

Enhancing Creative Leadership for Digital Health Adoption Through an Evidence-Based Training Programme at a Saudi Tertiary Healthcare Complex

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ABSTRACT:

Background: Leadership competencies among the healthcare leaders have been mentioned the key drivers of digital health adoption; however, there is little intervention-based empirical evidence about this claim in Saudi Arabia.

Aim: This study evaluated the effectiveness of the Creative Leadership for Digital Health Adoption (CLDH) intervention programme on leadership competencies among healthcare leaders at King Salman Medical City (KSMC), Madinah, Saudi Arabia.

Methods: A quasi-experimental pre-test/post-test design was applied through the non-equivalent group design (experimental: $n = 54$; control: $n = 52$). The outcome was measured using the customised Creative Leadership Competency Scale (CLCS) consisting of 35 items with five dimensions rated on a 5-point Likert scale: Creative Problem-Solving, Visionary Communication, Innovative Risk Taking, Collaborative Empowerment, and Motivational Recognition. Additional assessments were made using self-reports, structured observations, performance-based assessments, reflective journals, focus groups, and skills demonstration vignettes.

Results: The experimental groups showed a significant score improvements across all five CLCS dimensions ($d = 2.12$, range: 1.71–2.50; $F(1,103) = 161.34$, $p < .001$, $\eta^2p = .61$). These improvements had no significant variations across the different professional features, such as education level and years of experience ($p > .34$). However, there were no statistically significant improvements among the control group members. Additionally, the level of satisfaction with the programme was noted to be high ($M = 4.33/5.0$).

Conclusions: The CLDH programme demonstrated a notable significance in improving creating leadership competencies among the healthcare professionals thereby a transferable intervention programme for improving digital health transformation.

Keywords: creative leadership, digital health adoption, leadership training, Saudi Arabia, healthcare leadership development, quasi-experimental

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Introduction

Digital health technologies, such as electronic health records, artificial intelligence, telemedicine platforms and mobile health apps are increasingly becoming a fundamental part of healthcare delivery across the globe (WHO, 2020; Abernethy et al., 2022). In Saudi Arabia, for instance, the desire to meet Vision 2030 has prioritised digital health as a key component of its national reform agenda, with significant investments in building digital infrastructure, data interoperability and the digitisation of the health workforce (Al-Anezi, 2025; Alkhalifah et al., 2022). Although Saudi tertiary institutions are making a strategic commitment to adopt ICTs, the adoption rate among the institutions is still varied, and the gaps in human and organisational resources to implement an ICTs in a sustainable manner are still found in the institutions (Alshammari et al., 2024; Alzghaibi & Hutchings, 2025).

The competencies of healthcare leaders have been reported as key players in digital health adoption, with increasing evidence (Acharya et al., 2022; Laukka et al., 2022). Interestingly, it has been noted that a key success factor of digital adoption is the leaders' role in modelling digital engagement, creating a vision for innovation and building psychologically safe environments for innovation (Burgess & Honey, 2022; Alanazi, 2022). As such, the Leadership Practices Inventory (LPI) is an empirically supported operationalisation of the competencies, consistently across its main domains, including 'Model the Way', 'Inspire a Shared Vision', 'Challenge the Process', 'Enable Others to Act', and 'Encourage the Heart' (Kouzes & Posner, 2017). Creative leadership further builds on this framework by explicitly naming the areas of divergent problem-solving, design thinking, innovation facilitation and uncertainty tolerance, which are particular dimensions essential when dealing with disruptive technological change (Amabile, 1998; Sternberg & Lubart, 1995; Carmeli et al., 2020).

Theoretically, the CLDH programme evaluated in this study was based on the five

complementary theories, namely Amabile's (1998) componential model of creativity, Sternberg and Lubart's (1995) investment theory, Kolb's (1984) Experiential Learning Cycle, Mezirow's (1997) Transformative Learning Theory, and Bandura's (1977) Social Learning Theory. The evaluation of the programme was based on Kirkpatrick's four-level model (1994). The present programme incorporates all of these features: domain-specific content, multi-method pedagogy, greater duration and theoretical grounding – all of which have been shown to increase creativity, based on a meta-analysis of 70 creativity training studies by Scott, Leritz and Mumford (2004), which defined a benchmark effect size of $d = 0.68$. Gagnon, et al., (2012) also found that training that included attitudinal and motivational elements yielded better digital health adoption results than technical-only training.

