe have acknowledged low civic competence in addressing issues among themselves on university campuses (Medne et al., 2024). In the case of Barton (2024), educators perceived digital tools as a means to make civic education more relevant and to engage learners. The integration of ICT in civic education has been established to enhance learning skills and ensure civic competency (Misan-Ruppee et al., 2024; Mulyana, 2023; Nuryadi & Widiatmaka, 2023), which aligns with a similar study in Indonesia (Anggraeni et al., 2025; Wijaya & Amalia, 2024).

The section on the Civic Education Technology Adoption (CETA) framework addresses the identified gaps. The new framework extends TPACK to incorporate an infrastructure needs assessment component suited to resource-constrained delivery contexts.

TPACK FRAMEWORK APPLICATIONS AND LIMITATIONS

Having established the empirical and theoretical gaps in the literature, the following section introduces the CETA Framework, which addresses the infrastructure gap identified above by extending TPACK to include a needs assessment component.

Standard TPACK frameworks focus on the intersection of teachers' technological, pedagogical, and content knowledge, implicitly assuming that functional infrastructure is available (Mishra & Koehler, 2006). In Ghana's context, this assumption does not hold, as device scarcity and intermittent internet connectivity mean that infrastructure availability itself shapes educators' technological capabilities. To account for this, the present study extends TPACK to include an infrastructural needs assessment

component, producing the Civic Education Technology Adoption (CETA) framework elaborated in the theoretical framework. The adoption of TPACK as an analytical lens was to explore how NCCE in Ghana delivers civic education. Since Mishra and Koehler's (2006) original formulation, TPACK has been substantially developed. Angeli and Valanides (2009) argued that TPACK should be treated as a distinct knowledge type rather than the sum of its components, with implications for how it is measured and developed through training. Harris et al. (2009) demonstrated that contextual factors, including subject area, school culture, and available resources, moderate how TPACK translates into classroom practice.

Most relevant to the present study, Voogt et al. (2013) reviewed TPACK research in developing-country contexts and found that infrastructure constraints were consistently undertheorised. In the present study, the infrastructure constraint was assessed based on device and connectivity availability. This assumption is untenable in Ghana's civic education context, motivating the infrastructure extension developed in the CETA Framework. The use of TPACK was acknowledged as a means to address the limitations in teaching with technology in real-world settings (Angeli & Valanides, 2014). The use of technology in teaching should basically be influenced by the user's beliefs (Ertmer, 2005).

The TPACK model was used to study subjects in the classroom (Chai et al., 2011, 2013; Moreno et al., 2019; Silva et al., 2020; Tondeur et al., 2017), while Luthfi et al. (2023) used it to study civic education outside the classroom in Indonesia. Similar studies used TPACK in civic education (Dahnial et al., 2023; Luthfi et al., 2023; Yunita et al., 2023). However, such studies did not adequately address infrastructure constraints in Ghana in the context of TPACK. Similarly, the theoretical and practical use of TPACK in a paper indicated different understandings of technological knowledge of how to use it to bring impact (Voogt et al., 2013). Content knowledge and its associated teaching activities on technology-related issues call for TPACK (Harris et al., 2009). Harris et al. (2009) did not focus on a resource-constrained environment using TPACK and its related activities to achieve a given knowledge content.

Addressing the limitation of TPACK in civic education delivery in Ghana called for its adaptation. The adapted TPACK model is Civic Education Technology Adaptation (CETA), as shown in Figure 1. The left component of the TPACK model guided the data collection and analysis, whilst the Needs Assessment model on the right side addressed the contextual factors (ICT infrastructure availability, geographic context, and resource constraints) in the study.

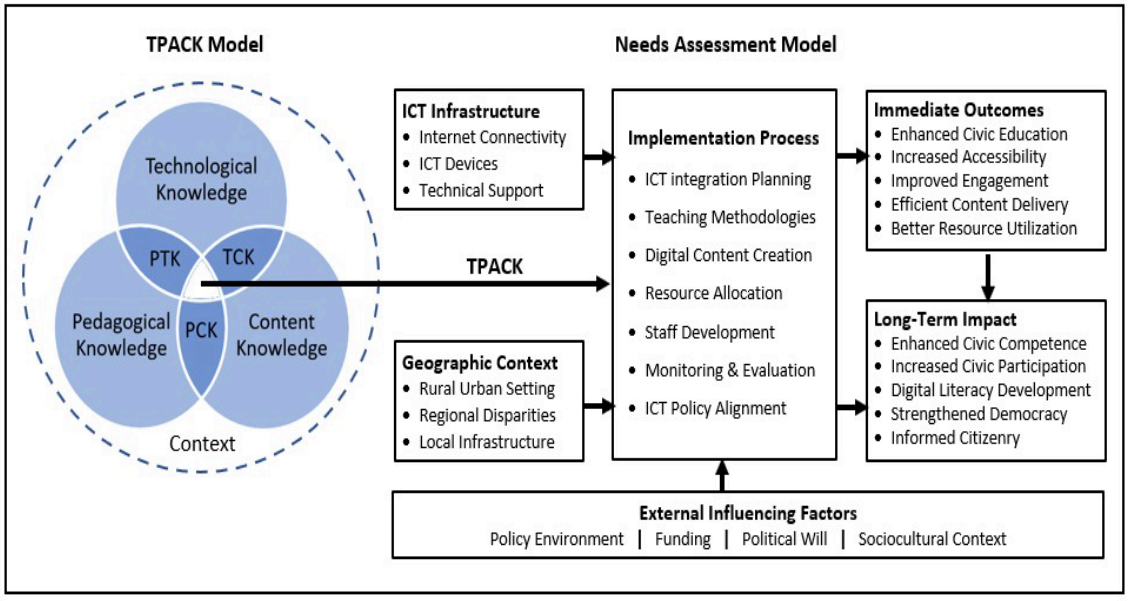

Figure 1. Civic Education Technology Adoption (CETA) framework

Social Media in Civic Education

The literature on social media, as one of the means ICT is used in civic education delivery, focuses on engaging citizens in civic issues (Buzzetto-Hollywood et al., 2021; Harmanto et al., 2023; Nuryadi & Widiatmaka, 2023). The use of E-learning platforms and social media for civic education may not come without misinformation (Nuryadi & Widiatmaka, 2023). The expansion of access to civic education, with a greater focus on rural areas, has become possible with the use of ICT tools in the environment (Guaña-Moya et al., 2022). Technological platforms, therefore, serve as a bridge to get everyone involved in civic education, especially in a developing country like Kenya (Cherotich, 2023; E. Mwita, 2023; Oduor, 2023). The use of social platforms was consistent with studies in Indonesia (Anggraeni et al., 2025; Wijaya & Amalia, 2024). Social media use for civic education engagement was either among teachers or students in formal educational settings, but not in informal settings.

