

Digital Health Training and Readiness for Primary Healthcare Practice among Final-Year Health Professional Students in Selected Training Institutions in Kenya

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ABSTRACT

The study examined the relationship between digital-health training and readiness for digitally enabled primary healthcare practice among final-year health professional students in selected Kenyan training institutions. A convergent multicentre mixed-methods design was employed across six health-training institutions. A structured questionnaire was completed by final-year students, while key-informant interviews were conducted with curriculum leaders, digital-health educators and clinical-placement supervisors. Digital-health training was measured through curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback. Quantitative data were analysed using descriptive statistics, Pearson's correlation and simultaneous multiple linear regression, while qualitative data were analysed using framework analysis and integrated with the quantitative findings. Of the 475 students invited, 386 completed the questionnaire, yielding an 81.3% response rate; all 18 invited key informants participated. Curriculum content and relevance received the highest training score ($M = 4.374$, $SD = 0.558$), followed by teaching and learning methods ($M = 3.777$, $SD = 0.797$). Practical and clinical exposure ($M = 2.707$, $SD = 0.821$) and assessment and feedback ($M = 2.770$, $SD = 0.831$) were weaker. Mean readiness was 3.628 ($SD = 0.705$). The four training dimensions jointly explained 62.3% of the variance in readiness (adjusted $R^2 = .619$; $F(4, 381) = 157.235$, $p < .001$). Practical and clinical exposure made the largest independent contribution ($\beta = .416$, $p < .001$), followed by curriculum content and relevance ($\beta = .278$, $p < .001$), teaching and learning methods ($\beta = .244$, $p < .001$), and assessment and feedback ($\beta = .224$, $p < .001$). Qualitative findings indicated that relevant theoretical content had not always been accompanied by realistic platforms, supervised system use or practical assessment. Training institutions therefore needed to connect curriculum content with simulation, supervised system access, performance-based assessment, structured feedback and dependable institutional support.

Keywords: digital health; health-professions education; primary healthcare; readiness; health professional students

INTRODUCTION

Digital technologies transformed how health systems documented patient encounters, exchanged information, supported clinical decisions, coordinated referrals and delivered services outside conventional health facilities. Electronic patient records, mobile-health applications, telehealth platforms, digital reporting systems and clinical dashboards increasingly became part of routine healthcare delivery. The World Health Organization (WHO, 2026) identified digital competence as an important workforce requirement encompassing patient care, information management, communication, technical proficiency and digital professionalism. This development placed a responsibility on health-training institutions to prepare graduates who could use digital technologies safely and appropriately in healthcare practice.

Digital-health preparation became particularly important in primary healthcare (PHC), where health professionals worked within multidisciplinary teams, community-based services, referral systems and facilities with varying levels of technological infrastructure. New health professionals were increasingly expected to enter and retrieve patient information, interpret digital data, use electronic referral systems, support teleconsultations

and communicate through digital platforms. They were also expected to protect patient confidentiality, respond appropriately to system failures and accommodate patients who experienced limited connectivity, inadequate digital skills or restricted access to suitable devices. Lawrence and Levine (2024) argued that health-professions education needed to address these digital determinants of health to prevent technological adoption from widening existing inequalities in healthcare.

Kenya strengthened its legal and institutional framework for digitally enabled healthcare through several reforms. The Digital Health Act, 2023 established the Digital Health Agency and provided for an integrated digital health information system, health-information exchange and protection of health data (Kenya, 2023a). The Primary Health Care Act, 2023 strengthened the organisation and delivery of community- and facility-based PHC services (Kenya, 2023b). The Data Protection Act, 2019 additionally established obligations governing the collection, storage and processing of personal information (Kenya, 2019). These reforms increased the need for graduates who understood digital systems, associated clinical workflows and their professional responsibilities when handling patient information.

Kenyan evidence nevertheless suggested that digital access and preparedness remained uneven. Kabare et al. (2022) found generally positive perceptions of e-learning among health-science students, but unreliable internet connectivity and limited motivation remained important challenges. Gachanja et al. (2021) demonstrated that a supported online research course could be delivered through the Kenya Medical Training College during the COVID-19 disruption. However, that study addressed online education rather than readiness to use digital systems in healthcare practice. Gicheru and Mwangi (2023) found that access to learning-management systems and basic digital skills was more common among faculty than advanced digital capability. Aldousari et al. (2025) reported that only slightly more than half of the undergraduate healthcare students included in their Kenyan study demonstrated high eHealth literacy. Although these studies provided important evidence about e-learning and information-seeking skills, they did not establish whether final-year students were prepared to use digital systems within PHC practice.

International evidence demonstrated a similar difference between interest in digital health and practical preparation. Machleid et al. (2020) found that only 40.6% of medical students surveyed across 39 European countries felt prepared to work in a digitised health system. Ma et al. (2023) found considerable demand for digital-health education among Chinese medical students and reported a preference for practical instruction and internship-based exposure rather than conventional lectures. Longhini et al. (2022) identified considerable variation in the competencies measured across health professional groups and study settings. Ferreira and Magalhães (2026) similarly found differences in the scope and psychometric quality of instruments used to assess digital-health capability.

Available evidence suggested that readiness depended on more than the presence of digital-health content in a curriculum. Curriculum relevance, teaching methods, practical experience, assessment and feedback influenced whether students could translate instruction into preparedness for practice. Car et al. (2025) emphasised the need for systematic digital-health learning outcomes rather than isolated instruction on individual technologies. Khurana et al. (2022) also demonstrated the importance of integrating relevant knowledge, practical skills and professional attitudes into health-professions education. Oni et al. (2026) reported improvements in students' familiarity and applied understanding after an African digital-health training programme that combined workshops, case studies, mentorship and group projects. These findings indicated the potential value of interactive and experiential learning.

The Unified Theory of Acceptance and Use of Technology provided part of the conceptual basis for the study. Venkatesh et al. (2003) proposed that performance expectations, social influence and facilitating conditions contributed to technology acceptance and use. The study applied this reasoning to the training environment, where devices, internet connectivity, electricity, technical assistance, educator support and system-access procedures could support or constrain students' readiness. A competency-based educational perspective additionally guided the expectation that curriculum content, teaching activities, practical experience and assessment needed to align with the capabilities expected in professional practice (Frank et al., 2010).

Despite Kenya's digital-health reforms, previous studies had not adequately established how the content and relevance of digital-health curricula, teaching and learning methods, practical and clinical exposure, and assessment and feedback related separately to readiness for PHC practice. Institutional and placement conditions that supported or constrained readiness also remained insufficiently understood.

The study therefore assessed the relationship between digital-health training and readiness for PHC practice among final-year health professional students in selected Kenyan training institutions. It specifically examined the relationships between readiness and four training dimensions: curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback. It also explored institutional and clinical-placement factors that facilitated or hindered digital-health training and readiness. The study hypothesised that each of the four training dimensions was significantly associated with readiness for digitally enabled PHC practice.

Study Objectives

General objective

To investigate the relationship between digital-health training and readiness for primary healthcare practice among final-year health professional students in selected training institutions in Kenya.

