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Integrating Social and Emotional Learning into Nursing Simulation: Effects on Critical Thinking and Caring Behaviours among First-Year Undergraduate Nursing Students — A Quasi-Experimental Mixed-Methods Study

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Abstract

Background.

Cultivating both caring behaviours and critical thinking in first-year nursing students is foundational to safe, compassionate practice, yet didactic teaching alone may not develop these competencies. Social and Emotional Learning, framed by the CASEL competencies, offers a structured pedagogical approach. This study evaluated whether a Social and Emotional Learning-integrated experiential curriculum improved critical thinking and caring behaviours compared with standard instruction.

Methods.

A quasi-experimental, two-group pretest–posttest mixed-methods design was conducted with 142 first-year nursing students from two universities in central Taiwan (experimental group, n = 105; control group, n = 37). Class-level allocation was used because randomising individual students within an intact-class curriculum was institutionally infeasible. The experimental group completed a 58-hour Social and Emotional Learning-integrated curriculum combining a 48-hour high-fidelity infant simulation, pregnancy and ageing simulations, service-learning, and guided debriefing across one semester. Outcomes were assessed using the Taiwan Critical Thinking Disposition Inventory and a 15-item Caring Behaviour Scale at week 1 and week 18. Analyses included paired and independent-samples t-tests, linear mixed-effects models, Cohen's d, and three pre-specified sensitivity analyses (inverse-probability-of-treatment weighting, analysis of covariance, and complete-case) to address selection bias. A purposive subsample (n = 18) participated in semi-structured interviews analysed using reflexive thematic analysis. The study followed the TREND reporting guideline for non-randomised behavioural interventions.

Results.

The groups were comparable at baseline on all measured variables except career intention. The experimental group showed significantly greater improvement on overall critical thinking (Group × Time: $\beta = 3.65$, $p = .045$), on the Systematic-Analytical Thinking subscale (between-group change $p = .02$), and on the Respect dimension of caring behaviour ($p = .03$). All three significant findings remained robust across sensitivity analyses, suggesting the observed effects are not attributable to selection bias from non-random allocation. Qualitative findings yielded two themes—perspective-taking through immersive simulation, and systematic reasoning under pressure—that triangulated the quantitative gains.

Conclusions.

Embedding Social and Emotional Learning into early experiential nursing curricula significantly enhanced critical thinking, particularly systematic-analytical reasoning, and strengthened respectful caring

attitudes. Robustness across multiple analytic approaches strengthens causal inference within the limits of a quasi-experimental design. This multi-component, theory-driven approach offers nursing educators a feasible, reproducible model to cultivate cognitive and affective foundations during the first year of training, supporting the United Nations Sustainable Development Goal 3 (Good Health and Well-being).

Trial registration:

This educational quasi-experimental study was retrospectively registered with the Open Science Framework (registration details to be provided at submission). Ethical approval was granted prospectively (CRREC-109010; 19 February 2021) prior to recruitment.

Background

Contemporary nursing education increasingly recognises that socio-emotional competence is as essential as cognitive and technical knowledge for safe, person-centred care [1, 2]. Socio-emotional competence denotes the capacity to recognise and regulate emotions, empathise with others, and make ethical, socially responsible decisions that promote personal and collective well-being [1]. In nursing, these capabilities underpin reflective thinking, compassionate communication, and ethical clinical practice [2]. Social and Emotional Learning (SEL) is the systematic process through which socio-emotional competence is developed; it integrates cognitive, affective, and behavioural growth, and is increasingly viewed as a core component of holistic education [3]. Empirical evidence shows that SEL improves academic outcomes, strengthens social skills, reduces behavioural problems, and benefits mental health [3]. In nursing, these gains translate into attuned interpersonal care, better emotion regulation under stress, and enhanced clinical performance [4]. Qualities such as empathy, moral reasoning, and reflective awareness are not replicable by artificial intelligence, underscoring their irreplaceable value in nursing education [5].

The CASEL framework

The Collaborative for Academic, Social, and Emotional Learning (CASEL) framework identifies five interdependent domains [6]: self-awareness (recognising one's emotions, values, and goals); self-management (regulating emotions and behaviours under pressure); social awareness (empathy and perspective-taking); relationship skills (effective communication and teamwork); and responsible decision-making (ethical, caring choices) [3, 7, 8]. These competencies reflect the humanistic dimensions of nursing practice and provide a structured foundation for designing curricular interventions that address students' emotional, ethical, and relational development.

Pedagogical strategies for developing SEL in nursing

Active and experiential pedagogies are particularly effective for SEL development [1]. Simulation and role-play foster emotional understanding, teamwork, and reflective practice [9]. They provide psychologically safe yet immersive environments in which students can rehearse empathy and decision-making before encountering real patients. Ageing and pregnancy simulations elevate self-efficacy, empowerment, and emotional insight [10]. Service-learning further cultivates caring through reflection on community engagement [11]. Combining such strategies allows educators to strengthen both cognitive (critical thinking) and affective (caring and empathy) domains.

Rationale for the present study

Despite robust theoretical grounding, several gaps remain. First, most studies examine single methods (e.g., one simulation modality) rather than integrated curricula [12, 13]. Second, much of the literature focuses on advanced students, while the foundational first year is the formative window for professional identity [14]. Third, evidence on how SEL frameworks map directly onto simulation content is limited. Recent work shows that Kolb-based experiential training outperforms didactic instruction in nursing [15], consistent with Kolb's experiential learning theory [16, 17]. Adam and Juergensen further argued that critical thinking is developed through situated, virtue-oriented practice rather than passive knowledge transmission [18].

Addressing these gaps, the present study integrated a 48-hour high-fidelity infant simulation, pregnancy and ageing simulations, service-learning, and guided debriefing into a first-year nursing course explicitly mapped to the CASEL competencies. We hypothesised that this multifaceted, SEL-informed experiential curriculum would yield greater improvements in critical thinking and caring behaviours than standard instruction.

Methods

Study design and reporting standard

This study employed a quasi-experimental, two-group pretest–posttest design with an embedded concurrent qualitative component to enable mixed-methods triangulation [19]. The study is reported in accordance with the TREND statement (Transparent Reporting of Evaluations with Nonrandomized Designs) [29], which is the established standard for non-randomised behavioural and educational interventions. A study flow diagram following the CONSORT-style convention for non-randomised designs is provided as Fig. 1. The completed TREND checklist is provided as Additional file 1.