Taken together, the literature reveals four gaps that the present study addresses. First, existing studies measure ICT use as a binary variable (used/not used); none quantify integration extent on an ordinal scale. Second, infrastructure factors (device availability, internet connectivity) are rarely studied alongside pedagogical predictors in the same model. Third, TPACK has been applied almost exclusively in formal K–12 settings, where infrastructure is not much of an issue, as in Ghana, where civic education infrastructure constraints are the case. Civic education in Ghana is delivered through non-formal means, which have not been researched. Fourth, there is no empirical baseline for ICT integration in Ghana's NCCE, leaving researchers and policymakers without evidence to assess the impact of the 2015 ICT integration mandate. The present study addresses all four gaps through a mixed-methods design grounded in the CETA Framework.

The next section presents the methodologies used in conducting the study. The methodology section discusses the research approach, research design, sampling phase, and sample size, the instrument used for the study, the data collection procedure, and the data analysis.

METHODOLOGY

Research Approach

The study adopted a mixed-methods approach (Morse, 2016), with an emphasis on an explanatory sequential mixed-methods design to understand the extent of ICT integration in civic education delivery in Ghana. The rationale for using qualitative interviews was to explain quantitative trends in a manner consistent with Creswell's explanatory sequential design (Creswell, 2015). Civic education in Ghana employs several approaches, with the most used being non-formal education by the NCCE (Kankam, 2016). The emphasis is on the qualitative data to explain the survey results.

Sampling Phases and Sample Size

The quantitative sampling phase of the survey used random sampling from 45 districts across the three geographical zones, with 165 civic educators from NCCE offices. Randomisation of the sampling was done after generating random numbers for the known staff numbers in each district. The 'RAND()' function in MS Excel was used to generate codes for civic educators. The randomly generated codes were then assigned to each staff member on the staff list in each sampled district. For ordinal logistic regression, we required a minimum of 15 cases per predictor (Peduzzi et al., 1996), yielding a minimum sample size of 15 × 7 predictors = 105. To detect medium effect sizes (OR = 2.0) with power = 0.80 at $a = 0.05$, G*Power analysis indicated n = 148 required. We recruited n = 165 (111% minimum), providing adequate power to detect medium-to-large effects.

The qualitative phase was done by inviting potential participants. The participants who agreed were interviewed across the three geographical zones (Fusch et al., 2018; K. Mwita, 2022; Naeem et al., 2024). We planned for 15-25 interviewers based on information power principles (Malterud et al., 2016). Saturation was assessed after each interview using the constant comparative method. We

achieved saturation at n = 22 participants, where three consecutive interviews yielded no new codes. The integration strategy for the two methods (qualitative and quantitative) using the survey results from the questionnaire and interview guide helped explain the survey trend results.

INSTRUMENTATION

A structured questionnaire and interview guide were developed based on the CETA framework. The questionnaire contained three sections: (1) demographic information, (2) ICT infrastructure assessment (7 items), and (3) ICT integration practices (12 items). Response formats included 5-point Likert scales and one open-ended item. Appendix A presents the details of the questionnaire used for data collection. Content validity was established through expert review by three educational technology specialists. The internal consistency reliability of the questionnaire was 0.71, Cronbach's alpha, whilst the internal Test-retest reliability correlation coefficient of 0.74 ($p < 0.01$) was the outcome of the instrument. The Test-retest was conducted with five NCCE staff from different districts where the main study was not done.

INTERVIEW PROTOCOL

Semi-structured interviews explored barriers and facilitators using the CETA framework domains:

1. *Technological Knowledge (TK) Questions:*
   'What type of ICT tools and platforms have you used in civic education (e.g., Learning management systems, online discussion forums, educational software)?'
   'How do you ensure that ICT tools are accessible and usable to your target groups?'
   'What additional ICT skills would help you deliver civic education more effectively?'
2. *Pedagogical Knowledge (PK) Questions:*
   'How do you integrate ICT into your civic education programs? Can you describe a typical activity?'
   'What challenges do you face in using technology pedagogically and how have you addressed them?'
   'Can you describe any future plans or initiatives for ICT integration in civic education that you are aware of?'
3. *Content Knowledge (CK) Questions:*
   'What policies and procedures can educational institutions implement to support the integration of ICT in civic education?'
   'How does using ICT change the civic education content you can deliver?'
   'Are there civic topics that particularly benefit from ICT delivery?'
4. *Infrastructure Questions:*
   'What ICT equipment is available in your district, and how adequate is it?'
   'Describe your internet connectivity situation.'
   'What support do you receive from NCCE headquarters for ICT integration?'

Interviews lasted 35-50 minutes (mean = 47 min), and interviews were audio-recorded with the participants' consent. They were then transcribed verbatim. The details of the items on the interview protocol are in Appendix B.

DATA COLLECTION PROCEDURES

Written permission was obtained from participants and respondents across the 45 districts in the three geographical zones (southern, middle, and northern). The process of obtaining permission was possible with ethical approval (Approval No.: HuSSREC/AP/175/VOL. 4) to conduct the study. The needs assessment of ICT integration in civic education was conducted as a gap in the literature reviewed. The data collection process was therefore guided by the TPACK model in Figure 1. Participants could choose between completing hardcopy questionnaires or digital questionnaires via Google Forms during data collection.

ICT Integration Measures

We developed five indices to measure ICT integration dimensions:

1. *Devices Index:* Participants reported a few ICT devices available at their district office from a checklist: desktop computers, laptops, tablets, smartphones, projectors, interactive white-boards, printers/scanners (0-7 scale). Cronbach's $a = 0.71$.
2. *Tools Index:* Participants indicated which digital tools they use for civic education from social media platforms (Facebook, X, Instagram, WhatsApp, YouTube), website/blog, conferencing (Zoom, Google Meet), presentation software (PowerPoint), document sharing (Google Drive, Dropbox), learning management systems, mobile apps (0-4 scale representing tool categories used). Internal consistency (α) = 0.68.
3. *Uses Index:* Participants rated frequency of ICT use for civic education tasks on a 5-point scale (1 = never to 5 = always) across: preparing educational materials, delivering civic messages, engaging with the public, training staff, recording/documenting activities (1-5 mean score). Cronbach's $\alpha = 0.74$.
4. *ICT Availability Rating:* Single-item measure: "How would you rate the overall availability of ICT infrastructure in your district?" (1 = very poor to 5 = excellent).
5. *Internet Connectivity:* Ordinal measure of internet quality: 1 = no internet, 2 = intermittent/unreliable, 3 = reliable but slow, 4 = reliable and fast.

The outcome variable (ICT Integration Extent) was, 'What is the level of ICT integration in civic education delivery across 45 districts in Ghana, and what factors (device availability, tool diversity, instructional use patterns, internet connectivity) predict integration extent?' (1 = not at all, 2 = some extent, 3 = significant extent, 4 = great extent).