Specific objectives

- i. To determine the relationship between the content and relevance of digital-health curricula and readiness for primary healthcare practice among final-year health professional students in selected training institutions in Kenya.
- ii. To examine the relationship between digital-health teaching and learning methods and readiness for primary healthcare practice among final-year health professional students in selected training institutions in Kenya.
- iii. To assess the relationship between practical and clinical digital-health exposure and readiness for primary healthcare practice among final-year health professional students in selected training institutions in Kenya.
- iv. To determine the relationship between digital-health assessment and feedback and readiness for primary healthcare practice among final-year health professional students in selected training institutions in Kenya.
- v. To explore institutional and clinical-placement factors that facilitate or hinder digital-health training and readiness for primary healthcare practice in selected training institutions in Kenya.

LITERATURE REVIEW

Theoretical Foundation

The study was principally informed by the Unified Theory of Acceptance and Use of Technology developed by Venkatesh et al. (2003). UTAUT proposed that technology use was influenced by performance expectancy, effort expectancy, social influence and facilitating conditions. Performance expectancy reflected the extent to which individuals believed that technology improved their performance, while effort expectancy concerned the perceived ease of using the technology. Social influence represented the influence of important individuals or professional groups, whereas facilitating conditions referred to the organisational and technical resources that supported technology use. The theory also recognised that age, gender and previous experience could affect technology acceptance and use.

UTAUT was relevant to the study because readiness for digitally enabled primary healthcare depended partly on whether students encountered technologies that were relevant to professional tasks and whether their training

environment supported learning and system use. Curriculum content and teaching methods could shape students' understanding of how digital technologies supported PHC work. Practical exposure, assessment and feedback could strengthen their preparedness to apply what they had learned. Facilitating conditions were reflected in access to devices and platforms, internet connectivity, electricity, technical assistance, educator support and institutional procedures governing students' access to digital systems.

Empirical Review

International studies generally showed that students recognised the importance of digital health but did not always feel adequately prepared for practice. Machleid et al. (2020) surveyed medical students from 39 European countries and found that only 40.6% felt prepared to work in a digitised health system, while approximately 85% wanted digital health to receive greater attention in medical curricula. The study demonstrated a gap between students' interest in digital health and their perceived preparation. However, it concentrated on medical students in Europe and did not examine the separate contribution of curriculum content, teaching methods, clinical exposure, and assessment and feedback.

In China, Ma et al. (2023) analysed 2,122 valid responses from students attending 467 medical schools. Although 87.24% of the participants believed that preparation for a digital health system was necessary, only 56.97% had undertaken a digital-health course. Practical training and internships were preferred by 78.02% of respondents, compared with 10.54% who preferred conventional lectures. The findings supported the relevance of experiential learning but examined students' preferences and expectations rather than their readiness to perform specific digital-health activities in PHC.

African evidence remained limited. Oni et al. (2026) assessed an eight-week African digital-health student bootcamp that combined workshops, mentorship and collaborative projects. Among 47 participants drawn from 13 African countries, 82.93% reported an improvement in their digital-health knowledge, skills and experience. The study suggested that structured and applied training could improve students' perceived capability. However, the small, self-selected sample and specialised bootcamp setting limited the transferability of the findings to routine pre-service health-professional curricula.

Kenyan studies addressed related but narrower aspects of digital preparation. Kabare et al. (2022) examined 294 health-science students and found that 79.6% had a positive attitude towards online learning. Nevertheless, 56.9% experienced unreliable internet connectivity and 73.7% reported limited motivation. The study demonstrated the importance of enabling conditions but assessed e-learning rather than readiness to use digital systems in healthcare delivery.

Aldousari et al. (2025) examined eHealth literacy and knowledge of social health financing among 207 undergraduate healthcare students from 21 Kenyan institutions. Only 54% of the participants attained the study's threshold for high eHealth literacy. Although the study provided recent evidence of uneven digital capability among Kenyan health professional students, eHealth literacy primarily concerned the ability to locate, understand and use electronic health information. It did not establish whether students had received relevant digital-health training or whether they were prepared to use electronic records, telehealth, digital reporting systems and other technologies within PHC practice.

Research Gaps

The reviewed studies left several gaps. First, much of the available evidence measured e-learning perceptions, digital literacy or interest in digital-health education rather than readiness to perform specific digital-health activities in PHC. Second, digital-health training was rarely separated into curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback. It therefore remained unclear which dimensions of training were most closely associated with readiness.

Third, the reviewed studies gave limited attention to the institutional and clinical-placement conditions under which students translated training into preparedness for practice. Access to functional systems, reliable connectivity, electricity, technical assistance, supportive preceptors and appropriate access procedures could

differ substantially across training settings. Fourth, most studies relied on structured surveys and did not combine student responses with explanations from curriculum leaders, educators and clinical supervisors.

The study addressed these gaps by examining the separate relationships between the four digital-health training dimensions and readiness among final-year students from several health professional programmes and institutions in Kenya. Key-informant interviews additionally examined how curriculum implementation and institutional or clinical-placement conditions explained the quantitative findings.

Conceptual Framework

The conceptual framework proposed that digital-health training was the independent variable and readiness for digitally enabled primary healthcare practice was the dependent variable. Digital-health training comprised four sub-variables: curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback.

Readiness was reflected in students' preparedness to manage electronic patient information, use digital data in PHC decisions, apply telehealth and mobile-health tools, meet data-protection and consent requirements, communicate digital procedures to patients, accommodate digital-access limitations, respond safely to system failures, adapt to unfamiliar systems and use appropriate digital technologies with minimal supervision.

Institutional and clinical-placement conditions were treated as contextual variables. They included access to functional devices and platforms, internet connectivity, electricity, technical assistance, educator and preceptor support, and procedures governing student access to digital systems. They were examined descriptively, qualitatively and through bivariate correlation with readiness but were not entered in the primary regression model and were not treated as moderators because no interaction effects were specified or tested.

Programme, age group, gender, institution, form of digital-health instruction and previous digital-system exposure were treated as participant background characteristics. They were summarised descriptively and excluded from the conceptual figure and primary four-predictor model. Academic programme and previous digital-system exposure were entered only in a secondary hierarchical sensitivity analysis to assess potential confounding.

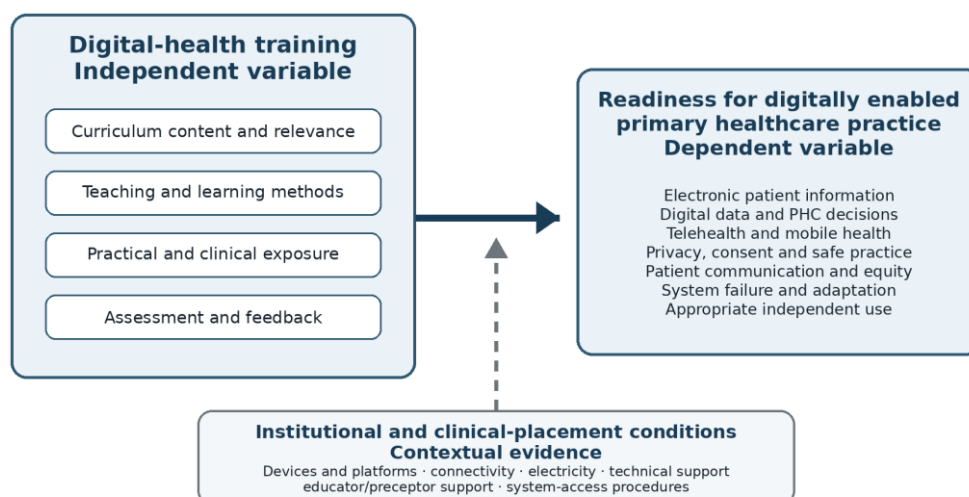


Figure 1: Conceptual Framework

METHODOLOGY

The study employed a convergent multicentre mixed-methods design comprising an analytical cross-sectional survey and key-informant interviews. The study covered six accredited health-training institutions in Kenya, which were purposively selected to provide variation in geographical setting, institutional ownership,

programme composition and access to primary healthcare training environments. The quantitative component examined the relationship between digital-health training and readiness for primary healthcare practice, while the qualitative component explored curriculum implementation and the institutional and clinical-placement factors that shaped students' preparation. Data were collected during June-August 2026. The two components were analysed separately and integrated during interpretation.