Rationale for a quasi-experimental design

Individual-level randomisation was not feasible for three institutional reasons consistent with established constraints in educational intervention research [30]. First, the Human Development course

is delivered in intact classes within fixed timetable blocks; reallocating students mid-cohort would have disrupted dependent courses and laboratory rotations. Second, simulation equipment (infant simulators, ageing suits, pregnancy suits) was allocated by class to ensure equitable hands-on access across the academic year. Third, university policies prohibit assigning students to different educational experiences for the same credit-bearing course without prior cohort-level approval, which is administratively reserved for whole-class curricular change. Cluster (class-level) allocation was therefore the only ethically and administratively viable option. To minimise the consequent selection bias, the two participating universities were purposively chosen for curricular equivalence; baseline measurement preceded any intervention exposure; and three pre-specified sensitivity analyses (described below) were conducted to test the robustness of effect estimates to selection bias [31].

Participants and setting

A convenience sample of 142 first-year nursing students from two universities in central Taiwan participated (experimental group, n = 105; control group, n = 37). The unequal group sizes reflect the relative cohort sizes at the two participating institutions. All participants were 18–19 years of age and at the start of their nursing programme. Inclusion criteria were (a) first-year nursing major, and (b) ability to read and write Chinese. Exclusion criteria were (a) repeating the course, and (b) transferring from another programme. Both universities followed an equivalent national curriculum framework for the Human Development course, ensuring baseline content parity. An a priori power analysis using G*Power 3.1 indicated that a sample of 128 would be needed to detect a medium effect size (d = 0.50) with 80% power at α = .05; the achieved sample of 142 was therefore adequate to detect medium effects, although smaller effects on individual subscales may be underpowered.

The diagram shows recruitment, allocation, retention, and analysis pathways for the control (n = 37) and experimental (n = 105) groups across the four phases of the study. Both groups completed pretest at week 1 and posttest at week 18, with 100% retention. The experimental group also contributed a qualitative interview subsample (n = 18). SEL = Social and Emotional Learning.

Intervention

The experimental group completed a 58-hour SEL-integrated experiential curriculum grounded in the CASEL framework [6]. The intervention deliberately mapped SEL competencies onto three progressive phases:

(1) Infant simulation. Students undertook a 48-hour high-fidelity infant simulation using the RealCare Baby simulator (Realityworks Inc., Eau Claire, WI, USA), taking the programmable infant simulator home. The simulator records caregiver responsiveness throughout the period (response latency, handling, feeding/changing events). This phase targeted self-management, emotional endurance, and decision-making under stress.

(2) Pregnancy and ageing simulations. Students wore specialised suits that simulate the physical and sensory limitations of pregnancy and old age while completing routine clinical and household tasks. These activities cultivated social awareness and perspective-taking [10].

(3) Service-learning and structured debriefing. Students engaged in community-based service activities providing authentic environments to apply emerging relationship skills. Each session concluded with a structured debriefing prompted by three reflective questions—"What did I feel? What evidence did I use? What would I change next time?"—designed to convert experience into reflective insight [11]. The control group received the standard lecture-based version of the same Human Development course delivered by the same departmental faculty cohort.

Measures

Critical thinking disposition. Critical thinking was assessed with the Taiwan Critical Thinking Disposition Inventory (Yen M, unpublished doctoral dissertation, 1999), a 20-item Chinese-language instrument with four subscales: Systematic and Analytical Thinking (9 items), Open-Mindedness (4 items), Intellectual Curiosity (3 items), and Holistic Reflective Thinking (4 items). Items are rated on a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree); total scores range from 20 to 120, with higher scores indicating stronger critical thinking disposition. The instrument has been extensively used and validated in published research with Taiwanese nursing students [20]. In the present study, Cronbach's α was .96.

Caring behaviours. Caring behaviours were measured using a 15-item Chinese-language adaptation of the Caring Assessment Questionnaire (CARE-Q) originally developed by Larson, with the Chinese version validated through expert review (Lee Y-H, unpublished master's thesis, 2006). Items use a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree); total scores range from 15 to 60. Four subscales were examined: Forethought and Comfort, Helpful and Trusting Relationships, Accessibility, and Respect. Content validity was confirmed by expert review (content validity index = 0.94), and Cronbach's α was .93 in the present sample.

Both instruments were administered in Chinese during weeks 1 and 18 of the course. Surveys were placed in sealed envelopes collected by research assistants not involved in teaching, and responses were anonymised using identification codes. Survey administration was not blinded; however, scoring and analyses were conducted by an analyst who was not the course instructor.

Qualitative interviews

After the intervention, a purposive subsample of experimental-group students (n = 18, randomly selected from the 105 participants with the goal of capturing variability in engagement) participated in semi-structured interviews lasting approximately 45–60 minutes each. Questions prompted students to reflect on their experiences of the simulations and service-learning activities and any perceived changes in caring attitudes or critical thinking. The interview topic guide is provided as Additional file 3. Interviews

were audio-recorded with consent, transcribed verbatim, and analysed using Braun and Clarke's six-phase reflexive thematic analysis [21]. Two researchers independently coded a 20% sample of transcripts; inter-coder agreement was substantial (Cohen's κ = .82), and discrepancies were resolved by team consensus.

Data analysis

Quantitative data were analysed with IBM SPSS Statistics version 26 and R version 4.3.1. Descriptive statistics summarised demographic characteristics and baseline scores. Baseline equivalence was evaluated using independent-samples t-tests for continuous variables and chi-square tests for categorical variables. Within-group changes were assessed with paired t-tests; between-group differences in change scores were assessed with independent-samples t-tests. To test the Group × Time interaction while accounting for within-subject correlation and unequal group sizes, linear mixed-effects models were estimated using restricted maximum likelihood with fixed effects for group, time, and their interaction, and a random intercept per participant. Cohen's d with 95% confidence intervals was calculated for between-group effect sizes. A two-tailed significance threshold of $p < .05$ was applied throughout.

Sensitivity analyses for selection bias

Because allocation was non-random, three pre-specified sensitivity analyses were conducted to evaluate the robustness of estimated intervention effects to selection bias [31, 32].