Data Analysis

We selected ordinal logistic regression because our outcome (ICT integration extent) had four ordered categories (1 = not at all, 2 = some extent, 3 = significant extent, 4 = great extent) where distances between categories were assumed non-equal (i.e., difference between 'not at all' and 'some extent' may differ from difference between 'significant extent' and 'great extent').

All analyses conducted in R 4.2.1 using packages: MASS (ordinal regression), car (diagnostics), mice (imputation). Alternative approaches considered but rejected:

Linear regression: Violates the assumption that the outcome is continuous and equally spaced.

Multinomial logistic regression: Ignores the ordinal nature, reducing statistical power.

Collapsing to binary: Loses information from a 4-level distinction.

For qualitative data analysis, we followed Braun and Clarke's (2023) six-phase reflexive thematic analysis:

Phase 1 - Familiarization: All three authors independently read five transcripts and documented initial impressions.

Phase 2 - Coding: First author systematically coded all transcripts using an inductive approach. Example codes: 'insufficient laptops', 'Facebook primary tool', 'no training from headquarters', 'internet unreliable'. A total of 89 initial codes were generated.

Phase 3 - Theme Generation: Authors met to organize codes into candidate themes using affinity mapping. CETA framework components (TK, PK, CK, Infrastructure) served as sensitizing concepts but did not restrict inductive coding.

Phase 4 - Theme Review: Authors checked themes against coded extracts and entire dataset. Collapsed three infrastructure-related themes into one overarching theme with sub-themes.

Phase 5 - Theme Definition: Defined scope and boundaries of each theme. Created theme descriptions and illustrative quotes.

Phase 6 - Reporting: Selected representative quotes ensuring diversity across geographical zones and participant roles.

Quality procedures

1. *Credibility:* Member checking with 5 participants who confirmed interpretation accuracy.
2. *Dependability:* Audit trail maintained documenting coding decisions.
3. *Confirmability:* Authors acknowledged positionality as university-based researchers potentially viewing NCCE staff through academic lens.
4. *Transferability:* The interview took place at the NCCE district level in Ghana. District directors and field workers (educators) from Ghana's three geographical zones (Southern, Middle, and Northern) participated in the interview. The participants had worked for NCCE for at least five years. The NCCE is the main body required by Ghana's 1992 Constitution to instruct Ghanaians on civic issues throughout the nation, while other civil groups and people do support its work.

Final themes

1. *Infrastructure Constraints* (3 sub-themes: device scarcity, connectivity issues, centralised supply).
2. *Pedagogical Knowledge Gaps* (2 sub-themes: lack of TK training, unclear PK for ICT integration).
3. *Improvised Solutions* (1 sub-theme: social media as accessible alternative).

The result presentation is in three main parts: assumptions behind the use of ordinal logistic regression and model equation; the survey results of ICT use; and qualitative results to explain what the results found.

RESULT

The Result section presents the assumptions behind the Ordinal Logistic Regression, and the results for research questions one and two. The findings are discussed. Others include limitations, conclusions, key contributions, critical implications, recommendations, and future research direction of the study.

QUANTITATIVE FINDINGS

The result of the quantitative Research Question 1 was on the distribution of ICT integration extent, an ordinal logistic regression to predict the degree of the extent, and the model ordinal logistic regression equation.

Research Question 1. What is the level of ICT integration in civic education delivery across 45 districts in Ghana, and what factors (device availability, tool diversity, instructional use patterns, internet connectivity) predict integration extent?

Distribution of ICT integration extent

The distribution of self-reported ICT integration extends across 165 civic educators. The modal category was 'some extent' (n = 107, 64.8%), followed by 'not at all' (n = 22, 13.3%), 'significant extent' (n = 24, 14.5%), and 'great extent' (n = 12, 7.3%). This distribution, as shown in Figure 2, shows ICT integration was predominantly low among Ghana's civic educators.

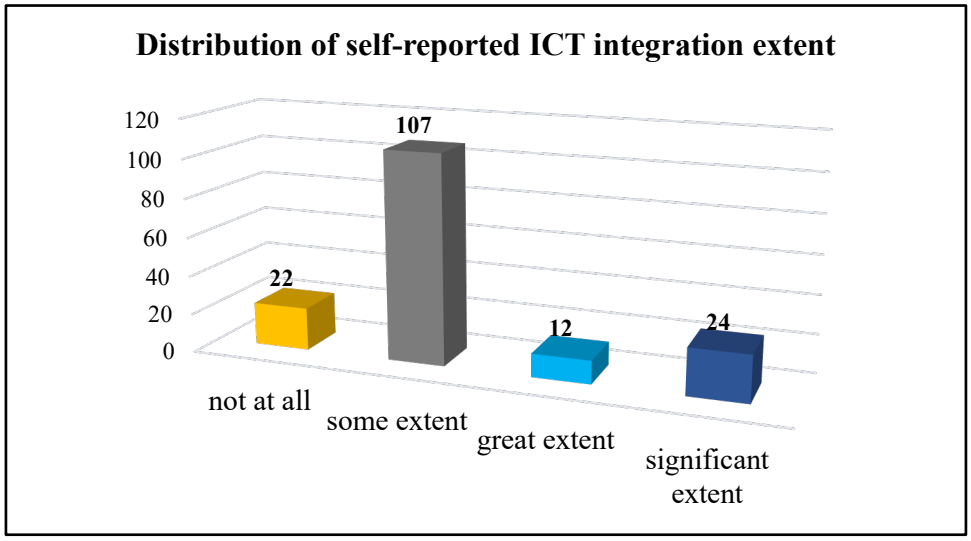

Figure 2. Bar chart of self-reported ICT integration extent in civic education delivery

In answering research question one directly, ICT integration in civic education delivery across 45 districts in Ghana is low, with most civic educators (65%) reporting only "some extent" of integration and 13% reporting no integration at all.

Predictors of ICT integration extent (ordinal logistic regression)

In predicting the extent of ICT integration in civic education delivery, the assumption behind ordinal logistic regression was tested, and the model equation was written.

Assumption testing

We tested six assumptions, and the summary of the results is presented (see Appendix C):

1. *Dependent variable ordinal:* Satisfied (4 ordered categories).
2. *Independent variables appropriate:* Satisfied (mix of continuous and ordinal).
3. *Independence of observations:* Satisfied (no duplicate respondents after checking).
4. *Proportional odds:* Brant test showed omnibus χ^2 (14) = 21.98, p = .08, marginally acceptable.

One localised violation for internet connectivity cubic term (p = .04). We proceeded because: (a) omnibus test non-significant, (b) only 1 of 7 predictors violated, (c) violation was for polynomial term, not primary predictor.

5. *Linearity in logit:* Satisfied (quadratic term comparison: LR χ^2(4) = 4.75, p = .31).
6. *No multicollinearity:* Satisfied (all VIF <1.21).