The quantitative population comprised final-year students enrolled in nursing, clinical medicine, medicine and surgery, pharmacy, public health, medical laboratory sciences, nutrition and dietetics, rehabilitation and other health professional programmes relevant to primary healthcare. Students were eligible if they were at least 18 years old, were enrolled in the final year of an included programme in one of the participating institutions and provided informed consent. Students who were on prolonged academic leave, were visiting students whose curricula were administered by other institutions, had participated in cognitive testing or piloting, or declined consent were excluded. Previous completion of a primary healthcare placement was not imposed as an eligibility requirement because the different levels of practical and clinical digital-health exposure formed part of the independent variable.

The quantitative sample was determined using Cochran's formula (Cochran, 1977) at a 95% confidence level, 5% margin of error and an assumed population proportion of 0.50. The calculation produced a minimum sample of 384 completed questionnaires. To accommodate non-response and maintain representation across the six institutions and eligible health-professional programmes, 475 students were selected for invitation. The invitation target was distributed proportionately across the six institutions and their eligible health professional programmes. Updated and de-duplicated lists of final-year students were obtained from authorised institutional offices, and computer-generated simple random sampling was applied within each programme stratum. The qualitative sample comprised 18 key informants, with three participants selected purposively from each institution. These participants represented curriculum or academic leadership, digital-health teaching or programme delivery, and clinical-placement supervision or preceptorship.

Quantitative data were collected using a structured, self-administered questionnaire programmed in KoboToolbox. Digital-health training was assessed using 14 five-point agreement statements organised into curriculum content and relevance (five items), teaching and learning methods (three items), practical and clinical exposure (three items), and assessment and feedback (three items), with responses ranging from 1 (strongly disagree) to 5 (strongly agree). Readiness was measured using nine task-specific preparedness items rated from 1 (not at all prepared) to 5 (fully prepared). Six five-point agreement items assessed institutional and clinical-placement conditions. Dimension scores were computed as item means: at least four of five content items, two of three items for each remaining training dimension, and eight of nine readiness items were required. Higher scores represented more favourable training experiences or greater readiness, and unanswered items were retained as missing values. To reduce common-method bias, the electronic form was anonymous, placed the training predictors and readiness outcome in separate sections, used different response anchors for the two constructs, and informed participants that participation was voluntary and would not affect their education or assessment.

Qualitative data were collected using a semi-structured key-informant interview guide containing eight principal questions on curriculum content, teaching methods, practical and clinical exposure, assessment and feedback, observed student readiness, institutional facilitators and barriers, and priorities for improvement. Interviews were conducted in English, lasted approximately 25–35 minutes, were audio-recorded with permission and were supplemented by field notes. Recordings were transcribed verbatim, checked against the audio and de-identified before analysis.

The research instruments underwent expert review, cognitive testing and piloting before the main study. A panel of six experts representing digital health, primary healthcare, health-professions education and research measurement assessed the relevance, clarity, completeness and contextual suitability of the questionnaire and interview guide. An item-level content-validity index of at least 0.78 and a scale-level average of at least 0.90 guided item retention and revision. Cognitive testing was conducted with eight final-year students from a non-participating institution to examine their interpretation of the questions, understanding of key terms, response selection and completion burden. A pilot study was subsequently conducted among 40 final-year health

professional students from another institution that was not included in the six main study sites. Cognitive-testing and pilot participants were excluded from the main study.

Questionnaire responses were exported from KoboToolbox and retained as an unaltered raw-data file. Data cleaning was performed in a separate versioned copy. Checks were conducted for duplicated participant identifiers, responses outside the permitted ranges, ineligible submissions, excessive missingness, uniform response patterns and implausibly short completion times. Institution and programme names were replaced with codes in the analysis dataset. All 386 respondents had complete closed-ended item and covariate data; 100 respondents did not answer the optional open-ended question, and those missing comments were not imputed. Audio recordings, de-identified transcripts, quantitative data and analysis files were stored in password-protected and access-controlled folders.

Quantitative data were analysed using IBM SPSS Statistics Version 28. Frequencies and percentages summarised categorical variables, while means and standard deviations summarised continuous scale scores. Internal consistency was examined using Cronbach's alpha and item-level diagnostics, with coefficients of at least .70 considered acceptable. Confirmatory factor analysis was conducted in Python 3.12.14 using normal-theory maximum-likelihood estimation on the Pearson correlation matrix, treating the five-point items as approximately continuous. The prespecified four-factor training model and one-factor readiness model were assessed using standardised loadings, the chi-square test, comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA) and standardised root mean square residual (SRMR). A supplementary unrotated single-factor diagnostic examined whether one general factor dominated the predictor and outcome items. All tests were two-sided, significance was evaluated at $\alpha = .05$, and estimates were reported with 95% confidence intervals and exact p-values except where $p < .001$.

Pearson's correlation coefficients were calculated for the relationships between the continuous scale scores. A simultaneous multiple linear regression model then examined the independent contribution of the four digital-health training dimensions to readiness for digitally enabled primary healthcare practice. Readiness was entered as the dependent variable, while curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback were entered simultaneously as the independent variables. Institutional and placement conditions and participant background characteristics were not entered into this primary model. A secondary hierarchical sensitivity analysis entered academic programme and previous digital-system exposure as dummy-coded covariates in Block 1 (reference categories: nursing and no previous exposure) and added the four training dimensions in Block 2. Change in R-squared tested the additional contribution of the training dimensions. Linearity, residual distribution, homoscedasticity, multicollinearity and influential observations were examined during model assessment.

Qualitative data were managed and analysed using NVivo 15.5 and a framework-analysis approach. Initial deductive categories reflected curriculum content and relevance, teaching and learning methods, practical and clinical exposure, assessment and feedback, student readiness, and institutional or placement conditions. Inductive coding captured explanations not anticipated in the initial framework. The author led the analysis, and a second trained qualitative researcher independently reviewed four transcripts to challenge and refine the coding framework. The author coded the remaining transcripts using the agreed framework. Analytical decisions, revisions to codes, discrepant cases and comparisons across participant roles and institutions were documented in an audit trail.

Quantitative and qualitative findings were integrated through a joint display. Statistical findings for each of the four digital-health training dimensions were compared with the explanations offered by key informants. Convergence was identified where both components supported a similar interpretation, complementarity where the interview findings extended or explained a statistical result, and dissonance where the two components produced different accounts. The integrated interpretation informed the study's conclusions and recommendations for improving digital-health preparation in health-training institutions.