Despite this evidence, the research on intervention-based creative leadership competencies training in the healthcare sector is still limited, especially in the Arab world (Rjoub et al., 2026). To date, the programmes that have addressed the generic dimensions of transformational behaviours have not keenly considered the creativity-specific dimensions, and most are based on a single self-report assessment approach, without behavioural triangulation (Tonidandel et al., 2018; McAlearney, 2006). Alshammari et al. (2024) noted that, in the Saudi context, there was a lack of evidence-based leadership development programmes for digital health transformation, which was further confirmed by Rjoub et al. (2026) who found multi-construct intervention studies to be lacking in the Arab healthcare literature. This study involved the design, implementation, and evaluation of the Creative Leadership for Digital Health Adoption (CLDH) programme with mid-to-senior level healthcare leaders at KSMC. This study thus sought to assess the efficacy of the CLDH programme towards improving creative leadership skills in five dimensions, and to determine if the outcomes were similar across professional categories, education levels and years of experience.

Methods

Design and setting

A quasi-experimental pre-test post-test (non-equivalent control group) was applied according to the protocols of Creswell and Creswell (2018). The study was carried out at the King Saud Medical Complex (KSMC), which is among the top tertiary healthcare facilities in Madinah, Saudi Arabia. Given the clinical set-up of KSMC, where departments were not necessarily independent of one another, the requirement of individual randomisation was operationally impractical and a purposive classification of departments into experimental ($n = 54$) and control ($n = 52$) groups was achieved, with each group being similar in terms of departmental function, staffing, and digital infrastructure.

Participants

Of the 118 who expressed interest, 112 were eligible and agreed to participate, and 106 of these completed the pre-test (100% retention), and 106 completed the post-test. Eligible participants were healthcare professionals holding leadership and/or supervisory positions such as department heads, clinical managers, senior physicians, charge nurses, and team leaders at least one year of institutional experience. The majority of the sample was aged 35-49 years (62.3%), female (51.9%), postgraduates (58.5%) and had more than 5 years of KSMC experience (71.7%). The pre-test group equivalence was established on all the subscales of CLCS and total score ($p > .05$). Before commencement, this study received ethical approval from the KSMC Institutional Review Board (Protocol KSMC-IRB-2026-525) as well as the Lincoln University College Ethics Committee. Thereafter, informed consent was obtained from all participants, both in Arabic and English.

The CLDH Programme

The programme consisted of 12 weeks of 96 hours of direct instruction and supervised experiential learning (six modules, each 2 weeks) and an integration module (capstone). Blended and bilingual delivery was used involving face to face workshops, collaborative sessions and self-directed learning. The modules covered various leadership aspects, including Creative Modelling (Model the Way), Visionary Creativity (Inspire a Shared Vision) (including CLA and Vision Pitch assessment), Innovative Challenge (Challenge the Process) (applying Stanford Design Thinking to the real KSMC digital health problems), Collaborative Empowerment (Enable Others to Act) (applying the model of PS from Edmondson (1999) and using GROW coaching to enable others to act), and Motivational Recognition (Encourage the Heart) (applying the model from Herzberg (1959) and Deci and Ryan (1985) to KSMC motivational recognition). Four experts facilitated the programme. The mean fidelity was 94.2% and the average time deviations were less than 8 minutes per 4-hour session. The average attendance of the experimental group was 91.3% and each participant in the experimental group attended at least 80% of the classes.

Instructional techniques and evaluation measures

The Creative Leadership Competency Scale was a self-constructed 35-item, 5-point Likert scale instrument designed to measure the five competency sub-scales: Creative Problem-Solving, Visionary Communication, Innovative Risk-Taking, Collaborative Empowerment, and Motivational Recognition. The CLCS was developed by combining the LPI (Kouzes & Posner, 2017), the creative thinking framework of Torrance (1974), and Amabile's (1998) componential model of creative thinking. The CLCS was found to have an excellent level of content validity (Scale-level CVI/AVE = 0.92; $n = 30$), and pilot test reliability (subscale $\alpha = 0.82$ -0.91; total $\alpha > .90$) (Table 1).