Predictors of ICT integration extent

To predict ICT integration extent from objective indicators, we substituted sample mean values into the fitted ordinal logistic regression model in Table 1. For a typical civic educator with:

- 3 ICT devices available (sample mean),
- ICT availability rating of 2/5 (poor; sample mean),
- Intermittent internet connectivity (category 2; sample mode),
- 2 tool types used (sample mean),
- Uses index score of 1/5 (rarely; sample mean).

The predicted probability distribution is:

- P(Y = 1 'not at all') = 10.2%,
- P(Y = 2 'some extent') = 72.4%,
- P(Y = 3 'significant extent') = 12.7%,
- P(Y = 4 'great extent') = 4.7%

The maximum a posteriori (MAP) prediction is Category 2 ("some extent"), with 72.4% probability. The expected integration score is 2.12 on the 1-4 scale (95% CI: [2.01, 2.23]), significantly below the midpoint of 2.5 (one-sample t-test: $t(164) = -8.43$, $p < .001$), confirming that ICT integration is systematically low across districts. Table 1 shows the predicted probability of each integration category for a typical civic educator with average observed predictor values.

Table 1. Predicted extent of ICT use based on substituted predictor values

Predictor/outcome	Value
Devices index	3
ICT availability rating	2
Internet connectivity	2
ICT tools index	2
ICT instructional uses index	1
P(Y = 1) (Very low use)	0.10
P(Y = 2) (Low use)	0.72
P(Y = 3) (Moderate use)	0.13
P(Y = 4) (High use)	0.05
Predicted extent category (MAP)	2 (Low use)
Expected extent score, E[Y]	2.12

Substituting the observed predictor values into the ordinal logistic regression model yielded a predicted extent of ICT use of Category 2 (low use), with an expected extent score of 2.12, indicating a low-to-moderate level of ICT integration.

The results indicate that a typical civic educator has a 72% probability of falling in the 'low use' category, confirming that limited ICT integration is the norm rather than the exception across districts.

Table 2 presents ordinal logistic regression results predicting ICT integration extent. The overall model was statistically significant (LR $\chi^2(7) = 36.86$, $p < .001$, McFadden pseudo-$R^2 = 0.109$), indicating that the predictors collectively explain approximately 11% of the variance in integration extent, a small-to-medium effect.

Table 2. Overall model fit (full vs. null model)

Statistic	Value
Likelihood-ratio χ^2 (df = 7)	36.86
p value	< .001
McFadden pseudo R^2	0.109
AIC (null model)	342.79
AIC (full model)	319.93

Note: AIC = Akaike Information Criterion

Interpretation of key predictors

The predictor factors for the extent of ICT integration were identified, along with their associated values for Beta (B), Standard Error (SE), Z-statistic (Z), p-value (P), Odds Ratio (OR), and Confidence Interval (CI). The detailed results are presented in Appendix C2. Counterintuitively, having more devices in a district office was associated with Lower (not higher) levels of ICT integration (Devices Index: OR = 0.62, p = .004).

The result suggests that simply distributing hardware is insufficient without accompanying connectivity, training, and maintenance. As the qualitative data reveal, many of these devices were broken or obsolete, meaning more devices in inventory often reflected accumulated unused equipment rather than functional infrastructure. This counterintuitive finding suggests that simply providing devices is insufficient, because devices may accumulate without proper training or internet connectivity.

Availability rating (β = 0.23, OR = 1.26, p = .17): ICT availability ratings showed no significant relationship with integration extent, despite a positive direction. This non-significant finding may reflect that educators' perceptions do not align with actual integration behaviours, or that 'availability' does not guarantee utilization.

Internet Connectivity (Linear: β = 0.49, p = .23; Quadratic: β = 0.14, p = .72; Cubic: β = 0.35, p = .31): None of the polynomial internet connectivity terms significantly predicted integration, though the positive direction suggests trends toward higher integration with better connectivity. The non-significance may reflect insufficient variability (85%) of participants who reported "intermittent/unreliable" or worse connectivity, limiting differentiation.

Tools Index (β = 0.69, OR = 2.00, p = .003): This was the strongest positive predictor. For each additional ICT tool type used (e.g., adding video conferencing to existing social media use), the odds of being in a higher integration category doubled (OR = 2.00, 95% CI, [1.26, 3.18]). Practically, an educator using 4 tool types versus 2 types has 4-fold higher odds of 'significant/great extent' integration ($OR^2 = 4.02$).

Uses Index (β = 0.60, OR = 1.83, p = .093): Frequency of ICT use for instructional tasks showed a marginally significant positive association (p < .10). Each 1-point increase in uses frequency nearly doubled the odds of higher integration (OR = 1.83, 95% CI, [0.90, 3.70]). While not reaching the conventional significance threshold, this suggests a dose-response relationship worthy of future investigation.

Model ordinal logistic regression equation

$$\text{Logit}\,[P(Y \leq j)] = a_j - (\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_7 X_7) \qquad (1)$$

where:

- Y = ICT integration extent (1-4)
- j = cumulative category (j = 1, 2, 3)
- a_j = threshold parameters
- $X_1 \ldots X_7$ = predictor variables (devices index, tools index, uses index, availability rating, internet connectivity)
- $\beta_1 \ldots \beta_7$ = regression coefficients

Qualitative Findings

The qualitative results on three sub-themes have been presented based on Research Question 2. The themes were 'Internet Connectivity as Bottleneck', 'Centralized Planning Limits Local Adaptation', and 'TK/PK Training Gaps Despite Policy Mandates'.

Research Question 2: How do the components of the extended TPACK framework (Technological Knowledge, Pedagogical Knowledge, Content Knowledge, and Infrastructure Needs) explain barriers to ICT integration in Ghana's civic education context?

Semi-structured interviews with 22 civic educators across six districts revealed three interrelated themes explaining the quantitatively observed low ICT integration extent:

Theme 1: Infrastructure deficits

Participants consistently identified hardware scarcity as the primary barrier, consistent with the negative devices index coefficient in regression results:

> We have the knowledge to use technology for civic education. The problem is that we do not have the tools. Headquarters supports us with one laptop and a desktop for the entire district office, with four staff to share. (Participant N2, Southern Zone district)

This quote exemplifies the CETA framework's insight. When infrastructure (devices, connectivity) is absent, Technological Knowledge (TK) and Pedagogical Knowledge (PK) cannot manifest in practice. Thus, the negative device coefficient makes sense qualitatively.

Districts reporting more devices often have unusable/broken equipment:

> Our office has three computers in inventory, but only one works. The others were broken beyond repair because they were old, no Windows updates, no antivirus. This creates frustration. (Participant B2, Middle Zone district)

Sub-theme 1a: Internet connectivity as bottleneck

19/22 participants (86%) described the internet as 'unreliable' or 'absent', limiting social media use as the one accessible ICT tool:

> We use personal smartphones and internet data for Facebook and WhatsApp to upload information. But we cannot use Google Drive, video conferencing, and zoom. These need a strong internet, but we do not have. (Participant Q1, Southern Zone district)

This excerpt explains why the tools index positively predicted integration, while the devices index was negative. Social media platforms (Facebook, WhatsApp) are low-bandwidth, mobile-friendly, accessible tools despite poor infrastructure. Civic educators improvise using personal smartphones, creating the paradox: more organizational devices ≠ more integration.