FINDINGS

Response Rates

The quantitative survey targeted 475 final-year health-professional students across the six participating institutions. A total of 386 students completed the questionnaire, resulting in a response rate of 81.3%. The achieved sample exceeded the minimum requirement of 384 completed questionnaires. For the qualitative component, all 18 planned key-informant interviews were completed, giving a qualitative response rate of 100.0%.

Table 1: Response Rate

Study component	Invited or planned	Completed	Response rate
Quantitative survey	475	386	81.3%
Key-informant interviews	18	18	100.0%

The survey response rate provided an adequate quantitative sample for the planned analyses, while completion of all 18 interviews ensured representation of curriculum leadership, digital-health teaching and clinical-placement supervision across the six institutions.

Demographic Information

Nursing students constituted the largest proportion of respondents at 33.2%, followed by students undertaking clinical medicine at 18.9% and medicine and surgery at 14.5%. Most respondents were aged 20–24 years (72.0%), while 52.8% were female.

Previous exposure to digital-health systems varied considerably. Approximately 41.2% of respondents had used a digital system under supervision, 25.6% had observed its use, 16.6% had used a system independently within an authorised role, and 16.6% reported no previous exposure. Academic programme and previous system exposure were summarised as background characteristics and were subsequently included only in the hierarchical sensitivity analysis.

Digital-Health Training Experiences

Digital-health training was examined through four dimensions: curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback. The findings for each dimension are presented separately.

Measurement Quality

All composite measures demonstrated acceptable internal consistency. Cronbach's alpha was .799 for curriculum content and relevance, .756 for teaching and learning methods, .763 for practical and clinical exposure, .777 for assessment and feedback, .903 for readiness, and .864 for institutional and clinical-placement conditions.

The four-factor training model showed good fit, $\chi^2(71) = 109.042$, $p = .003$, CFI = .976, TLI = .969, RMSEA = .037 (90% CI [.022, .051]) and SRMR = .045. Standardised item loadings ranged from .631 to .783. The one-factor readiness model also fitted the data well, $\chi^2(27) = 26.705$, $p = .480$, CFI = 1.000, TLI = 1.000, RMSEA = .000 (90% CI [.000, .039]) and SRMR = .021, with loadings from .644 to .762. These results supported the use of the prespecified composite scores.

In the supplementary common-method diagnostic, the first unrotated factor accounted for 35.4% of the variance across the 14 training and nine readiness items. No single factor therefore accounted for a majority of the item variance, although this diagnostic did not eliminate the possibility of common-method bias.

Curriculum Content and Relevance

Table 2 presents the students' assessment of the content and relevance of the digital-health training included in their programmes.

Table 2: Curriculum content and relevance

Statement	Mean	SD	Interpretation
Electronic patient records and routine health-information systems	4.570	0.625	Very favourable
Telehealth, mobile-health and community applications	4.179	0.860	Favourable
Use of digital information for decisions, referrals and reporting	4.070	0.878	Favourable
Safe and ethical practice, data protection and cybersecurity	4.619	0.626	Very favourable
Relevance of content to Kenyan primary healthcare tasks	4.430	0.715	Very favourable
Composite mean	4.374	0.558	Very favourable

Curriculum content and relevance recorded a composite mean of 4.374 (SD = 0.558), indicating that students generally evaluated this dimension very favourably. Training in safe and ethical digital-health practice, data protection and cybersecurity received the highest rating (M = 4.619, SD = 0.626). The finding suggested that ethical and legal responsibilities had received considerable attention within the training programmes.

Training in electronic patient records and routine health-information systems was similarly rated very favourably (M = 4.570, SD = 0.625). Students also viewed the relevance of the content to Kenyan primary healthcare tasks very favourably (M = 4.430, SD = 0.715). Telehealth, mobile-health and community applications received the lowest mean within this dimension, although the result remained favourable (M = 4.179, SD = 0.860).

The qualitative evidence suggested that the required content had been included, but its integration across courses was not always clear:

“Electronic records and data protection appeared in several units, but students did not always see how those pieces connected during a PHC consultation.”

KII-01, curriculum leader

The findings showed that students had received relevant digital-health content, particularly concerning ethical practice, information systems and data protection. Nevertheless, the qualitative account indicated that the relationship between these topics and the complete primary healthcare consultation had not always been made explicit.

Teaching and Learning Methods

Table 3 presents the findings on the methods used to teach digital health.

Table 3: Teaching and learning methods

Statement	Mean	SD	Interpretation
Use of primary healthcare examples and cases	4.031	0.908	Favourable
Demonstrations, simulations and practical exercises	3.580	0.993	Favourable

Active participation in digital-health problem-solving	3.720	1.011	Favourable
Composite mean	3.777	0.797	Favourable

Teaching and learning methods recorded a composite mean of 3.777 (SD = 0.797), indicating a favourable assessment of the methods used to deliver digital-health training. The use of primary healthcare examples and cases received the highest rating within this dimension (M = 4.031, SD = 0.908). This finding indicated that students had generally encountered digital-health concepts within situations that reflected primary healthcare practice.

Active participation in digital-health problem-solving was also rated favourably (M = 3.720, SD = 1.011). However, the relatively large standard deviation indicated that students' opportunities to participate actively had varied.

Demonstrations, simulations and practical exercises received the lowest rating within the dimension (M = 3.580, SD = 0.993). Although the mean remained favourable, the result suggested that practical teaching activities had not been offered with the same intensity or consistency across all programmes and institutions.

Overall, the findings indicated that primary healthcare cases had been used more consistently than demonstrations and simulations. The wider variation in responses to practical teaching methods suggested that some students had received interactive digital-health instruction, while others had experienced more conventional classroom teaching.

Practical and Clinical Exposure

Table 4 presents the students' experiences of practical and clinical exposure to digital-health systems.

Table 4: Practical and clinical exposure

Statement	Mean	SD	Interpretation
Access to a functional digital-health system or realistic training platform	2.720	1.037	Mixed or uncertain
Observation of digital-system use during clinical placement	3.080	1.025	Mixed or uncertain
Supervised use of a digital-health system	2.321	0.923	Unfavourable
Composite mean	2.707	0.821	Mixed or uncertain

Practical and clinical exposure recorded a composite mean of 2.707 (SD = 0.821), reflecting mixed or uncertain student experiences. Observation of digital-system use during clinical placement received the highest mean within this dimension (M = 3.080, SD = 1.025). The result indicated that some students had seen digital systems being used in clinical environments, although these opportunities were inconsistent.

Access to a functional system or realistic training platform recorded a mean of 2.720 (SD = 1.037). The relatively large standard deviation showed that access had differed considerably across institutions and programmes.

Supervised use of a digital-health system received the lowest rating in the dimension (M = 2.321, SD = 0.923) and was interpreted as unfavourable. Students had therefore been more likely to observe a qualified healthcare professional using a system than to operate the system themselves under supervision.

The qualitative evidence provided a direct explanation for the limited supervised exposure:

“Most students observed the system from behind the provider. Very few received a training account that allowed them to practise safely.” KII-02, clinical preceptor

The findings indicated that clinical exposure had often remained observational. Limited access to protected student accounts and functional training platforms had reduced opportunities for students to translate classroom knowledge into practical digital-health competence.

Assessment and Feedback

Table 5 presents the findings on the assessment of digital-health knowledge and skills and the feedback students received.