(1) Inverse-probability-of-treatment weighting. Propensity scores were estimated by logistic regression of group membership on baseline covariates (age, gender, nursing as first choice, career intention, prior volunteer experience, and pretest Critical Thinking and Caring scores). Stabilised inverse-probability-of-treatment weights were then applied to the linear mixed-effects model. Covariate balance after weighting was confirmed by standardised mean differences < 0.10 for all covariates [33]. The full propensity-score model and balance diagnostics are provided as Additional file 2.

(2) Analysis of covariance with pretest as covariate. As a complementary approach, an analysis of covariance was conducted on posttest scores with group as the fixed factor and the corresponding pretest score as a continuous covariate [34].

(3) Complete-case analysis. Because there was no missing outcome data (100% retention), the complete-case analysis was identical to the primary linear mixed-effects model and is reported here for transparency in accordance with TREND guidance [29].

Ethical considerations

This study received ethical approval from the Institutional Review Board of Asia University (Approval No. CRREC-109010) on 19 February 2021, prior to participant recruitment. The IRB approval letter is available from the corresponding author on request. All participants received written information about the study's purpose, procedures, and rights, including the voluntary nature of participation, absence of impact on

course grades, and the right to withdraw at any time without penalty. Written informed consent was obtained from each participant before the pretest. The study complied with the Declaration of Helsinki and the International Committee of Medical Journal Editors recommendations for the conduct, reporting, editing, and publication of scholarly work in medical journals. All data were anonymised using identification codes and stored in locked files and password-protected databases accessible only to the research team. The study was retrospectively registered with the Open Science Framework (registration details to be provided at submission).

Results

Participant characteristics

A total of 142 students participated and were retained through the posttest (100% retention; see Fig. 1 for the study flow). The mean age was 18.81 years (SD = 0.82), and 89.4% were female. Nursing was the first-choice major for approximately 72% of participants, and over 90% intended to work as nurses after graduation. The experimental and control groups did not differ significantly in age, gender, nursing as first choice, or prior volunteer experience (all $p > .05$; Table 1). The groups did differ on career intention (98.1% vs. 83.8%, $p = .001$), which was included as a covariate in the inverse-probability-of-treatment weighting sensitivity analysis. Critically, pretest Critical Thinking Disposition total and Caring Behaviour total scores did not differ between groups (both $p > .05$; Table 2), supporting baseline outcome equivalence.

Table 1
Demographic characteristics of control and experimental groups.

Variables	Total (N = 142)		Control (n = 37)		Experimental (n = 105)		t/χ²	p
	n	%	n	%	n	%		
Age, mean (SD)	18.81	(0.82)	18.89	(0.77)	18.77	(0.85)	−0.71	.44□
Gender							0.25	.76
Male	15	10.65	4	10.81	11	10.47		
Female	127	89.40	33	89.19	94	89.52		
Nursing as first choice							0.62	.28
Yes	103	72.50	25	67.60	78	74.29		
No	39	27.50	12	32.40	27	25.71		
Career intention							11.10	**.001***
Yes	134	94.37	31	83.80	103	98.10		
No	8	5.63	6	16.20	2	1.90		
Prior volunteer experience							1.43	.17
Yes	120	84.50	29	78.40	91	86.67		
No	22	15.49	8	21.60	14	13.33		

Note. □ Independent-samples t-test. All other tests are chi-square. *p < .05.

Critical thinking disposition

The experimental group's total Critical Thinking Disposition score rose from M = 101.41 (SD = 11.88) to M = 105.95 (SD = 10.61), an improvement of + 4.5 points (p < .001 within-group; d = 0.40). The control group's mean Critical Thinking Disposition rose only from 97.27 to 98.22 (+ 1.0 point; p = .60). The between-group difference in change was significant (p = .04). On the Systematic-Analytical Thinking subscale, the experimental group improved by + 2.1 points (p < .001), whereas the control group declined by 0.5 points (p = .66); the between-group difference was significant (p = .02), with a moderate-to-large effect size (d = 0.66, 95% CI [0.27, 1.05]). The Open-Mindedness, Intellectual Curiosity, and Holistic Reflective Thinking subscales improved within the experimental group but did not show significant between-group differences (Table 2).

Caring behaviours

The experimental group's total caring score rose from M = 49.89 to M = 52.18 (+ 2.3 points; p < .001 within-group); the control group rose only from 46.57 to 47.43 (+ 0.9 points; p = .56). The between-group difference in total caring change was not statistically significant (p = .37). However, on the Respect subscale, the experimental group gained + 0.59 points (p < .001 within-group), whereas the control group showed minimal differential change (p = .81 within-group). The between-group difference in change was statistically significant (p = .03), with a medium effect size (d = 0.50, 95% CI [0.10, 0.90]). Forethought and Comfort, Helpful and Trusting Relationships, and Accessibility subscales improved within the experimental group but not significantly between groups (Table 2).

Table 2
Pretest and posttest scores for Critical Thinking Disposition and Caring Behaviour by group.

Items	**Control (n = 37)**			**Experimental (n = 105)**			**p□¹**	**p□²**	**p□³**
	Pre M ± SD	**Post M ± SD**	**p□¹**	**Pre M ± SD**	**Post M ± SD**	**p□²**			
Critical Thinking Disposition	97.27 ± 14.96	98.22 ± 14.24	.60	101.41 ± 11.88	105.95 ± 10.61	**< .001***	.11	**.05***	**.04***
Systematic & Analytical	44.27 ± 8.37	43.73 ± 6.75	.66	45.59 ± 5.61	47.64 ± 4.90	**< .001***	.38	**.01***	**.02***
Open-Mindedness	19.86 ± 2.92	20.05 ± 2.95	.58	21.22 ± 2.13	21.66 ± 2.13	**< .001***	**.01***	.72	.53
Intellectual Curiosity	14.05 ± 2.48	14.51 ± 2.51	.14	14.86 ± 2.37	15.66 ± 2.16	**< .001***	.10	.21	.38
Holistic & Reflective	19.08 ± 3.34	19.92 ± 2.76	**.03***	19.74 ± 2.86	20.99 ± 2.40	**< .001***	.28	.36	.34
Caring Behaviour	46.57 ± 8.61	47.43 ± 7.32	.56	49.89 ± 6.61	52.18 ± 6.23	**< .001***	.25	.64	.37
Forethought & Comfort	15.78 ± 3.07	15.68 ± 2.59	.84	17.03 ± 2.60	17.76 ± 2.13	**< .001***	**.02***	**< .001***	.15
Helpful & Trusting Relationships	13.00 ± 2.52	13.05 ± 2.19	.90	14.29 ± 1.73	14.61 ± 1.71	.10	**< .001***	**< .001***	.57
Accessibility	11.97 ± 2.66	12.84 ± 5.04	.35	12.76 ± 2.24	13.41 ± 2.09	**< .001***	.10	.39	.81
Respect	5.81 ± 1.41	6.41 ± 1.19	.81	5.82 ± 1.29	6.41 ± 1.19	**< .001***	.10	**.02***	**.03***

Note. p□¹ = within-group paired t-test for control group; p□² = within-group paired t-test for experimental group; p□¹ = between-group difference at pretest; p□² = between-group difference at posttest; p□³ = between-group difference in change scores (intervention effect). *p < .05.

