RESEARCH PAPER

Digital Organizational Empowerment and the Sustainability of Primary Healthcare Nursing Competency: Empirical Evidence from a Sequential Mixed-Methods Study in Saudi Arabia

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ABSTRACT

Purpose

Despite growing investment in digital health transformation under Saudi Vision 2030, the mechanisms through which digital empowerment programmes sustain primary healthcare (PHC) nursing competency remain theoretically underspecified and empirically underexplored. This study evaluates the impact of the Digital Organizational Empowerment Programme Tool (DOEPT) on PHC nursing competencies among Saudi nurses in the Taif Health Cluster, integrating Social Cognitive Theory (SCT) and the Technology Acceptance Model (TAM) within a unified explanatory framework.

Design/Methodology/Approach

A sequential explanatory mixed-methods design was employed. Phase I used a Mini-Delphi consensus process (n = 7 nursing and digital health experts) to develop and validate the DOEPT. Phase II administered a structured survey to 645 PHC nurses, analysed via Partial Least Squares Structural Equation Modelling (PLS-SEM) using SmartPLS 4.0. Seven hypotheses examined direct effects, control variables, and moderation effects.

Findings

Information availability and quality was the strongest predictor of PHC competency ($\beta = 0.358$, $p < 0.001$), followed by organizational support ($\beta = 0.294$, $p < 0.001$) and DOEPT ($\beta = 0.181$, $p < 0.001$). Neither previous training mode ($\beta = 0.032$, $p = 0.303$) nor duration of service ($\beta = -0.026$, $p = 0.388$) reached significance. DOEPT did not moderate the information-competency or support-competency relationships; instead, it functions as an independent, additive predictor. The model accounts for 41.1% of the variance in PHC competency ($R^2 = 0.411$).

Originality/Value

This study provides the first empirical integration of SCT and TAM to evaluate a digital empowerment programme for PHC nurses in the Saudi context. It challenges the prevailing assumption that tenure and prior training modality predict competency, demonstrating that sustainable competency development requires a tripartite approach: high-quality information infrastructure, robust organizational support, and structured digital empowerment training. The conceptualization of DOEPT from a hypothesized moderator to an independent direct predictor advances current theoretical models of digital empowerment in nursing.

Keywords: Digital empowerment; primary healthcare; nursing competency; PLS-SEM; DOEPT; Saudi Vision 2030; Social Cognitive Theory; Technology Acceptance Model.

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1 Introduction

The sustainability of nursing competency constitutes one of the most persistent challenges facing contemporary health systems. While organizational empowerment - broadly understood as the institutional processes by which employees acquire autonomy, access to resources and participation in decision-making (Furterer and Wood, 2021) - is widely recognized as a precondition for nursing effectiveness (Mansour *et al.*, 2020), relatively little is known about how digitally mediated empowerment programmes translate into sustained, measurable competency gains in primary healthcare (PHC) settings (Apell and Eriksson, 2023). This gap is consequential: PHC nurses serve as the first point of contact for the majority of patients in most health systems, and competency deficits at this level carry systemic cost in terms of delayed diagnosis,

suboptimal care coordination and preventable readmissions.

Digital technologies, electronic health records, clinical decision-support systems and telehealth platforms among them have fundamentally reshaped the informational environment within which nurses operate (Hants *et al.*, 2023). These tools potentially expand clinical capability by accelerating access to patient data, reducing cognitive load during assessment and enabling real-time consultation. Yet the mere deployment of digital infrastructure does not automatically produce competency gains; the mechanisms linking technology adoption, organizational context and individual skill development remain poorly understood (Zhou *et al.*, 2022). This study is motivated precisely by that explanatory gap.

The Saudi Arabian context lends particular urgency to these questions. Saudi Vision 2030 mandates a sweeping digital transformation of the national healthcare system (Kingdom of Saudi Arabia, 2016), yet substantial evidence suggests that traditional training modalities persist in many PHC settings, yielding suboptimal knowledge retention and uneven skill application (Alhakami, 2018). A preliminary survey of 621 Saudi nurses documented a mean self-efficacy score of only 3.35 out of 5, with notable deficits in patient assessment, clinical decision-making and administrative management (Alshamlani *et al.*, 2024; Eldeeb *et al.*, 2021). These findings are compounded by a documented nursing workforce shortage that constrains the frequency and quality of professional development activities (NHS England, 2023; Alrabiah *et al.*, 2024). Taken together, they suggest a systemic misalignment between the institutional ambitions of Vision 2030 and the ground-level reality of PHC nurse capacity.

Against this backdrop, the present study evaluates the impact of the Digital Organizational Empowerment Programme Tool (DOEPT) a mobile-optimised, expert-validated, micro-learning-based training intervention on PHC nursing competency in the Taif Health Cluster. The study is guided by four interconnected research objectives:

1. To develop and validate the DOEPT in collaboration with nursing content experts and digital health specialists.
2. To establish the level of PHC nursing competency among the study population prior to and following the DOEPT intervention.
3. To examine the direct and moderation effects of DOEPT, information availability, and organizational support on PHC nursing competency using PLS-SEM.
4. To assess whether demographic and occupational characteristics - specifically prior training modality and duration of service - significantly predict PHC competency outcomes.

The study makes three original contributions. First, it provides the first empirical test of an SCT-TAM integrated framework applied to a digital nursing empowerment programme in the Saudi PHC context. Second, it challenges long-standing assumptions about the predictive role of tenure and prior training mode in competency development. Third, by demonstrating that DOEPT operates as an independent, additive predictor rather than a moderator, it advances theoretical models of digital empowerment in ways that have direct implications for programme design and evaluation.