Table 5: Assessment and feedback

Statement	Mean	SD	Interpretation
Formal assessment of digital-health knowledge	3.171	1.028	Mixed or uncertain
Practical assessment of digital-health ability	2.461	1.001	Unfavourable
Useful feedback on digital-health knowledge and skills	2.679	0.967	Mixed or uncertain
Composite mean	2.770	0.831	Mixed or uncertain

Assessment and feedback recorded a composite mean of 2.770 (SD = 0.831), indicating mixed or uncertain student experiences. Formal assessment of digital-health knowledge received the highest mean within the dimension (M = 3.171, SD = 1.028). The finding suggested that some programmes had included digital-health concepts in written examinations or other knowledge-based assessments.

Practical assessment of digital-health ability received an unfavourable rating (M = 2.461, SD = 1.001). Students had therefore received fewer opportunities to demonstrate their ability to use digital systems than to answer theoretical questions about digital health.

Useful feedback on digital-health knowledge and skills recorded a mean of 2.679 (SD = 0.967), indicating mixed or uncertain experiences. The result suggested that feedback had not been offered consistently or had not always addressed the students' performance of practical digital-health tasks.

A lecturer described the difference between written assessment and demonstrated ability:

"Students could define confidentiality and interoperability in an examination, yet we had not consistently assessed whether they could apply those principles in a case." KII-06, lecturer

The quantitative and qualitative findings showed that assessment had concentrated more heavily on theoretical knowledge than on demonstrated digital-health performance. Limited practical assessment and feedback may consequently have reduced students' opportunities to identify and address gaps in their competence.

Across the four dimensions, curriculum content and relevance received the most favourable assessment, while practical and clinical exposure received the least favourable assessment. The overall digital-health training score was 3.545 (SD = 0.483), indicating a favourable training experience. Nevertheless, the individual dimension results showed that favourable content coverage had coexisted with weaker practical exposure, assessment and feedback.

Readiness for Digitally Enabled Primary Healthcare

Table 6 presents the students' perceived readiness to undertake specific digital-health tasks in primary healthcare settings.

Table 6: Readiness for digitally enabled primary healthcare practice

Digital-health task	Mean	SD	Interpretation
Enter, retrieve and update patient information	4.231	0.835	Fully prepared
Use digital information in primary healthcare decisions	3.920	0.973	Very prepared
Use telehealth or mobile-health tools for primary healthcare tasks	3.031	0.998	Moderately prepared
Use digital systems safely and ethically	4.521	0.692	Fully prepared
Explain digital-health tools clearly to patients	4.080	0.883	Very prepared
Adapt care for patients with limited digital access	3.070	1.023	Moderately prepared
Maintain safe care during digital-system failure	2.689	1.018	Moderately prepared
Learn unfamiliar digital systems and seek assistance	3.731	0.964	Very prepared
Use appropriate digital technologies with minimal supervision	3.381	1.021	Moderately prepared
Composite readiness mean	3.628	0.705	Very prepared

The composite readiness mean was 3.628 (SD = 0.705), indicating that the respondents generally considered themselves very prepared for digitally enabled primary healthcare practice. Students felt most prepared to use digital systems safely and ethically (M = 4.521, SD = 0.692). They also considered themselves fully prepared to enter, retrieve and update patient information (M = 4.231, SD = 0.835). These findings were consistent with the favourable curriculum-content ratings for data protection, ethical practice and electronic patient records.

Respondents considered themselves very prepared to explain digital-health tools to patients (M = 4.080, SD = 0.883), use digital information in primary healthcare decisions (M = 3.920, SD = 0.973), and learn unfamiliar systems while seeking assistance when necessary (M = 3.731, SD = 0.964). Readiness was lower for telehealth and mobile-health tasks (M = 3.031, SD = 0.998), adapting care for patients with limited digital access (M = 3.070, SD = 1.023), and using digital technologies with minimal supervision (M = 3.381, SD = 1.021). Maintaining safe care during a digital-system failure received the lowest readiness rating (M = 2.689, SD = 1.018).

The qualitative evidence similarly showed that routine digital tasks had presented fewer difficulties than system failures:

“Students were comfortable entering routine information, but they hesitated when the system generated an error or the network went down.” KII-08, clinical instructor

The findings therefore indicated that the students’ perceived readiness was strongest for routine information-management and ethical tasks. Readiness remained less developed for telehealth, system failures, digital-access inequalities and independent system use.

Institutional and Clinical-Placement Conditions

Table 7 presents the institutional and placement conditions that supported or constrained students’ digital-health training.

Table 7: Institutional and clinical-placement conditions

Institutional or placement condition	Mean	SD	Interpretation
Access to functional devices and digital-health platforms	3.080	1.005	Mixed or uncertain
Reliable internet connectivity	2.679	0.994	Mixed or uncertain
Reliable electricity	2.420	0.986	Unfavourable
Availability of technical assistance	2.531	1.012	Unfavourable
Support from educators and clinical preceptors	3.630	0.964	Favourable
Procedures allowing appropriate student access to digital systems	2.829	1.005	Mixed or uncertain
Composite mean	2.861	0.767	Mixed or uncertain

Institutional and clinical-placement conditions recorded a composite mean of 2.861 (SD = 0.767), indicating mixed or uncertain experiences. Support from educators and clinical preceptors received the most favourable rating (M = 3.630, SD = 0.964). This suggested that staff members had generally been willing to guide students despite limitations in the training environment.

Access to functional devices and digital-health platforms recorded a mean of 3.080 (SD = 1.005), while procedures allowing students to access digital systems appropriately had a mean of 2.829 (SD = 1.005). The relatively large standard deviations showed that access differed between institutions and clinical-placement sites.

Internet connectivity received a mixed assessment (M = 2.679, SD = 0.994). Reliable electricity was rated unfavourably (M = 2.420, SD = 0.986), as was the availability of technical assistance (M = 2.531, SD = 1.012). These conditions could have interrupted practical lessons even where educators had been willing to provide digital-health training.

Overall, the results showed that supportive educators and clinical preceptors had not always been matched by adequate infrastructure. Unreliable electricity, limited technical assistance, inconsistent connectivity and restricted student access had constrained the practical implementation of digital-health training.

Correlation Between Digital-Health Training and Readiness

Pearson's product-moment correlation analysis was conducted to determine the direction and strength of the relationship between the digital-health training dimensions and readiness for digitally enabled primary healthcare practice. Statistical significance was evaluated at $\alpha = 0.05$.

Table 8: Pearson correlations with readiness for digitally enabled primary healthcare practice

Variable	Pearson correlation	Sig. (2-tailed)	N	Decision at $\alpha = 0.05$
Curriculum content and relevance	0.530**	<0.001	386	Significant
Teaching and learning methods	0.472**	<0.001	386	Significant
Practical and clinical exposure	0.625**	<0.001	386	Significant
Assessment and feedback	0.449**	<0.001	386	Significant

Institutional and clinical-placement conditions	0.483**	<0.001	386	Significant
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Dependent variable: Readiness for digitally enabled primary healthcare practice.
*Correlation was statistically significant at the 0.05 level (2-tailed).

Curriculum content and relevance had a positive and statistically significant relationship with readiness ($r = 0.530$, $p < 0.001$). Since the p-value was below 0.05, the relationship was considered statistically significant. Students who reported more relevant and comprehensive digital-health content also tended to report greater readiness for digitally enabled primary healthcare practice.

Teaching and learning methods were positively and significantly related to readiness ($r = 0.472$, $p < 0.001$). The result suggested that students who had experienced primary healthcare cases, demonstrations, simulations and active problem-solving tended to report higher readiness.