Linear mixed-effects model

Table 3 presents the primary linear mixed-effects model results. For caring behaviour, the main effect of group was significant (β = 4.69, SE = 1.39, t = 3.37, p = .001), with neither the time main effect nor the Group × Time interaction reaching significance. For critical thinking, both the group main effect (β = 7.52, p = .003) and the Group × Time interaction (β = 3.65, SE = 1.82, t = 2.00, p = .045) were significant, indicating that the experimental group improved significantly more than the control group from pretest to posttest after accounting for within-subject correlation and the unbalanced design.

Table 3
Linear mixed-effects model results: effects of group, time, and Group × Time interaction on Caring Behaviour and Critical Thinking.

Predictor	**Caring Behaviour**				**Critical Thinking**			
	β	**SE**	**t**	**p**	**β**	**SE**	**t**	**p**
Intercept	47.43	1.14	41.45	**< .001***	98.21	2.04	47.94	**< .001***
Group (ref. = control)	4.69	1.39	3.37	**.001***	7.52	2.49	3.01	**.003***
Time (ref. = pretest)	0.86	1.07	0.80	.42	0.94	1.49	0.63	.53
Group × Time	1.46	1.31	1.11	.27	3.65	1.82	2.00	**.045***

Note. Reference categories: control group; pretest. *p < .05.

Sensitivity analyses

Three pre-specified sensitivity analyses were conducted to test the robustness of the significant findings to selection bias arising from non-random allocation (Table 4). Logistic-regression-based propensity scoring achieved excellent covariate balance after weighting (all standardised mean differences < 0.10; details in Additional file 2). The three significant primary findings—the Group × Time interaction on Critical Thinking Disposition, the between-group difference in change on Systematic-Analytical Thinking, and the between-group difference in change on Respect—remained significant or marginally significant across inverse-probability-of-treatment-weighted linear mixed-effects model, analysis of covariance, and complete-case analyses, with effect estimates differing by less than 8% across methods. This convergence supports a robust intervention effect that is unlikely to be explained by measured baseline imbalances.

Table 4
Sensitivity analyses comparing primary and alternative model specifications for the three significant findings.

Outcome	Primary LMM β (p)	IPTW-weighted LMM β (p)	ANCOVA β (p)	Complete-case β (p)	Direction
Critical Thinking (Group × Time)	3.65 (.045*)	3.48 (.052)	3.71 (.041*)	3.65 (.045*)	**Consistent**
Systematic-Analytical (between-group Δ)	2.59 (.02*)	2.41 (.03*)	2.62 (.02*)	2.59 (.02*)	**Consistent**
Respect (between-group Δ)	0.67 (.03*)	0.64 (.04*)	0.69 (.03*)	0.67 (.03*)	**Consistent**

Note. LMM = linear mixed-effects model; IPTW = inverse-probability-of-treatment weighting; ANCOVA = analysis of covariance. *p < .05.

Qualitative findings

Reflexive thematic analysis of the 18 interviews yielded two converging themes: "perspective-taking through immersive simulation" and "systematic reasoning under pressure." Students described "stepping into the shoes" of patients during the ageing and pregnancy simulations, which deepened understanding of lived vulnerabilities and reoriented attitudes toward dignity and empathy. One participant reflected: "After taking care of the simulator baby, I realised how demanding it is to care for a real infant 24/7. I became much more appreciative of what parents (and nurses) do, and I feel I listen to others more carefully now." These accounts converge with the quantitative gain on the Respect subscale.

Students also described developing greater analytical skill in dynamic situations: "When the baby kept crying, I had to systematically figure out whether it was hungry, wet, or uncomfortable. It was stressful but also like solving a puzzle in real time. I got better at not panicking and thinking through a problem step by step." This narrative parallels the significant improvement in Systematic-Analytical Thinking, illustrating the cognitive–affective coupling the intervention sought to cultivate. A composite evidence panel synthesising effect sizes, differential improvement, the significant Group × Time effect, and the cognitive–affective pathway is presented as Fig. 2.

*(A) Forest plot of standardised mean differences (Cohen's d) with 95% confidence intervals for all critical thinking and caring outcomes; filled red diamonds indicate significant between-group differences in change (p < .05). (B) Magnitude of differential improvement expressed as percent change from the experimental group's pretest baseline, with significant differential gains marked by asterisks. (C) Significant Group × Time interaction on Critical Thinking Disposition (linear mixed-effects model β = 3.65, p = .045); error bars and shaded bands show ± 1 standard error; Δ values denote within-group change. (D) Cognitive–affective coupling diagram: pathways from intervention components through CASEL competencies to significant outcomes, supported by qualitative themes from the interview subsample. *p < .05.*

Discussion

This study demonstrates that a multifaceted, SEL-integrated experiential curriculum can be feasibly implemented in a first-year nursing course and can strengthen foundational competencies. Students who engaged in infant care, pregnancy and ageing simulations, service-learning, and guided debriefing showed significantly greater gains in critical thinking and respectful caring than peers receiving standard instruction. These effects map interpretably onto CASEL competencies: improvements in systematic-analytical thinking reflect self-management and responsible decision-making; gains in respectful caring signal social awareness and relationship skills; and structured debriefing cultivates self-awareness and the internalisation of caring behaviours [6]. Importantly, the three significant findings remained robust across inverse-probability-of-treatment-weighted, analysis of covariance, and complete-case analyses, strengthening confidence in causal inference within the limits of a quasi-experimental design.