The remainder of the paper is structured as follows. Section 2 reviews the theoretical and empirical literature and presents the conceptual framework. Section 3 describes the methodology. Section 4 presents the results. Section 5 discusses the findings and their theoretical and practical implications. Section 6 concludes the paper.

2 Literature Review

This section critically reviews four intersecting bodies of literature bearing on the study's central questions: (1) digital competence and the effectiveness of e-learning in nursing contexts; (2) digital transformation in public health education; (3) motivation and behavioural intentions in digital learning; and (4) simulation and blended learning in competency development. The section concludes by presenting the theoretical framework and the hypotheses derived from it.

2.1 Digital Competence and E-Learning Effectiveness in Nursing

A growing body of evidence confirms that digital literacy constitutes a foundational dimension of nursing competency, yet its determinants and trajectories remain incompletely specified. A cross-sectional study of 300 hospital nurses found that the majority exhibited advanced digital literacy, with age, gender and educational attainment emerging as significant predictors (Dumbre *et al.*, 2025). However, it is important to note that cross-sectional designs preclude causal inference, and the extent to which digital literacy translates into clinical competency - as opposed to technology proficiency - remains a distinct and underexplored question.

The COVID-19 pandemic catalyzed a rapid, system-wide transition to e-learning that produced mixed results. While accessibility and scheduling flexibility improved, studies consistently identified technological barriers and psychological disengagement as significant impediments (Haanes *et al.*, 2024).

A scoping review of continuing education programmes found that validated frameworks for digital skills training remain sparse, and called for the systematic integration of artificial intelligence, robotics and ethical reasoning into structured learning pathways (Tischendorf *et al.*, 2024). These findings collectively suggest that access to digital tools is a necessary but insufficient condition for competency development; pedagogical design and organisational infrastructure matter equally.

Evidence from interprofessional education points in a consistent direction: collaborative, case-based learning produces significant gains in communication, role awareness and conflict-resolution competency (Gill *et al.*, 2017). A quasi-experimental comparison of competency-centered and traditional nursing induction programmes found that nurses trained under the competency-centred model achieved significantly higher scores across theoretical, practical and Mini-CEX assessments (F. Luo *et al.*, 2025). These findings strengthen the case for structured, outcomes-oriented digital empowerment programmes over generic e-learning provision.

2.2 Digital Transformation in Public Health and Continuing Education

The transformation of public health education by digital technologies raises both opportunities and systemic risks. A rapid review of the Canadian public health competency framework highlighted the urgent need to embed digital health literacy, data governance and informatics within national competency standards (Ramachandran *et al.*, 2024). This normative demand is partially supported by evidence: a PRISMA-based synthesis of 47 reviews concluded that e-learning enhances accessibility and educational quality, but that its effectiveness depends critically on robust technological, pedagogical and managerial infrastructures (Arian *et al.*, 2025). The implication is clear digitization of training alone does not guarantee competency improvement; the organizational ecosystem in which training is embedded is a co-determining factor.

This view is further supported by domain-specific evidence. A meta-analysis of e-learning for pressure injury management documented substantial improvements in knowledge and classification accuracy (Ding *et al.*, 2024), while a Joanna Briggs Institute review found that blended learning, simulation and peer interaction collectively produced significant gains in digital knowledge and self-efficacy (Kulju *et al.*, 2024). What emerges from this literature is a picture of conditional effectiveness: digital training programmes produce the most durable competency improvements when they combine multimodal delivery, situated practice and adequate organizational support.

2.3 Motivation and Behavioral Intentions in Digital Learning

The relationship between digital competence and motivational variables is theoretically important yet empirically contested. A large-scale cross-sectional study among Egyptian nursing students found significant positive correlations between digital competence, academic motivation and lifelong learning orientation (Amin *et al.*, 2025). In the Saudi context, research on Blackboard-based nursing programmes confirmed generally high perceptions of accessibility and pedagogical effectiveness, though observed variability in engagement patterns suggests that intrinsic motivation cannot
be taken for granted (Pangket *et al.*, 2025). A PLS-SEM analysis identified perceived usefulness and performance expectancy as the dominant predictors of e-learning adoption intention, with perceived ease of use playing a secondary mediating role (Alshammari *et al.*, 2025). This pattern is consistent with the core propositions of TAM (Davis, 1989) and underscores the importance of designing digital training tools that are not merely accessible but genuinely useful from the learner's perspective.

2.4 Simulation and Blended Learning in Competency Development

The most robust evidence on digital learning for nursing competency comes from simulation and blended learning research. A systematic review concluded that virtual and mixed-reality simulations significantly enhance problem-solving, communication and professional competency (Alsharari *et al.*, 2025), while a meta-analysis confirmed that blended learning models improve knowledge acquisition, critical thinking and psychological wellbeing in nursing populations (Niu *et al.*, 2023). An ADDIE-framework-based blended learning programme produced marked improvements in self-directed learning, critical thinking and learner satisfaction among nursing staff (R. Luo *et al.*, 2024). Crucially, these studies converge on the finding that competency development is most effective when training is structured, iterative and aligned with explicit professional standards - precisely the design principles embodied by the DOEPT developed in the present study.

2.5 Theoretical Framework and Study Hypotheses

This study draws on two complementary theoretical traditions. Social Cognitive Theory

(SCT) (Luszczynska and Schwarzer, 2015) conceptualizes learning as the product of reciprocal determinism among personal, behavioral and environmental factors. Central to SCT is the construct of self-efficacy: an individual's belief in their capacity to execute the behaviors required to produce specific outcomes shapes both motivation and performance (Schunk and DiBenedetto, 2020; Artino Jr *et al.*, 2019). Organizational culture, information availability and structured feedback are theorized as environmental inputs that shape self-efficacy and, in turn, competency. The Technology Acceptance Model (TAM) (Davis, 1989) complements SCT by specifying the conditions under which individuals adopt and use technological tools, with perceived ease of use and perceived usefulness identified as the proximal determinants of adoption intention (Venkatesh and Bala, 2008). The integration of SCT and TAM enables the present study to address both the psychological mechanisms of empowerment and the technology-specific adoption dynamics that determine whether digital training produces lasting behavioral change (Zhou *et al.*, 2022).