Practical and clinical exposure produced the largest bivariate correlation with readiness ($r = 0.625$, $p < 0.001$). Students who had accessed functional systems, observed their use and received supervised opportunities to use them tended to report greater readiness.

Assessment and feedback were also positively and significantly associated with readiness ($r = 0.449$, $p < 0.001$). More favourable assessment and feedback experiences were therefore associated with higher readiness scores.

Institutional and clinical-placement conditions had a positive and statistically significant relationship with readiness ($r = 0.483$, $p < 0.001$). Access to devices, connectivity, electricity, technical assistance, supportive educators and appropriate system-access procedures was associated with greater readiness.

Although practical and clinical exposure produced the largest correlation coefficient, the correlations represented unadjusted relationships. The primary multiple regression therefore estimated the contribution of each training dimension while holding the other three dimensions constant. A secondary sensitivity analysis additionally controlled for academic programme and previous digital-system exposure.

Multiple Regression Analysis

Multiple linear regression was conducted with readiness for digitally enabled primary healthcare practice as the dependent variable. Curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback were entered as the primary independent variables.

No demographic, institutional or previous-exposure variables were entered into the primary regression model. Academic programme and previous digital-system exposure were entered only in the secondary hierarchical sensitivity analysis.

Model Summary

Table 9 presents the model summary for the relationship between the four digital-health training dimensions and readiness for digitally enabled PHC practice.

Table 9: Model summary for digital-health training and readiness

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.789	.623	.619	.435

Predictors: (Constant), curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback.

The multiple correlation coefficient was .789, indicating a strong collective relationship between the four dimensions of digital-health training and readiness for digitally enabled PHC practice. The model produced an R^2 of .623, meaning that curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback jointly explained 62.3% of the observed variation in readiness.

The adjusted R^2 was .619, indicating that the model explained approximately 61.9% of the variation in readiness after accounting for the number of predictors included. The remaining 38.1% of the variation was associated with factors that were not included in the model.

Overall significance of the regression model

The analysis of variance was used to determine whether the four-predictor regression model significantly improved the prediction of readiness compared with a model containing no independent variables.

Table 10: ANOVA for the regression model

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	119.072	4	29.768	157.235	<.001
Residual	72.131	381	.189		
Total	191.203	385			

Dependent variable: Readiness for digitally enabled PHC practice. Predictors: (Constant), curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback.

The regression model was statistically significant, $F(4, 381) = 157.235$, $p < .001$. The probability value was below the predetermined significance level of .05; therefore, the null hypothesis that the four regression coefficients were jointly equal to zero was rejected.

The result showed that the four dimensions of digital-health training, when considered collectively, significantly predicted readiness for digitally enabled PHC practice. The large regression mean square relative to the residual mean square further indicated that the model explained considerably more variation in readiness than remained unexplained.

Individual regression coefficients

Table 11 presents the unstandardised coefficients, standard errors, standardised coefficients, test statistics, probability values, confidence intervals and collinearity statistics for the four predictors.

Table 11: Regression coefficients for predictors of readiness

Predictor	B	Std. Error	Beta	t	Sig.	Lower 95% CI	Upper 95% CI	Tolerance	VIF
Constant	-.215	.188	—	-1.146	.252	-.584	.154	—	—
Curriculum content and relevance	.351	.043	.278	8.105	<.001	.266	.436	.843	1.187
Teaching and learning methods	.216	.030	.244	7.279	<.001	.157	.274	.884	1.132

Practical and clinical exposure	.357	.029	.416	12.129	<.001	.300	.415	.841	1.189
Assessment and feedback	.190	.028	.224	6.704	<.001	.134	.245	.890	1.124

Dependent variable: Readiness for digitally enabled PHC practice.
Statistical significance was assessed at $\alpha = .05$.

The estimated regression equation was:

$$\text{Readiness} = -0.215 + 0.351X_1 + 0.216X_2 + 0.357X_3 + 0.190X_4$$

where (X_1) represented curriculum content and relevance, (X_2) represented teaching and learning methods, (X_3) represented practical and clinical exposure, and (X_4) represented assessment and feedback.

Curriculum content and relevance had a positive and statistically significant relationship with readiness ($B = .351$, $\beta = .278$, $t = 8.105$, $p < .001$). Holding the other training dimensions constant, a one-unit increase in curriculum content and relevance was associated with a .351-unit increase in readiness. The 95% confidence interval ranged from .266 to .436 and did not include zero, confirming the statistical significance of the relationship.

Teaching and learning methods also had a positive and statistically significant relationship with readiness ($B = .216$, $\beta = .244$, $t = 7.279$, $p < .001$). A one-unit improvement in teaching and learning methods was associated with a .216-unit increase in readiness, with the other predictors held constant. The 95% confidence interval ranged from .157 to .274.

Practical and clinical exposure had the largest standardised regression coefficient ($B = .357$, $\beta = .416$, $t = 12.129$, $p < .001$). A one-unit increase in practical and clinical exposure was associated with a .357-unit increase in readiness after the other three dimensions were controlled. Its confidence interval ranged from .300 to .415. Practical and clinical exposure therefore emerged as the most influential of the four training dimensions in the primary regression model.

Assessment and feedback had a positive and statistically significant relationship with readiness ($B = .190$, $\beta = .224$, $t = 6.704$, $p < .001$). A one-unit increase in assessment and feedback was associated with a .190-unit increase in readiness, holding the remaining predictors constant. Its confidence interval ranged from .134 to .245.

The constant was negative but was not statistically significant ($B = -.215$, $t = -1.146$, $p = .252$). Its lack of statistical significance did not undermine the overall model because the constant represented the predicted readiness score when all four training dimensions equalled zero, which fell outside the meaningful range of the five-point scales.

Based on the standardised coefficients, the predictors were ranked as follows:

Practical and clinical exposure had the largest standardised coefficient ($\beta = .416$), followed by curriculum content and relevance ($\beta = .278$), teaching and learning methods ($\beta = .244$), and assessment and feedback ($\beta = .224$).

All four predictors were statistically significant because their probability values were below .05. Their tolerance values ranged from .841 to .890, while the variance-inflation factors ranged from 1.124 to 1.189. These values indicated that multicollinearity was not a concern in the four-predictor model.

Overall, the regression findings showed that students' readiness was not associated with a single aspect of training. Readiness was supported by the combined contribution of relevant curriculum content, appropriate teaching methods, practical exposure and meaningful assessment. Practical and clinical exposure made the largest distinctive contribution, indicating that direct experience with digital-health systems was particularly important in translating instruction into readiness for PHC practice.

Hierarchical Sensitivity Analysis

A hierarchical regression analysis assessed whether the four training dimensions retained predictive value after academic programme and previous digital-system exposure were controlled. Academic programme and system exposure were entered as categorical variables, with nursing and no previous exposure as the reference categories.

Table 12: Hierarchical regression model summary

Model	Predictors	R	R ²	Adjusted R ²	ΔR ²	F (df), p
1	Academic programme and previous system exposure	.651	.423	.406	—	24.959 (11, 374), <.001
2	Model 1 variables plus four training dimensions	.808	.652	.638	.229	46.311 (15, 370), <.001

Note. The addition of the four training dimensions significantly improved the model, $\Delta F(4, 370) = 60.989, p < .001$.