Theme 2: Centralized planning limits local adaptation

Multiple participants (14/22, 64%) described centralised decision-making at NCCE headquarters that fails to account for district-specific needs:

> All ICT activities are planned at the national headquarters. They send us programs to implement, but tools to deliver are not provided. One-size-fits-all doesn't work. (Participant C2, Southern Zone district)

The organizational barrier described by this participant connects to CETA's "Implementation Process" dimension. Even with adequate infrastructure, the lack of Pedagogical Knowledge (PK) for adapting centralized content to local ICT contexts limits effectiveness:

> Headquarters does not provide projectors and reliable internet for PowerPoint-based civic education modules. We mostly do not print handouts, an indication of no technology involved, despite being ICT-integrated. (Participant B3, Middle Zone district)

Theme 3: TK/PK training gaps

15/22 participants (68%) requested technology training, revealing Technological Knowledge (TK) deficits:

> We need more ICT materials from the head office (NCCE-Head office) and staff training. (Participant N2, Northern Zone district)

Similarly, Pedagogical Knowledge (PK) gaps emerged, as educators are not sure how to integrate ICT pedagogically:

> I can use the tools personally, but I do not know how to make civic education interactive with technology. No one has taught us digital pedagogy. (Participant A3, Middle Zone district)

These quotes validate the CETA framework's insistence that TK and PK must be developed simultaneously with infrastructure provision. Ghana's 2015 ICT Policy mandates integration but provides no accompanying capacity-building, creating policy-implementation gaps.

Convergence of quantitative and qualitative findings

The findings from the qualitative and quantitative research for Research Questions 1 and 2 are merged in Figure 3.

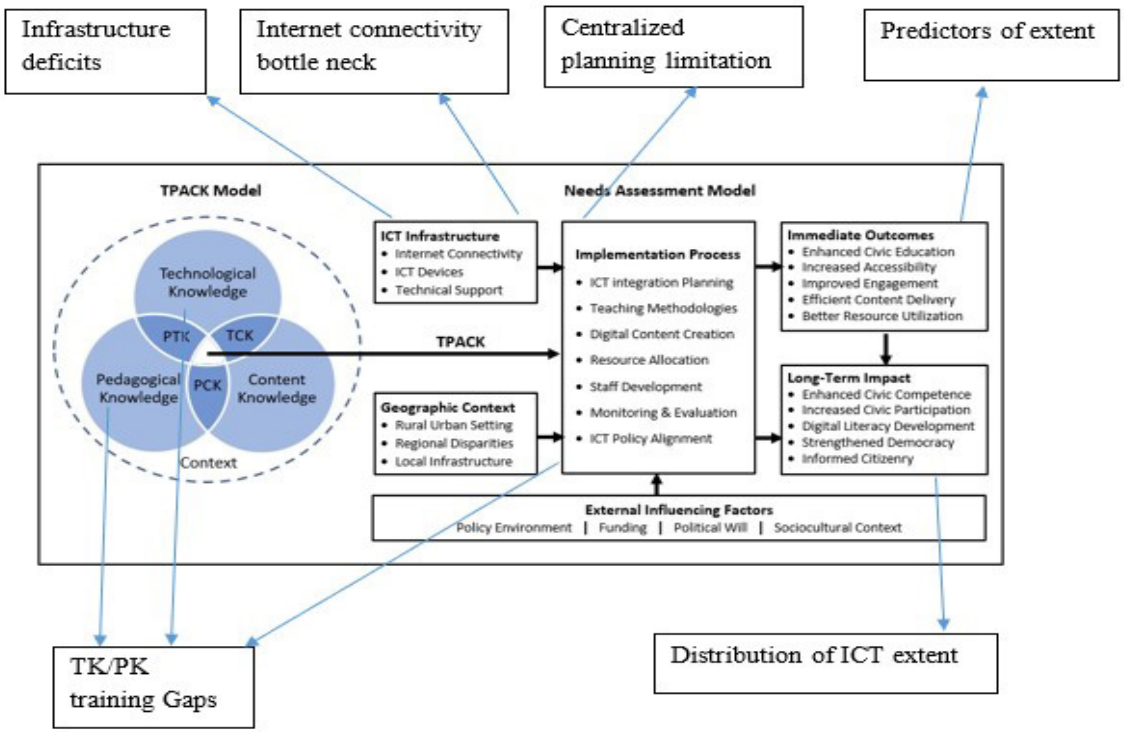

Figure 3. Converged results of qualitative and quantitative

The convergence of quantitative and qualitative findings points to a consistent picture of low but uneven ICT integration driven by infrastructure and training deficits. The discussion section that follows interprets these findings in relation to prior research and develops their theoretical, policy, and practical implications.

Discussion

The discussion of the results focused on the ICT integration level and its predictors; the CETA framework components as explanatory mechanisms; and the theoretical implications of the CETA framework. The study's policy implications, practical implications, limitations, and conclusion were discussed.

ICT integration level and its predictors

Using an extended TPACK framework (CETA), we found that ICT integration was systematically low across 45 districts. Less integration of ICT was driven by infrastructure deficits and pedagogical capacity gaps rather than educator unwillingness or policy absence.

Our quantitative and qualitative findings converge on a stark conclusion: Ghana's 2015 ICT Education Policy has not translated into meaningful civic education technology adaptation. With 65% of civic educators reporting "some extent" ICT integration and expected integration scores (2.12/4.0) significantly below the midpoint, implementation lags policy intent by nearly a decade. The low level of ICT integration could be accounted for by the exposure of NCCE to deploying ICT tools and platforms for civic education. Moreover, supervision of staff on the deployment could account for the low level of ICT tools and platforms to deliver civic education.

The policy-implementation gap has direct democratic consequences. As government services shift toward digital platforms, including e-voting, online public consultations, and digital civic services. Citizens who have not received ICT-integrated civic education risk being excluded from meaningful participation in governance. If civic educators in Ghana lack ICT tools/skills, they cannot prepare citizens to participate in digital democracy. This result is consistent with Barton (2024), who recommends engaging the public in civic education with digital platforms. The use of ICT in civic education delivery could encourage the public to participate fully in governance discourse. NCCE's ICT budget may be misdirected, as shown in the result. Our findings indicate that device quantity negatively predicts integration. This suggests that throwing hardware at the problem is counterproductive without addressing connectivity, training, and maintenance.