Figure 1 presents the proposed conceptual framework. Information availability and quality, organizational support and DOEPT are specified as the primary explanatory constructs; previous training mode and duration of service are treated as control variables; PHC competency (encompassing assessment, communication and management domains) is the dependent construct. In its initial specification, consistent with SCT's emphasis on the catalytic role of environmental enablers (Bandura, 1986), DOEPT is hypothesized to function as a moderator that amplifies the relationships between information availability, organizational support and PHC competency.

The seven hypotheses derived from this framework are as follows:

H1: Information availability and quality positively and significantly predict PHC nursing competency.

H2: Participation in DOEPT positively and significantly predicts PHC nursing competency. **H3:** Organizational support positively and significantly predicts PHC nursing competency. **H4:** Previous training mode significantly predicts PHC nursing competency.

H5: Duration of service significantly predicts PHC nursing competency.

H6: DOEPT moderates the relationship between information availability and PHC competency.

H7: DOEPT moderates the relationship between organizational support and PHC competency.

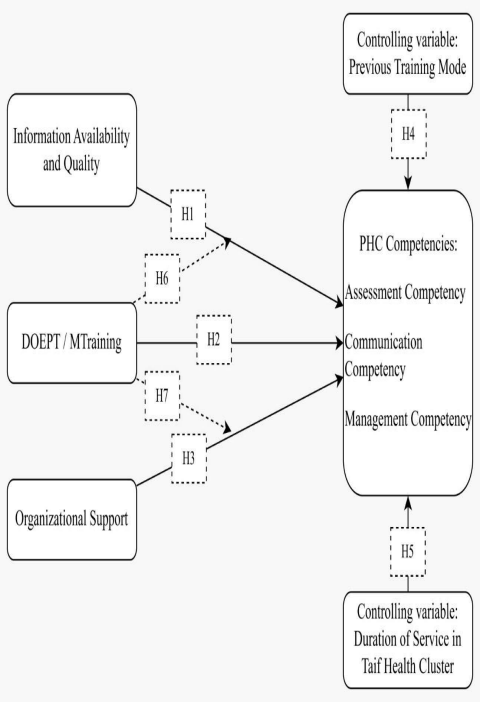


Figure 1: Conceptual framework: impact of digital organisational empowerment on PHC nursing competency, integrating SCT and TAM

3 Methodology

3.1 Research Design and Philosophical Positioning

This study adopts a post-positivist epistemological stance, maintaining that objective measurement of competency-related constructs is possible while acknowledging the role of expert interpretation in instrument validation (Creswell and Poth, 2016). Methodologically, a sequential explanatory mixed-methods design was employed: a qualitative Phase I generating expert-validated programme content informed the measurement framework for a quantitative Phase II. A quasi-experimental structure within Phase II enabled examination of cause-and-effect relationships between the DOEPT intervention and competency outcomes in a naturalistic clinical setting where random assignment was neither feasible nor ethically appropriate (Cook and Campbell, 1979; Miller *et al.*, 2020). Figure 2 illustrates the pre-test-post-test two-group design; Figure 3 summarizes the overall research process.

3.2 Study Population and Sampling Strategy

The target population comprised the approximately 940 nursing personnel distributed across the 107 PHC centers of the Taif Health Cluster. In Phase I, a purposively selected panel of seven experts comprising two nursing directors, two nurse managers and

three nurse educators with complementary digital health specializations participated in DOEPT development and validation through a Mini-Delphi process. This deliberate purposive sampling strategy prioritized breadth of expertise and strategic seniority over panel size, consistent with established Delphi methodology (Campbell and Stanley, 1963).

For Phase II, the minimum required sample was calculated using G*Power 3.1.9.7, specifying a medium effect size ($f^2 = 0.15$), $\alpha = 0.05$ and statistical power of 0.95, yielding a minimum of 176 participants. This was increased by 10% to 194 to account for anticipated non-response.

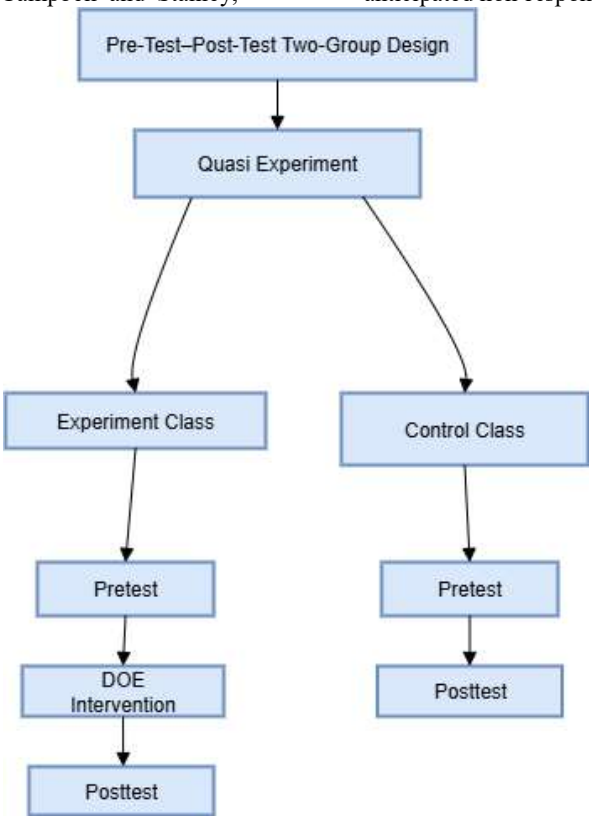


Figure 2: Flowchart of the research design: pre-test-post-test two-group design (adapted from Creswell and Creswell, 2022)