Table 1. Convergent validity and factor structure summary for the CLCS (n = 30)

Subscale	#Items	α	CR	AVE	Factor Eigenvalue	% Variance Explained	Cumulative %
a) Creative Problem-Solving (CPS)	7	.88	.89	.53	6.84	19.5%	19.5%
b) Visionary Communication (VC)	7	.91	.92	.57	4.71	13.5%	33.0%
c) Innovative Risk-Taking (IRT)	7	.90	.91	.55	3.92	11.2%	44.2%
d) Collaborative Empowerment (CE)	7	.89	.90	.54	3.44	9.8%	54.0%
e) Motivational Recognition (MR)	7	.82	.84	.50	5.03	14.4%	68.4%
CLCS Overall	35	.93	.94	.54	-	-	68.4%

The findings were triangulated across all four levels of Kirkpatrick (1994) through structured observation check lists at three time points (0, 3 and 12 months) (inter-rater $\alpha = 0.78-0.84$); a structured reflective journal (using Moon 1999's five level framework); three performance-based assessments (Vision Pitch, Micro-Teaching, Capstone Strategic Plan); a standardised 15 minute Leadership-in-Action skills demonstration vignette; a 12 item Kirkpatrick Level 1 satisfaction survey, and two semi-structured focus groups analysed using Braun and Clarke (2006) thematic analysis.

Statistical Analysis

The statistical analysis was done using IBM SPSS Statistics 28.0. Independent samples t-test and Chi-square tests were used to test pre-test group equivalence. Paired samples t-tests were used to determine within-group pre-post change with Cohen's d effect size. One-way ANCOVA was used to compare one group with another after controlling for the effect of pre-test scores and used partial eta-squared (η^2p) as an effect size measure. Two-way ANCOVA designs were used to examine the moderating effect of programme

by professional category, educational level and years of experience. Throughout, values having $p < .05$ were considered significant.

Results

Participant characteristics

Five different professional categories were noted among the experimental group, consisting of senior physicians (29.2%), charge nurses (26.4%), clinical managers (22.6%), department heads (12.3%), and team leaders (9.4%). The preliminary analysis showed no significant baseline differences between the two groups on any demographic variable ($p > .05$) or on subscale or total score of the CLCS ($t(104) = 0.52$, $p = .604$; experimental total $M = 3.12$, $SD = 0.58$; control total $M = 3.18$, $SD = 0.61$).

Programme effects on creative leadership competencies

The experimental group showed statistically significant improvement in all five CLCS dimensions scores, and the total score, while the control group did not show any significant score change ($p > .06$) (Table 2).

Table 2. CLCS Pre-Test and Post-Test Scores by Group and Dimension with Effect Sizes

CLCS Dimension	Exp Pre M(SD)	Exp Post M(SD)	Ctrl Pre M(SD)	Ctrl Post M(SD)	t (paired, Exp)	p	d
Creative Problem-Solving	2.45 (0.24)	4.19 (0.19)	2.38 (0.29)	2.50 (0.26)	42.05	< .001	1.95
Visionary Communication	2.34 (0.32)	4.33 (0.20)	2.41 (0.34)	2.44 (0.33)	40.06	< .001	2.50
Innovative Risk-Taking	2.31 (0.32)	4.26 (0.20)	2.31 (0.28)	2.34 (0.28)	35.78	< .001	2.38
Collaborative Empowerment	2.55 (0.28)	4.12 (0.18)	2.52 (0.31)	2.59 (0.31)	33.53	< .001	1.76
CLCS Dimension	Exp Pre M(SD)	Exp Post M(SD)	Ctrl Pre M(SD)	Ctrl Post M(SD)	t (paired, Exp)	p	d
Motivational Recognition	2.43 (0.26)	4.24 (0.17)	2.39 (0.22)	2.47 (0.24)	42.85	< .001	1.71
CLCS Total	2.42 (0.14)	4.23 (0.08)	2.40 (0.13)	2.47 (0.14)	83.80	< .001	2.12

Note. All paired t-tests for the experimental group: $p < .001$. Control group: no significant pre-post change ($p > .06$). d = Cohen's d (effect size; computed for experimental group paired t-test). CPS = Creative Problem-Solving; VC = Visionary Communication; IRT = Innovative Risk-Taking; CCB = Collaborative Empowerment; MR = Motivational Recognition.