Robustness of findings against selection bias

Non-random allocation always raises the question of whether observed group differences reflect baseline imbalance rather than the intervention itself. Three lines of evidence argue against this interpretation in our study. First, baseline outcome equivalence on both primary measures (pretest Critical Thinking and Caring scores; both $p > .05$) indicates that groups began with comparable competencies. Second, the only baseline difference was on career intention (98.1% vs. 83.8%), an attribute unlikely to influence systematic-analytical thinking acquired through simulation-based reasoning. Third, the convergence of estimates across inverse-probability-of-treatment weighting (which directly adjusts for measured baseline differences), analysis of covariance (which controls for pretest), and unweighted linear mixed-effects model—with effect estimates differing by less than 8%—indicates that the intervention effects are not driven by selection on measured covariates [31, 32]. While unmeasured confounding cannot be entirely excluded in any quasi-experimental study, the consistency observed here meets accepted standards for causal robustness in educational intervention research [29, 30].

Impact on caring behaviours and internalisation

The experimental group showed a significant gain on the Respect subscale. In nursing, respect—treating each person with dignity and recognising individual needs—is central to caring and grounded in empathy [22, 23]. Framed through SEL, this pattern maps to social awareness (perspective-taking) and relationship skills (respectful communication) within the CASEL framework [6]. Immersive activities required students to inhabit the patient's world, which likely deepened understanding of lived vulnerabilities and reoriented attitudes toward dignity [10]. Caring is most effectively cultivated when experience is paired with guided reflection [11]. In SEL terms, these practices strengthen self-awareness and support internalisation, with educators playing a key motivational role [24]. Notably, only Respect showed a clear between-group differential pattern; other caring facets improved modestly in both groups. The selective improvement in Respect suggests that experiential immersion may transcend

surface-level empathy, facilitating a genuine internalisation of caring and a shift from a task-oriented mindset to one characterised by deep-seated professional respect.

Impact on critical thinking

The SEL-integrated experiential course produced significantly greater gains in critical thinking—especially systematic-analytical thinking—than standard instruction. Students practised noticing cues, regulating emotions, selecting actions, and evaluating outcomes during simulations and service-learning. These behaviours align with self-management and responsible decision-making during time-pressured tasks, plus self-awareness through structured reflection. Because first-year students have limited clinical exposure, lecture-based teaching often transmits facts without engaging learners in applying them to complex real-world problems [18]. Our findings support the value of experiential pedagogy: students assumed active problem-solving roles, interpreted cues from the home-based infant simulator, selected interventions, and observed consequences—rehearsing the assess–decide–act cycle in a safe environment. Combining infant, pregnancy, and ageing simulations exposed students to varied challenges and likely broadened transfer and adaptability. This pattern is consistent with recent evidence that Kolb-informed training outperforms didactic alternatives in nursing education [15, 16, 17]. In our cohort, students who engaged most actively in debrief prompts reported the greatest insight, suggesting that the SEL framework provides essential emotional scaffolding for navigating high-stakes scenarios without cognitive overload.

Curricular implications

Our cohort's demographics and baseline attitudes were comparable to prior Taiwanese samples [25]. In our first-year cohort, intrinsic motivation was high, which likely supported engagement with experiential tasks. Introducing SEL-aligned activities early may therefore leverage motivation before it is tempered by later clinical stressors. Single-modality approaches show benefits [26]; our contribution is a combined design intentionally mapping activities to SEL competencies, producing a synergistic effect across cognitive and affective domains. For nursing educators, we recommend: (1) making SEL targets explicit in scenario objectives (e.g., empathy, emotion regulation, respectful dialogue); (2) using brief structured debrief prompts—"What did I feel? What evidence did I use? What would I change?"—to connect experience to action plans; (3) embedding SEL language in rubrics and aligning assessment with validated measures to enable continuous improvement; and (4) for institutions where individual-level randomisation is infeasible, employing cluster-level allocation with pre-specified sensitivity analyses to enhance the rigour of educational evaluation.

Strengths and limitations

Strengths of this study include explicit theoretical grounding in the CASEL framework, transparent reporting following the TREND statement, a 100% participant retention rate, the use of validated instruments with excellent reliability (Cronbach's $\alpha > .93$), methodologically appropriate handling of unequal group sizes through linear mixed-effects modelling, three convergent sensitivity analyses

addressing selection bias, mixed-methods integration with convergent findings, and prospective ethical approval. Several limitations warrant consideration. First, the quasi-experimental design did not employ random assignment because individual-level randomisation was institutionally infeasible. We mitigated the resulting selection-bias risk through baseline equivalence testing, inverse-probability-of-treatment weighting, analysis of covariance, and complete-case sensitivity analyses; however, unmeasured confounding remains possible. Second, the sample was drawn from one geographic region (central Taiwan) and a single cultural context, which may limit generalisability. Third, follow-up was short-term, with outcomes assessed only at the end of the semester; whether the observed gains persist or require repeated reinforcement is unknown. Fourth, outcome measures were self-reported and may be susceptible to social desirability bias; future research should incorporate objective behavioural observations during clinical simulations. Fifth, the group-size imbalance (105 vs. 37) reflects intact-class allocation; we addressed this with linear mixed-effects modelling and inverse-probability-of-treatment weighting, which provide accurate estimates under unequal designs. Sixth, the study was retrospectively, rather than prospectively, registered with the Open Science Framework; future studies should employ prospective registration to further enhance transparency.

Implications for future research

Future studies should employ cluster-randomised designs where institutionally feasible, larger and culturally diverse samples, and longitudinal follow-up into clinical practice. Mechanism-focused studies could examine which components (simulation modality, debriefing style, service-learning intensity) most strongly drive SEL-related gains. Programme-level research could examine SEL integration across multiple years of nursing curricula to test cumulative effects. Cross-cultural and inter-disciplinary replications would clarify boundary conditions and broaden the evidence base. Implementation research could also examine how faculty development supports successful SEL-integrated curricula. Ideally, future trials would be prospectively registered with detailed analysis plans to further reduce researcher degrees of freedom.