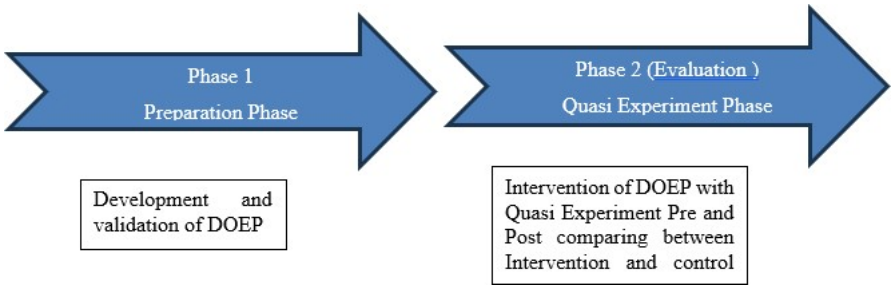


Figure 3: The research process

The final sample of $N = 645$ nurses exceeded this threshold substantially, reflecting the decision to recruit from all six districts of the Taif cluster through proportionate stratified random sampling in order to ensure adequate representation of rural and peri-urban PHC settings and to maximise the generalisability of findings within the cluster (Nguyen *et al.*, 2021). The larger sample also provides sufficient statistical power to detect small moderation effects, which require notably greater sample sizes than main effects under bootstrapped PLS-SEM (Hair *et al.*, 2022).

3.3 Research Setting

The study was conducted within the Taif Health Cluster, Taif Province, western Saudi Arabia. Figure 4 illustrates the spatial distribution of the 13 major healthcare facilities across the province. Table I summarises the distribution of PHC centres and nursing staff across the six administrative districts.

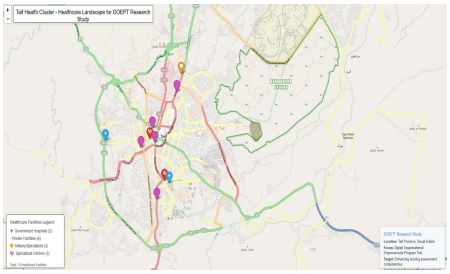


Figure 4: Distribution of 13 major healthcare facilities across Taif Province Table I: Distribution of PHC centres and nursing staff in Taif Province

District	No. of PHCs	No. of Nurses	Nurse-to-PHC Ratio
Taif City	75	734	9.8
Turubah	7	56	8.0
Ranyah	6	36	6.0
Al-Khurmah	6	36	6.0
Al-Muwayh	5	30	6.0

3.4 Study Instruments

Three instruments were employed. **Instrument A** captured sociodemographic and occupational characteristics. **Instrument B**, the Professional Competency Questionnaire, comprised six validated domains (professionalism; PHC clinical competency; communication; collaboration and partnership; quality assurance and research; and leadership), each measured on a five-point Likert scale anchored at 1 = "strongly disagree" and 5 = "strongly agree." **Instrument C** was the DOEPT training programme itself, structured across five sequential stages: orientation and baseline assessment; core module delivery; interactive practice; competency assessment and feedback; and consolidation with three-month sustainability reassessment.

3.5 DOEPT Programme Development and Expert Validation

The DOEPT was developed through a systematic Mini-Delphi consensus process (Figure 5). The programme comprises multimedia-based microlearning modules aligned with the six PHC competency domains, each capped at 15 minutes to accommodate nurses' clinical schedules. Content was delivered through a mobile-optimized platform supporting offline access and bilingual (Arabic/English) navigation. Figure 6 presents a prototype of the module interface.

3.6 Statistical Analysis

Quantitative data were analyzed using PLS-SEM implemented in SmartPLS 4.0 (Hair *et al.*, 2022). PLS-SEM was selected over covariance-based SEM on three grounds: the predictive-explanatory orientation of the research model; the inclusion of both reflective and formative measurement specifications; and the observed non-normality of key variables, assessed through multivariate kurtosis indices. The measurement model was evaluated for internal consistency reliability (Cronbach's α and composite reliability ρ_c), convergent validity (average variance extracted, AVE; outer loadings) and discriminant validity (Heterotrait-Monotrait ratio, HTMT) (Fornell and Larcker, 1981; Henseler *et al.*, 2015). Structural model paths, *t*-statistics, *p*-values and bias-corrected 95% confidence intervals were estimated via bootstrapping with 5,000 subsamples. Common method bias was assessed using Harman's single-factor test and the full collinearity VIF procedure prior to hypothesis testing.