The most surprising finding was that device availability negatively predicts integration (β = -0.479, OR = 0.619, p = .004), while tool diversity positively predicts integration (β = 0.695, OR = 2.004, p = .003). Devices accumulated and unused due to obsolescence, lack of maintenance, or incompatibility with poor internet infrastructure explain why the device availability predicts negative and positive integration. This divergence from Guaña-Moya et al. (2022) is attributable to a critical contextual difference: Ecuador's study took place in schools with functional maintenance infrastructure, where additional hardware translated into usable resources.

In Ghana's NCCE context, devices accumulate without maintenance budgets or technical support, so a higher device count often signals a larger inventory of broken equipment rather than greater operational capacity. This finding illustrates why hardware-centred interventions that succeed in middle-income contexts may be counterproductive in lower-resource settings. The result aligns with Oduor's (2023) finding in Kenya, but where Oduor measured competency as a general construct, the present study identifies tool diversity, specifically, the ability to use low-bandwidth mobile platforms, as the operationally relevant competency in infrastructure-constrained contexts. This specificity has direct training implications that a general competency measure may not consider for training. Our study extends this by showing that competency matters. By way of competency, the educators could use the available ICT platforms and devices to engage with their learners in the field.

CETA framework components as explanatory mechanisms

The theoretical contribution is that the challenge posed by technological determinism is the assumption that providing technology automatically leads to adoption (Selwyn, 2011). Context-specific barriers (infrastructure, training, organizational culture) mediate technology's impact, supporting the socio-technical systems theory (Bijker & Law, 1994). Technology availability and effective use for civic education delivery could impact how civic messages are channeled out. The theoretical contribution of the study was how civic education could be delivered, which would be underpinned. Therefore, the proper direction of civic education delivery would be guided to make the needed impact.

Given the deficit in ICT infrastructure, 68% (15/22) were linked to Technological Knowledge (TK). This suggests training for the NCCE staff to update their knowledge of how to use ICT infrastructure to deliver civic education. Regarding the Pedagogical Knowledge (PK) deficit, it suggests that the civic educators were unsure how to use ICT to deliver civic education.

The Content Knowledge (CK) of the civic educators suggested no issues in their knowledge. The demonstration of the civic educators in the subject matter was a good sign, as educators possess civic content knowledge.

The primary barrier (devices, connectivity, and centralized planning at the NCCE Headquarters, thus, the identified barriers were tied to the headquarters of NCCE, suggesting the office might be overwhelmed with the situation. Some of the barriers (devices and internet connectivity) demand funding from the central source to address them. Despite increased budgetary allocations to NCCE from 2017 to 2025, the barrier has not been addressed. The existence of infrastructure barriers could go beyond funding alone. The number of districts that need regular internet infrastructure and maintenance could not be sustained due to their capital-intensive nature. The annual budgetary allocation to NCCE may not be sufficient to cover internet infrastructure and maintenance expenses.

The internet infrastructure suggests that interventions should prioritize low-bandwidth tool training (social media, mobile apps) that work with existing infrastructure (Short-term), decentralized planning allowing district-level adaptation (Medium-term), and infrastructure investment (devices, connectivity) coupled with ongoing TK/PK professional development (Long-term). In contrast with Standard TPACK, if we had used standard TPACK without the infrastructure dimension, we might have concluded that TK/PK training alone would solve the problem. But our findings show that training is futile without functional devices and connectivity, hence underscoring CETA's value.

Standard TPACK assumes infrastructure exists, focusing on TK-PK-CK intersections. Our CETA framework revealed that in resource-constrained contexts, infrastructure availability mediates the TK-PK-CK relationship. An educator can possess high TK and PK, but without functioning devices and connectivity, these competencies remain latent. This suggests that TPACK needs a fourth dimension: 'Infrastructure Knowledge' (IK). The purpose of this dimension is to understand which tools function within local constraints. Qualitative findings show that Facebook, X, Instagram, and WhatsApp are primary ICT tools, used via personal smartphones with personal data plans. This improvisation reflects educator agency but also highlights precarity.

Civic education relying on educators' personal resources is unsustainable and inequitable. Educators who buy internet data for public education could become fatigued over time. This study aligns with findings on Indonesian civic education's social media use (Harmanto et al., 2023; Wijaya & Amalia, 2024). However, Indonesia's digital infrastructure (78% internet penetration versus Ghana's 72%; International Telecommunication Union, 2023) enables richer multimedia content. Ghana's lower connectivity limits social media civic education to text/image posts, reducing pedagogical possibilities.

While the study's findings support social media as a pragmatic short-term solution for civic education delivery, its adoption as a primary platform carries risks that NCCE has not yet addressed. Algorithmic curation on Facebook and WhatsApp tends to amplify content that generates high engagement, which may not correspond to content that promotes balanced civic understanding. None of our interview participants mentioned content-vetting procedures or guidelines for what constitutes appropriate civic education material on personal social media accounts, which suggests an institutional oversight gap. Additionally, uneven digital literacy among Ghana's citizenry means that social media-based outreach may systematically exclude older adults and rural residents who are less comfortable with these platforms, potentially widening rather than narrowing civic engagement disparities.

Nuryadi and Widiatmaka (2023) warned that social media use in civic education without digital literacy training risks spreading misinformation. However, the literature suggests that Gen Zs can use social media to participate in governance, thereby mitigating its negative effects (Buzzetto-Hollywood et al., 2021). Our participants did not raise concerns about misinformation, suggesting that NCCE may lack protocols for verifying content shared on platforms. The ability of NCCE to evaluate the content posted on social media, whether it contains misinformation, would have been better.

Theoretical implications

This study contributes to educational technology theory by demonstrating that TPACK requires a fourth dimension: infrastructure knowledge (IK) in resource-constrained delivery contexts where device and connectivity availability mediate the relationship between educator knowledge and integration practice.

Policy implications

For Ghana's Ministry of Education and NCCE leadership, the findings indicate that the 2015 ICT Policy's objectives cannot be achieved through hardware distribution alone: connectivity, maintenance, and structured pedagogical training must be addressed simultaneously and costed into budget planning.

Practical implications

For NCCE district directors and field educators, the most actionable finding is that tool diversity, not device quantity (which predicts integration), is more achievable within current infrastructure constraints than waiting for ideal hardware or connectivity. Focusing on professional development on WhatsApp and Facebook for civic engagement strategies is more achievable than waiting for ideal hardware or connectivity.

Limitations of the study

1. *Sampling Limitations:* Our sample (45 districts in 6 regions) represents only 17% of Ghana's 261 districts. The southern zone was over-represented at 38%, the northern zone was the least sampled at 29%, and the middle zone was sampled at 33%.
2. *Measurement Limitations:* Self-report bias: ICT integration extent is self-reported, potentially inflated by social desirability. Observational validation (field observations and device audits) would strengthen the claims.
3. *Reliability concerns:* The reliability ratio of the questionnaire was $a = 0.71$.
4. *Proportional odds assumption:* Marginal violation ($p = .08$) suggests some predictors may affect category transitions differently. Future work should use partial proportional odds models.
5. *Small pseudo-R^2:* Model explains only 11% of variance; substantial unexplained variation remains. Unmeasured factors (organizational culture, leadership support, workload) may matter.
6. *Qualitative saturation:* Achieved at $n = 22$, but all participants were civic educators, including headquarters staff. Triangulation with citizens would have provided a full picture.