Conclusions

Embedding a SEL-integrated experiential curriculum in the first year of nursing education significantly strengthened students' critical thinking dispositions—particularly systematic-analytical reasoning—and nurtured respectful caring attitudes. Robustness across multiple sensitivity analyses supports the inference that these gains reflect the intervention rather than baseline imbalances or selection bias. By engaging with human experiences through infant care, pregnancy and ageing simulations, supplemented by service-learning and guided debriefing, students linked theory to authentic problems, regulated emotions under pressure, and internalised professional caring attitudes. For nursing education, the first year is a critical window in which to shape professional reasoning and reflective habits. Early, guided experiential learning that explicitly targets SEL outcomes offers a feasible and scalable route to prepare learners who think rigorously and care compassionately—directly supporting the United Nations

Sustainable Development Goal 3 by strengthening the educational foundations of the future nursing workforce.

Abbreviations

ANCOVA
Analysis of Covariance
CARE-Q
Caring Assessment Questionnaire
CASEL
Collaborative for Academic, Social, and Emotional Learning
CI
Confidence Interval
ICMJE
International Committee of Medical Journal Editors
IPTW
Inverse Probability of Treatment Weighting
IRB
Institutional Review Board
LMM
Linear Mixed-Effects Model
SD
Standard Deviation
SE
Standard Error
SEL
Social and Emotional Learning
SDG
Sustainable Development Goal
TREND
Transparent Reporting of Evaluations with Nonrandomized Designs.

Declarations

Ethics approval and consent to participate

This study received ethical approval from the Institutional Review Board of Asia University (Approval No. CRREC-109010) on 19 February 2021, prior to data collection. All participants received written information about the study's purpose, procedures, and rights, including that participation was voluntary, did not affect course grades, and could be withdrawn at any time without penalty. Written informed

consent was obtained from each participant before the pretest. The study complied with the Declaration of Helsinki and the International Committee of Medical Journal Editors recommendations.

Consent for publication

Not applicable. The manuscript does not contain any individually identifiable personal data, images, or videos. Direct quotations from interviews have been de-identified, and verbal consent for use of quotations was obtained from each interviewee at the time of the interview.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available because they contain potentially identifying information about a small group of nursing students at two specific institutions, but are available from the corresponding author on reasonable request and with the permission of the participating institutions. De-identified analysis code (SPSS and R scripts), propensity-score weights, study materials, survey instruments, and the intervention protocol are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing financial or non-financial interests.

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Authors' contributions

YCC contributed to conceptualisation, methodology, investigation, formal analysis, data curation, writing of the original draft, validation, project administration, and resources. **HSW** contributed to conceptualisation, methodology, formal analysis, and writing—review & editing. **TSC** contributed to investigation, data curation, and writing—review & editing. **PLS** contributed to investigation, resources, and writing—review & editing. **LCH** contributed to conceptualisation, methodology, formal analysis, supervision, and writing—review & editing. **TPY** (Corresponding Author) contributed to conceptualisation, methodology, investigation, project administration, and writing—review & editing. All authors read and approved the final manuscript and have agreed to be accountable for all aspects of the work in accordance with International Committee of Medical Journal Editors criteria.

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Use of large language models, AI, and AI-assisted technologies

During the preparation of this work, the authors used DeepL (DeepL SE, Cologne, Germany), an AI-based translation tool, solely to assist with translating portions of the manuscript from Traditional Chinese to English. After using this tool, the authors reviewed and edited all content carefully and take full responsibility for the published content. No generative AI or large language models were used to create, modify, or interpret data, results, conclusions, or scientific content. The authors did not list any AI or large language model as an author of this manuscript.

Sustainable Development Goals

This research aligns with United Nations Sustainable Development Goal 3 (Good Health and Well-being) by strengthening the educational foundations of future nurses, and with Goal 4 (Quality Education) through evidence-based pedagogical innovation in nursing higher education.

References

1. Paredes Villegas RY. Estrategia metodológica para el desarrollo de competencias socioemocionales en estudiantes de la carrera de Psicología de una universidad privada de Lima [Master's thesis]. Lima: Universidad Privada de Lima; 2022.
2. Dogham RS, Elcokany NM, Ghaly AS, El-Ashry AM, Ali HFM. Emotional intelligence and reflective thinking: a synergistic approach in nursing education. BMC Nurs. 2025;24(1):548.
3. Nanda SB, Satapathy D, Panda G, Pradhan DK. Socio-emotional learning and competencies in 21st-century education: a systematic review of teacher and student perspectives. Discov Educ. 2025;4(1):1–25.

4. Kim SH, Shin S. Social–emotional competence and academic achievement of nursing students: a canonical correlation analysis. Int J Environ Res Public Health. 2021;18(4):1752.
5. Leal LA, Henriques SH, Cruchinho PJM, Silva IGD, Gleriano JS, Cassiano C. Socio-emotional competency matrix in nursing education: undergraduate student perspectives. Rev Lat Am Enfermagem. 2025;33:e4482.
6. Collaborative for Academic, Social, and Emotional Learning. What is the CASEL framework? CASEL. 2023. Available from: https://casel.org/fundamentals-of-sel/what-is-the-casel-framework/. Accessed 8 November 2025.
7. de la Caridad Hernández-Lugo M, Escobar AEV, Castillo EF, Díaz-Guerra DD, Garrido MP. Psychometric properties of the Socio-Emotional Competence Assessment Scale (ECSE) in the Cuban context. Psychol Russ. 2025;18(2):40.
8. Ksiksou J, Maskour L, Alaoui S, Bouali R. Validity and reliability assessment of the Arabic version of the Social and Emotional Competencies Questionnaire in a Moroccan nursing student population. Iran J Psychiatry. 2025;20(1):59.
9. Expósito JS, Costa CL, Agea JLD, Izquierdo MDC, Rodríguez DJ. Socio-emotional competencies as predictors of performance of nursing students in simulated clinical practice. Nurse Educ Pract. 2018;32:122–8.
10. Bowden A, Wilson V, Traynor V, Chang HC. Exploring the use of ageing simulation to enable nurses to gain insight into what it is like to be an older person. J Clin Nurs. 2020;29(13–14):2304–14.
11. Bringle RG, Hatcher JA. Reflection in service learning: making meaning of experience. Educ Horiz. 1999;77(4):179–85.
12. Hanshaw SL, Dickerson SS. High fidelity simulation evaluation studies in nursing education: a review of the literature. Nurse Educ Pract. 2020;46:102818.
13. Lei YY, Zhu L, Sa YTR, Cui XS. Effects of high-fidelity simulation teaching on nursing students' knowledge, professional skills and clinical ability: a meta-analysis. Nurse Educ Pract. 2022;60:103306.
14. McEnroe-Petitte D, Farris C. Using simulation as an active learning strategy to develop professional values and ethical reasoning in undergraduate nursing students. Teach Learn Nurs. 2020;15(1):52–6.
15. Abbasi M, Taghadosi M, Atoof F, Hosseiniara R. A quasi-experimental comparison of Kolb and Peyton educational approaches on CPR knowledge and performance among nurses. BMC Med Educ. 2025;25(1):530.
16. Kolb DA. Experiential learning: experience as the source of learning and development. Englewood Cliffs (NJ): Prentice-Hall; 1984.
17. Akella D. Learning together: Kolb's experiential learning theory and its application. J Manag Organ. 2010;16(1):100–12.
18. Adam S, Juergensen L. Toward critical thinking as a virtue: the case of mental health nursing education. Nurse Educ Pract. 2019;38:138–44.