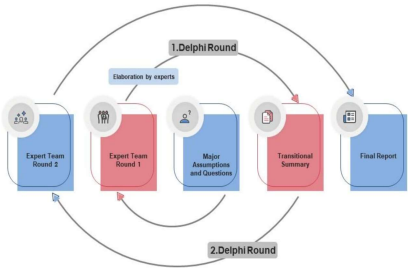


Figure 5: Delphi method process flow

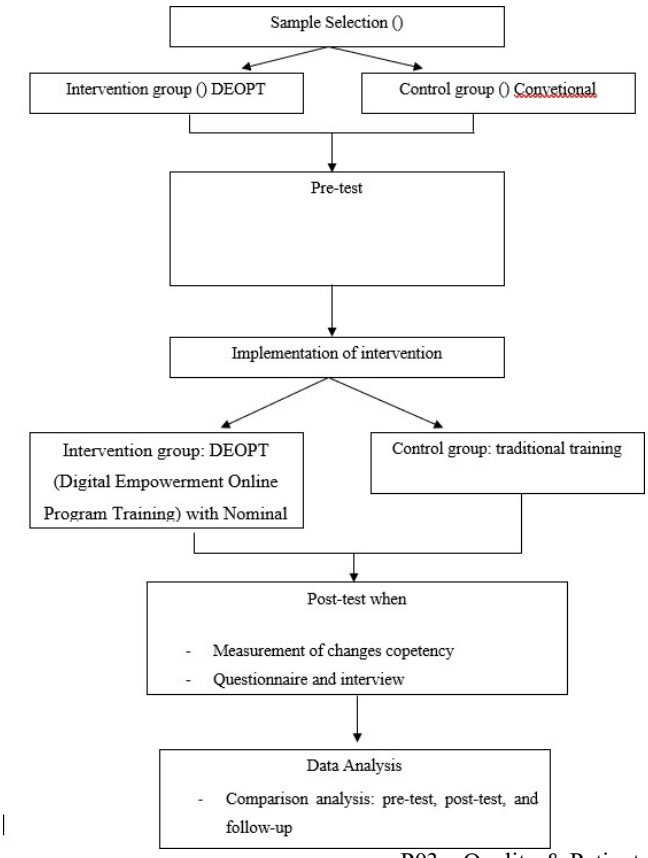


Figure 6: Example of the Alif Module Prototype

4 Results

4.1 Phase I: Expert Validation of the DOEPT

Seven nursing and digital health experts participated in two structured Delphi rounds. Table II presents the panel demographics, reflecting a combined experience base of 96 years across curriculum development, patient safety, PHC operations, digital health integration and workforce planning. Round 1 involved systematic thematic coding of 63 expert responses across three domains (digital empowerment, training usability and competency alignment), yielding 28 initial themes, of which 15 were refined into DOEPT design propositions. Round 2 achieved consensus (≥80% agreement) on 12 of 14 ratable propositions, with an overall agreement level of 85.7%.

Table II: Demographic profile of the expert panel ($N = 7$)

Code	Role	Years	Specialization
P01	Training & Education Coordinator	10	Curriculum development
P02	Nursing Quality Coordinator	8	Quality standards, MOH policy
P03	Quality & Patient Safety Coordinator	24	Patient safety, clinical auditing
P04	Senior Nursing Supervisor	15	PHC operations
P05	Digital Health Integration Specialist	12	E-learning platforms
P06	Clinical Education Lead	9	Simulation training
P07	PHC Nursing Director	18	Workforce planning

Items achieving unanimous consensus (100%) included: mobile-optimised access with offline capability; bilingual (Arabic/English) multimedia content delivery; microlearning format (modules ≤ 15 minutes); built-in competency checklists aligned with Ministry of Health (MOH) standards; and integrated pre/post assessment

with a three-month sustainability reassessment. Two propositions did not achieve initial consensus: the full replacement of face-to-face training components (57% agreement) and the incorporation of gamification elements (71% agreement), both of which were accordingly excluded from the final DOEPT design. The overall Content Validity Index (CVI) was 0.92, and 94% of experts confirmed face validity. Figure 10 presents the thematic analysis output from Round 1.

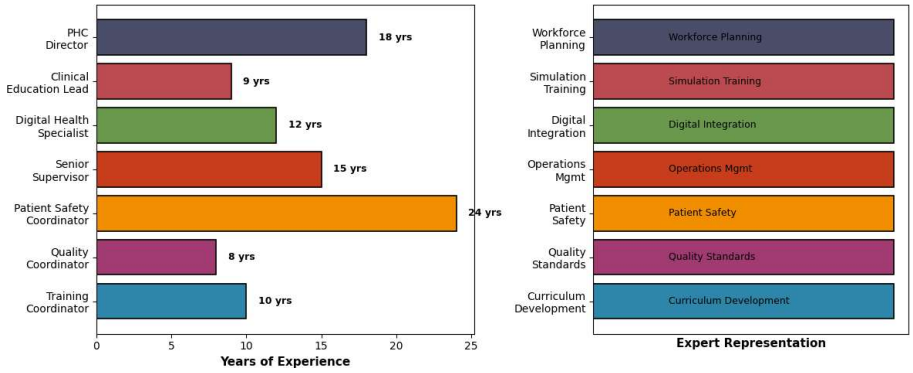


Figure 7: Professional experience and specialisation areas of the expert panel

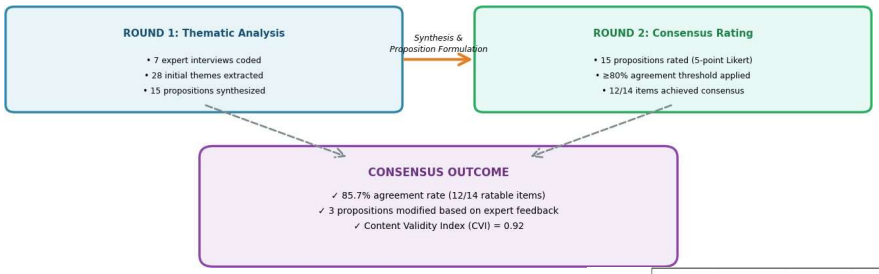
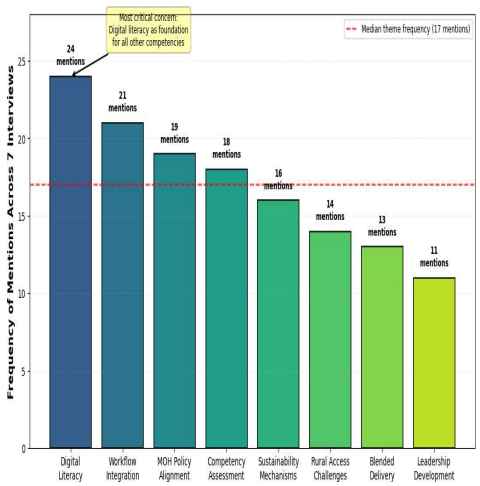