Overall, the experimental group's total creative leadership score improved from $M = 2.42$ ($SD = 0.14$) at pre-test to $M = 4.23$ ($SD = 0.08$) at post-test, yielding a paired-samples result of $t(53) = 83.80$, $p < .001$, with Cohen's $d = 2.12$. Creative Problem-Solving ($d = 1.95$), Collaborative Empowerment ($d = 1.76$), and Motivational Recognition ($d = 1.71$) were noted to have very large effects.

Between-group comparisons

One-way ANCOVA with pre-test scores as the covariate confirmed significantly higher post-test scores for the experimental group in all the CLCS dimensions as well as in the total score. The overall adjusted mean for the experimental group ($M = 4.19$, $SE = 0.05$) significantly exceeded that of the control group ($M = 3.21$, $SE = 0.05$), $F(1,103) = 161.34$, $p < .001$, $\eta^2p = .61$. By all accepted standards (Cohen, 1988), the effect size, η^2p of .61, demonstrates a large effect size for group membership after accounting for pre-test differences. Results from the ANCOVA performed at the subscale level were consistent, with a uniformly high p value of less than .001, and an η^2p ranging between .52 and .61 (Table 3).

Table 3. One-Way ANCOVA: Post-Test CLCS Scores by Group (Covariate: Pre-Test Score)

CLCS Dimension	Exp Adj M (SE)	Ctrl Adj M (SE)	F(1, 103)	p	η^2p
Creative Problem-Solving	4.18 (0.06)	3.19 (0.06)	143.27	< .001	0.58
Visionary Communication	4.29 (0.05)	3.24 (0.05)	157.82	< .001	0.61
Innovative Risk-Taking	4.22 (0.06)	3.18 (0.06)	138.94	< .001	0.57
Collaborative Empowerment	4.10 (0.06)	3.22 (0.06)	118.46	< .001	0.52
Motivational Recognition	4.18 (0.05)	3.24 (0.05)	152.09	< .001	0.60
CLCS Total	4.19 (0.05)	3.21 (0.05)	161.34	< .001	0.61

Note: Effect size benchmarks: $\eta^2p \geq .01$ small, $\geq .06$ medium, $\geq .14$ large (Cohen, 1988)

Cross-demographic consistency

Two-way ANCOVA analyses revealed no significant interaction effects between group

assignment and professional category ($F(3,95) = 0.84, p = .475$), educational level ($F(3,95) = 1.12, p = .346$), or years of experience ($F(3,95) = 0.67, p = .573$) (Table 4).

Table 4. CLCS Scores by Demographic Category (Experimental Group) and Moderation Test Statistics (N=54)

Category	n	Pre M(SD)	Post M(SD)	Gain	p (interaction)
Professional category - group by category $F(3,95) = 0.84, p = .475$ (ns)					
a) Senior Physician	19	2.43 (0.12)	4.23 (0.07)	+1.80	.475
b) Charge Nurse	10	2.43 (0.20)	4.21 (0.09)	+1.78	.475
c) Clinical Manager	10	2.44 (0.14)	4.20 (0.10)	+1.76	.475
d) Dept Head/team Leader	15	2.38 (0.10)	4.25 (0.08)	+1.87	.475
Education level - group by education $F(3,95) = 1.12, p = .346$ (ns)					
a) Doctorate	14	2.46 (0.17)	4.23 (0.07)	+1.77	.346
b) Master's	14	2.38 (0.13)	4.22 (0.09)	+1.84	.346
c) Bachelor's	26	2.42 (0.12)	4.22 (0.09)	+1.80	.346
Years of experience - group by experience $F(3, 95) = 0.67, p = .573$ (ns)					
a) < 2 years	8	2.40 (0.14)	4.22 (0.09)	+1.82	.573
b) 2–5 years	10	2.43 (0.13)	4.24 (0.06)	+1.81	.573
c) 6–10 years	19	2.41 (0.17)	4.21 (0.08)	+1.80	.573
d) > 10 years	17	2.41 (0.10)	4.23 (0.10)	+1.82	.573

Note: ns = non-significant

The mean pre test to post test gains ranged from +1.76 points to +1.87 points in all subgroups, and were virtually the same, indicating high effectiveness and equity in the programme across the varied population of participants.