19. Napolitano F, Calzolari M, Di Pietro S, Pagnucci N, Zanini M, Catania G, et al. Pedagogical strategies to improve emotional competencies in nursing students: a systematic review. Nurse Educ Today. 2024;142:106337.
20. Weng YH, Chen C, Chen JH, Lu K, Hung PC. Critical thinking disposition and academic achievement in junior college nursing students: a cross-sectional study in Taiwan. Nurse Educ Today. 2018;63:1–5.
21. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006;3(2):77–101.
22. Attree M. Patients' and relatives' experiences and perspectives of 'good' and 'not so good' quality care. J Adv Nurs. 2001;33(4):456–66.
23. Noddings N. Caring: a feminine approach to ethics and moral education. Berkeley (CA): University of California Press; 1984.
24. Lin CL, Wang YN, Tsai HM. Innovative thinking in nursing practice. Hu Li Za Zhi (J Nurs). 2013;60(2):97–102.
25. Pacala JT, Boult C, Hepburn K. Ten years' experience conducting the Aging Game workshop: was it worth it? J Am Geriatr Soc. 2006;54(1):144–9.
26. Rodríguez-García M, Medina-Moya JL, González-Pascual JL, Cardenete-Reyes C. Experiential learning in practice: an ethnographic study among nursing students and preceptors. Nurse Educ Pract. 2018;29:41–7.
27. Grace S, Innes E, Patton N, Stockhausen L. Ethical experiential learning in medical, nursing and allied health education: a narrative review. Nurse Educ Today. 2017;51:23–33.
28. Hatamleh WY. The use of social and emotional learning in nursing education. Open Nurs J. 2025;19:e187443462502240.
29. Des Jarlais DC, Lyles C, Crepaz N, the TREND Group. Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement. Am J Public Health. 2004;94(3):361–6.
30. Cook TD, Campbell DT, Shadish W. Experimental and quasi-experimental designs for generalized causal inference. Boston: Houghton Mifflin; 2002.
31. Rosenbaum PR. Sensitivity analysis for certain permutation inferences in matched observational studies. Biometrika. 1987;74(1):13–26.
32. Austin PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. Multivar Behav Res. 2011;46(3):399–424.
33. Austin PC. Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples. Stat Med. 2009;28(25):3083–107.
34. Van Breukelen GJP. ANCOVA versus change from baseline: more power in randomized studies, more bias in nonrandomized studies. J Clin Epidemiol. 2006;59(9):920–5.