Figure 8: Mini-Delphi consensus process for DOEPT validation



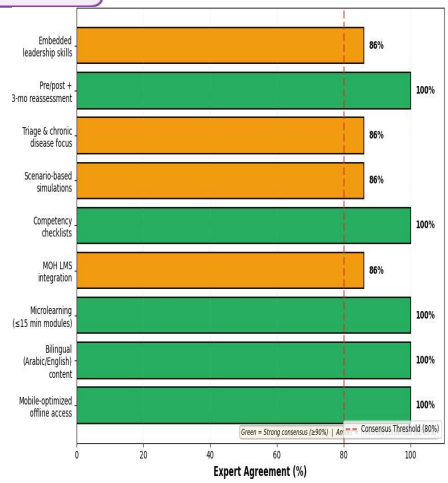


Figure 9: Expert consensus levels across DOEPT components ($N = 7$, Mini-Delphi Round 2)

Figure 10: Thematic analysis: key concerns in DOEPT design (Round 1)

4.2 Phase II: Quantitative Findings

4.2.1 *Respondent Profile*

Table III summarises the demographic characteristics of the N = 645 respondents. The sample was predominantly female (88.2%), consistent with the gender composition of the Saudi nursing workforce. The majority held bachelor's degrees (80.2%) and occupied staff nurse positions (83.5%). The modal age group was 25-34 years (51.4%), and the largest experience category was > 10 years (33.5%), suggesting a moderately experienced workforce. Prior training backgrounds were heterogeneous: traditional classroom-based (34.4%), fully online (26.8%), blended (25.6%) and no prior formal training (13.2%), providing sufficient variability to test H4.

4.2.2 *Measurement Model Assessment*

Table IV presents construct reliability and convergent validity indices. All Cronbach's α values exceeded 0.89, all composite reliability (ρ_c) values exceeded 0.92, and all AVE values exceeded the 0.50 threshold (Fornell and Larcker, 1981). All indicator outer loadings surpassed 0.70. All pairwise HTMT ratios fell below 0.85, satisfying the criterion for discriminant validity (Henseler *et al.*, 2015). Variance Inflation Factor (VIF) values across all constructs remained below 3.3,

Table III: Demographic characteristics of survey respondents (N = 645)

Variable	Category	*n*	%
Gender	Female	566	88.2
	Male	76	11.8
Age Group	<25 years	27	4.2
	25-34 years	330	51.4
	35-44 years	219	34.1
	45-54 years	66	10.3
Education	Diploma	86	13.4
	Bachelor's	516	80.2
	Master's	33	5.1
	Doctorate	8	1.2
Position	Staff Nurse	537	83.5
	Head Nurse	54	8.4
	Supervisor	29	4.5
	Administrator	23	3.6
Experience	<1 year	28	4.4
	1-3 years	155	24.1
	4-6 years	128	19.9
	7-10 years	117	18.2
	>10 years	215	33.5
Training Mode	Traditional	217	34.4
	Online	169	26.8
	Blended	161	25.6
	None	83	13.2
Duration in Taif	<1 year	149	23.2
	1-3 years	260	40.5
	>3 years	233	36.3

indicating the absence of substantial common method bias.

Table IV: Construct reliability and convergent validity

Construct	Cronbach's α	CR (ρ_c)	AVE
DOEPT	0.894	0.926	0.759
Information Availability and Quality (INF)	0.892	0.920	0.697
Organisational Support (OS)	0.895	0.922	0.703
PHC Competency	0.933	0.942	0.576

4.2.3 *Structural Model: Direct Effects*

Table V presents the structural path estimates. Three of the five direct hypotheses were supported. Information availability and quality (H1: β = 0.358, t = 10.276, p < 0.001) was the strongest predictor of PHC competency, followed by organizational support (H3: β = 0.294, t = 9.104, p < 0.001) and DOEPT (H2: β = 0.181, t = 5.116, p < 0.001). The control variables - previous training mode (H4: β = 0.032, t = 1.029, p = 0.303) and duration of service (H5: β = −0.026,
t = 0.864, p = 0.388) - did not reach statistical significance. The overall model yielded R^2 = 0.411,
indicating that the five predictor constructs collectively account for 41.1% of the variance n PHC competency.

4.2.4 *Moderation Analysis*

Table VI presents the moderation estimates. Neither moderation hypothesis was supported: the DOEPT × INF interaction term (β = −0.007, t = 0.218, p = 0.828) and the DOEPT × OS interaction term (β = 0.025, t = 0.790, p = 0.430) were both statistically negligible. These

Table V: Structural model: direct effects and hypothesis testing (H1-H5)

H	Path	β	t	p	Decision
H1	INF → PHC Competency	0.358	10.276	<0.001	**Supported**
H2	DOEPT → PHC Competency	0.181	5.116	<0.001	**Supported**
H3	OS → PHC Competency	0.294	9.104	<0.001	**Supported**
H	Previous	0.032	1.029	0.303	Not