The covariates explained 42.3% of the variance in readiness. Adding the four training dimensions explained a further 22.9%, increasing total explained variance to 65.2% (adjusted R² = .638).

Table 13: Training-dimension coefficients in the adjusted sensitivity model

Training dimension	B	SE	β	t	p	95% CI
Curriculum content and relevance	.350	.043	.277	8.131	<.001	[.265, .434]
Teaching and learning methods	.205	.029	.231	6.985	<.001	[.147, .262]
Practical and clinical exposure	.172	.051	.201	3.386	<.001	[.072, .272]
Assessment and feedback	.180	.028	.212	6.410	<.001	[.125, .235]

Note. Dependent variable: readiness for digitally enabled PHC practice. Covariates: academic programme and previous digital-system exposure. Reference categories: nursing and no previous exposure.

All four training dimensions remained statistically significant after adjustment. Curriculum content and relevance had the largest adjusted standardised coefficient among the training dimensions ($\beta = .277$), followed by teaching and learning methods ($\beta = .231$), assessment and feedback ($\beta = .212$), and practical and clinical exposure ($\beta = .201$). Each level of previous system exposure was positively associated with readiness relative to no exposure ($p = .009$ to $p < .001$), whereas no academic-programme category differed significantly from nursing at the .05 level. The reduction in the practical-exposure coefficient from the primary model indicated expected shared variance between the practical training measure and previous system exposure.

DISCUSSION

Principal findings

The study examined whether four dimensions of digital-health training were associated with students' readiness for digitally enabled PHC practice. The principal finding was that students appeared to receive relevant digital-health content without receiving equivalent opportunities to practise, demonstrate and receive feedback on the use of digital-health technologies. Curriculum content and relevance were rated very favourably, whereas practical and clinical exposure and assessment and feedback received substantially lower ratings. Although

overall readiness was comparatively favourable, important weaknesses remained in telehealth use, responding to system failure, accommodating patients with limited digital access and using digital technologies with minimal supervision.

All four training dimensions were positively correlated with readiness. In the primary model, the dimensions jointly explained 62.3% of the variance, and practical and clinical exposure had the largest standardised coefficient ($\beta = .416$). The reviewer-requested sensitivity analysis then controlled for academic programme and previous digital-system exposure. All four training dimensions remained statistically significant and added 22.9% explained variance beyond the covariates. The adjusted model explained 65.2% of readiness, with curriculum content and relevance having the largest adjusted coefficient among the training dimensions ($\beta = .277$). These findings indicated that readiness reflected both prior familiarity with digital systems and the content, teaching, practice and assessment provided by the training programmes.

Curriculum content and relevance

The high curriculum-content score suggested that electronic patient records, routine health information systems, data protection and the application of digital information to PHC had received considerable attention in the included programmes. Safe and ethical digital practice received the highest item rating ($M = 4.619$, $SD = 0.626$), while instruction on electronic patient records and routine health information systems also received a high rating ($M = 4.570$, $SD = 0.625$). This emphasis was consistent with Kenya's Data Protection Act, Digital Health Act and Primary Health Care Act, which increased the professional responsibilities of health workers in relation to health-information management, privacy and digitally supported service delivery (Kenya, 2019, 2023a, 2023b).

The findings were also consistent with the competency clusters identified by the World Health Organization (2026), which included patient care, data and informatics, communication, technical proficiency and digital professionalism. Similarly, the DECODE framework emphasised professionalism, patient and population digital health, health-information systems and health-data science as important domains of digital-health education (Car et al., 2025). The breadth of curriculum content therefore appeared broadly aligned with the emerging expectations of digitally competent health professionals.

Curriculum content and relevance was positively associated with readiness in the primary model ($\beta = .278$, $p < .001$) and remained significant after academic programme and previous system exposure were controlled ($\beta = .277$, $p < .001$). The adjusted finding showed that relevant coverage of electronic records, routine information systems, telehealth, data use and digital professionalism contributed to readiness beyond students' prior system familiarity. Content still needed to be connected with opportunities to apply digital-health knowledge in realistic learning and practice settings.

This interpretation was consistent with competency-based education, in which the organisation of content was expected to culminate in observable professional ability rather than knowledge acquisition alone (Frank et al., 2010). Khurana et al. (2022) similarly identified knowledge, skills and attitudes as interdependent components of digital-health competence. Curriculum reform should therefore have focused not only on what students were taught but also on what they were expected to demonstrate before graduation.

Teaching and learning methods

Teaching and learning methods received a favourable mean score and were associated with readiness in both the primary model ($\beta = .244$, $p < .001$) and the adjusted sensitivity model ($\beta = .231$, $p < .001$). PHC examples and cases were used more consistently than demonstrations, simulations and practical exercises. The persistence of the association after control variables were entered supported the importance of active, contextualised instruction.

The finding supported evidence that students preferred applied digital-health instruction to conventional lecture-based delivery. Ma et al. (2023) found that practical training and internships were considerably more popular among medical students than traditional lectures. In the African digital-health bootcamp evaluated by Oni et al. (2026), workshops, mentorship and collaborative projects were followed by substantial reported improvements

in participants' knowledge, skills and experience. Although that programme differed from a routine professional curriculum, it illustrated how structured and participatory learning could make digital-health concepts more concrete.

The qualitative findings helped explain the quantitative relationship. Cases and patient journeys reportedly improved students' understanding because they connected digital technologies with decisions made during PHC encounters. However, simulation time, large student groups and limited access to appropriate platforms reduced individual participation. Teaching methods were therefore most likely to support readiness when each student performed defined tasks rather than merely watching a lecturer or another student operate a system.

Practical and clinical exposure

Practical and clinical exposure was the lowest-rated training dimension apart from assessment and feedback. Supervised use of digital-health systems received the lowest rating among all training items ($M = 2.321$, $SD = 0.923$). Students were more likely to have observed a digital system during placement than to have used one under supervision.

Practical and clinical exposure had the strongest bivariate association with readiness ($r = .625$, $p < .001$) and the largest coefficient in the primary four-predictor model ($\beta = .416$, $p < .001$). It remained significant after academic programme and previous system exposure were controlled ($\beta = .201$, $p < .001$). The reduction in magnitude was expected because previous system exposure overlapped conceptually and empirically with opportunities to observe and use systems. The adjusted result nevertheless showed that structured practical and clinical learning contributed beyond prior exposure.

The qualitative findings indicated that the availability of student accounts and placement-site policies influenced whether learners practised or observed system use. Restrictions on access were understandable because facilities had responsibilities to protect confidential patient information. Nevertheless, passive observation did not provide the same opportunity to develop skill, confidence or an understanding of system workflows. Protected training environments, simulated records, role-restricted student accounts and supervised tasks could have enabled students to practise without compromising patient information.

The importance of practical exposure was consistent with Ma et al. (2023), who reported a strong preference for practical training and internship experience. It also complemented the findings of Oni et al. (2026), whose applied programme combined instruction with mentorship and collaborative projects. Together, these findings suggested that authentic or realistically simulated experience was an essential bridge between digital-health knowledge and professional readiness.

Assessment and feedback

Assessment and feedback received a mixed overall rating but remained positively associated with readiness in the primary model ($\beta = .224$, $p < .001$) and adjusted sensitivity model ($\beta = .212$, $p < .001$). Formal assessment of digital-health knowledge was more common than practical assessment. The rating for practical assessment of digital-health ability was particularly low ($M = 2.461$, $SD = 1.001$), while feedback was inconsistently provided.