CONCLUSION

This study provides the first empirical assessment of ICT integration in Ghana's civic education sector. The finding revealed a serious gap in policy implementation. Despite a decade-old ICT mandates, civic education delivery remains largely technology-free; 65% of educators reported limited ICT integration across the 45 districts. More critically, we identified why integration remains low: infrastructure deficits (broken devices, poor connectivity) and pedagogical capacity gaps (lack of TK/PK training) combine to prevent ICT integration, even among willing educators.

KEY CONTRIBUTIONS

Empirical contribution

We established the baseline integration level (2.12/4.0, significantly below midpoint) that previous research lacked, enabling future studies to track progress and policymakers to assess intervention effectiveness.

Theoretical contribution

The CETA framework extends TPACK by integrating infrastructure needs assessment, revealing that, in resource-constrained contexts, infrastructure availability mediates the effects of pedagogical knowledge. This challenges technology-deterministic assumptions in mainstream educational technology theory and suggests that TPACK requires adaptation for developing country contexts where device/connectivity scarcity are the norm rather than the exception.

Methodological contribution

We demonstrated the utility of ordinal logistic regression for measuring "extent" (not binary presence/absence) of ICT integration, providing a nuanced understanding of partial adoption. The surprising negative device coefficient (more devices = less integration) emerged only through ordinal modelling – binary approaches would miss this.

Practical contribution

We identified tool diversity, not device quantity, as the integration driver of actionable insight for resource-constrained institutions. Focusing training on low-bandwidth, social media platforms achievable with existing infrastructure is more pragmatic than awaiting ideal hardware/connectivity.

Critical Implications

Simply distributing devices without addressing connectivity, maintenance, and training perpetuates 'hardware graveyards' – unused equipment accumulating in offices. Ghana's experience mirrors laptop distribution failures in Peru (Cristia et al., 2017). Rather than dismissing social media as "informal," NCCE should systematize it by developing evidence-based guidelines for civic engagement on Facebook/WhatsApp; training educators in digital community management; and creating branded content templates. Leveraging platforms like Facebook, where citizens already engage, is more strategic than building a separate social engagement infrastructure. Centralized ICT planning creates one-size-fits-all programs that fail heterogeneous districts. Accra districts with 4G connectivity need different approaches than Northern regions with intermittent 2G coverage. Decentralized planning, paired with district-level ICT needs assessment using the CETA framework, could customize interventions.

Recommendations

1. Conduct an infrastructure audit across all 45 districts using the CETA framework dimensions.
2. Pilot WhatsApp-based civic education program in 10 low-connectivity districts, measuring reach/engagement.
3. Establish quarterly TK/PK training using a cascade model (train district coordinators → train staff).
4. Launch the "Civic Educator Digital Champions" program, recognizing innovative ICT integration.

Future Research Direction

Our cross-sectional design identified correlates but not causes. Future research should randomly assign districts to: Control (status quo), Training-only (TK/PK workshops), Infrastructure-only (devices + connectivity), and Combined (training + infrastructure), and measure integration extent at 6, 12, and 18 months. Doing this would establish causal pathways and identify cost-effective interventions.

Disclosure Statement

No conflict of interest was declared by the authors.

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APPENDIX A

QUESTIONNAIRE FOR CIVIC EDUCATION EDUCATORS

The study is to explore the extent to which ICT integration in civic education delivery in Ghana is the case. The study is for academic purposes as a requirement for a PhD degree in the Kwame Nkrumah University of Science and Technology. The findings are envisaged to add knowledge to empirical literature on the use of ICT integration in civic education in Ghana. The findings will be published in journals and presented at conferences. Be assured of your identity protection in the remit of KNUST and the Ghana Data Protection Act 843 of 2012. Thank you for agreeing to participate in the study to contribute to knowledge.

Part I: Demographic Data of Respondents

1. Indicate the geographical zone your office is located in by selecting the appropriate option:
   Southern [ ]
   Middle [ ]
   Northern [ ]
2. How long (years) have you been teaching civic education in NCCE? … years
3. Indicate your highest academic qualification ……..…….

Part II: Extent of ICT integration in Civic Education

Section 1: ICT Infrastructure

4. What types of ICT devices are available for teaching and learning in your institution? (select all that apply)
   [ ] Desktop computers
   [ ] Laptops
   [ ] Tablets
   [ ] Smartphones
   [ ] Interactive whiteboards
   [ ] Other (please specify)

5. How would you rate the availability of ICT devices for teaching and learning in your institution? (where 1 is 'very limited' and 5 is 'very adequate')
   [ ] very limited
   [ ] limited
   [ ] moderate
   [ ] adequate
   [ ] very adequate
6. What is the internet connectivity like in your institution? (Select one option)
   [ ] Fast and reliable
   [ ] Slow but reliable
   [ ] Unreliable
   [ ] No internet connectivity

Section 2: ICT Integration in Civic Education

7. To what extent do you use ICT in your civic education teaching? (Scale: 1-4, where 1 is "not at all" and 4 is "to a great extent")
   [ ] not at all
   [ ] some extent
   [ ] significant extent
   [ ] great extent

8. Which of the following ICT tools do you use in civic education teaching? (Select all that apply)
   [ ] Learning management systems (LMS)
   [ ] Online discussion forums
   [ ] Social media
   [ ] Educational software
   [ ] Online simulations/games
   [ ] Other (please specify)

9. How do you use ICT to support student/public learning in civic education? (Select all that apply)
   [ ] To access online resources and materials
   [ ] To facilitate online discussions and collaborations
   [ ] To create and share multimedia content

Section 3: Impact and Future Directions

10. To what extent do you think ICT integration has improved student/public learning outcomes in civic education? (Scale: 1-4, where 1 is 'not at all' and 4 is 'to a great extent')
    [ ] not at all
    [ ] to some extent
    [ ] to a significant extent
    [ ] to a great extent

11. What are the plans for integrating ICT in civic education? …….

APPENDIX B

INTERVIEW SCHEDULE FOR PARTICIPANTS

The study is to explore the current state of ICT integration, facilitating or hindering effective delivery of civic education in Ghana. The purpose of the study is for academic purposes as a requirement for a PhD degree in the Kwame Nkrumah University of Science and Technology. The findings from the study are envisaged to add knowledge to empirical literature on the use of ICT to deliver civic education in the country. The findings will be published in journals and presented at conferences. Be assured of your identity, or any wording to point at you as a person will not be used, which would go against the ethics of research and that of the university and the Ghana Data Protection Act 843 of 2012.