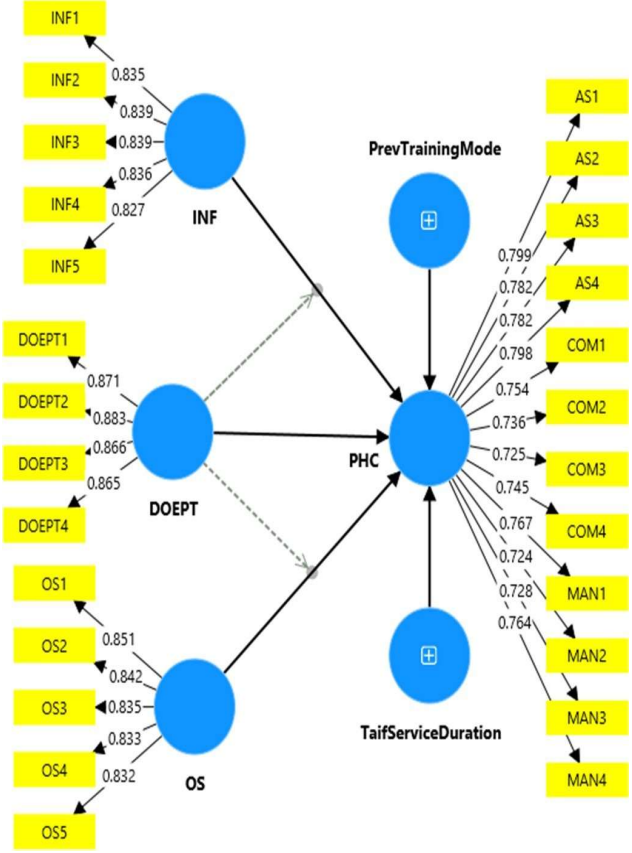


Figure 11: Measurement model with standardised outer loadings (SmartPLS 4.0)

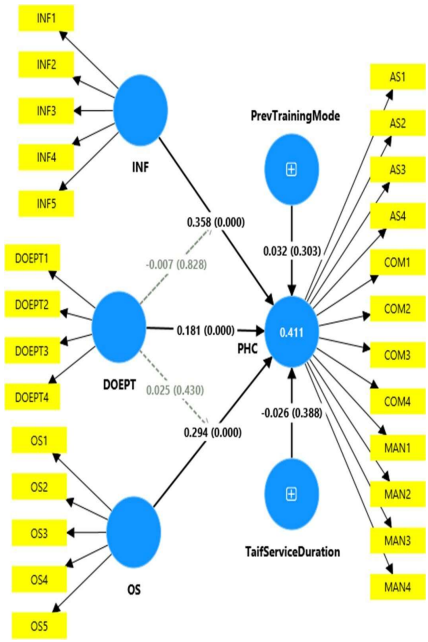


Figure 12: Structural model: path coefficients (β), p-values and $R^2 = 0.411$

4	Training → PHC Competency				Supported
H5	Service Duration → PHC Competency	−0.026	0.864	0.388	Not Supported

null moderation results, combined with the significant main effect of DOEPT, indicate that the programme exerts a direct, independent contribution to competency rather than amplifying the effects of information availability or organisational support.

Table VI: Moderation effects of DOEPT (H6-H7)

H	Interaction Path	β	t	p	Decision
H6	DOEPT × INF → PHC	−0.007	0.218	0.828	Not Supported
H7	DOEPT × OS → PHC	0.025	0.790	0.430	Not Supported

4.2.5 *Measurement and Structural Model Visualisations*

4.2.6 *Summary of Hypothesis Testing*

Table VII consolidates all seven hypotheses. Three of the five direct effects hypotheses were supported; both control-variable and both moderation hypotheses were not supported.

Table VII: Summary of hypothesis testing results

H	Statement	β	p	Decision
H1	INF → PHC Competency	0.358	<0.001	**Supported**
H2	DOEPT → PHC Competency	0.181	<0.001	**Supported**
H3	OS → PHC Competency	0.294	<0.001	**Supported**
H4	Training mode → PHC Competency	0.032	0.303	Not Supported
H5	Service duration → PHC Competency	−0.026	0.388	Not Supported
H6	DOEPT × INF → PHC Competency	−0.007	0.828	Not Supported
H7	DOEPT × OS → PHC Competency	0.025	0.430	Not Supported

5 Discussion

5.1 The Centrality of Information Infrastructure

The finding that information availability and quality constitutes the strongest predictor of PHC nursing competency ($\beta = 0.358$) carries both theoretical and practical significance. Theoretically, this result is consistent with SCT's proposition that the informational environment is a primary determinant of self-efficacy and goal-directed behaviour

(Bandura, 1986): nurses who have timely, reliable access to clinical evidence and patient data are better positioned to develop and exercise
competent judgement. Empirically, the finding resonates with international evidence documenting the pivotal role of information infrastructure in workforce performance (Ramachandran *et al.*, 2024; Hants *et al.*, 2023). Within the Saudi context, it provides direct empirical support for continued investment in clinical decision-support systems and interoperable digital health platforms under Vision 2030 (Baradwan and Al-Hanawi, 2023).

Notably, however, the present study cannot distinguish between the quantity and quality of information available to nurses, nor between formal knowledge repositories and informal peer-generated information channels. Future research employing information audit methods alongside competency assessments would help to disentangle these pathways and identify the specific informational inputs most amenable to intervention.

5.2 Organizational Support as a Structural Enabler

The second strongest predictor, organizational support (β = 0.294), confirms the critical role of the institutional environment in shaping individual competency trajectories. This finding is consistent with a substantial body of systematic review evidence demonstrating that structural empowerment - encompassing managerial support, access to resources and opportunities for professional development - is a robust predictor of nursing commitment and performance (Fragkos *et al.*, 2020; Teixeira *et al.*, 2023). The result resonates with Kanter's 1977 theory of structural empowerment, which argues that organizational conditions, rather than individual attributes alone, determine the degree to which employees can deploy their capabilities effectively. In the Saudi PHC context, where centralized governance structures and resource constraints can limit managerial flexibility, this finding suggests that competency development programmes will yield suboptimal returns unless they are accompanied by deliberate investments in supervisory support, workload management and career progression infrastructure.