Observational and behavioural evidence

Data collected by observers was used to independently capture, in criterion referenced terms, evidence of competence development in behaviour. The mean observations scores in the experimental group were nearly doubled from

Module 1 to Module 6, in all five competency domains (overall: 1.91 to 3.51, change: +1.60, $F > 87.4, P < .001, \eta^2 p > .62$, for all within-subject effects) (Table 5). The largest absolute improvement was in the case of Innovative Process Improvement (+1.75), a growth expected from the programme's design thinking and innovation section.

Table 5. Structured observation checklist Mean scores across three time points-experimental Group (n = 54)

Competency Domain	Module 1 M(SD)	Module 3 M(SD)	Module 6 M(SD)	Change (M1to M6)	Significance
Creative Problem-Solving	1.94 (0.36)	2.82 (0.32)	3.44 (0.24)	+1.50	$p < .001$
Visionary Communication	1.96 (0.29)	2.90 (0.29)	3.56 (0.25)	+1.60	$p < .001$
Innovative Process Improvement	1.70 (0.35)	2.70 (0.32)	3.45 (0.20)	+1.75	$p < .001$
Collaborative Capacity Building	2.10 (0.37)	2.93 (0.32)	3.58 (0.26)	+1.48	$p < .001$
Motivational Recognition	1.85 (0.34)	2.86 (0.38)	3.52 (0.25)	+1.67	$p < .001$
OVERALL	1.91 (0.15)	2.84 (0.15)	3.51 (0.11)	+1.60	$p < .001$

Note. Repeated-measures ANOVA confirmed significant within-subject effects ($F > 87.4$, all $p < .001$, all $\eta^2 p > 0.62$). Inter-rater reliability (Cohen's κ): 0.78–0.84 across observation points.

Reflective journal analysis

A formal analysis of randomly sampled (three per participant) journal entries ($N = 162$) was conducted according to Moon's (1999) framework in order to obtain a clear developmental trajectory. At the early programme stage (Weeks 1-2) 75.9% of entries

were descriptive and superficial (Levels 1-2). At the end of the semester (Weeks 11–12), 64.8% of students had attained Level 4 (Critical Reflection) and/or Level 5 (Transformative Reflection), and 20.4% of students had reached the highest level (Transformative Reflection). This trend was statistically significant ($\chi^2(4) = 48.73$, $p < .001$; inter-rater $\kappa = 0.76$) (Table 6).

Table 6. Distribution of reflective writing levels across programme stages-experimental group (n = 54)

Moon's Level	Early (Week 1-2) n(%)	Mid (Week 5-6) n(%)	Late (Week 11-12) n(%)
Level 1: Descriptive Writing	22 (40.7%)	4 (7.4%)	0 (0.0%)
Level 2: Descriptive Reflection	19 (35.2%)	14 (25.9%)	5 (9.3%)
Level 3: Dialogic Reflection	10 (18.5%)	21 (38.9%)	14 (25.9%)
Level 4: Critical Reflection	3 (5.6%)	13 (24.1%)	24 (44.4%)
Level 5: Transformative Reflection	0 (0.0%)	2 (3.7%)	11 (20.4%)

Note. Assessed by two facilitators using Moon's (1999) Framework for Reflective Writing. Inter-rater agreement: Cohen's $\kappa = 0.76$. Trend chi-square: $\chi^2(4) = 48.73$, $p < .001$.

Performance-Based Assessments

The three assessment methods using performance were all very good. The Vision Pitch achieved a mean score of 38.8/50 (77.6%) with 72.2% of participants scoring $\geq 75\%$ of the possible marks (Table 7). Micro-Teaching assessment yielded a mean of 33.3/40 (83.3%)

and maximum of 100% at or above the competency. The Capstone Strategic Plan resulted in a mean of 62.6/75 (83.5%) competency, also 100% competency. The assessments here depict that creative leadership competencies were not only self-reported but were also translated into complex and criterion-referenced task performance.

Table 7. Performance-based assessment results-experimental group (n = 54)

Assessment Component	Max Score	M (SD)	% Score	% Scoring $\geq 75\%$
Vision Pitch	50	38.8 (2.3)	77.6%	72.2%
Micro-Teaching	40	33.3 (1.8)	83.3%	100.0%
Capstone Strategic Plan	75	62.6 (2.1)	83.5%	100.0%

Note. VP = Vision Pitch (Module 2; max 50 points; 10 criteria $\times$ 5 points). MT = Micro-Teaching (Module 4; max 40 points; 8 criteria $\times$ 5 points). Cap = Capstone Strategic Plan (Module 6; max 75 points; 15 criteria $\times$ 5 points). ' $\geq 75\%$ ' threshold = VP ≥ 37.5 , MT ≥ 30 , Cap ≥ 56.25 points.