Thank you for agreeing to participate in the study to contribute to knowledge.
Date of interview: ……
Time of the interview: …….
Name of geographical zone: ……
Initials of participants: …… …… …… ……. …….

Part I: Demographic Data of Participants

1. What is your academic qualification?……..……...…..……
2. For how many years have you been working as an educator/instructor at NCCE? ……..…
3. For how many days or times does your institution go out for education on civic issues? ……..…
   a. On what issue exactly does your civic education centre? ..…….…….…. ……..……..

Part II: State of ICT integration in civic Education

4. Are ICTs being integrated into civic education?
   a. If Yes, why? ……..……..……
   b. If No, why? …….
5. How is ICT incorporated in the teaching of civic education? ……..…..…….
6. What type of ICT tools and platforms have you used in civic education (eg. Learning management systems, online discussion forums, educational software)?
7. How do you ensure that ICT tools are accessible and usable to your target groups?
   ……..……...……..
8. Can you provide examples of some indicators that can paint a clear picture of the current of ICT integration in civic education?
   a. If Yes, then give a vivid mental picture/infographic about the state
      ……..……..…….
   b. If No, why?……..……...…
9. How can you describe integration of ICT in your educational purposes as an institution (NCCE)?……...…….
   a. Give some examples to indicate the condition prevailing on ICT integration in civic education
      …..……..……..…….
      ……..……
      ……..…..…
10. Can you provide examples of how you have used ICT to teach civic education concepts (e.g., democracy, human rights, and social justice)?……...……...……
    ……..…….
11. On the scale of 1 to 10, what is the current state of ICT integration in civic education?
    ……...……..……..……
12. What is/are accounting for the current state of ICT integration in civic education?
    ……...……
    ……...……
    ……...……

Part III: Factors that promote the integration of ICT in civic education

A: Technical factor

13. What type of ICT infrastructure (eg. Computer, tablets, internet connectivity) are necessary for effective ICT integration in civic education?……...…….…….
    ……..……...……
14. How can educators ensure that ICT tools are compatible with existing educational systems?
    ……
15. What role can ICT support staff play in facilitating the integration of ICT in civic education?
    ……...…….
    ……...…….

B: Pedagogical factors

16. How can educators design civic education curricula that effectively integrate ICT to promote critical thinking, problem-solving and collaboration?……...……
    ……..……..
    .
17. What teaching methods and strategies can educators use to promote the effective integration of ICT in civic education?……..……..
18. Are there challenges in assessing participants in learning outcomes in civic education?
    ……

C: Organizational factors

19. Are there any organisational policies that help to positively impact integration of ICT in civic education?
    ……
    ……
20. What role can parents and the community play in supporting the integration of ICT in civic education?
    ……...……

Part IV

Hindering factors affecting ICT integration in civic education if (any)

21. What challenges have you faced when integrating ICT in civic education and how have you addressed them?…….
……..……..……

A: Organizational Factors

22. What policies and procedures can educational institutions implement to support the integration of ICT in civic education?……...……
……..……...……
23. How can educators and administrators work together to promote a culture of ICT integration in civic education? ……..……...…….
……..……...……..
24. What role can parent and community involvement play in supporting the integration of ICT in civic education?
……..……...……..

B: Socio-cultural Factors

25. How can educators address potential socio-cultural barriers to ICT integration in civic education, such as disparities in access to technology?
……...…...……
26. What is/are the cost(s) associated with integrating ICT in civic education, and how can educators and administrators allocate resources effectively?…….…....…….
……..……...……
27. How can educators and administrators ensure that ICT integration in civic education is cost-effective and sustainable in the long term?……..……..……
28. What role can government funding, grants, and private sector partnerships play in supporting the integration of ICT in civic education?……..……..……..…….
……
27. How can educators use ICT to promote cultural diversity, equity, and inclusion in civic education?…… ……..……...……
……..……..…….

Part V: Suggestions to reduce negative impact(s) in the integration process

29. Can you describe any future plans or initiatives for ICT integration in civic education that you are aware of? ……..…….
……
30. How do you think ICT integration in civic education can be sustained and scaled up over time?……...…….……
……..……..……
31. What strategies can educators use to promote digital literacy and ICT skills among students from diverse socio-cultural backgrounds?……..……..……..……
……..……..…….
32. How can educators and administrators ensure that ICT integration in civic education is environmentally sustainable, e.g., reducing e-waste, energy consumption? ……..……...……
……...
33. What strategies can educators use to promote environmental awareness and sustainability through ICT-integrated civic education?……..……..……
……..……...…….
34. How can educators and administrators balance the benefits of ICT integration in civic education with potential environmental drawbacks?……..……..……..…….
……

APPENDIX C

Table C1. Summarised ordinal logistic regression assumptions (N = 165)

Assumption	Diagnostic/test	Result	Decision
1. Dependent variable is ordinal	Outcome specified as an ordered factor with four categories (1–4)	ICT extent coded as ordered factor; distribution: 1 = 13.3%, 2 = 64.8%, 3 = 14.5%, 4 = 7.3%	**Satisfied**
2. Independent variables appropriately specified	Variable type inspection and descriptive summaries	Predictors include continuous indices (devices, tools, uses), an ordinal factor (Internet), and a numeric availability rating	**Satisfied**
3. Independence of observations	Duplicate row check	19 duplicated response patterns identified; data collected from distinct respondents completing the questionnaire once	**Satisfied***
4. Proportional odds (parallel regression)	Brant test (χ^2)	Omnibus: χ^2 (14) = 21.98, p = .08; one localized violation for internet (cubic term, p = .04)	**Acceptable**
5. Linearity in the logit (continuous predictors)	Quadratic term comparison (LR test & AIC)	LR χ^2 (4) = 4.75, p = .31; AIC increased (319.93 → 323.18)	**Satisfied**
6. No multicollinearity	Variance Inflation Factor (VIF)	All VIF values between 1.02 and 1.21	**Satisfied**

Table C2. Predicting extent of ICT use (ordered logit; N = 165)

Predictor	B	SE	Z	p	OR	95% CI for OR
Devices index	-0.479	0.167	-2.865	.004*	0.619	[0.446, 0.860]
Availability rating	0.233	0.164	1.418	0.156	1.262	[0.915, 1.742]
Internet (linear)	0.488	0.406	1.201	0.23	1.629	[0.735, 3.611]
Internet (quadratic)	0.138	0.38	0.363	0.717	1.148	[0.545, 2.418]
Internet (cubic)	0.347	0.34	1.021	0.307	1.414	[0.727, 2.752]
Tools index	0.695	0.235	2.955	.003**	2.004	[1.264, 3.178]
Uses index	0.604	0.36	1.679	.093†	1.829	[0.904, 3.702]

Note. OR = odds ratio; CI = 95% Wald confidence interval. The Internet was entered as an ordered factor, producing polynomial contrasts (L, Q, C). † for p < .10, * for p<.05, ** for p < .01.

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