5.3 DOEPT as an Independent Empowerment Mechanism

The significant direct effect of DOEPT on PHC competency (β = 0.181) validates the programme as an effective, evidence-based intervention that adds explanatory value beyond information access and organizational support. This result is consistent with evidence that structured, technology-mediated training programmes produce significant and replicable improvements in digital and clinical nursing skills (Kulju *et al.*, 2024; Ramos-Morcillo *et al.*, 2024; R. Luo *et al.*, 2024). From the perspective of TAM (Davis, 1989), the convergence between the qualitative validation data - where experts confirmed the programme's perceived usefulness and ease of use - and the quantitative effectiveness evidence represents a particularly compelling form of triangulated support for the DOEPT's design validity.

The magnitude of DOEPT's direct effect (β = 0.181), while smaller than those of information
availability and organizational support, should not be interpreted as indicating marginal utility. Unlike information infrastructure and organizational climate, which are largely beyond the control of individual nurses or programme designers, the DOEPT represents a directly implementable, scalable intervention. Its independent contribution to the R^2 of 0.411 demonstrates that structured digital empowerment training addresses a distinct dimension of competency - technology-mediated clinical skills and digital literacy - that cannot be achieved through information access or supportive management alone.

5.4 Re-examining the Role of Training Mode and Service Duration

The non-significance of previous training mode (H4: β = 0.032, p = 0.303) challenges the widespread assumption that the channel through which training is delivered - whether traditional classroom, online or blended - constitutes an independent determinant of learning outcomes. This finding aligns with Clark's **Clark1994** equivalency theorem, which holds that instructional media are vehicles for learning rather than its primary determinants, and that outcome differences between modalities tend to disappear when instructional content and design are held constant. The practical implication is consequential: healthcare administrators who invest heavily in modality transitions shifting from face-to-face to fully online training, for example without simultaneously attending to content quality, learner engagement and organizational support may find their investments yield limited competency returns.

The non-significance of service duration (H5: β = −0.026, p = 0.388) is equally instructive. The negative, albeit non-significant, direction of this coefficient is consistent with the competency
stagnation hypothesis articulated by Choudhry *et al.*, (2005), which proposes that clinical performance can plateau or decline over time in the absence of active professional development. Together, these null findings

deliver a powerful message with direct policy implications: tenure credentials and historical training records are unreliable proxies for current clinical competency, particularly in rapidly digitalizing healthcare environments where the knowledge and skill demand of practice are in continuous evolution.

5.5 Theoretical Reconceptualization: From Moderator to Independent Predictor

Perhaps the most theoretically significant finding is the absence of moderation effects (H6 and H7). The original conceptual framework, guided by SCT's emphasis on environmental catalysts, predicted that DOEPT would amplify the competency-enhancing effects of information availability and organizational support. The data do not support this hypothesis. Instead, DOEPT operates as a co-equal, additive contributor alongside information and support, each addressing a distinct pathway to competency rather than potentiating the others.

This reconceptualization has important implications for theoretical model development. It suggests that digital empowerment training is not merely a facilitator of environmental inputs but an autonomous intervention domain that targets a qualitatively different set of competency-enabling mechanisms namely, structured skill acquisition and digital tool proficiency - that neither information availability nor organizational support can fully substitute. The tripartite additive model proposed here extends both SCT-based empowerment frameworks and TAM-based adoption models by specifying independent, non-redundant pathways to competency in digitally transformed healthcare settings.

6 Conclusion

This study has examined the impact of the DOEPT on PHC nursing competency in the Taif Health Cluster using an integrated sequential mixed-methods design grounded in Social Cognitive Theory and the Technology Acceptance Model. The findings yield three principal conclusions.

First, sustainable PHC nursing competency development requires a tripartite, additive approach: enhancing information availability and quality, strengthening organizational support structures and implementing structured digital empowerment programmes. Each pillar contributes independently and non-redundantly; no single element can fully compensate for deficits in the others.

Second, the study challenges two persistent assumptions in healthcare education research: that tenure predicts competency, and that training modality independently influences learning comes. In a rapidly digitalizing healthcare environment, these assumptions are not only empirically unsupported but potentially counterproductive when they displace attention from content quality and organizational enablers.

Third, the reconceptualization of DOEPT from a moderating variable to an independent predictor advances current theoretical frameworks, suggesting that digital empowerment training dresses a distinct and currently underserved dimension of nursing competency that warrants formal institutionalization within professional development systems.

Practical implications. The Ministry of Health, Saudi Arabia, should prioritize the institutionalization of DOEPT as a standard professional development programme, establishing competency-based progression criteria that replace tenure-based assumptions. Simultaneous, strategic investment in clinical information infrastructure and line-management capacity for organizational support is essential to realize the full tripartite model. Healthcare administrators should ensure equitable access across all training modalities through blended delivery mechanisms, particularly in resource-constrained rural and peri-urban PHC settings.

Limitations. The cross-sectional Phase II design precludes definitive causal inference between DOEPT participation and competency gains; causal conclusions must await longitudinal data. The study is geographically bounded to the Taif cluster, and replication in other Saudi regions and internationally is required to establish external validity. Self-reported competency measures introduce social desirability bias, and future studies should incorporate objective clinical assessments. The predominantly female sample composition (88.2%) reflects the demographic reality of the Saudi nursing workforce but nonetheless limits generalisability to settings with more balanced gender distributions. Finally, the unexplained 58.9% of competency variance signals the presence of important predictors - potentially including motivation, leadership style, team climate and regulatory environment - that warrant investigation.

Future research. Researchers should prioritise longitudinal designs incorporating assessments at 3, 6 and 12 months post-intervention, objective clinical performance measures (Objective Structured Clinical Examinations, clinical audit data), multi-site and international replications, and cost-effectiveness analyses to inform resource allocation decisions at the system level.

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