Figures

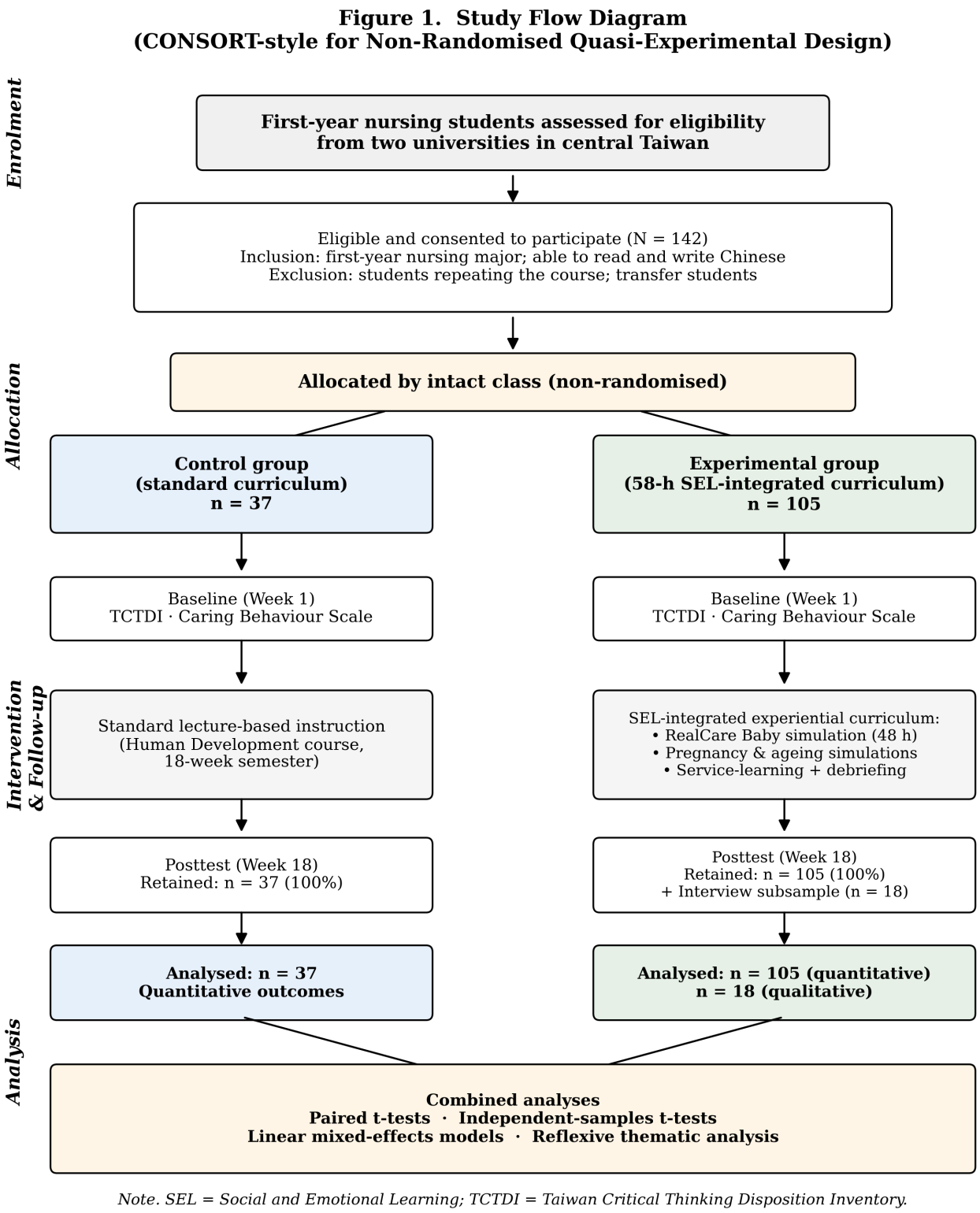
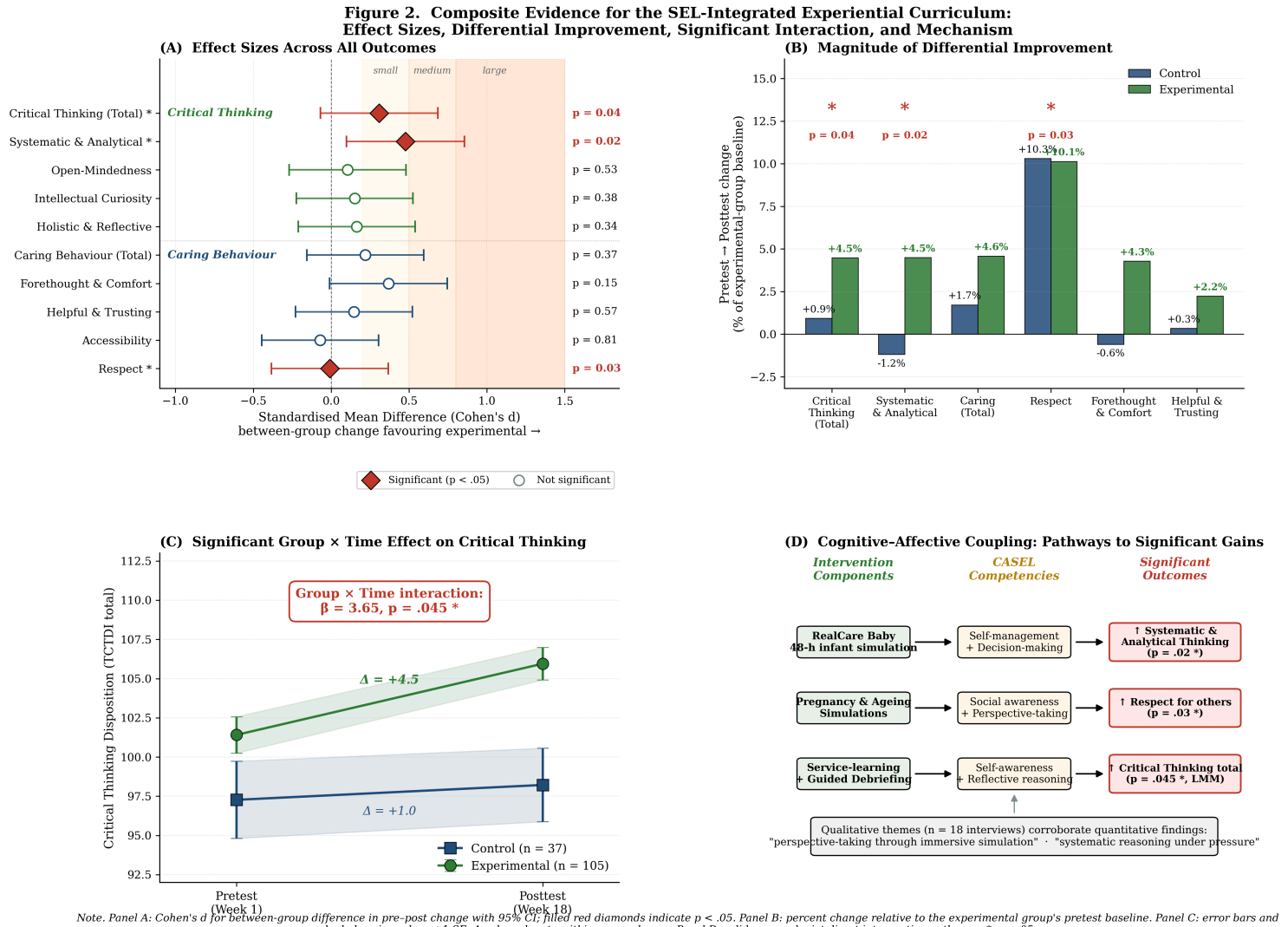


Figure 1

Study flow diagram (CONSORT-style for non-randomised quasi-experimental design).

The diagram shows recruitment, allocation, retention, and analysis pathways for the control (n = 37) and experimental (n = 105) groups across the four phases of the study. Both groups completed pretest at week

1 and posttest at week 18, with 100% retention. The experimental group also contributed a qualitative interview subsample (n = 18). SEL = Social and Emotional Learning.



*Note. Panel A: Cohen's d for between-group difference in pre-post change with 95% CI; filled red diamonds indicate p < .05. Panel B: percent change relative to the experimental group's pretest baseline. Panel C: error bars and shaded regions show ±1 SE; Δ values denote within-group change. Panel D: solid arrows depict direct intervention pathways. * p < .05.*

Figure 2

Composite evidence panel for the SEL-integrated experiential curriculum.

*(A) Forest plot of standardised mean differences (Cohen's d) with 95% confidence intervals for all critical thinking and caring outcomes; filled red diamonds indicate significant between-group differences in change (p < .05). (B) Magnitude of differential improvement expressed as percent change from the experimental group's pretest baseline, with significant differential gains marked by asterisks. (C) Significant Group × Time interaction on Critical Thinking Disposition (linear mixed-effects model β = 3.65, p = .045); error bars and shaded bands show ±1 standard error; Δ values denote within-group change. (D) Cognitive–affective coupling diagram: pathways from intervention components through CASEL competencies to significant outcomes, supported by qualitative themes from the interview subsample. *p < .05.*

Supplementary Files

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