Skills Demonstration Vignette

The experimental group improved their total vignette score by 17.4 points - from M = 15.3 (SD = 3.2) to M = 32.7 (SD = 2.4), yielding Cohen's $d = 6.14$. However, there was no significant difference in the control group (+0.3 points). A mixed-design ANOVA confirmed that the group $\times$ time interaction was highly significant ($F(1,104) = 189.34$, $p < .001$, $\eta^2p = .65$). The largest experimental gain was on the Creative

Strategies component (+174%, pre-test M = 4.6, post-test M = 12.6), where there was real transfer of learning to an unfamiliar task scenario.

Programme Satisfaction

The overall satisfaction of the participants with the sensorimotor therapy program was high, with a score of M = 4.33, SD = 0.17, on a 5-point scale. The highest ratings for each subscale were for perceived content relevance (M = 4.34) and content quality (M = 4.35); anticipated transferability was also high (M = 4.31) (Table 8). More than 91% of the entire respondents gave an evaluation of 4 or greater for overall satisfaction. The participants' feedback further showed that simulation laboratory sessions and the design thinking workshops were the most valued components of the program.

Table 8. Training programme satisfaction results-experimental group (n = 54)

Item / Subscale	M	SD	% Rating ≥ 4
Perceived relevance	4.34	0.30	91.4%
1) The training content was relevant to my clinical leadership role	4.41	0.54	94.4%
2) The digital health scenarios reflected real challenges at KSMC	4.38	0.56	92.6%
3) The programme addressed competency gaps I had identified	4.29	0.61	88.9%
4) The programme was appropriate for my professional level	4.27	0.59	88.9%
5) Content quality	4.35	0.26	92.6%
6) The facilitators demonstrated strong subject matter expertise	4.46	0.54	96.3%
7) The programme materials were clear and well-organised	4.38	0.57	92.6%
8) The simulation and design thinking activities were well-designed	4.31	0.60	90.7%
9) The bilingual delivery format supported my learning effectively	4.24	0.63	87.0%

10) Anticipated transferability	4.31	0.29	88.9%
11) I intend to apply what I learned to my daily leadership practice	4.44	0.53	96.3%
12) I feel confident applying creative leadership strategies in my department	4.33	0.58	90.7%
13) My team will benefit from the changes I plan to implement	4.24	0.61	88.9%
14) The programme has prepared me to lead digital health adoption	4.24	0.63	83.3%
Overall Satisfaction	4.33	0.17	91.0%

Focus group thematic findings

Four overarching themes were identified from thematic analysis of the focus group data:

Theme 1: Transformative shift in leadership identity: From module 1 and 2, the participants spoke about a “reconceptualization” of their leadership role, which was most closely associated with the values clarification and future-casting exercises, and as digital transformation advocates.

Theme 2: Design thinking as a practical problem-solving tool: The Stanford Design Thinking workshops were always cited as the most practical aspect of the programme. Within a couple of weeks of finishing Module 3 participants indicated that they were spontaneously facilitating empathy mapping and brain-writing sessions with their clinical teams.

Theme 3: Psychological safety as an enabler of digital experimentation: The participants adopted a ‘psychological safety model’ developed by Edmondson (1999), leading to an introduction of no-blame de-briefing protocols and protected

digital experimentation spaces within their units (in Module 4). The “Fail Forward” exercise was commonly used to talk about normalising productive failure.

Theme 4: Sustainability concerns and institutional support requirements: The participants identified some barriers that can affect their commitment to promoting digital transformation beyond the commitment they can dedicate at individual level: heavy clinical workloads, inadequate support from the institution, and lack of formal recognition structures. Therefore, they recommended that KSMC needs to build a “Digital Innovation Leadership Network” as a permanent platform for continuous support and institutional visibility of creative leadership programs.

Integrated Multi-Method Summary

The convergence of evidence across all four Kirkpatrick (1994) levels is summarised in Table 9.