The result suggested that assessment influenced what students prioritised and the extent to which they consolidated their digital-health abilities. Where assessment concentrated on definitions, legislation and general principles, students could perform well academically without demonstrating that they could enter patient information, conduct a digital referral, communicate through telehealth or respond safely to a system failure. This finding reinforced the competency-based expectation that assessment should examine observable performance (Frank et al., 2010).

Practical assessment could have been integrated into objective structured clinical examinations, simulation exercises, case-based assignments and placement evaluation tools. Such assessments could have required students to demonstrate secure data entry, electronic referral, interpretation of routine data, telehealth communication, informed consent, confidentiality and continuity of care during system downtime. Feedback

should then have identified the particular steps that the student performed well and the skills requiring further practice.

Readiness for digitally enabled PHC practice

Students reported an overall readiness mean of 3.628 (SD = 0.705). They felt most prepared to comply with ethical and data-protection requirements and to enter, retrieve and update patient information. However, they reported weaker preparedness to use telehealth or mobile-health technologies, adapt care for people with limited digital access, maintain safe services during system failure and use digital technologies with minimal supervision.

The pattern was important because readiness for digital practice could not be reduced to the ability to operate an electronic record. Digital-health competence also involved communication, adaptability, professional judgement, equity and the ability to continue providing safe care when technology failed. Lawrence and Levine (2024) argued that health-professions education needed to address digital determinants of health so that technology did not increase existing inequalities. The lower preparedness to support patients with limited digital access therefore represented an important PHC training gap.

Direct comparison with previous studies remained difficult because different instruments and definitions had been used. Machleid et al. (2020), for example, found that 40.6% of surveyed European medical students felt prepared for a digitised health system, whereas Aldousari et al. (2025) found that 54% of undergraduate healthcare students in their Kenyan sample met the study threshold for high eHealth literacy. The present study measured preparedness for particular PHC activities rather than applying a percentage threshold for general digital literacy. Nevertheless, all three studies indicated that favourable attitudes or basic digital literacy did not necessarily mean that every student was ready for digitally enabled healthcare practice.

The difficulty of making direct comparisons reflected the wider measurement problem identified by Longhini et al. (2022). Their systematic review found considerable variation in the constructs and tools used to assess digital-health competence. Ferreira and Magalhães (2026) further found that multidimensional instruments with comprehensive psychometric evaluation remained limited. The task-specific approach used in the present study helped identify the particular activities for which students felt more or less prepared, although the resulting scores still represented self-reported preparedness rather than observed competence.

Institutional and placement conditions

Institutional and placement conditions received a mixed overall rating ($M = 2.861$, $SD = 0.767$) and were positively correlated with readiness ($r = .483$, $p < .001$). This was a bivariate contextual relationship rather than an independent regression effect. Access to devices, platforms, internet connectivity, electricity, technical assistance, educator support and clearly defined procedures therefore remained relevant to how consistently students encountered digital-health learning opportunities.

The finding supported the facilitating-conditions component of UTAUT, which proposed that organisational and technical resources influenced technology use (Venkatesh et al., 2003). Training activities that depended on digital platforms could not be implemented consistently when devices, connectivity, electricity or technical assistance were unreliable. In the sensitivity analysis, each level of previous system exposure was positively associated with readiness relative to no exposure, reinforcing the value of safe, progressive contact with digital systems during training.

The findings were consistent with Kenyan evidence. Kabare et al. (2022) identified unreliable internet access as an important challenge for health-science students. Gachanja et al. (2021) also found that technological difficulties affected participation in a supported online research course at the Kenya Medical Training College. Among faculty at the same institution, Gicheru and Mwangi (2023) found a progressive divide between access to technology, basic digital skills and confidence in more advanced teaching activities. Together, these studies showed that infrastructure and human support needed to develop simultaneously.

Implications for health-professions education

Digital-health training should be organised as a longitudinal, competency-based component of PHC education. Relevant content should be introduced early and reinforced through cases, simulation, supervised placements and performance-based assessment. Learning outcomes should specify the digital task, required level of supervision, data-protection standard and observable performance expected before graduation.

Institutions with constrained infrastructure can establish protected EHR simulation environments without connecting students to live patient records. A locally hosted or offline-capable training instance should use synthetic patient records, role-based student accounts, audit logs and automatic reset procedures. Accounts should permit only defined training tasks and should be deactivated after each rotation. Where devices or connectivity are limited, institutions can use a local network, staggered small-group sessions, shared task schedules and backup power while ensuring that each student personally completes the required activities.

Simulation should require each student to register and update a synthetic patient record, interpret routine PHC data, complete an electronic referral, conduct a telehealth interaction and restore safe care during a simulated system failure. Educators should assess these tasks with standardised checklists and provide individual feedback. Governance procedures should cover account approval, confidentiality, incident reporting, data-protection review, minimum device-to-student access, connectivity, power backup and technical support. Placement agreements should then define the supervised tasks students may perform on real systems and the conditions under which access must be withdrawn.

Strengths and limitations

The multicentre mixed-methods design strengthened the study by combining student-level estimates with explanations from curriculum, teaching and clinical-placement personnel across six institutions and several health-professional programmes. Item-level reporting also identified specific strengths and weaknesses that would have been obscured by the overall training and readiness scores.

The findings nevertheless required interpretation within the limitations of a cross-sectional design, which did not establish temporal or causal relationships. Readiness was self-reported rather than assessed through observed performance, and responses could have been affected by recall or social-desirability bias. Purposive selection of the institutions limited national generalisability, while differences between programmes and placement sites could have contributed to unmeasured variation. Anonymous administration, separation of predictor and outcome sections, and different response anchors reduced but did not eliminate common-method bias; the 35.4% single-factor result was only a supplementary diagnostic. Although confirmatory factor analysis supported the prespecified structures, the models were evaluated in the same sample used for the substantive analysis and require validation in an independent sample. The qualitative component provided contextual explanation but was not intended to estimate prevalence.

CONCLUSION

Final-year health professional students received comparatively strong and relevant digital-health content, particularly in electronic records, routine information systems, data protection and ethical practice. However, their training provided fewer opportunities for supervised system use, realistic simulation, practical assessment and individual feedback. Consequently, readiness was stronger for routine information handling and ethical practice than for telehealth, equitable care for digitally excluded patients, system downtime and independent digital practice.

Curriculum content and relevance, teaching and learning methods, practical and clinical exposure, and assessment and feedback were each independently associated with readiness in the primary model, which explained 62.3% of the variance. Practical and clinical exposure made the largest contribution in that model. All four associations remained significant in the sensitivity model controlling for academic programme and previous system exposure; the adjusted model explained 65.2% of readiness. Curriculum inclusion was therefore

important but needed to be connected with experiential learning, performance-based assessment and structured feedback.

Health-training institutions should establish protected, offline-capable simulation platforms using synthetic records, role-restricted accounts, audit logs and reset procedures. They should standardise practical digital-health learning outcomes, use checklist-based assessment and individual feedback, and strengthen placement agreements that permit safe supervised participation. Investment in educator preparation, devices, connectivity, electricity backup and technical support can narrow the gap between knowing about digital health and using it safely, equitably and effectively in Kenyan PHC practice.

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