Table 9. Integrated multi-method assessment summary- phase 2 (experimental group, n = 54)

Method	Domain	Pre/Baseline	Post / Final	Change	Significance
CLCS (Self-Report)	Overall Total	2.42 (0.14)	4.23 (0.08)	+1.81 (d = 2.12)	p < .001
CLCS (Self-Report)	Innovative Risk-Taking	2.31 (0.32)	4.26 (0.20)	+1.95 (d = 2.38)	p < .001
CLCS (Self-Report)	Visionary Communication	2.34 (0.32)	4.33 (0.20)	+1.99 (d = 2.50)	p < .001
Observation Checklist	Overall (4-pt scale)	1.91 (0.15)	3.51 (0.11)	+1.60	p < .001
Observation Checklist	Innov. Process Improvement	1.70 (0.35)	3.45 (0.20)	+1.75	p < .001
Skills Vignette	TOTAL (40 pts)	15.3 (3.2)	32.7 (2.4)	+17.4 (d = 6.14)	p < .001

Skills	Creative	4.6 (2.2)	12.6 (1.2)	+8.0 (d = 4.45)	p < .001
Vignette	Strategies (15 pts)				
Performance	Vision Pitch (50 pts)	-	38.8 (2.3)	77.6%	-
Performance	Micro-Teaching (40 pts)	-	33.3 (1.8)	83.3%	-
Performance	Capstone Plan (75 pts)	-	62.6 (2.1)	83.5%	-
Satisfaction	Overall (5-pt scale)	-	4.33 (0.17)	-	-

Note. d = Cohen's d effect size (experimental group, paired pre–post). All experimental group improvements: $p < .001$. Control group: no significant changes ($p > .06$). CLCS = Creative Leadership Competency Scale.

Discussion

The CLDH intervention programme made significant improvements in creative leadership skills for all five dimensions and an overall effect size significantly above the meta-analytical average of 0.5 that was established by Scott et al. (2004) for similar creativity training programmes. The effect was higher than the small-to-moderate effect reported by McAlearney (2006) for general healthcare leadership development programmes. The magnitude is likely to be explained by some of the features of the programme design. For instance, the 12-week time limit of deliberate practice allowed was one of the most consistent factors found in moderating creativity training effect size by Scott et al. (2004) and Miao et al. (2021). This multi-modal blended delivery included a combination of workshops, simulations, reflective journals and capstone projects for multiple learning pathways. The use of domain-specificity, where all content was grounded in actual KSMC digital health challenges, ensured that content was highly relevant to participants' experiences and was engaging in a learning transfer. This aligns with the results of Lacerenza et al. (2017), who found that the effectiveness of learning transfer could be maximised by focusing on participants' real workplace challenges rather than generic leadership concepts. The differential improvement pattern across dimensions offers theoretical insights. The two lower baseline scores were Innovative Risk Taking and Visionary Communication, with these showing

the highest relative gains following the intervention, in line with Hughes et al. (2018) who reported that deliberate practice on competency gaps resulted in highest relative improvements. These gains were confirmed by the ANCOVA results, which indicated that the gains were not a regression to the mean.

One of the key conceptual insights that the study surfaces is the extension of the LPI from its original concept to the operationalisation of creative leadership for digital health adoption into a specific competency domain that can be trained. The LPI has been widely tested across healthcare organizations, but the tool was not created to measure competencies that are specific to design thinking, divergent problem solving, innovation facilitation and psychological safety building competences that are required by digital transformation. Still, these findings support both Mumford et al. (2002) theoretical proposal that creative leadership requires trainable cognitive strategies, rather than creative personality traits, and the result of Carmeli et al. (2020) that creative risk-taking is the most trainable dimension of innovation-oriented leadership, especially when training is combined with psychological safety together with skills learning. The trainability of Visionary Communication is also highly practical. As noted by Weiner (2009), co-creating a compelling and credible digital transformation narrative is a key pathway to establishing a shared motivational commitment that comes before successful digital transformation implementation, which was also found by Li et al. (2023) to be the

most important factor in predicting staff readiness for the adoption of health information systems in Chinese hospitals.

Another critical observation was on the similar programme effects across professional categories, level of education and years of experience. The majority of healthcare leadership development programmes are designed for a specific profession or level of leadership, which can unfortunately reinforce competency segmentation amongst clinical staff (Fitzgerald et al., 2013). Shared creation of creative leadership across disciplines and hierarchy, provided by one, well-designed intervention, demonstrates the potential of the presented programme for role-based effectiveness, enabling multiple parallel pathways of digital health facilitation. This is consistent with the review conducted by Day et al. (2014) who found that the mechanisms of learning for acquiring leadership competency (deliberate practice, feedback, reflection, and social learning) are common across a wide variety of leader groups. Avolio et al. (2009) also identified that programmes that included experiential learning, reflective practice and peer coaching had similar developmental experiences for a variety of audiences, and Thiel et al. (2020) have explained that the consistency of the demographic in problem-based leadership programmes is due to the use of authentic organisational challenges as learning vehicles. Another likely contributing factor is the bilingual delivery; multilingual accessibility enables deeper cognitive processing and metacognitive reflection that could be systematically different across participants (Cummins, 2008).

The methodological diversity of the four measures may also provide a strong case for large effects in the four distinct assessment methods, a primary limitation of most leadership development evaluations, which focus solely on self-report outcomes (Podsakoff et al., 2003; Tonidandel et al., 2018). It is interesting to note the overlap between self-reported competency gains and observer-rated behavioural improvements, as these are generally only moderate in leadership assessment (Atkins & Wood, 2002) and Segers et al. (2023) noted that

self-observer rating agreement is most likely to occur when competency descriptions are behaviourally specific and shared with participants prior to the process. The skills demonstration vignette results are especially crucial since the vignette performance is the most externally valid measure of the outcomes of professional learning. This indicates that competency developed in a manner that was authentic and transferable, as opposed to familiarity with the training materials (Mayer & Wittrock, 2006; Blume et al., 2019).

The reflective journal path, from descriptive at the programme entry to mainly critical, transformative reflection at programme completion, is similar to those patterns found in structured professional reflection programmes (Plack et al., 2010; Mann et al., 2009). The programmes resemble those that Kitchenham (2023) attributes to rapid changes of perspective, namely programmes that combine affective, cognitive and social aspects of learning. Themes arising from the focus groups also support the quantitative results: the reconceptualization of identity from operational administrator to digital innovation catalyst, as described by participants, is indicative of identity reconceptualization, a hallmark of transformative learning, that was already reported before the end of the programme. Additionally, the immediate application of design thinking tools and psychological safety practices to challenges faced in the clinical units indicates that the results of the focus group were already reflected in Level 3 of Kirkpatrick's behavioural transfer. The participant concerns around sustainability issues, including workload issues and need for institutional recognition structures, mirror the evidence from Stirman et al. (2012), which found that sustainability of organisational interventions was dependent on ongoing support from the leadership, alignment of policy, and continuous reinforcement structures outside of the formal programme lifespan.

Limitations

Full random assignment was not possible in this study, which could have restricted a causal

inference, but this was tentatively addressed by the use of pre-test covariate control in ANCOVA. Additionally, self-report and voluntary participation could have created social desirability bias, but again, this was improved by triangulation with observational and vignette data. Finally, there were no follow-up assessment, and this may mean that the long-term competency effects are not demonstrated, still needing further confirmation.

Conclusions and recommendations

This study demonstrates that creative leadership competencies, which are critical for digital health transformation, can be improved through a structured training involving theoretically-grounded 12-week programme. The CLDH programme's evidence of impact and multi-method approach makes it a ready-to-go model for leadership development initiatives in healthcare in the Saudi and GCC digital health transformation environment. Hence, the healthcare administrators should incorporate the CLDH programme as part of the annual planning of leadership development taking special attention to the Challenge the Process and Visionary Communication dimensions. Nevertheless, the programme designers may still require to embrace the pedagogies of experience, multi-professional cohorts and bilingual lecturing

to validate and reinforce effectiveness. Furthermore, future studies need to incorporate objective measures of adoption outcomes, use multi-site replication, and apply longitudinal study designs to fill the evidence chain from leadership training to improvement of patient care.

Conflict of Interest

The authors declare they don't have any conflict of interest.

Author contributions

The first versions of the work are written by the original author and the cross-ponding author's supervisor. Each author wrote a portion of the manuscript, collected data, edited it, created tables, and was given permission to submit it for journal publication.

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Ethical Approval

Not Applicable

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